DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

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Comparative Scenario Synthesis Report

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SCENARIO PLANNING COMPARATIVE SYNTHESIS REPORT

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1. Executive Summary

- In DESIRA, scenario planning was carried out with all LLs to understand the possible future implications of digitalisation across three rural domains – agriculture, forestry and broader rural community development. In DESIRA we co-constructed scenarios 10 years in the future with the LLs. The scenario workshops, as well as the analysis of country-level reports presented in this synthesis report, follow the STEEP method, which allows for identification of drivers of change (DOC) which are: Societal, Technological, Economic, Environmental and Political.
- As stakeholders considered alternate futures, it was fascinating to see how contrasting stakeholder visions pivoted around the same themes. Developments that in one future universe could be welcomed as enhancing lived experience, in other imagined ten-year horizons resemble dark mirrors. A case in point is robotics whereby equally bright and dark outcomes might transpire depending on interactions with other drivers of change and on the specifics of their implementation. In this way many drivers of change are presented as ambivalent harbingers of an uncertain future and the reader is minded to appreciate this flux in the contradictory narrative elements that are presented.

SOCIETAL drivers of change:

- Demographic renewal was of concern across all LLs, with most LLs fearing a future where decreasing and ageing populations continue to be a concern. In the more negative scenarios, a lack of human capital means that rural communities are unable to embrace the benefits of digitalisation. In more positive scenarios, new entrants (particularly young people) are attracted by strong digitalisation; their skills contribute to narrowing the digital divide.
- Cooperation and collaboration are seen as critical to positive digital futures. In the more positive scenarios, initiatives such as data cooperatives are envisaged; these collaborations enable trust to be increased at the local level.

TECHNOLOGICAL drivers of change:

- From smart water management and disease livestock control to preventative and responsive management of forest fires, the deployment of remote sensing and supporting digital platforms (for example livestock EID), promises to revolutionise the early warning capabilities across domains over the next 10 years. Negative scenarios depict untrusting or unskilled rural populations unable or unwilling to embrace such tools.
- Negative scenarios imagine the ongoing lack of decent broadband connectivity contributing to an increasing digital divide: without parity pressures, two-speed approaches continue to penalise rural regions. In more positive visions, local people act to ensure access to digitalisation, and connectivity enables better access to local services and wider markets for services and products.

ECONOMIC drivers of change:

- Digitalisation can potentially make energy transitions more efficient, but the ways in which rural stakeholders are able to generate and sell the necessary alternative energy supplies will depend upon the power structures and land ownership surrounding fuel sources.

- Digitalisation potentially offers future economic advantages such as reduced overheads (e.g. labour costs), through automation and efficiency savings. It can also open access to new markets through innovative supply chains and new retail models. For rural communities to see these benefits investments will be required, and farms, forestry and rural communities will need to fund future technological development. In positive scenarios, digitalisation will support rural livelihoods by enabling remote and flexible working, supporting a larger population to live and work in rural areas.
- Positive scenarios see digitalisation supporting shorter supply chains where customers demand more sustainably developed products. In negative scenarios, supply chains do not shorten due to digitalisation driving globalisation and reinforcing current market trends.

ENVIRONMENTAL drivers of change:

- In more positive scenarios, digitalisation supports the creation of biodiverse rich habitats. For example, the adoption of new technologies can reduce pressure on natural resources. In more negative scenarios, the uptake of digitalisation results in disadvantages to biodiversity – for example, digitalisation supports the ongoing move towards monocultures and resulting reduction in biodiversity.
- Digitalisation can lead to more sustainable rural futures. For example, digital tools can enable a more equitable stake amongst rural stakeholders to the use of certain resources. However, negative scenarios envisage a future in which progressing digitalisation promotes less sustainability, including the promotion of large-scale rural tourism which has negative environmental impacts and reduces availability of affordable local housing.
- Extreme weather events are seen to increase in the next 10 years across all LLs. Digitalisation can support our response to climate change - extreme weather events are more predictable and digital tools enable greater forecasting. However, future digital tools raise concerns, notably scepticism over their reliability, the preventative high cost of the tools to different land users and the lack of digital skills needed to utilise the tools effectively.

POLITICAL drivers of change:

- Rural communities can be empowered by digitalisation – for example, by giving people access to information or an active role in local decision-making. Digitalisation can disempower rural communities where digital inequalities are predicted to increase, resulting in an uneven balance of power between the more and less digitally skilled local actors.

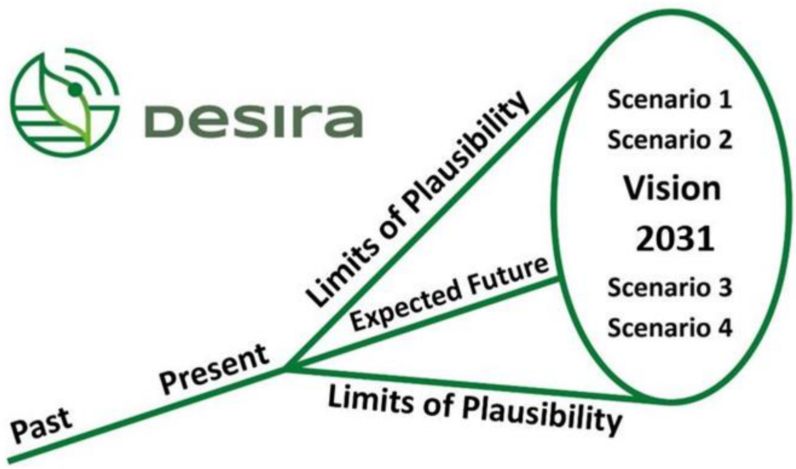
COVID-19:

- The Covid-19 pandemic saw many communities accelerate their acceptance of digital technologies as coping strategies to deal with social distancing, travel restrictions and an increase in their abilities to interact with friends and family, and colleagues online.
- The pandemic has facilitated rapid changes in health care including improved digital services.
- However, Covid-19 will also have a long-term financial impact which might hinder the development of digitalisation, particularly in remote rural regions.

2. Introduction

No one knows what will happen. The future is inherently uncertain. Contrastingly, we are able to look at both past events and the current situation with a greater degree of confidence. We can detect themes and construct patterns that act as guides, albeit imperfect ones, to the future. Scenario Planning is a methodology developed to consider a range of plausible outcomes, based on what we do know about the past and present. It harnesses human creativity and imagination, in order to make flexible plans now; plans that are robust enough and sufficiently flexible to deal with unpredictable developments.

Figure 1. DESIRA's Cone of Plausibility (after Bezold & Hancock, 1993)



As shown in Figure 1, the future can depart from expectations exponentially the farther ahead we attempt to foresee. In short, while tomorrow may be very much like today, a future day 100 years from now will almost certainly be completely different in all sorts of ways and imagining what they might be tests the limits of our creative faculties. This consideration affects the selection of a suitable time horizon for the scenario exercise: in DESIRA we have chosen a horizon of 10 years so our scenarios will relate to 2031.

There are many ways to conduct scenario planning. These can range from highly quantitative approaches to more qualitative, participatory approaches (Government Office for Science, 2017). One taxonomy differentiates between: *Predictive Scenarios* at the quantitative end of the scale, seeking to model what *will* happen; *Exploratory Scenarios* offering insights into what *may* happen; and *Normative Scenarios* setting out what *should* happen. It is worth noting however that all forms of scenario planning are subject to normative influences and furthermore the three forms are not mutually exclusive (see also Cho, 2013).

DESIRA has adopted an ‘exploratory’ scenario development approach, which incorporates a strong qualitative focus. Kok et al. (2011) argue that *“…exploratory scenarios often strive for awareness raising, the stimulation of creative thinking, or gaining insight into the way social, economic, and environmental drivers influence each other”*. They are crafted to form plausible accounts of what the future might look like in consideration of known drivers of change having specific effects over time, with a strong qualitative element shaping the entire exercise. DESIRA developed exploratory scenarios through participatory exercises with stakeholders in each of the Living Labs. With a characteristic narrative element, exploratory, qualitative scenarios lend themselves well to stakeholder workshop settings.

Plausibility

The concept of plausibility is often preferred over that of probability by scenario planners. This distinction relates to the ambition to creatively explore future possibilities rather than make forecasts. It also connects with distinctions between more qualitative and more quantitative or probabilistic scenario planning. While both approaches have their merits, (for a full discussion see Ramirez & Selin, 2014), choosing plausible outcomes over probable outcomes allows greater flexibility to move beyond current assumptions. This distinction is important. We are not attempting to determine what the future *will* most likely be like. After all, what appears more probable today, or in other words, ‘the expected future’ often proves to be a poor guide to what will happen tomorrow. The concept of plausibility allows scenario planners to remain within the realm of realistic developments but to go beyond conventional thinking (see Fig. 1).

3. The STEEP approach and thematic analysis

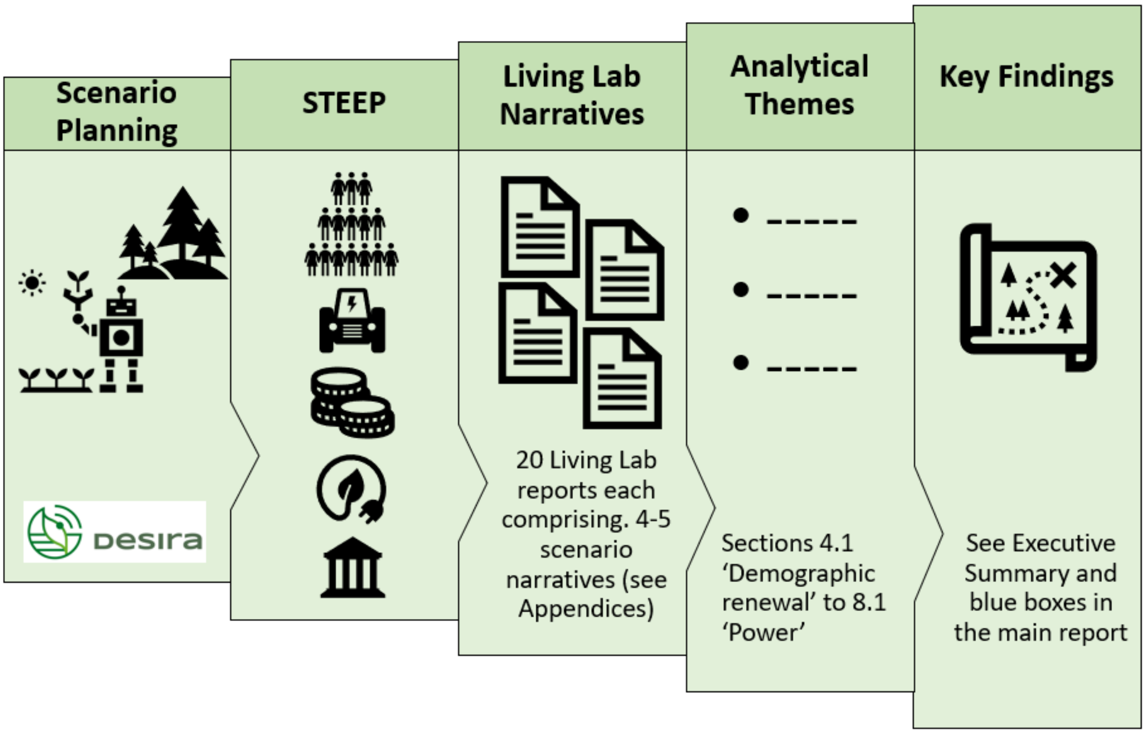
3.1 DESIRA scenarios

The analysis that follows draws upon the DESIRA exploratory scenarios introduced above. A full description of our methodology is presented in Section 10. The following schematic overview, (see Figure 2) will allow the reader to navigate the thematic analysis (sections 4 to 8).

Work Package 3 took a structured approach, from the Theoretical Framework, through a STEEP workshop methodology to individual Living Lab narratives which were thematically analysed and produced Key Findings presented in this report.

As shown in Figure 2, 20 DESIRA Living labs conducted Scenario Planning workshops and developed contrasting future scenarios for their context. Through a participatory process they formulated a relevant Scenario Focal Question. For a full list of Scenario Focal Questions see Table 1.

Figure 2: DESIRA Scenario Planning process.



A range of Drivers of Change (DOC) were then identified using STEEP as an organising principle to ensure that a broad-based exploration was undertaken. STEEP is fully detailed in section 11. For each STEEP DOC assumptions were made corresponding to a range of impacts from more positive to more negative and including 'business as usual' (BAU) assumptions in many cases. This allowed the construction of narratives ranging from optimistic to pessimistic during participatory foresight exercises set in each of the Living Lab contexts. The narratives were subjected to thematic analysis and the resultant themes are explored in sections 4 to 8. The final step was to extract and develop key findings.

This structured approach has enabled the integration, within this report, of future visions from stakeholders across Europe. Flexibility has been balanced against methodological rigour to achieve an extended engagement during a particularly challenging period with social distancing in operation to control the global Covid-19 pandemic. The different LLs were given freedom to hold in-person or virtual sessions with group sizes varying, reflecting the difficulties recruiting and hosting workshops under exceptional constraints (see section 9 on Covid considerations). Our approach allowed for deadlines to be extended and compromises to be reached in terms of numbers of participants recruited and time resources allocated to the analysis and reporting.

Table 1: LL names, country codes and associated final scenario questions

Country	Section in document and page number	Final scenario question and scenarios	LL name
The Netherlands (NL)	13.1	What does the urban farming community of Oosterwold look like in 2031, and what role could digital systems play? 1: Oosterwold in an open landscape with self-organisation 2: Oosterwold open landscape with strict governmental regulation 3: Oosterwold in a closed landscape with stricter governmental regulation regulation 4: Oosterwold in a closed landscape with self-organisation	Oosterwold, the Netherlands LL
Finland (FI)	13.2	What will the bioeconomy in Central Ostrobothnia be like in 2031, given the progress of digitalisation, circular economy, energy transition and RDI? 1: Distance work scenario 2: Energy transition scenario 3: Inequality scenario 4: Knowledge based management scenario	Biovalley Finland LL
Germany (DE1)	13.3	What will digital living (together) look like in Betzdorf-Gebhardshain in 2031? 1. Worse not Worst scenario: A grey day in our municipal community 2. Better not Best scenario: Life is good – The positive work-life balance in Betzdorf-Gebhardshain as an administrative employee 3. Life is good	Betzdorf-Gebhardshain, Rhineland-Palatinate (Germany): Between Digital Villages and Online Access Act – Digital Transformation in Rural Areas

		4. Life is perfect	
Poland (PL)	13.4	(What) will spatial planning in rural areas of Poland look like in the increasingly digitalised age of 2031? 1. Pause: full digital toolbox but no participation 2. Re-record: Full participation but no digital toolbox 3. Fast forward to GeoDesign 4. Rewind to analogue rural planning	Geodesign in Rural Poland
Latvia (LV)	13.5	How to make use of the potential inherent in digital marketing for selling beef? 1. Vicious circle 2. Penetrating niches 3. Best case 4. Worst case	Living Lab Latvia
Germany (DE2)	13.6	How can digitalisation contribute to sustainable fruit production in 2031? 1. Scenario 1 2. Scenario 2 3. Dystopia 4. Utopia	Lake Constance Region LL
Austria (AT)	13.7	What will timber tracking look like in 2031 in Europe? 1. Overexploitation (Dystopia) 2. Exploitation 3. Sustainability 4. Conservation (Utopia)	Round Wood Traceability in Austria

Switzerland (CH)	13.8	How will weeds be managed in Swiss organic vegetable farming in the increasingly digitalized age of 2031? 1. Small is beautiful! 2. Back to dairy industry 3. Impossible is not Swiss! 4. Digital Nightmare	Weed management in Swiss organic vegetable growing
Greece (GR1)	13.9	How can digital tools impact the management of water resources in relation to Trikala's farming, rural and urban needs in 2031? 1. Common goods in private disposal. 2. Digital vision - citizen adoption – focused public administration, the trifecta of data driven water. 3. Reformation of Rural life through Smart-Digital transition. 4. A 'not-so-smart' implementation of smart transition.	Sustainable Water Management Living Lab
Greece (GR2)	13.10	How to develop new digital services and functionalities for rural communities based on utilisation of existing agricultural infrastructure and tools. How can these services support economy and farmers' income in rural communities? 1. Digitalisation throws out of business producers that are unable to follow 2. Digital services in the Trilofos region support sustainable agriculture and resilient society 3. Digital farming practices change Trilofos' agricultural focus	LL Digital Services for Rural and Farmer Communities

		4. Digital solutions in Trilofos' agriculture fail to lift-off leaving the farming community wandering about the future	
Croatia (HR)	13.11	How digital technologies will improve the promotion and sale of local agricultural products in the tourism market by 2031. 1. Rural idyll 2. Digitally coloured rural life 3. Elite, local, ecological, digital tools 4. Great depression	DigiFarmTour - Digital solutions for connecting local agriculture and tourism in the Adriatic region of Croatia
Italy (IT1)	13.12	How will digital tools transform Italy's wood-energy sector traceability by 2031? 1. Digitalised and transparent forestry-wood-energy supply chains: a path towards a sustainable forest bioeconomy 2. Digitalisation for traceability in the forestry-wood-energy sector: a postponed chance 3. Forests for Future: a dream called circular, digitalised and sustainable wood-energy supply chains 4. Escape the (exploited) forests: a nightmare paved with good intentions	Wood-energy traceability in Italy
Italy (IT2)	13.13	How will the ordinary land management in mountain areas of the Reclamation Consortium "Toscana Nord" be managed in 2031? What role will digital	Toscana Nord LL

		technologies play in this process? 1. Human and technology cooperation 2. Business as usual 3. Technology intensive 4. Human intensive	
Spain (ES1)	13.14	How can digitalisation contribute to reduce the damage caused by wildfires and to make more effective firefighting and degraded land restoration by 2030? 1. Less shepherds, more developers 2. In tech we trust 3. Total disaster 4. Revitalised Spain “La España rellenada”	Forest Fires in Andalusia
Spain (ES2)	13.15	How digitalisation and the 2030 agenda will change Maestrazgo and Gúdar-Javalambre by 2031? 1. Windmill fields 2. Europe's sky 3. The nightmare of the future: empty of people and full of industrial waste. 4. The flagship on how to turn a depopulated territory into a whole new dimension on sustainable future.	Maestrazgo and Gúdar-Javalambre LL
France (FR1)	13.16	What will French viticulture look like in 2031 in connection with the evolution of digital? 1. Technological and carbon neutral French wine 2. Environmentally friendly French wines	Inno’vin LL

		3. The digital divide 4. The end of an era	
France (FR2)	13.17	What will be the contributions of digital technology to accompany the reduction of inputs in agriculture by 2031? 1. Zero chemical inputs 2. On the right path 3. Target missed 4. Zero digital inputs	Agronov LL
Scotland (SCO)	13.18	What will crofting communities be like in 2031 given future digitalisation? 1. Gross Domestic Happiness 2. Digital Clearances 3. The ideal scenario 4. A bleak landscape	Crofting in Coigach (Scotland)
Belgium (BE)	13.19	What will be the impact of digitalisation and monitoring on ammonia emissions in 2031 1. A farmers' choice 2. Benefits of a crisis 3. Uncertain futures 4. Stagnation till the end	Flemish Living Lab
Ireland (IE)	13.20	How might a rural community enterprise centre support regional resilience in 2031, in the context of digitalisation and socio-ecological transitions? 1. High energy (from humans), low energy (from fuel) 2. Older and wiser – less active and viable 3. The Future is Bright – but not Burning 4. Down but not Out…Yet.	Cultivate LL

3.2 Thematic analysis

Each Living Lab report was closely analysed and themes were developed that allow the individual drivers and assumptions to be clustered, compared and synthesised.

4 Societal (S) drivers of change

These thematic drivers of change and the related assumptions that were developed to create a range of contrasting scenarios in each Living Lab, primarily concern the cultural dimensions of our collective lives. They include values, demographic influences on communities, attitudes, lifestyles, and the media. For DESIRA Scenario Planners, a focus on digitalisation is explicit. Participants were requested to focus on societal drivers impacting on digitalisation or impacted by the changes digitalisation may bring.

4.1 Demographic renewal

Few rural contexts in Europe do not have concerns about future demographic composition. With the notable exception of the Netherlands, where a peri urban Living Lab had specific concerns about urbanisation (NL), all DESIRA Living Labs feared scenarios with declining populations, an ageing demographic (good examples being DE1 & FR1) and a consequential structural inability to embrace future digitalisation effectively due to a lack of human capital. Much of this shortfall was characterised around agricultural labour (CH, HR, GR2, ES2). A case in point was in the extensive livestock sector where a greater valuation in the activity and better returns for the product underpinned by digitalisation in the supply chain (including digital marketing (LV)) was seen as a potentially positive driver in arresting population decline (GR2). Similarly brighter futures were envisaged for family farms in other sectors:

> *Fruit production in family farms and farm succession has become more attractive for young people, which positively affects the preservation of small family farms.*
> *(a more optimistic vision in DE2)*

Here, a family farming future was rejuvenated within a digitalised rurality. New entrants to farming were similarly attracted to digitally enriched opportunities (GR1). The appeal to a younger generation potentially draws upon future 20-30 year olds previously mobilised by Climate Action as school children and seeking alternatives with Green-appeal (IE). In contrast, alternative land use options, for example holiday homes (including a negative impact from the AirBnB model (FI) and seasonal tourism (SCO) and other forms of unregulated or unsympathetic development including prohibitive transportation costs and associated fuel poverty (IE) would reinforce existing negative trends and were seen as potentially disenfranchising for local communities (see also Section 8). Robotics, automation, and labour saving, while generally seen as supportive of vibrant rural populations, were not viewed as without risk. A high use of technology in agriculture, as history has shown, sits hand in hand with a large decrease in population in negative scenarios (IT2).

Beyond agricultural labour, a general rural community capacity (SCO, PL) was envisaged in some of the more optimistic scenarios, including distributed manufacturing (IE) enabling young people to continue living in rural communities or encouraged to inwardly migrate through the virtualisation of work (SCO). This repeated theme around rural mobilities including remote working was often expressed as a hoped-for paradigm shift (FI, ES2). Given longstanding declines in rural populations throughout Europe many participants found it easier to conceive of a continuation of rural depletion considering this to be both plausible and a constraint upon positive digitalisation (SCO, HR, CH). In polar opposition, a design feature of the scenario exercise we implemented, another plausible opportunity was positive digitalisation enhancing demographic renewal (SCO, PL, ES1, ES2, GR2). This included a partnership approach to land use with farmers and local communities with greater empowerment in decision making through digital fora (IT2, SCO).

The idea that digitalisation can increase the attractiveness of a rural locality (GR2, SCO) by supporting work, reducing isolation, increasing opportunities, and offering parity with urban areas in terms of data service provision, was a component of many of the more positive future visions that stakeholders shared. This idea intersects with positive aspirations around diversity (see Section 4.5) with inward migration connected to open, welcoming, informed, and modern rural communities and disconnected to closed, inward-looking, conservative societies (GR2, SCO). Mountainous areas were highlighted (IT2) as critically in need of improved connectivity to stave off depopulation. It was also noted that employment opportunities might take a turn for the worse or continue to decline (IT1), reinforcing rural depletion and that poor connectivity drives further outward migration (DE1, IT2) particularly for young people.

4.2 Digital Literacy

Who will operate the digitalised future? Many LLs considered different trajectories that explored positive and negative outcomes from a highly skilled, competent rural workforce spearheading a digital transformation of practices, to a rurality lacking the requisite digital literacy and ill equipped to take on the challenge (BE, SCO, LV, GR2, ES1, PL). Despite the potential for digital technologies to be more widely available and usage increased (DE2), providing many opportunities for rural communities (IE) even in the brighter futures, it was acknowledged that everyone would not acquire sophisticated technological acumen. However, in the pessimistic futures a complete lack of digital skills and rejection of digital tools (FR2) and thus the training and upskilling of the workforce to become more digital literate with digital technologies is imperative (e.g. for agriculture FR1, IT2) and is seen as critical to a successful digital future. Other LLs felt that those lacking digital skills ought still to have a viable future and the wider farming community could play a part in supporting them perhaps through the championing of ‘digital-natives’ (BE, DE2) or alternatively, they must compensate through non digital skills.

Digital literacy was felt to be uneven (NL); a digital literacy divide could emerge between those with high and low digital skills, with FR1 arguing such a divide could create a *“two-speed viticulture”.* Currently digital literacy divides exist whereby more ageing populations have reduced digital literacy and acceptance of technology both in general (DE1, GR2) and in the workforce (ES1) it is also felt that the digital gap between older and newer residents may also grow in the short-term (DE1, DE2, FI GR1). It will be important to minimise digital literacy divides so that the LLs do not fall behind urban areas, for example digital skills may need to be taught in schools (DE1) and young people may be the aid in promoting increased digital literacy building confidence and skills (SCO, FI). Other LLs (FR2) identified that it will be important that training that promotes digital skills should be available to all to enable them to embrace the full benefits digitalisation can bring to rural communities (FR2, GR1). One way in which digital literacy could be decreased is by “digital-natives” in the region acting as a sort of champion and to do outreach work/teaching to others in the community (DE2) and by using digital tools more frequently, which could help to build knowledge and develop confidence (DE2). In Italy (IT2) it was suggested that low digital literacy and skills justify the need for fully autonomous technologies rather than assuming collaboration and integration with humans and technology, and FI found that automation in farming is seen positively and as a means to remain profitable.

Many more positive futures envisaged a growing younger demographic boosting the viability and sustainability of rural communities motivated to become involved in rural livelihoods including farming, by having the necessary digital skills to make it profitable (GR2). Covid-19 has also promoted increased digital education and literacy (e.g. through new ways of delivering healthcare - ES2). The wider use of digital tools in both farming and across the wider rural community helps to build confidence and promote the ongoing use and interest in new digital innovations and tools (IE, FI).

Standard services expect time commitment and access to travel to make appointments and visit official offices. Although people see the advantages of using digital services for convenience (ES1), speed of accessing services on-line, reducing travel and the need to visit offices (especially a problem during covid-19 - see Section 9) they also see the disadvantages, including the lack of face-to-face contact, not being able to speak to a point of contact to explain problems, and the subsequent feelings of isolation that can come from this. In some countries (DE1, SCO) a hybrid way of accessing medical services, initiated during Covid, was welcomed, whereby people were able to make appointments on-line and were given some resources (access to live chat, phone calls) for triage assessment but were then able to visit a GP for final diagnosis. This was not the case in all countries - some resisted the hybrid health care opportunities (ES2) preferring the ability to embrace a more personal touch. Some flexibility is accepted in remote rural communities where people see the advantage of digital services and have welcomed the ability to access services like those provided by banks through updated banking apps (SCO) reducing time and travel costs.

Flexible working options (working from home) have given people the choice of relocating from urban to rural locations (FI). There is also the possibility of reducing working hours and all year working (FI). In some regions, communities debate whether to regulate who should move in depending on their commitment to the community’s values and ideas on participation (NL).

4.3 Trust

Although people realise that digital services can bring benefits they are often fearful that their data will be misused. They balance the advantages gained through trusting people with their digital data with the disadvantages that allowing access might bring, for example potentially losing their capability to control access to their personal data (DE1) with stories of stolen identities (SCO). Some citizens have a mistrust of public/local authorities in general (IT1). Others hope that embracing digitalised and participatory services might increase trust associated with planning (Pl).

In the agriculture domain a general mistrust of digital tools for agriculture processes (GR2) is countered by the advantages gained by better transparency on production and environmental impacts

(FR1,FR2) and traceability to allow provenance to be recognised (HR). The reliability of on-farm tech has helped increase trust of digital technology in some areas (DE2) although not for all technologies, for example drones have low acceptance due their limitation related to weather and ability to identify specific events (IT2).

4.4 Cooperation and collaboration

The social aspects of co-operation and communication were seen as necessary between different stakeholders in the most positive scenarios being developed (AT, IT1). Incidences where co-operation and communication were enhanced were also likely to lead to increased trust (NL). In the more positive plausible scenarios, positive cooperation and communication was seen to be able to amplify voices (e.g. political voices in SCO). In PL, access to new methods in spatial planning through community negotiation was felt to be the starting point to making the rural environment more multifunctional and diversified. In GR2 improved collaboration of farmers through a strong farmers union was seen as being positive to negotiating with technology providers. Whilst in FR2 cooperatives were seen to exist in the better not best scenario to aid in data sharing and in FR1:

“Winegrowers have also organized themselves and created data cooperatives in the middle of the 2020’s. Those data cooperatives oversee collecting and valorising data for all their members. The data cooperatives also ensure the sovereignty of the data.” FR1

As well as positive forms of communication and cooperation leading to increased digital bargaining opportunities, it could also lead to other positive scenarios such as the opportunity to share digital tools thus reducing investment costs (DE2). Enhanced communication and cooperation can lead to ventures such as the FabLab leading to diverse (digital) opportunities: “*the FabLab is used to produce and repair things for the Ecovillage, to create artworks for local festivals held on Ecovillage land, and to make products and packaging for sale through the Open Food Hub. Frequent ‘repair cafe’ events take place, during which technicians dedicate their time to fixing any broken items that individuals bring in.” (IE)*

In some of the more positive plausible future scenarios, cooperation between local actors is considered critical for local management in the future and responding to extreme weather events etc (e.g. IT2 and ES1) and also for food production (NL). Collaboration and co-operation were also seen as important between local water management agencies and regional authorities (GR1).

4.5 Diversity

Currently, there are general pushes to a more diverse society, and in many cases (SCO,) positive plausible scenarios show increased digitalisation leading to a more diverse society (e.g. LGBTQ+ may be more accepted and promoted in a more digitally progressive community -SCO), and in PL digitised spatial planning was felt to promote more diverse voices to be included in the future participating and accessing spatial planning, thus increasing diversity. In the predominantly negative futures where rural demographic challenges remain diversity is restricted because only those currently living in the area participate (GR1). Diversity may also increase tension between those who have lived in a community for a long time and younger incomers relating to the speed of (digital) change and the implementation of new ideas of the community (IE). There was some division about whether diversity of immigrants meant a more positive or negative future as in FI diversity was seen to signify a weakness of the local economy when there is reliance from immigrants to fulfil certain jobs, however in NL an ambassador is recruited in the optimistic scenario, and *"This new generation of residents became more diverse in terms of ethnic and cultural background, age, and experience with agriculture. One task of the ambassador was to welcome people from all backgrounds to Oosterwold and get them up to speed in both the community and practices around urban agriculture."*. Even the foods grown become more diverse thanks to the diverse cultural background of residents.

Rural depopulation

A common theme in rural research across Europe and beyond, depopulation is one of the key drivers of rural decline. This concern is echoed across the majority of the scenario workshops, with the notable exception of the Netherlands LL which was set in a peri-urban region (and in which the key concern was rather urbanisation). Of interest across the scenarios is the extent to which digitalisation can either reinforce rural depopulation (for example, through poor digital infrastructure which makes it more difficult for people to live and work in rural areas, and low levels of digital skills which mean that opportunities are unrealised), or through the positive impacts of digitalisation (infrastructure, skills, investment etc.) which lead to a thriving community and local economy.

5. Technological (T) drivers of change

DESIRA has a special focus on technological factors in line with our aim to a respond to the challenges and opportunities of digitalisation in rural areas. Factors typically investigated in this part of a STEEP analysis include automation, technological shifts, the rate of change, innovation, and how these various factors may combine to shape the future. For DESIRA, all Living labs were encouraged to consider more than one technology driver.

5.1 Data privacy

The concept of data privacy encompassed notions around data sovereignty and data ownership. A full range of concerns emerged echoing popular discourse. Data privacy was variously considered a political driver (BE) to be tackled through the rule of law but was more generally seen as a technological consideration (FI, DE1, DE2, LV, HR, IT1, ES1, FR1, FR2, SCO). Participants feared an absence of digital privacy in a brave new world in which big corporations increasingly erode individual's data ownership and control (FI). Due to a lack of digital literacy farmers didn't realise the need to protect their data, 20 years later in some countries (e.g. FR1) it is felt they have missed the opportunity as large companies collect data from digital technologies and use the information to manipulate markets. In more positive futures, however data sharing is seen as the norm and encourages interoperability (FR2, GR1). Improved regulations on sharing would help acceptance (DE2) although there are discussions on who is responsible to implement these (DE2) - legal clarity is needed (CH) , in conjunction with National databases and online protocols (ES1). This would help citizens to trust the sharing of personal data and the acceptance of Open Access agreements (OAA; DE1).

Political dimensions and potential resolution through regulation and oversight again demonstrate the transversality of Drivers of Change. In West Flanders (BE), science led innovation was projected as a potential solution whereby farmers could share and access data equitably through neutral hubs.

In the forestry domain multi source data allows traceability of wood, reducing illegal felling and trading in non-traceable wood commodities (AT, IT1).

5.2 Digital tools and technologies

Central to DESIRA are the technologies that are already and will continue to shape rural society, including agriculture and forestry in the coming decade. The LLs were replete with examples of potentially game changing developments. From cargo drones that may emerge to support local produce along short supply chains (HR) to weeding robots overcoming labour shortages in the organic vegetable sector (CH), digitalisation can reshape many existing practices. Many of the technologies DESIRA details have specifics that allow limited comparison to other LLs albeit they will be replicated elsewhere in Europe, and for this layer of information the reader is directed to the Appendices for a fuller account of these individual future developments. This synthesis is largely confined to a higher level comparison of digitalisation features and future impacts that may be relevant across LLs.

Real-time or effectively real-time information platforms were discussed in terms of their potentially strategic benefits. From smart water management (GR1) to disease livestock control (LV) to preventative and responsive management of forest fires (ES1), the deployment of remote sensing and supporting digital platforms (for example livestock EID), promises to revolutionise the early warning capabilities across domains. Wildfires and forest fires are exacerbated by climate change, and increased extreme weather events, a state of affairs unlikely to be addressed by 2031, and better forecasting and incidence alerting was envisaged to offer significant mitigation in more optimistic scenarios. It was said that 'geolocation saves lives' (ES1). Similarly, access to new GIS technologies and more sophisticated processing of geospatial data will potentially lead to the administrative units dedicated to the mapping and appraisal of water resources (smart water), ensuring that regional water needs can be covered and water is handled in a sustainable manner (GR1). Remote sensing in particular is an area through which digitalisation can improve decision support (BE, ES1). A darker side was imagined, particularly in agriculture, where the emergence of a Panopticon accompanies a large decrease in local population:

"… the eye of technology replaces the knowledge and experience of those who live, work and experience the land." (IT2)

Beyond dystopian surveillance, worse not worst scenarios posited the challenges around interoperability, failure to share data effectively, and slow roll-out of fast broadband to address rural needs. A general digital divide between urban and rural, reinforced by current experience, coloured many more negative scenarios. Without parity pressures, two-speed approaches will remain that effectively penalise rural areas (PL). With equivalence of provision, particularly broadband speeds, more local farmers will start to experiment with the adoption of digital tools leading to new opportunities and value chains, technology providers will offer new possibilities for upscaling applications to a wider geographical range and making tools adapted to rural contexts (GR2, FI, PL).

Enhanced traceability is another aspiration found across Living Labs. Harnessing digitalisation (including blockchain) to improve and extend the traceability of products, from wood biomass (IT1, AT) to meat (LV) was viewed as a potential digital game changer in terms of both controlling and regulating trade, and through building trust and confidence with consumers.

The farming future was animated with robotics deployed at the field scale, weeding (CH) and generally replacing agricultural labour (FR2, DE2). Drones can be seen delivering goods along short supply chains (HR) and conducting other autonomous or semi-autonomous tasks. Drone delivery is just the front-end of a new retail experience with virtual reality on-line shopping promoting local products (EI). Infrastructure, such as Switzerland's Agroscope Smart Farming Institute (CH), spring-up to drive farming forward. Easy to use apps are in the hands of farmers (DE2) who practice precision farming (DE2, FI, NL).

"They provide technological means to reduce inputs and are adapted to all types of production and protection products. They free up human time for complex operations." (FR2)

Local communities are partners in the technological renaissance envisaged for positive scenarios. Digital healthcare (DE1, ES2), on-line banking (SCO) and platforms supporting rural tourism (FI) flourish. Distributed manufacturing shrinks distances and supports local opportunities (IE). Where optimism gives way to pessimism, there is a lack of understanding of tech, and a reticence to adopt by many actors. In the absence of robotic success, whether due to neo-Luddism or the lack of digital skills, agricultural industries fail to compete effectively. In one worst case scenario, there is a complete lack of digital skills and rejection of digital tools (FR2). Other fears surround the loss of appropriate in-person contact and a descent into an inhuman metaverse. Patients cannot see real nurses or doctors and many taken-for-granted contacts are reduced or withdrawn.

In general, the availability of tech was appreciated as a resource likely to become more affordable and more diffused (CH). Something akin to Moore's law appears likely to continue to drive down cost and reduce barriers to entry moving towards 2031. This is not necessarily a positive trajectory as both the desirable and undesirable effects may be spurred through the relentless march of digitalisation.

Digital game changers

A key theme in the DESIRA project has been the exploration of digital game changers relevant to rural economies including agriculture and forestry. Digital game changers discussed in the scenario workshops included cargo drones to support local produce along short supply chains, weeding robots overcoming labour shortages in the organic vegetable sector, real-time information platforms, smart water management, disease livestock control technologies, technologies for the prevention and management of forest fires, remote sensing and digital platforms for livestock monitoring and management. Whilst these technologies have the potential to revolutionalise rural economies, dystopian visons emerge encompassing challenges around interoperability, failure to share data effectively, and two-speed issues and digital divides that could result in uneven benefits of technology that have been typical of rural digitalisation to date.

5.3 Innovation

Innovation was associated with the more positive plausible scenarios particularly around taking advantage of new digital opportunities or existing technologies in new ways (for example the use of the What three words App to identify rural positions for food deliveries (SCO)). It was seen to happen at community level and professional levels. For example, highly innovative companies were seen as necessary to increase employment in some ways (DE1). Innovation was also seen to aid diversification in businesses (GR2). In agricultural it was seen as a way to increase skills, and share knowledge and skills with others through digital platforms (FR2).

Innovation in technological development was felt to be able to aid tackling environmental hazards such as forest fires (ES1) through the employment of digital tools such as remote sending, RTI flows and modelling based on artificial intelligence to predict impact and decrease response times (ES1).

However in the more negative plausible scenarios innovation through diversification could increase business risks (GR2). Innovation may also be promoted more effectively in some places than others by legislation in some worst case scenarios (FR2): *"Strengthening of the AOC's, which reinforces the link to the territory and the environment and prohibits many innovations. The international definition of wine is becoming stricter. The terroir viticulture is now the only one that remains"* - FR1. In IT2 however in the better not best case, policies would support the creation of an innovation ecosystem and facilitate the integration of innovation and digitalisation policies. Crises and possible more negative scenarios may also lead to innovation and creativity in response in some areas, for example to global supply chain crisis, or hinder it through unavailability of goods to solve issues innovatively (IE).

6. Economic (E) drivers of change

Factors potentially shaping the future rural economy include the cost of goods, both retail prices for goods that are produced on farms and in forests, but also the cost of capital investment required in digital transitions. DESIRA scenario planners were encouraged to consider subsidies, consumer demand, consumer prices, and the underlying costs of technology. Again, these drivers were intended to be set against digitalisation towards 2031.

6.1 Energy transitions

An energy transition requires a deep structural change from a reliance on fossil fuels, natural gas and coal to renewable energy sources such as wind and solar and other alternative sources. Whilst an energy transition implies a global structural change, the LLs in their discussion of energy transitions reflected local and regional level changes requiring the cooperation of and drive from local government agencies (SCO, GR1, FI). A global energy crisis and resulting fuel poverty was still imagined in the positive future scenario (IE) and while this brought hardship for many it also served as an opportunity to drive localised solutions and find alternative sources of energy (SCO, GR1, FI, IE, IT1). In agreement, the French LLs (FR1, FR2) stated; *"a more environmentally aware sector embraces alternative energy sources in the more climate-friendly scenario."* A growing rural population interested in the environment and climate impact can not only drive the popularity of alternative energy sources but also apply significant pressure for the sustainable use and reduction in illegal trade of certain forest products (AV).

One common suggestion shared by both the Scottish (SCO) and Trikala, Northern Greece (GR1) LLs was for local authorities to convert wastewater into an energy source and also provide nutrients to the agricultural sector (potentially reducing reliance on added nutrients sourced from elsewhere). The Finnish LL in their better not best scenario saw a particular benefit to rural areas from selling electricity, biogas or hydrogen to urban centres and industrial plants and the "a*dvancing energy transition through digital technologies is a great opportunity to increase the sustainability of energy system in Central Ostrobothnia" (FI).* Digitalisation was able to make the energy transition overall more efficient. The ways in which rural stakeholders are able to generate and sell the necessary alternative energy supplies will depend upon the power structures and land ownership surrounding the fuel sources. Necessary infrastructure will also require significant investment. In the Irish LL, there was an apparent 'regret' over prior inaction to replace or repair faulty solar panels before the components became difficult to source in a future contending with a global demand and supply issue. Yet certain areas or 'pocket neighbourhoods' are able to keep a steady supply of locally generated electricity thanks to the effectiveness of 'micro-grids' and the installation of biodiesel generators (IE).

6.2 Fair prices and future investment arrangements

Many Living Labs focussed their attention on the likely effects of digitalisation on the prices that they can anticipate from their produce under different scenarios. Concerns incorporated some thinking about future subsidy and investment arrangements. A digital landscape offers opportunities to reduce overheads, notably labour costs, through automation and efficiency savings. It also potentially opens-up new markets through changed supply chains and new retail models. To seize benefits however investments will be required, and farms, forestry and rural communities will need to finance future technological development.

Opportunities were identified on a number of fronts. The possibility of improving produce and commanding higher prices was discussed by several Living Labs (LV, NL, BE, IE). The idea that customers may be willing to pay higher prices for products that have trusted provenance (HR, LV, SCO), or that enhanced traceability can better protect forestry (IT1, AT) and farming goods from illegal and unfair competition, carried attractive prospects for stakeholders. Linked to new digital capabilities to guarantee provenance would be new opportunities in sustainable markets including housing and construction (AT). New European demand for traceable items (IT1) may boost the production of roundwood (AT), sheep skins (SCO) and food products, both utilising shortened supply chains. Regional branding and marketing might be further developed and promoted through digital platforms (SCO).

"The agro-ecological label finds its place among the recognitions and brands of quality. It makes sense for the consumer, who is ready to pay more for a premium and environmentally friendly product." (FR2)

Consumer willingness to pay more was also problematised in negative scenarios (FR1, IT2). One uncertainty rests with the cost of implementing the smart tools required for transitioning (FI, GR2). The example of connectivity in very remote areas (IT2), and more generally of costs falling directly on farmers and foresters (FI), injected negative sentiments into Scenario Planning sessions. A central issue foreseen is that many smaller operators, for example family run farms, do not have the capacity to invest for the long term and require more immediate return on investment to re-tool or up-skill. One example was virtual fencing for sheep ranching that may continue to be prohibitively expensive (SCO). The lack of affordable housing for locals was another current constraint projected to continue in more negative scenarios (NL, SCO), including the digitalisation of tourism, creating demand through an AirBnB model of holiday accommodation pricing locals, particularly youngsters, out of the housing market (SCO, NL). These negative considerations turned the discussion towards subsidies and other models to underpin a technological transition.

More structural investment, often at the European scale, was envisaged (HR). A Rural Development Program and new CAP strategic plan could result in financing for tailored solutions to meet the needs of local communities (GR1). This might include public investment to support rural digital literacy (IT1) and to develop e-Government platforms (IT2). A Green Dividend derived from programs including carbon sequestration giving value to environmental assets that currently don't have one (ES1) might provide structural funding to develop smart management approaches. Energy transitions might further boost rural incomes if models that reward community wind power are adopted, although trade-offs are difficult to predict (FI).

6.3 Changing societal demands and changing consumption patterns

Stakeholders considered the future of rural communities, agriculture, and forestry towards 2031 through the lens of demand and consumption. Changes in values, particularly around consumption, clearly present both opportunities and threats, and future uncertainty framed a wide-ranging discussion.

A drive towards self-sustainability and supply of local produce through short supply chains (NL), predicated upon changing public perspectives about planetary boundaries and sustainability, was eagerly anticipated (IE). In other words, a reorientation of food systems from globalised markets to local, seasonal and sustainable short supply chains was prevalent in many better not best- and best-case scenarios (IE, NL, SCO, LV). The ability to respond to new demand was strongly associated to product traceability and provenance which in turn were areas for digitalisation to play a major role. Domains included wood products from forestry (AT) and food from agriculture (NL, IE, SCO, LV). Local food hubs utilising online platforms and local businesses directly marketing or using digital services in inventive ways already exist within our sample and positive projections saw growth and benefits to rural areas. In the food sector such developments were said to potentially encourage diversification of local produce (NL) which in turn was foreseen as stimulating demand (NL).

Different assumptions considered the extent to which consumers will embrace environmentally friendly products and be prepared to pay more for them (see Section 6.2). While digital technology is considered instrumental for transparency of provenance of (HR, AT, FR2), setting standards and enabling trust, the degree of appetite for change was questioned through our structured approach. An engaged public, in the more optimistic scenarios, had a strong appetite for authentic touristic experiences (IT2, HR), for sustainable food (IE, NL, LV) from ethical businesses maintaining high animal welfare (LV, IE) and other strongly shared values. In one Living Lab (IE), an 'Open Food Network Ireland' constitutes a digital farmers market:

The platform now includes a virtual element, so customers are able to visit the producers online to see exactly where their food comes from, and to judge for themselves whether products meet their ethical standards (the public is now much more concerned about sustainability and food origins and holding businesses accountable). (IE)

However, one positive scenario (FR1) saw a downside to shorter supply chains. For wine, one scenario envisaged only the most famous, prestige wines being exported and declining access to international markets for lesser brands due to equivalent preferences for short supply chains in distant markets. The caveat to optimism surrounding short supply chains being that many high value global supply chains sustain rural enterprises and change will create losers amongst those currently enjoying export markets. Another exemplar was in GR2 where a declining market for tobacco is already leading to agricultural diversification that does not enjoy the old certainties. Where the region used to have a collective ability to grow and market tobacco with an established, efficient infrastructure, it now suffers from a loss of identity with products such as leeks not replicating the niche.

More negative scenarios assumed that supply chains would not necessarily shorten. In one *worse not worst* scenario, eco-friendly farming practices reduce because it has not been possible to promote these practices effectively to consumers (FR2). Another more pessimistic outlook detected a move to more online buying threatening the viability of small shops, farms, and rural businesses (IT2).

6.4 Local livelihoods

The way in which people work may vastly change in the future particularly one in which digitalisation has increased the opportunity for people to live remotely from their physical workplace as well as increasing the resilience of both individuals and communities (FI) by allowing them to take advantages of the local economy and food chains (NL). There may also be less disparity between rural and urban incomes (FI). For others, digitalisation might mean that their job is redundant or partly replaced by technology. In the more positive scenarios, it was felt that digitalisation might create opportunities for rural communities (SCO) or affect rural infrastructure and the availability of the labour force (ES2) e.g. more widely accessible university training in rural communities (SCO). However in the more negative scenarios it was felt that more people might move to live and work in rural communities without local knowledge which could negatively affect the region's sustainability through inappropriate land management (Including in forest areas, ES2).

For farming, it was felt digitalisation may increase farmers income (IT2, GR2). FI specified that this could be achieved through diversification and income coming from different sources such as tourism and forestry. Other ways in which the sector might be affected in the more positive scenarios included: attracting new individuals to work in rural regions (GR2); less reliance on short-term seasonal workers (e.g. for harversting DE2); and less on-field work (DE2). In IT2, the better not best scenario imagines an initiative in which involving farmers in local water management is rewarded with income: *"The Reclamation Consortium "Toscana Nord" verifies the need for the intervention and, if possible, assigns it to the farmer responsible for the area (who often is the same one who made the alert), with the corresponding **payment for the maintenance work**. This represents an important income integration for farmers in remote areas and it is also an interesting **incentive for participating in E-governance** initiatives and providing data on the status of the environment with a citizen science approach."*

Other sectors that felt that rural livelihoods could be affected by digitalisation in the future included forestry (ES2), circular economy including water management (e.g. 'hubs' able to extend outreach from water management to other sectors GR1). It was also noted that many small businesses have sprung up: growing, harvesting, preparing, preserving and selling local produce, and using online methods is now the norm for creative industries. (IE)

Local livelihoods and changing economic roles

The scenarios revealed that rural communities anticipate change in relation to their economic roles in the future. Such change will be driven by a number of factors, not least by the changing demands of consumers, particularly in relation to the sustainability and traceability of their food and forestry products. Digitalisation has the potential to impact positively in supporting stakeholders to communicate the provenance of their produce to consumers, but a downside exists too, particularly where online markets have the potential to take custom away from the smaller producers and retailers in rural areas who do not market their produce online.

On the other hand, digitalisation supports more people to work and run businesses from rural locations, which in turn can bring incomers to rural areas and alleviate the problems of rural depopulation. Yet these benefits are only sustainable where digital infrastructures are adequate for such purposes and are improving at a competitive rate.

7. Environmental and ecological (E) drivers of change

Sustainability, biodiversity, and climate change are all fundamental factors that need to be taken into account to understand the unfolding future. The physical constraints that the climate emergency is imposing on food production, forestry, and the rural environment more generally, not least, extreme weather events, will continue to impact the future beyond 2031. In addition, mitigating those effects through regulatory and policy instruments in the context of changing values directly related to the environment, will result in pro-environmental behaviours that must be factored into our strategic foresight. Living Labs were asked to consider these drivers within the context of digitalisation in rural areas.

7.1 Biodiversity

The biodiversity of the planet has been a concern for many years with many critically endangered species present on the red threatened endangered species list. Positive action would see a brighter future with creation of biodiverse rich habitats enhanced by the uptake of digital technologies. (AT) Adoption of new technologies reduce pressure on natural resources (FR2), use of digital wood traceability will encourage illegal practices (AT, IT1), whilst water levels can be ratified and maintained with new tools (GR1). Although some countries see the uptake as unhelpful resulting in the depletion of soils leading to a reduction in biodiversity (FR2). The use of monocultures continues to decrease biodiversity. Measures taken to enable the use of some new technologies have disastrous effects on biodiversity e.g. increased fencing or land consolidation to make smaller plots , decreases movement of wildlife (DE2, FI)

7.2 Sustainability

Digitalisation can help the building of a sustainable future. Majority of LLs in the more positive scenarios envisaged a public concerned with wider sustainability issues across different sectors including the environment (IT2, FR1), agriculture (FR2, FI), economy and tourism sector (SCO, GR1, DE2) and in the building of community resilience (IE). A demand from consumers for more environmentally sustainable products (FR1), along with eco labelling of earth friendly products (HR) has brought about changes in some sectors. However, some producers remain unconvinced of the need for specific certification (organic, environmentally friendly) adding unnecessary costs to the business (FR2). Whilst consumers and wider society are looking for environmentally friendly produce there is a fear that legislation is insufficient or unattainable for many producers (FR1).

An overall growing environmental awareness is seen (IT2) although sometimes this is driven by top-down activities or mixed attitudes which can lead to positive activities on different levels and scales (PL). An increased demand for carbon neutral produce and services stimulate the diffusion of clean energies and traced (legally imported) biomasses for energy purposes (IT1). Affordable housing (SCO) and improved energetic performances of buildings, domestic boilers and industrial plants increases demand (IT1). Although efficient energy is sought, some areas see the placing of wind turbines to increase the clean energy supply as detrimental to the environment and therefore unsustainable (ES2). Digital tools however can be utilised to plan in the effective siting of windmills to maximise returns (ES2). A scarcity of land to build houses however is a block to this future (NL). Similarly, an increase in tourists due to a prolonged tourism season (HR, see also 'Climate Impact') is a concern for communities to have sufficient housing for residents as opposed to visitors (SCO). An increase in 'agri-tourists' could lead to an overall ineffectiveness of some digital tools that require parts of the landscape to be closed off (DE2) and therefore building tension amongst different land-users.

Finally, many LLs saw changes that were to benefit the wider rural and regional community. This was envisaged through moves to a circular economy (GR1) tied into pursuing local alternatives to meet global energy crises' and building community resilience (IE). Digital tools to enable effective water monitoring, benefits the entire region as water management is necessary to the sustainability of the region (GR1). Digital tools enable a more equitable stake amongst different rural stakeholders (FR2) to the use of certain resources. Agriculture diversifies to become 'multi-functional agriculture' (FI) and other income streams are available, lessening risks associated with specific monocultures.

7.3 Climate impact

Climate change and the impact from this was a concern to most LLs. In particular, the potential for digitalisation to mitigate the impacts from an increase in extreme weather events focused attention (DE1, DE2, IT1, FR2). Forest fires, floods and droughts were deemed to largely increase in frequency and impact across both rural and urban areas in future scenarios, as well as threats from zoonoses (LV) due to the changing climate. The digital response however, notably brought winners and losers across the rural, agricultural and forestry domains. Extreme weather events are more predictable (FR2) and digital tools enable greater forecasting (ES2) which can aid in the preparation of adequate responses (DE2, FR2). However, the tools developed raise concerns, notably scepticism over their reliability (FR2), the preventative high cost of the tools to different land users (FR2) and the lack of digital skills needed to utilise the tools effectively (IT2). In the worst-case scenarios, the overall threat and concern from increasing extreme weather events affects the growing season for many farmers to the extent that they leave the sector altogether (FR1), and agricultural land abandonment with unregulated forestry can also increase the fire risks posed (ES1). However, the changing climate enables a longer tourist season (HR) and potentially provides an alternative income to rural stakeholders.

Given the increased frequency of these weather events as well as the indiscriminate nature of the effects from extreme weather there is an increase in public interest to find solutions (IE, ES1, DE1, IT1). A "general awareness" (ES1) applies pressure to create enhanced cooperation and coordination amongst different land users to mitigate damages from extreme weather (ES1, IT2). A mobilised public including former School Strikes for Climate movement activists (IE), and a demographic renewal in rural areas (see 6.1), leads to a burgeoning creativity to develop local solutions to combat the worst of climate change effects (IE, IT2, DE2, ES1). Digital tools include waste receptors, sensors to record water quality (GR1), high-tech cultivation measures (DE2) and enhanced monitoring tools (IT2). Other non-digital measures include a reduction in "frivolous" travel (IE) and increased domestic holidays (FI) that lead to a conserve of energy that can be directed into alternative uses and important savings on carbon emissions (FI). Importantly: "*The increasing extreme climatic events ask for improved land and water monitoring system in remote and mountain areas and an improved ordinary land management strategy, to reduce the potential hydrogeological risk." (IT2).* In this scenario, a holistic land management strategy incorporates both human capital and new digital tools.

Climate change and digitalisation

Of central concern in visioning rural futures is environmental sustainability. In particular, climate change is a prime issue across the majority of LLs. Many LLs were concerned with the impacts of extreme weather events on their near future (wildfires, floods and droughts in particular). Digital technologies are considered to have the potential to mitigate risks, for example through tools which bring more accurate predictability. On the other hand, new digital divides are emerging which see disparities between land owners and managers in terms of who is and isn't able to benefit from digital tools, due to issues of infrastructure (and access), cost, and digital skills. On the other hand, climate change can lead to "improved" weather conditions which extend tourist seasons allowing more farmers to diversify into agritourism.

8. Political or policy (P) drivers of change

A political lens allowed participants to consider how power dynamics may reshape European rurality towards 2031. In the domains of European agriculture and forestry, the European scale has had a profound effect on production and markets over the past fifty years or more and it was expected that DESIRA Scenario Planners would explore the role of the CAP and of subsidies on future developments. As with the preceding driver domains, DESIRA Scenario Planners were asked to retain a focus on digitalisation. The impact of digitalisation on the political landscapes across Europe intrigued many participants. A generalised fear that power may shift away from local stakeholders to become more consolidated in the hands of big corporate players within the metaverse was evident in several LLs (SCO). Power can be furthered by digitalisation by giving people access to information or a say in things they might not have had before, for example in GR1, increased public awareness and participation in water management decisions could apply pressure to local authorities to ensure sufficient water standards (GR1). In other examples, digitalisation was also felt to reduce disparities between urban and rural areas (FI). Power can also be hindered when digital inequalities are predicted to increase, for example in terms of uneven balance of power being observed between the more and less digitally savvy viticulturalists (farm owners - FR1). Continuing with the digital divide and digital literacies theme, a shift in power between different scales of enterprise (farms etc.) was considered in the worse not worst case in IT2, where it was felt tech companies have the most power due to the high rise in tech usage.

Power was also mentioned as occurring at difference scales. At the European or larger scale, politicians and private companies may push the positive experiences of digitalisation (DE2). Other examples included: the influence of green political European parties in pushing a sustainable and green agenda (AT) – specifically in this Living Lab on the role of forestry in international climate pledges including reforestation for carbon sequestration; more public investment in Spanish rural areas and more responsibility by public administration to establish data protocols and data interoperability mechanisms (ES1); post-communist context to Croatia where a more narrowly focussed EU was envisaged with political instability as a potential dystopia (HR). At the local municipality or authority level – local administration responsibilities and privatisation was mentioned for example through the implementation of an online act – OAA in DE1. The role of the state in implementing acts to digitalise data to increase accessibility was also considered in relation to spatial planning in PL. Digital transition in spatial planning in Poland has transformed the political and governance system (started in 1990s) which introduced a decentralised model of spatial planning including participatory planning and increased digital transition in terms of spatial planning processes and data (in the more positive scenario). Formalised through Spatial Planning Acts (2003) and in 2020 the act was revised to make digitalisation of planning documents necessary which continues to increase sustainability and local democracy (PL). In NL, the two scenarios reflect tensions around how much the community will be regulated externally or be allowed to self-organise in the future. In IE, a new co-operative governance model in place was led by older pioneers but they find their ideas and experience are often sidelined by younger generations keen to make their own mistakes and take new risks.

Power was also mentioned in terms of local power in some scenarios such as lobbying against clean energy slowing the uptake of legal wood sources (IT1) tobacco growers in Greece (GR

), landownership in Scotland (SCO), an uneven balance of power is seen between the more and less digitally savvy farmers (FR2), in FI fragmentation of forest land ownership in streamlined. In NL, in the more positive scenario, self-organisation persists in the future, and very quickly, *"By 2022, there were weekly meetings where residents visited each other and told the community about their plans and obstacles".*

9. Covid-19

The start of the Covid pandemic saw many communities accelerate their acceptance of digital technologies as coping strategies to deal with social distancing, travel restrictions and increase their ability to interact with friends and families as well as a renewed way of working. Some now fear that this boost to digitalisation might be lost and the advantage won through dire circumstances might not be embraced as the new 'norm'. Increased digitalisation is not necessarily all good and needs to be considered as a solution for social connections when face to face is not possible, there will be divides between those who want to start meeting in person to socialise versus those who wish to continue to engage digitally.

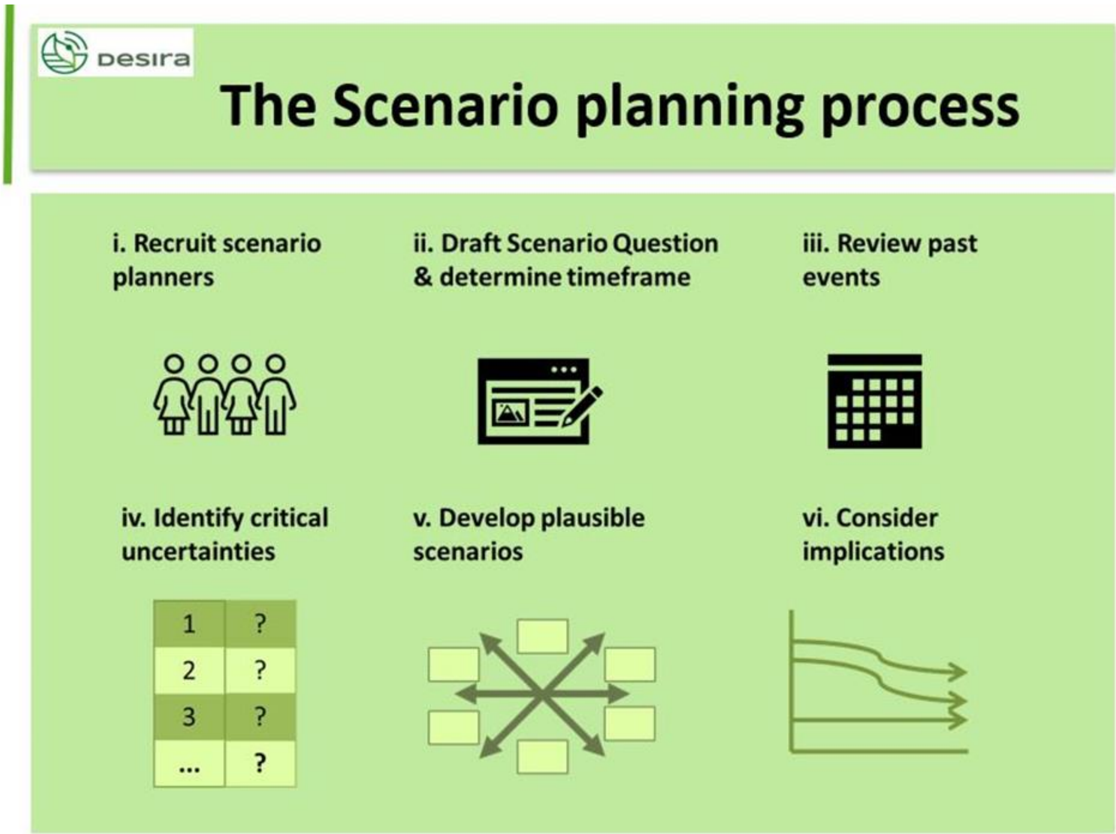
The pandemic has facilitated rapid changes in health care which will continue with improved digital services (ES2). Another way in which the pandemic may have improved rural circumstances is through increased mobilities and demographic renewal in rural regions as the pandemic has increased digital connections and capabilities in rural communities and distance learning opportunities to allow the young to remain in their local rural areas (IT2, SCO) e.g. *"the possibility of using* ***distance education services****, which at the moment (with the covid-19 pandemic forcing the use of distance learning), are at the limit of acceptability in terms of quality."*(IT2). It also presents the opportunity for new people to migrate to rural communities as digitalisation enables greater flexibility and internet connectivity (GR1, SCO, FI).

However, Covid has had a big financial impact on European economies which may lead to worse case scenarios like that of FR2 where *"Legislation hinders the development of digital technologies (data sharing, precautionary principle...). The weight of the Covid debt prevents any public financing towards companies." FR1*. Migration due to covid was also not all positive and acquiring a seasonal workforce was difficult prior to Covid but has intensified since. More automation could thus help preserve family farms who rely upon these seasonal workers (DE2).

10. Methodology

10.1 Scenario planning step by step

Figure 3: Simplified scenario planning process



The process of scenario development was based on one or two workshops carried out by the Living Labs which were run as illustrated in Figure 3. Steps i and ii (along with some elements of the other steps, notably iv and v) were completed before the workshop although a short discussion of the scenario question was in some cases accommodated at the beginning of the workshop. The first workshop was dedicated to the elaboration of four scenario frames (steps iii. to iv.) Prior to the scenario workshop there was a workshop held as part of WP2 with the Living Labs which identified the past and current state of digitalisation in each case. The outcomes of this workshop acted as a starting point for the two scenario planning workshops (see point iii in Figure 3). The second scenario workshop (or second part of the single workshop) completed steps v and vi.

Step i. Assembling of Scenario Planners

Scenario Workshops were held by each Living Lab across the DESIRA regions. Scenario planners were members of the Living Labs, and those who participated in the WP2 workshop (or a subset of them). Where necessary and/or useful, additional people were asked to join the workshop(s). The first scenario planning workshop session in each Living Lab was followed by a second session each taking approximately 3 hours. The sessions were either held on separate days with an interval, or on the same day. In some cases, the Covid-19 situation compromised the preferred plan to hold face to face participatory scenario planning meetings and these workshops were therefore held online.

Step ii. The Scenario Question and Time Horizon

Scenario Question: Because the Living Labs already had the concept of a 'Focal Question' and because scenario planning requires a special, future oriented question (conventionally also called a *focal question*), we defined the term 'Scenario Question' to make a clear distinction between the questions framing the broader LL and the questions framing the scenario planning components of the LL. Scenario questions are about future visions (e.g. what will 2031 be like?). The draft Scenario Question was produced ahead of the workshop and discussed in the workshop with participants, who were welcome to alter the question to better suit the context. It adds legitimacy to participatory scenarios if the participants have their say on the Scenario Question and are given the opportunity to modify or replace it (Duckett *et al*. 2017). While in an ideal participation a blank sheet of paper maximises the control that stakeholders have over the process, in practice there is always a balance to be struck about how much can be achieved in the precious workshop time when the stakeholders will have a steep learning curve and be may be challenged to complete scenarios in the time allowed.

Methodologically, a **time horizon** is required. Future scenarios are temporally fixed to allow scenario planners to envision a state of play at a specific point in the future. Too far in advance and the scenario becomes highly speculative as the uncertainties mount and of little interest to decision makers with policy cycles to consider; set too near to the present, scenarios lack strategic depth (see Fig. 1.) and may be more appropriate for operational level decision making as opposed to the desired strategic level of most scenario planning. For DESIRA we specified a Time Horizon of 2031 which was also stated in each scenario question. Importantly the objective of scenario planning is to think about current strategy or actions that are needed now in light of future uncertainty. One can think of scenarios as a roadmap from the present to the future.

Step iii: Review of past events

Prior to the scenario planning workshops, the WP2 workshop had already reviewed past and present digitalisation. The outcomes of this previous WP2 workshop provided briefing material for use at the first scenario workshop session (Step iii, Fig. 3). Stakeholders found it helpful to consider a timeline of past events roughly equivalent to the length of time to the future horizon (i.e. the decade from 2011 to the present acts as a prompt for the coming decade until 2031). Looking back at the last decade and events identified by the WP2 workshop while thinking about the Scenario Question demonstrates to the stakeholders how radically the situation, particularly digitalisation, has changed and therefore how radical future visions need to be.

Figure 4: Example of a participatory 'timeline' exercise

Step iv: Identifying DOC and critical uncertainties

A key concept underpinning scenario planning is that of Drivers of Change (DOC). Myriad ways of conceptualizing drivers have been developed and our approach is robust but not the only one. Most methods proceed by characterizing different types of driving forces: External driving forces (drivers that cannot be controlled by the actors of the scenario (e.g. Geo-political forces) and internal driving forces (parameters that can be influenced by stakeholders within the scenario (e.g. technology adoption). Both internal and external driving forces shaping any given scenario and any future behaviours, can have a high degree of uncertainty associated with them, in which case we refer to them as *Critical Uncertainties*.

One can think of DOC as the scaffolding around which the scenarios are built or as its internal structure. In order to elaborate our scenarios in a way that will give them a level of comparability across the project, we needed a common, underlying structure around which to build plausible narratives about the future. For example, in the case of the Tuscany LL, if stakeholders select 'robotics' to be a plausible DOC for an alternative future affecting the risk of flooding in 2031 it is added to the list under consideration. Equally, if 'extreme weather events' is a plausible force that may shape flood risk management differently in 2031, it is added to the list.

STEEP

In order to encourage the compilation of an appropriate and broad ranging list, we applied a STEEP analysis. STEEP stands for Social, Technological, Environmental, Economic and Political. It is a simple checklist method to ensure that drivers are selected across multiple domains. It prevents stakeholders becoming too narrowly focused on, for example, economic drivers, whilst neglecting technological dimensions. The approach promotes the identification of DOC for each letter in the STEEP acronym.

Figure 5: The STEEP workshop tool

We acknowledge that DOC are not necessarily categorizable in neat and simple boxes. They are typically transversal or able to be seen in different domains by different stakeholders. One stakeholder's technological driver may be another stakeholder's economic driver, for example e-commerce. STEEP was not used to create a taxonomy of drivers but simply to encourage wide ranging thinking. The transversality of many drivers was something noted at the Rural Development Forum meeting and in several Living Labs.

We also recommended to facilitators the pre-preparation of an initial set of drivers before the workshop. Experience dictates that this can be a time-consuming exercise and all elements of scenario building need to be completed in two, constrained workshop days (or sessions). We followed what has been done successfully in previous exercises – the pre-preparation of a set of drivers, drawing on researchers' background knowledge of the context, for example, existing knowledge about the LL specificities plus information from WD1.3 to select digital game changers. This guided the participatory exercises towards reviewing, modifying or supplementing this preprepared set but did not prevent the addition of DOC at the discretion of the local facilitators. In order to support the preparation of relevant DOC the WP lead compiled a compendium of drivers of change based on a literature search including previous germane scenario exercises.

Given a DESIRA focus on the role of digitalisation in the future, we encouraged participants to consider a combination of technical change and societal/behavioural change. A scenario of a future 'socio-technical system') should then incorporate at least the following types of elements:

Figure 6: Guidance for STEEP DOC

STEEP	DOC
	Demographic issues? Depopulation? Digital literacy? Local community issues? Cooperation? Stakeholders and their technology adoption? SCP?
	What are the relevant Digital Game Changers? Data? Information flow? Platforms? Solutions? Infrastructure? SCP? Equipment? Production methods?
	Sustainability? Land management? Climate Emergency? Natural environment?
	Macroeconomic environment? Local economy? Markets? Labour force?
	Types of governance? Extent of future governmental support? Local norms and values? Institutions? Formal and informal interactions between stakeholders?

The preprepared set of ~5-10 DOC representing the critical uncertainties and most significant game changers need to have a corresponding set of assumptions. No one knows how or which drivers will influence events given that the future is inherently uncertain, however, scenario planning works by exploring different assumptions about how drivers of change may operate. Workshop organisers developed 2-5 assumptions for each DOC in advance of the first session. This allowed for the development of plausible scenarios.

Step v: Develop Plausible Scenarios

A number of methods exist allowing the development of scenarios. Each have advantages and disadvantages both methodologically and practically. So that the scenarios developed in each Living

Lab could be comparable and for them to form a coherent set, a common, structured approach was required. We employed a variant of morphological scenario methodology. Morphological Scenario Planning is structured around a matrix or Morphological Box. The Matrix contains Drivers of Change

along one axis and a range of plausible assumptions about how they may shape the future along the other. For DESIRA, DOC must include the driving forces of digitalisation, both internal and external and plausible assumptions about how these drivers of change may shape the future. For example, 'low degree of connectivity in the rural area' or 'low level of availability of open data'. In each scenario outline, digital game changers, (DGC) guided by the Taxonomy (D1.3) and by WP2 Workshop 1, alongside other DOC introduced by the participants, were used to populate ~8 rows. DOC therefore, were not exclusively digital entities and should include heterogenous entities.

After selecting 5-10 DOC to be included in the matrix, participants next decided what different states those DOC might plausibly take. This can be binary (e.g. high/low) or more expansive (e.g. high/medium/low), (see figure 7). It was strongly recommended that the facilitators had already developed possible states for the preprepared drivers. This helped participants to understand what was required for any new drivers selected - and participants were also encouraged to challenge and change any states suggested by facilitators. These assumptions were used to flesh out the detail in the morphological box around the DOC.

Figure 7: Morphological Box populated with 4 Drivers of Change (DOC)

STEEP DOC	Assumption 1	Assumption 2 – BAU	Assumption 3	Assumption 4
Digital gender divide	Gap is narrowed. Affirmative action and effective women in STEM policies have created a more level 'digital' playing field.	Gender Gap remains. There are fewer digital opportunities for women. Women have lower levels of technology skills and are paid less in STEM fields.	Gap is widening due to post Covid austerity. GiG economy and lack of effective action around women in STEM have worsened outcomes.	
Connectivity in the rural area & Digital training platforms	Connectivity is HIGH, favourably comparable with UK urban areas with 7G and 8G services available. Digital training platforms are widely adopted.	Connectivity is MODERATE, service provision lagging behind urban areas. 6G is the typical service provision for this area. Adoption of Digital training platforms is limited.	Connectivity is POOR 4G and 5G services limit both opportunities for rural businesses and availability of services in this area. Digital training platforms are rare.	
Ecommerce supporting diversification/ pluractivity	Ecommerce platforms are providing a lucrative market for croft based enterprises.	Ecommerce provides a modest market for croft based enterprises supplementing other incomes.	Ecommerce is a weak driver for croft based enterprises.	Ecommerce platforms are dominated by larger players and act to exclude croft based enterprises.
Rewilding, Native Restoration, Living Landscape	Under a strong Green Recovery, Rewilding and high valuation around Living Landscapes benefits crofting	Under a modest Green Recovery, crofting continues to make moderate progress	Without effective Green Recovery crofting declines	Green Recovery promotes rewilding over Living Landscapes to the detriment of traditional crofting
Crofting support mechanisms	Strong public support is available for crofting inc. payments that safeguard livelihoods	Weak public support for crofting does little to safeguard livelihoods		

Assessing the socio-economic impact of digitalisation in rural areas 17

The template also organises the assumptions from positive (left) through Business as Usual or BAU (centre) to negative (right). Regarding practical constraints, we needed to limit the complexity of the task and complete it in a timely manner at the workshops. For these reasons we recommended setting a ceiling of 10 DOC and a maximum of 4 states (assumptions) for each. Furthermore, it was recommended that the matrix should cover all 5 STEEP categories. This was to reflect the reality that the future is determined by a heterogeneous set of factors.

10.2 Scenario Outlines

The third step to complete the Morphological Box was to consider combinations of assumptions or pathways through the matrix to form outlines of scenarios. In the next example the blue cells represent the outline of one possible scenario. A scenario outline can be thought of as the framework of a scenario. There are hundreds of possible pathways though the matrix. The workshops each selected only 2-4. The pathway must represent a plausible outline or in other words, the set of assumptions must be consistent with one another.

Figure 8: The third stage of matrix construction – selecting a scenario outline

STEEP DOC	Assumption 1	Assumption 2 – BAU	Assumption 3	Assumption 4
Digital gender divide	Gap is narrowed. Affirmative action and effective women in STEM policies have created a more level 'digital' playing field.	Gender Gap remains. There are fewer digital opportunities for women. Women have lower levels of technology skills and are paid less in STEM fields.	Gap is widening due to post Covid austerity. GiG economy and lack of effective action around women in STEM have worsened outcomes.	
Connectivity in the rural area & Digital training platforms	Connectivity is HIGH, favourably comparable with UK urban areas with 7G and 8G services available. Digital training platforms are widely adopted.	Connectivity is MODERATE, service provision lagging behind urban areas. 6G is the typical service provision for this area. Adoption of Digital training platforms is limited.	Connectivity is POOR 4G and 5G services limit both opportunities for rural businesses and availability of services in this area. Digital training platforms are rare.	
Ecommerce supporting diversification/ pluractivity	Ecommerce platforms are providing a lucrative market for croft based enterprises.	Ecommerce provides a modest market for croft based enterprises supplementing other incomes.	Ecommerce is a weak driver for croft based enterprises.	Ecommerce platforms are dominated by larger players and act to exclude croft based enterprises.
Rewilding, Native Restoration, Living Landscape	Under a strong Green Recovery, Rewilding and high valuation around Living Landscapes benefits crofting	Under a modest Green Recovery, crofting continues to make moderate progress	Without effective Green Recovery crofting declines	Green Recovery promotes rewilding over Living Landscapes to the detriment of traditional crofting
Crofting support mechanisms	Strong public support is available for crofting inc. payments that safeguard livelihoods	Weak public support for crofting does little to safeguard livelihoods		

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Given workshop constraints of ~10 scenario planners it would be challenging to fully develop 4 scenarios in each LL. Therefore, it was proposed that 2-3 scenarios were fully articulated, and another 2 scenarios were developed in outline form only. The direction was to consider a plausible positive scenario (e.g., Fig. 8 above) and a plausible negative scenario as the main scenarios. These might be regarded as a better (not best) case and a worse (not worst) case scenario and would enable a systematic exploration of both opportunities and threats respectively. It is often considered good scenario methodology to avoid extremes because history generally reveals more nuanced patterns. The 2 fully articulated scenarios avoid utopian or dystopian characteristics but develop around more plausible good, and plausible bad features.

A third Business as Usual (BAU) scenario was developed in larger workshops wanting to have 3 breakout groups. The BAU outline generally adopted cells from the centre columns of the matrix (either column 2 or 3 depending on whether the number of assumptions), however, BAU also requires plausibility and internal consistency so careful judgement must still be applied.

The 2 scenarios that are not fully articulated were a 'utopian best-case scenario' and a 'dystopian worst picture' containing more extreme elements. These were developed in a less detailed manner in plenary during the second session.

10.3 Elaborating scenario narratives

With four scenario outlines determined the next task was to more fully articulate the scenarios. The participants worked with the two intermediate scenarios in breakout groups to 'bring the scenario to life'. There was first a discussion on the plausibility of the scenario outline and a consideration of internal consistency i.e. it must allow a coherent narrative to be told.

This checklist of questions and activities was provided to LL coordinators, to be used in 'bringing the scenario to life'.

- **Ground-truth assumptions – are they plausible – is the set internally consistent**
- **Consider your Socio-Cyber Physical System (SCPS) in 2031**
- **How do the assumptions combine to influence the SCPS?**
- **Who are the winners and losers?**
- **What are the challenges and opportunities?**
- **What uncertainties are present?**
- **What predetermined elements exert influence?**
- **Add detail and colour to the scenario**
- **What is it like to live in this version of the future?**
- **How is daily life different?**
- **How is the community different?**
- **Compare the new SCPS of 2031 with the old SCPS of 2021**

This synthesis report draws on an analysis of the 20 scenario reports that were produced as outcomes of the scenario planning workshops held with the existing living labs established in WP2, details of which can be found on the DESIRA website. The scenario questions were finalised with the workshop participants, and all feature the required year 2031 (Figure 2).

11. Rural Digitalisation Forum workshops

Between December 2021 and February 2022, the Rural Digitalisation Forum (RDF) of DESIRA organised an EU scenario planning exercise. The activity was structured in two workshops, which took place on 7 December 2021 and 8 February 2022. Bringing together 30 stakeholders from different backgrounds (research, public authorities, SMEs, stakeholders' organisations, members of National Rural Networks), the exercise was intended to create linkages between the 2031 scenarios developed by DESIRA Living Labs and the European Commission's long-term vision for rural areas. Building on the existing approach (stronger, connected, more resilient rural areas that foster well-being, and prosperous rural areas), DESIRA aimed to add a fifth element: the vision for digitalisation of rural areas.

Expert stakeholders worked together to explore how a positive future in terms of rural digitalisation can be reached. They concluded that rural futures and solutions should be different from urban ones. The process should be driven by a bottom-up approach to create change. Central and high-level organisations could act as enablers of social innovation at the local level, and as connectors to link local initiatives together and to improve learning processes among them. This process must be steered, and local initiatives should be integrated. In this sense, visions have a strong influence on creating integration by leaving space for communication between organisations. The full report can be found in Appendix B.

12. References

Bezold, C. and T. Hancock (1993). An Overview of the Health Futures Field in Health Futures in support of health for all World Health Organization.

Cho, Y. (2013). Investigating the merge of exploratory and normative technology forecasting methods. 2013 Proceedings of PICMET '13: Technology Management in the IT-Driven Services (PICMET).

Duckett, D. G., A. J. McKee, L.-A. Sutherland, C. Kyle, L. A. Boden, H. Auty, P. R. Bessell and I. J. McKendrick (2017). Scenario planning as communicative action: Lessons from participatory exercises conducted for the Scottish livestock industry. Technological Forecasting and Social Change 114: 138-151.

Government Office for Science (2017). The Futures Toolkit: Tools for Futures Thinking and Foresight Across UK Government.

Kok, K., M. van Vliet, I. Bärlund, A. Dubel and J. Sendzimir (2011). Combining participative backcasting and exploratory scenario development: Experiences from the SCENES project. Technological Forecasting and Social Change 78(5): 835-851.

Ramirez, R., and C. Selin (2014). "Plausibility and probability in scenario planning." Foresight - The journal of future studies 16.

13. Appendices

Appendix A – Compendium of drivers of Change DOC

Figure 9: Compendium of drivers of change offered to LLs to inspire their thinking

STEEP	Drivers of Change (DOC)						
	DOC	DOC	DOC	DOC	DOC	DOC	DOC
SOCIETY **Demographics Future of Health Future of Education Changing Values**	Global population growth	Global health including pandemic	Virtual Medical Services	Education services in remote areas	Changing values and aspirations	Gender, Digital gender divide	Urbanization at the local or regional level
	Rural ageing	Inward migration	Gentrification	Rural population density	Dietary change (particularly less meat)	Education level of farmers	Farm succession/new entrants
	Societal demand (for healthy environment)	Societal expectations towards organic	Self-image of organic sector	Manual labour (tedious)	Image of farming		
TECHNOLOGY **Digitalisation**	Public/private Investment in relevant science and technology	Internet of Things & Cloud Computing	Precision agriculture	Robotics	E-commerce	Driverless cars	Drones
	Connectivity in the rural area	Availability of open data	Innovation	Affordability of technology	Digital literacy,	Digital training platforms, Digital outreach	Remote sensing

	Useful Apps	Data hubs, platforms for data sharing	Virtual Veterinary Services				
ECONOMIC **Macro-economy** **Future of Food**	International trade and globalization of markets	(World) commodity prices (e.g. timber)	Energy Prices	Decentralised energy systems	Distributive Manufacturing	Future of Food – synthetic meat	Poverty
	Availability of Labour force	Availability of investment capital	Rural infrastructure	Supply chain	Ecommerce	Diversification, pluractivity	Costs of labour
	Market situation for (organic) vegetables	Consumer demand	Consumer prices	Costs of technology			
ENVIRONMENT **Climate Change**	Water scarcity	Extreme weather events (inc. wildfires)	Rainfall variation	Biodiversity	Soil health	Rewilding, Native Restoration, Living Landscape	Environmental awareness
	Availability of seeds/ choice of seed varieties	Energy consumption					

POLICY	Neoliberal markets	Protectionism	International climate accord	Extension services / AKIS	Subsidies, CAP	Green Recovery	Strength of governance (particularly relevant for forestry)
	Security of tenure	Crofting Arrangements inc. subsidies	Legal framework for pesticide use				

Appendix B – Rural Digitalisation Forum Report

SECOND MEETING OF THE RURAL DIGITALISATION FORUM

Authors: Lucia Garrido and Alexandre Duporte (AEIDL), Gianluca Brunori (University of Pisa), Leanne Townsend (James Hutton Institute)

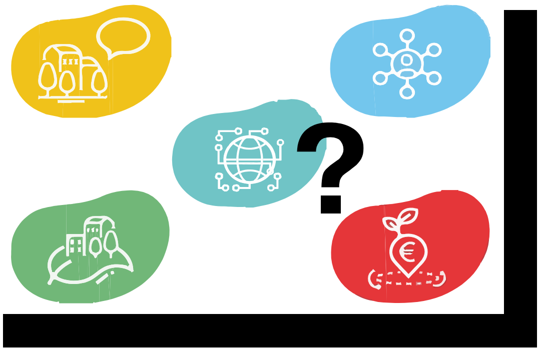
Between December 2021 and February 2022, the Rural Digitalisation Forum (RDF) of DESIRA (Digitisation: Economic and Social Impacts in Rural Areas) organised an EU scenario planning exercise. The activity was structured in two workshops, which took place on 7 December 2021 and 8 February 2022.

Bringing together 30 stakeholders from different backgrounds (research, public authorities, SMEs, stakeholders' organisations, members of National Rural Networks), the exercise was intended to create linkages between the 2031 scenarios developed by DESIRA Living Labs and the European Commission's long-term vision for rural areas.

First Workshop: Setting the context

7 December 2021

On 7 December 2021, the first workshop of the EU RDF foresight exercise was held. The event featured presentations from high-level speakers, who introduced the necessary context for the exercise. Around 30 experts from different backgrounds, spread across breakout rooms, discussed how digitalisation could affect the different areas of action composing the long-term vision for rural areas.



Stronger rural areas

Facing weaknesses of the administration and lack of services provision, municipalities have the potential to join forces, using existing digital technologies. If rural broadband penetration increases in the future, it can open opportunities, if the lack of digital skills in some communities is addressed. Decentralised policy-making can provide autonomy to rural areas, allowing them to pursue their own political agendas independent of central government, while allowing them to still have a voice in the national context. Online services and platforms can welcome and attract urban dwellers and businesses.

Connected rural areas

Digitalisation can create new market dynamics, promote remote and flexible work, develop community digital networks, enhance the valorisation of value chains, and bridge the gap between urban and rural areas. However, there is a cultural resistance. Rural dwellers may not accept a technological future,

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818194

if it is seen as a threat to traditional knowledge and identity, and presents loss of human interactions and sense of community.

More resilient rural areas that foster well-being

Digitalisation can lower the use of agricultural inputs (fertilisers, pesticides, antimicrobials) and facilitate agriculture, livestock, and forestry management. Labour-intensive manual work, as well as administrative and bureaucratic processes, can be reduced. Rural activities would diversify and open up labour options for women and business. Nonetheless, there are some risks such as security of data use, loss of farmers' and other actors' techniques, dependency on robotisation, reduction of labour and lack of affordability of digital technologies.

Prosperous rural areas

Employment and the value-added of farming and agri-food activities could both improve thanks to digital technologies. Robots and other devices could make agricultural activities more feasible in areas severely affected by climate change. Appropriate technologies could improve the productivity of agroecological practices, so far neglected by agri-tech. Farmers could get more visibility on the market through digital tools. On the negative side, tech giants could take over the market in rural areas and affect small producers. People not used to digital tools, such as the elderly or those with few resources, could be left behind.

Second workshop: EU Scenario exercise

8 Februrary 2021

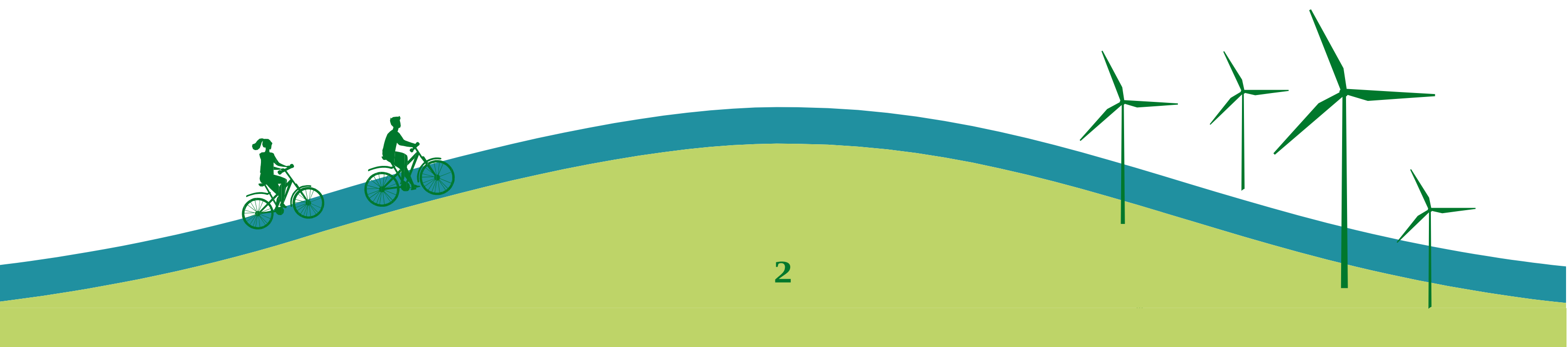
The second workshop of the RDF scenario planning exercise was held on 8 February 2022. The RDF experts came together to contribute to the work of DESIRA on the Scenario Planning, linking it to the long-term vision for rural areas. During the second half of 2021, 20 DESIRA Living Labs carried out scenario planning workshops, in which they developed plausible narratives of what the future could look like, by 2031 taking into account known drivers of change that have specific effects over time. DESIRA has synthesised this work in a report that compares the different scenarios by type of region, sector/sub-sector, and type of game-changer.

Building the narrative 'Digital Rural Areas'

The aim of the discussion was to shape a fifth element or area of action for the long-term vision, 'Digitalisation of rural areas'. The long-term vision for 2040 is optimistic. In order to summarise findings that can be used to construct the fifth element, the workshops focused on elements of the plausible, optimistic narratives, termed 'better not best' and 'utopia' in the methodology.

Digital rural areas

By 2040, rural areas are vibrant, attract newcomers and offer qualified jobs with decent salaries. Rural areas are fully connected to urban areas, and population flows are bi-directional. The rural digital divide has consistently reduced, as governance mechanisms in place that monitor it have successfully intervened with specific initiatives. Rural administrations can offer a wide range of digital technologies to all, and this significantly improves their quality of life. Digital technologies fully support local administrations in managing the rural environment and the related environmental risks.



Building on the 'Drivers of Change' (DoC) identified by DESIRA Living Labs through these workshops, RDF participants held three rounds of discussions in breakout rooms, following a building blocks methodology, which provided input through the following guiding questions:

Round 1: What is relevant from DESIRA and what is missing?

Participants reflected on how the DESIRA Drivers of Change can help rural communities and businesses reach their full potential in the coming decades, as well as potential DoC or concepts that might have been missing.

Round 2: What should be done?

Building on the discussion from the previous round, participants discussed possible actions needed to achieve these impacts by 2040, as well as when these actions should take place.

Round 3: Proposed solutions

In the third and final round of discussions, the experts proposed concrete solutions that can contribute to the vision statement, and define what should be done and who should do it to achieve this vision by 2040.

What is relevant from DESIRA?

Opportunities related to digitalisation:

- Digitalisation allows a more flexible approach to work and education, including remote participation, which has been enhanced by the pandemic.
- Digitalisation can make rural areas more attractive to young people.
- Digitalisation can support new social services and collaborative actions in communities, for example, with support of digital platforms.
- Use of robotics and drones will shape agricultural activity.
- Short supply chains can bring extra value to local businesses.
- Local supply chains enable consumers to make more ethical choices and shop locally.
- Digitalisation brings opportunities for new business models, empowering farmers, foresters, and other rural actors.
- Digital technologies allow for an improved use of resources, and a more sustainable agriculture, promoting the transition to agro-ecology.
- Rural areas can act as guardians of biodiversity.

Threats:

- Local knowledge on environmental monitoring could be lost due to ageing and retiring populations, but digital platforms can capture this knowledge.

Conditions for grasping opportunities:

- groups might need extra support to adopt digital technologies (e.g. the elderly).
- There is a need for data privacy standards, and data ownership needs to be regulated.
- Equal access to connectivity is a precondition.
- Technological solutions should be co-designed so they are appropriate for each rural area.
- Balance of power: rural dwellers should have a stronger say in local decision-making.
- Urban recognition of rural role in society: the urban-rural gap should be closed.

What should be done?

- Strengthen services, such as education, childcare, housing, and mobility, to attract population to rural areas, especially attracting or retaining young people or families.
- Enhance access to digital tools and digital knowledge through, for example, digital AKIS.
- Municipalities should be proactive instead of reactive, and put policies in place to retain rural inhabitants and investors.
- Establish focus groups at municipal level to reflect on issues at local level.
- Ensure digitalisation does not replace human connections and face-to-face interactions.
- Guarantee connectivity not only in villages, but also in forest and agricultural lands, to improve environmental monitoring.

- Raise awareness and improve skills of municipalities to increase technological acceptance.
- Engage rural people in the design of applications and technologies.
- Create and promote EU data spaces.
- Boost investments linked to the digital transformation, but also strengthen the role of rural agencies to make sure these investments have a positive impact.
- Support start-ups and rural entrepreneurship.
- Improve the capacity of public administration to assess environmental performance.
- Set up open access for data ownership.
- Desirgn policies to ensure the right to own and the right to repair.
- Digitalisation strategies should be designed at local or municipal level.
- Incorporate tools and mechanisms to allow rural citizens to contribute to decision-making.

Proposed solutions by rdf experts

- Guide digitalisation in rural areas.
- Balance the roles of governments and markets as drivers of digitalisation.
- Develop digital platforms that enable collaboration and cooperation of rural areas, knowledge exchange, peer-to-peer learning and capacity building.
- Develop online platforms to support access to local food and sustainable products.
- Encourage strong cooperation with different types of stakeholders (telecom operators, local authorities, rural citizens, researchers).
- Introduce and enhance financial regulation and financial support for connectivity.
- Reinforce the role of extension services on technical and subsidies advice.
- Establish indicators to monitor impacts of digitalisation.
- Create a conducive environment for sustainable digitalisation.
- Empower municipalities, through skilled human resources, joining forces with other municipalities, getting technical support from higher levels, promoting bottom-up decision-making.
- Enhance coordination and interoperability between different administrations.
- Adapt environmental regulation to acknowledge digital realities.
- Improve representation for rural populations at the political level.
- Foster the role of programmes such as LEADER to emphasise digitalisation opportunities.

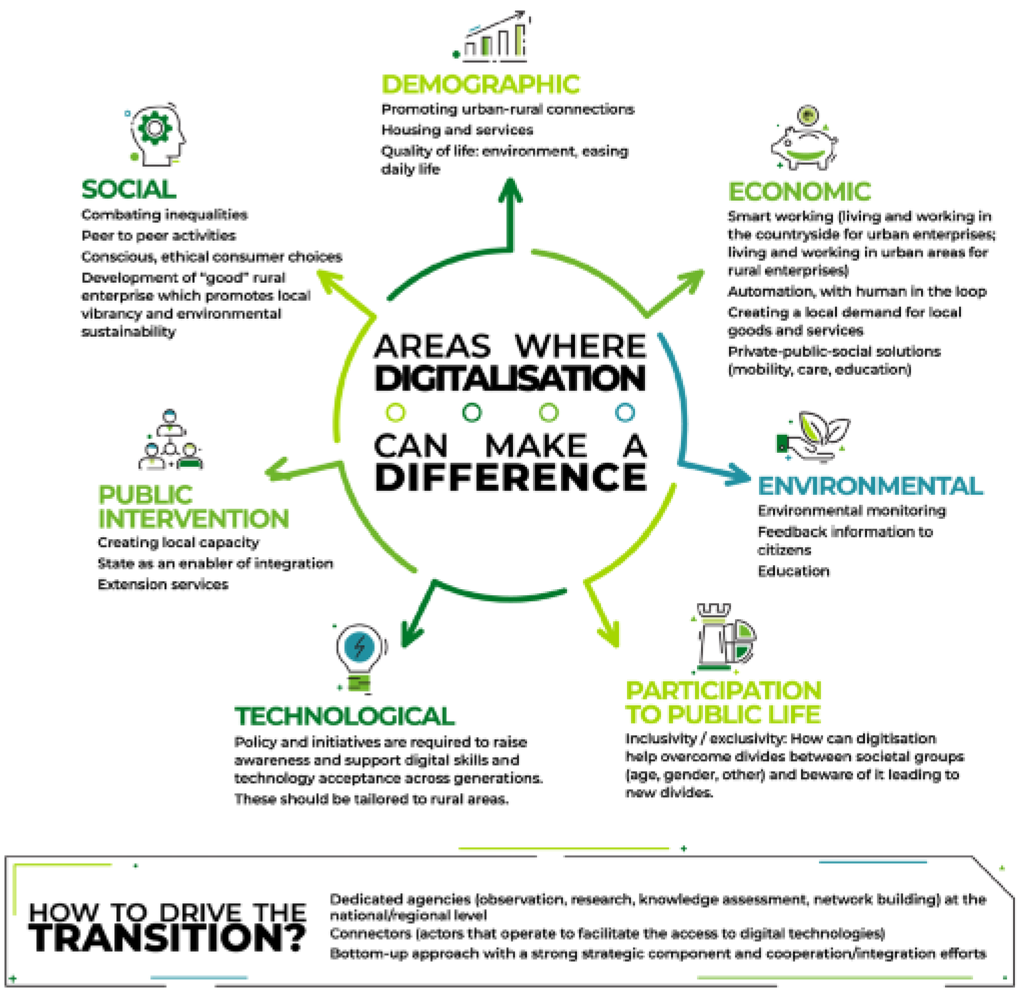
Final remarks

Gianluca Brunori, coordinator of the project, concluded the second workshop, highlighting that **the digital future for rural areas will depend on the vision that we have now**. Digitalisation will not automatically lead to a better future, so we need to identify a clear vision on how we want rural areas to

It is important to understand what contributes to a good quality of life in rural areas: social services, remote working, mobility, and connectedness. Quality of life is linked to vibrant communities that have a sense of community and self-identity, healthy social relations, and institutional capacities. Sometimes it is also strongly linked to the quality of the environment.

Digitalisation can address everything: providing feedback and information concerning the state of the environment, improving the social capital by communication means, integrating services between local administrations, providing data to speed bureaucratic activities up, and robotisation to relieve people from hard manual work or as a solution to staff shortages in rural areas. There is a need to stimulate the creativity and capacities of technology developers. **Rural futures and solutions should be different from urban ones**.

The process should be driven by a bottom-up approach to create change. Central and high-level organisations could act as enablers of social innovation at the local level, and as connectors to link local initiatives together and to improve learning processes among them. This process must be steered, and local initiatives should be integrated. In this sense, visions have a strong influence on creating integration by leaving space for communication between organisations.



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Appendix C – Country-level scenario reports

13.1 The Netherlands

Scenario workshops

Oosterwold (NL)

30.11.2020

Ellen Bulten, Darleen van Dam, Jan Eelco Jansma, Koen van der Gaast, Kelly Rijswijk

SCENARIO WORKSHOPS REPORTING TEMPLATE

Project name	**DESIRA | Digitisation: Economic and Social Impacts in Rural Areas**
Project ID	818194
H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Doc
File Name	Scenario workshops Oosterwold (NL)
Authors	Ellen Bulten, Darleen van Dam, Jan Eelco Jansma, Koen van der Gaast, Kelly Rijswijk
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

Table of contents

Introduction

This report describes the scenario workshops in Living Lab Oosterwold, the Netherlands.

1. Living lab summary

1.1 Name of LL

Oosterwold, the Netherlands

1.2 Brief summary of LL

Oosterwold is a peri-urban residential area in the province of Flevoland, The Netherlands that highly relies on self-organisation within a limited set of rules. At the moment, around 2000 people live in Oosterwold with plans to expand the residential area towards 45,000 residents into a 'phase 1b and 2' but this is still in early stages. One of the ambitions of Almere and adjoining municipality Zeewolde is that Oosterwold should provide 10% of the food basket of Almere city region in the near future. In order to achieve that, residents of Oosterwold need to dedicate ad least 50% of their plot to urban agriculture. Oosterwold can therefore be seen as a pilot where the local government is experimenting with a self-organisational residential area where urban agriculture has a pivotal position. To facilitate residents in their self-governance and urban-agriculture efforts, land prices of residential plots are significantly lower compared to elsewhere in the Netherlands.

Since the first residents moved into their homes in 2016, urban agriculture is also taking shape. However, there is a need to support exchange of food in short food supply chains. That is where digital systems come in: how can digital technology support urban agriculture and community building in Oosterwold?

1.3 LL participants

Living Lab participants include residents of Oosterwold, Oosterwold development authority (which formally coordinates the development and planning of the area) , the municipality of Almere, short food supply chain initiatives, research and education representatives. For the scenario workshop, we send out targeted invitation to ensure participation of important stakeholders such as the municipality of Almere and initiators of food cooperatives in Oosterwold. Besides these targeted invitations, we send out invitations through the Oosterwold online news letters and Oosterwold Facebook groups, to make sure we also reached residents beyond the 'usual suspects' (i.e. very active members of the community).

There was some overlap between participants of the first and second workshop, but most participants attended one of the two scenario workshop. During each workshop, there was a representative of the Oosterwold development authority, at least 1 initiator of a food chain initiative and a mixed representation of Oosterwold residents.

We hired artists to visualise the discussion during both workshops with the living lab.

1.4 Timing of Scenario Planning (WP3) workshops

We organised two face-to-face workshops in Oosterwold. The first workshop was organised on the 21st of September and focussed on scenarios for the future of Oosterwold. The second workshop was organised on the 5th of October and focussed on transition pathways from the current situation towards the future vision. We concluded the second workshop with a discussion about roles for stakeholders and an action agenda for Oosterwold.

2 Scenario question

2.3 Draft scenario question

What does the urban farming community of Oosterwold look like in 2031, and what role could digital systems play?

2.4 Finalised Scenario question

What does the urban farming community of Oosterwold look like in 2031, and what role could digital systems play?

2.5 Methodology used to finalise scenario question

In the preparatory phase, we virtually discussed the most important topics for our Living Lab in Oosterwold with a group of 5 people all connected to Desira and Oosterwold. Based on our previous Living labs in Oosterwold and on the outcomes of the stakeholder interviews carried out in preparation of the scenario workshops, we agreed on 3 main topics to be discussed during the Scenario workshop:

1. Urban agriculture
2. Community building
3. The role of digital technology in supporting urban agriculture and community building

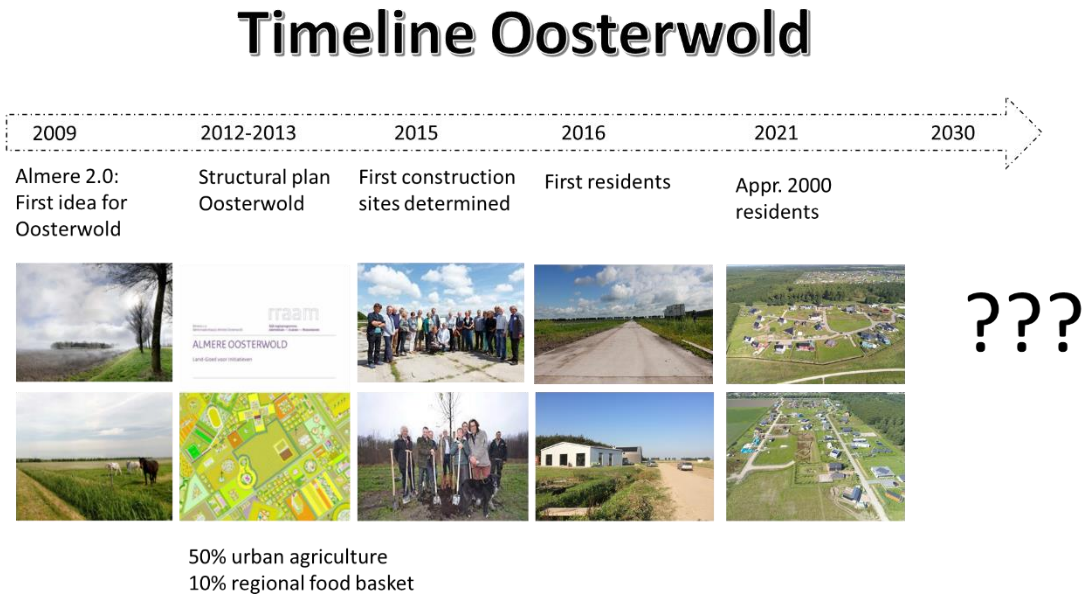
Self-organising urban agriculture and community building is the central element of Oosterwold and plays an important role in the every-day lives of its residents. Recently, the role of digital community has been a topic of discussion: how can digital technologies support and advance urban agriculture and community building? After we agreed on these three 'ingredients' for a focal question, we formulated the final scenario question. The final scenario question was not further debated during the scenario workshop on the 21st of September.

2.6 Relevant feedback on scenario question from participants

Not applicable, since we co-produced the scenario question before the scenario workshop and verified its relevance via the stakeholder interviews.

3 Relevant past events

3.3 Overview of relevant past events



3.4 Description past event activity

Relevant past events were discussed during the preparatory meeting and presented on a timeline during both scenario meetings. The timeline starts from the first idea of Oosterwold as a self-governing, peri-urban residential area in 2009. We presented relevant events related to the development of Oosterwold and decided to present them on a timeline to show participant that a lot can change in about 10 years. The timeline is therefore not exhaustive, but captures major developments leading up to the current situation with approximately 2000 residents in Oosterwold. Starting from this current situation, we worked towards future visions for 2031 with workshop participants.

3.5 Relevant feedback from participants

Participants did not provide any feedback on the timeline, except to mention that in reality the process of getting from the initial idea of Oosterwold as a self-organising peri-urban area to the current situation was of course not as straight forward as the timeline may suggest. In reality, this process is messy and stakeholders (including residents, institutions and municipality) need(ed) to find their way. A process that is completely different from other residential areas in the Netherlands.

4 Drivers Of Change (DOC)

4.3 List initial set of DOC

STEEP	DOC
Social	• Growth of Almere with 15.000 new homes towards 2031 --> rising number of new residents (from 2,000 (today) towards 45,000) • Oosterwold as a peri-urban area • Oosterwold as a self-organising area • Residents predominantly have an urban background, often with no sufficient experience or expertise in food production/processing • National housing crisis (high shortage of new homes)
Technological	• Use of digital platforms (e.g. Facebook) for exchange of food products between neighbours • Availability of fast fibre connection in the area • Supportive equipment for urban agriculture is mostly low-tech due to small plots
Environmental	• 50% of Oosterwold earmarked as urban agriculture • Transformation of 4,300 ha rural polder land into a hybrid rural-urban area towards 2031 • Fertile soil and good growing conditions • Average urban agriculture plot size Oosterwold between 500-2,500 m2
Economic	• Expected excess food production (due to number of new residents) • Mostly food produced for self-sustenance, no financial need/driver to sell surplus food (main income resident from elsewhere) • Focus in the area on short food supply chains (some residents) • National housing market crisis, i.e. shortage of new homes • Land prices in Oosterwold are low compared to rest of NL, but are rising
Political	• Oosterwold as a self-organising area

	• Local Government requirement of 50% food production on each parcel in Oosterwold • Local Policy goal: Oosterwold provides 10% of local food production • National pressure (due to shortage of homes) at Almere to create and condense new build-up areas in Oosterwold

4.4 List selected DOC

External drivers
Housing market
Land prices
Demography
National policy and governance
Internal drivers
(self)organisation of Oosterwold
Type of area
Governance (local)
Digitalisation
Plot sizes
Food production
Community building

4.5 Describe methodology to select DOC

Drivers of Change were selected based on years of involvement with the development of urban agriculture in this area, complemented by stakeholder interviews and preparatory discussions between the workshop organisors.

4.6 Relevant feedback from participants

The Drivers of Change were not extensively discussed during the workshop, except for clarifications of concepts. Instead, we made an initial list of drivers and confirmed and complemented this list through the stakeholder interviews.

5 Matrix

5.3 Matrix description

The matrix below describes the most important external and internal drivers that will influence the development of Oosterwold:

Assumption	Condition 1		Business as usual		Condition 2
External drivers					
Housing market	Crisis in housing market cools down	Enough opportunities to build houses elsewhere in Almere	Soaring housing prices, national housing crisis		Severe housing crisis, Oosterwold has space that needs to be utilised effectively
Land prices	Land prices in Oosterwold are lowered		Land prices in Oosterwold have increased, but are still lower than elsewhere in NL	Land prices in Oosterwold are further increased	Land prices in Oosterwold are aligned to ‘regular’ land prices
Demography	All new residents have a rural background and extensive agronomic knowledge		Residents with predominantly urban background and little agronomic knowledge		All new residents have urban background and no agronomic knowledge
National policy and governance	Centralised (de-decentralised) policy: national governance of spatial planning		Decentralised governance with responsibilities: local governance of spatial planning		
Internal drivers					
(self)organisation of Oosterwold			Oosterwold as a self-organising area		Oosterwold as a ‘regular’ urban area, organised and regulated by formal authority
Type of area	Oosterwold as a rural area	Oosterwold as a peri-urban area with open landscape	Oosterwold as a peri-urban area	Oosterwold as a peri-urban area with closed landscape	Oosterwold as an urban area

Governance (local)	No governmental interference; laissez faire attitude		Little governmental interference; few rules such as 50% of plots used for food production	Increased governmental interference; stricter rules	Strict -topdown-governance; Oosterwold no longer a self-governing pilot
Digitalisation	Value chain and community building set-up around active digital technology networks	Digital technology used for interaction and basic demand and supply	Use of basic digital technology (e.g. Facebook groups)		Abandonment of digital technology
Plot sizes	Plot sizes of UA in Oosterwold larger 500-2,500 m^2		Plot sizes of UA in Oosterwold between 500-2,500 m^2		Plot sizes decrease (e.g. because of rising land prices); less food production per plot possible
Food production	More than 50% of individual plots are used for food production and professionally distributed to Almere city region		50% of individual plots should be used for food production, food mainly produced for Oosterwold residents, no professional distribution		Some individual plots still used for food production, many have outsourced food production to professionals or totally abandoned the food production at their plot
Community building	Close cooperative community around urban food production		Some community building starting up, people are still finding their way and settling in	Fragmented community around urban agriculture	No community around urban agriculture

5.4 Define 4 scenarios selected

Based at the aforementioned DOC we defined two axes along the lines of two important characteristics of Oosterwold area: the type of area in terms of landscape and the way the area is governed (degree of self-organisation and role of the local government). These two axes produce four fields, or scenario's (see next). Scenarios 1 and 3 were selected by the participants of the first scenario workshop as most inspiring, yet, controversial to explore.

Scenario 1: Oosterwold in an open landscape with self-organisation

Main characteristics of this scenario are Oosterwold as a peri-urban area, with an open landscape. Governmental interference is limited; Oosterwold is a self-organising area. Oosterwold is also mainly self-sufficient in terms of food production with a close community around urban food production. Surpluses of locally produced foods are sold through short supply chains to Almere city region. To support food production within Oosterwold, digital technology is used for interaction between food suppliers (residents) and to locally coordinate supply and demand.

Scenario 2: Oosterwold open landscape with strict governmental regulation

This scenario is characterised by an open landscape, with Oosterwold being a peri-urban area with more rural characteristics but without self-organising governance. Food production thus is a centrally organised activity. The community around urban agriculture is fragmented. To ensure good quality food production and steady supply stream, governmental interference is tightened. There is basic use of digital technology (e.g. Facebook groups) to facilitate interaction between residents and share tips and tricks for food production.

Scenario 3: Oosterwold in a closed landscape with stricter governmental regulation regulation

This scenario is characterised by Oosterwold as a more closed, more densely (traditionally) build-up area, leaning more towards an urban atmosphere with high-rise buildings combined with urban agriculture. Driver is the national housing crisis, i.e. land prices increase resulting in smaller plots and a closed landscape. New residents don't all have agricultural knowledge or interest in urban agriculture. Many new residents have outsourced food production to professionals or even abandoned, nevertheless still some individual plots are used for food production. Community building around agriculture is fragmented. Digital technology is used by professionals for precision farming and residents use apps to coordinate the food production process and share knowledge. Self-organisation of the area is ended, the local authorities strictly coordinate the development of the area. They employ surveillance officers to ensure that residents adhere to the rule of using 50% of plots for agriculture.

Scenario 4: Oosterwold in a closed landscape with self-organisation

In this scenario, the national housing crisis and rising land prices forces new residents to build on smaller plots. Main characteristic of this scenario is a closed landscape, with smaller plots and a densely built environment that resembles a 'regular' urban area. However, Oosterwold is still a self-organising area with little governmental organisation. Individual contributions to agriculture therefore also become smaller. However, there is a close community around urban food production and digital technology is used to strengthen community building and digital technology facilitates exchanging knowledge about food production.

5.5 Identify the 2 pathways that will be defined in more detail

Scenario 1 "Room for everyone" and 3 "Manhattan with rules" were further explored, defined and depicted with the attendees in the workshops. The visualisations of both scenarios are presented below:

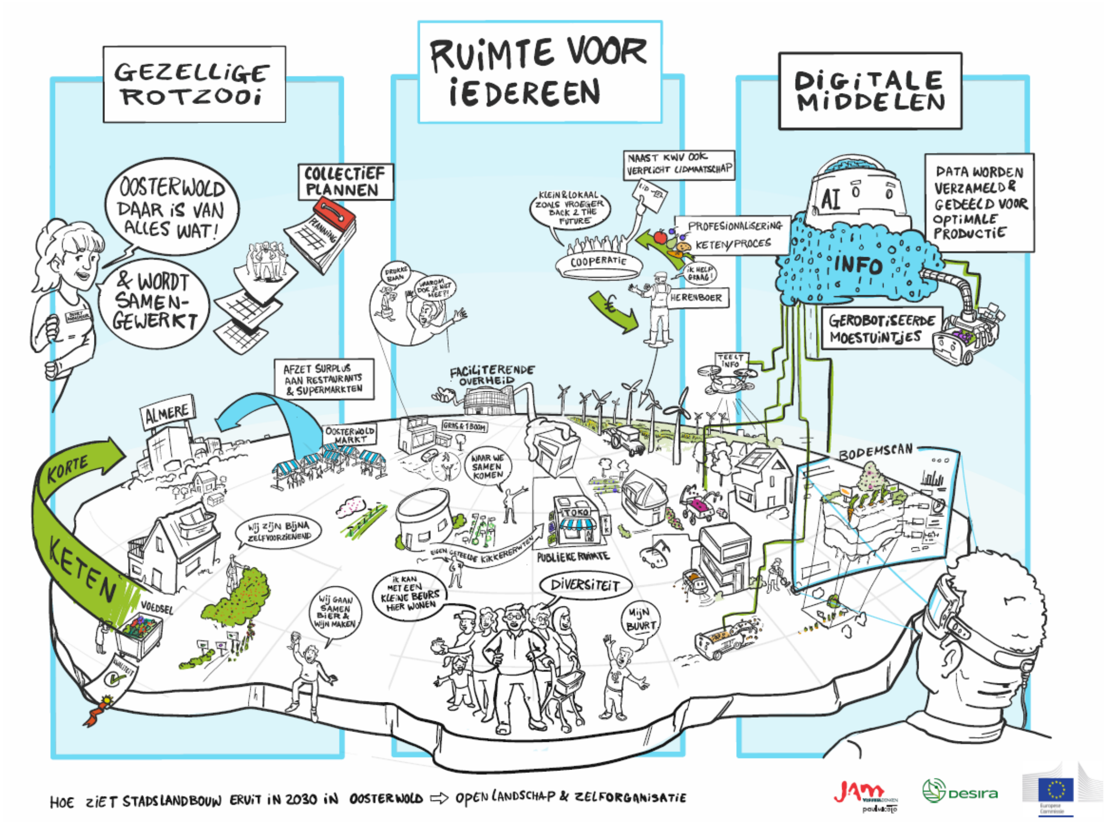


Figure 1: Visualisation of scenario 1 “Room for everyone”

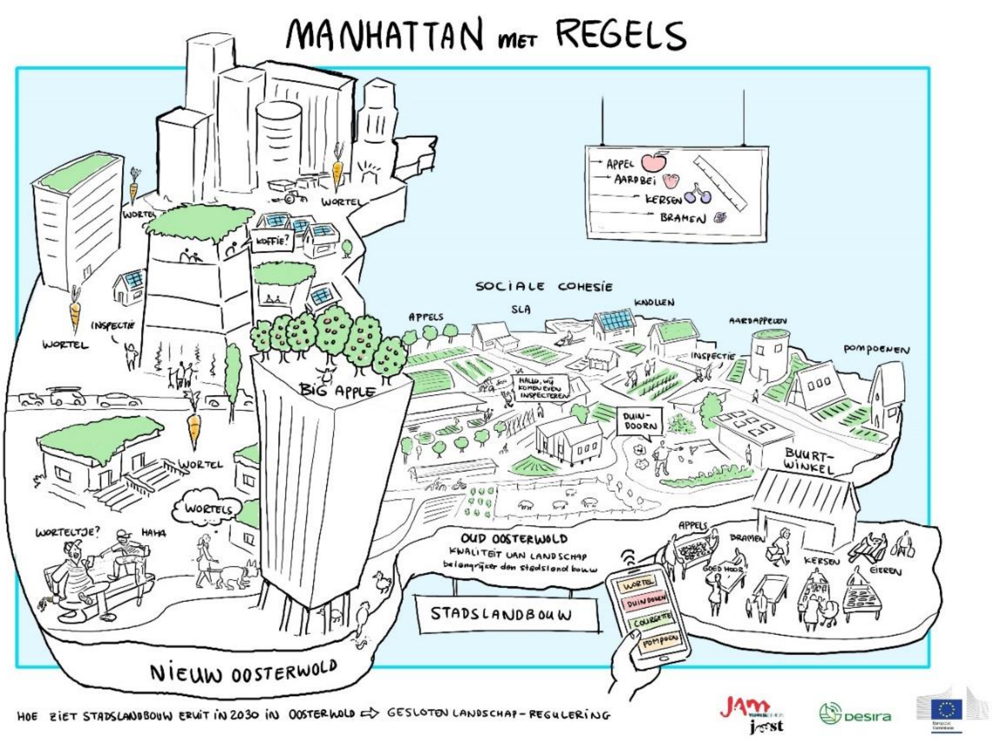


Figure 2: Visualisation of scenario 3 “Manhattan with rules”

The table below provides a summary of these scenarios in terms of community building, urban agriculture and digital technology:

	Manhattan with rules	Room for everyone
Community building	- Contrast between 'new' and 'old' residents - 'new Oosterwolders' see 'old Oosterwold' more as a recreational area - Community stores are important place where people meet	- Aimed for social diversity among residents (income, age, ethnicity, etc.) - Public spaces for people to meet, facilitated by local government - Collective planning and collaboration among residents - External support for professionalisation
Urban agriculture	- Larger role for law enforcement around urban agriculture - 'new Oosterwold' more uniform in terms of type of crops and higher food production - 'old Oosterwold' lower yields, higher emphasis on landscape - Agriculture in 'old Oosterwold' outsourced to professionals	- Focus on self-sufficiency; including diversity of crops - Focus on production for own community, excess is distributed via short supply chains to Almere - Investment in local products for multi-cultural background - Mandatory subscription to food cooperation - Professionals are hired for hard-to-cultivate spaces (e.g. between wind mills)
Digital technology	- App to monitor what is grown where and what can be sold - Digital technology as tool to communicate and coordinate who grows what - 'Manhattan farmers' work with precision farming	- Soil scans to monitor soil for optimal land use - Use of small-scale robotics to reduce labour and increase self-sufficiency - Knowledge sharing through app and knowledge platform - Digital platforms to coordinate food production process

5.6 Methodology used to identify pathways

To identify the pathways, we worked with a timeline (shown below) running from 2021 to 2031. The top part of the timeline was dedicated to the first scenario (Manhattan with rules) and the bottom to the second scenario (Room for everyone). For each scenario, the artist drew a couple of major headlines based on the discussion during the first workshop. Then, we asked participants to answer two main questions (in two rounds, using sticky notes and stickers):

1. **Who** does **what** on the way to the 2031 scenario?
2. Which developments / interventions / elements on the timeline do you find **desirable** versus **undesirable**?

Figure 3: Impression of the timeline after the second workshop

For each round, we first let participants individually write their input on sticky notes after which we discussed the content and let participants explain what they wrote down and why. As facilitators, we challenged participants to specify their input and thus encourage the discussion about why some developments were seen as desirable and others as undesirable. Based on the input on the timeline and the associated debate, we constructed an action agenda that can help stakeholders to reach a desirable smart urban agriculture community for 2031.

5.7 Relevant feedback from participants

Participants appreciated the visualisations that the artists provided during both workshops. They also appreciated the conversation about the future for Oosterwold. Afterwards the conversation continued about how they can continue this way of thinking around the future for community building, urban agriculture and digital platforms for exchanges within Oosterwerold.

6 Scenario Narratives

6.3 Name Scenarios

The names of the scenarios:

1. **Manhattan with rules**
2. **Room for everyone**

'Manhattan' in the first scenario title refers on the one hand to the more densely built residential area (closed landscape) in this scenario, but also to the size of 'phase 2' (the area where the second phase of houses in Oosterwold will be built) which happens to be roughly the same size as Manhattan. 'With rules' implies that self-organisation is abandoned.

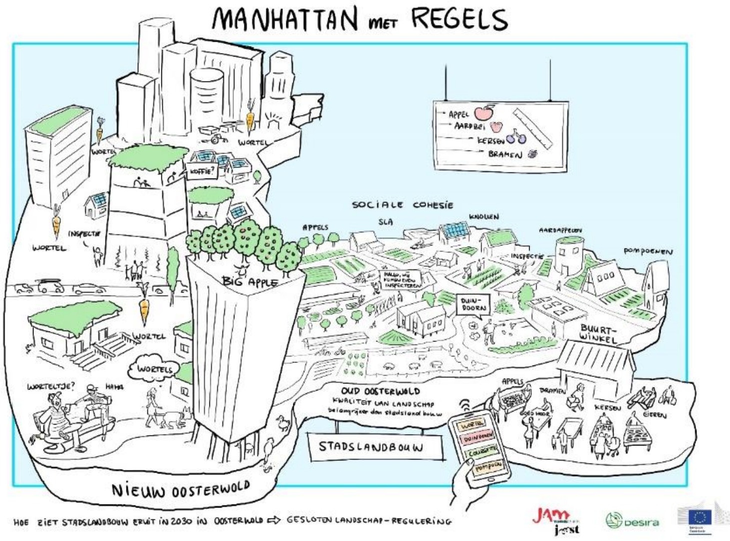
'Room for everyone' refers to room in the literal sense; an open landscape with large plots but also in the figurative sense; this scenario allows for diversity among residents (e.g. residents with a smaller budget).

6.4 Write the 2 or 3 detailed scenario narratives

Figure 4: Sketch that was used during the second workshop: a timeline for both scenarios with some main headlines on the way from 2021 to 2031.

Both narratives are written from the perspective of 2031. The narratives should not be interpreted as best case and worst case scenarios necessarily. In some respects the two scenarios even show overlap, as for example in the application of digital tools to facilitate the communication between residents. Instead, the scenarios can be interpreted as plausible future visions for Oosterwold that were agreed upon by participants.

Manhattan with rules



In 2021, after the first planning phase for Oosterwold was finalised, the second planning phase was the start of 'New Oosterwold' as we know it today. The second planning phase changed the course of New Oosterwold, which is why the landscape of Oosterwold changed immensely over the past 9 years. Due to increasing land prices and national pressure to build more affordable housing, the municipality of Almere decided to develop New Oosterwold in a more -traditional- urban way, with a new skyscraper district in Oosterwold. Between the high-rise buildings, the plans for New Oosterwold still included an important role for urban agriculture. To the regret of residents in Old Oosterwold, the new plans revealed that the municipality and investors have teamed up to build skyscrapers directly next to the open landscape of diverse houses and tiny houses of Old Oosterwold. In 2023 the following article went viral:

Project developers reveal plan for 'Manhattan Oosterwold'

The role of the municipality became increasingly important in Oosterwold. Old Oosterwold was also influenced by stricter regulations, even though it was known to be highly independent of the municipality before 2022. To facilitate the growth of the local food supply chain, it became compulsory to each new resident to participate in urban agriculture workshops. First, there were no penalties for the omission of participation. The core idea of the compulsory workshops was to encourage the village to grow together and become better in agriculture. During the workshops, residents also learned how to use the then newly developed app "Growing Oosterwold". Initially, the app was developed to support the communication between residents and to exchange experiences. The change also applied to land ownership in Old Oosterwold, as people are obliged by law to use 50% of their parcel for urban agriculture from 2024 onwards. Not everyone could adapt to these changes immediately. The municipality gave people the chance to adapt until the summer of 2024. From summer 2024 onwards surveillance officers checked on the residents and their effort to grow crops in their gardens. If they failed, a penalty followed soon.

In the newspaper of 12.06.2024 the following was written:

Municipality sends surveillance officers to enforce rules around urban agriculture in 'Old Oosterwold'

As investors started to make more concrete plans about the skyscrapers in Oosterwold, residents tried to boycott the construction of these sky-high apartment complexes as not appropriate to the intention of Oosterwold. They requested that apartment buildings should not be higher than 3 floors. However, the municipality did not support these wishes by the people of Old Oosterwold. Rapidly, the village of Oosterwold welcomed their new residents who started living in the apartments, as could be read in the newspaper in 2025:

Delighted first residents of new apartment building receive their key-cards

When the new residents came to the neighbourhood the social dynamics of the village changed. Residents of Oosterwold found it hard to break the social barriers between the old and the new inhabitants of Oosterwold. At the same time, people in Old Oosterwold grew more and more 'forgotten' crops, which were sold at the local market and were also delivered to the city of Almere. Digital technologies played an increasingly important role in the local food supply. However, not only the people of Old Oosterwold grew crops. In New Oosterwold, conventional farmers started to grow crops, which were sold to supermarkets in Almere. The new farmers were given the name 'Manhattan farmers' as their fields are located directly next to the skyscrapers. Since the year 2026, more and more digital technologies were used and farmers increased their efficiency by implementing precision technology.

In 2027 the newspapers reported:

'Manhattan farmers' introduce first drones to support precision agriculture

In 2027, the buddy-system was implemented to connect the people from Old Oosterwold and New Oosterwold. As we know today, this programme was no success and the gap between the two parts of the village remains until today. The introduction of the buddy-system showed that the interest of the two parts of Oosterwold differs immensely. The municipality received many complaints from people living in Old Oosterwold, who perceived the dog walking people from New Oosterwold as a disturbance. Even though the people in Old Oosterwold complained about the dogs, the municipality thought that the problem was rather the social discrepancy between the people in Old Oosterwold and the dogs' owners. The issue thus shed light on the social gap between the two parts of the village. Therefore, it was not surprising that the following article was published in 2028:

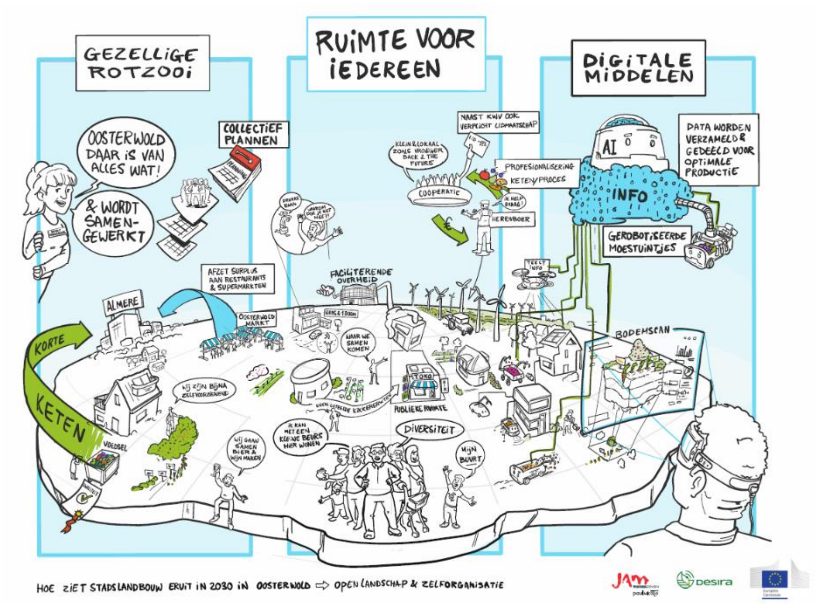
Disturbance by dogs leads to unrest in 'Old Oosterwold'

Only recently more and more land was converted into arable land used to grow potatoes, onions and beets. Because of the growing population of Almere, the demand for intensified farming also increases. This year, a new farmer started her business in Oosterwold, and is now the third Manhattan farmer in Oosterwold. This could be seen in the article that made the news last year:

Third Manhattan farmers starts in Oosterwold

Nowadays, in 2031, we see that the increasing involvement of the municipality has led to a more structured and more effective form of urban agriculture in Old Oosterwold. Even though the community is profiting because of these developments, there is much resistance from some people in Old Oosterwold. They complain about the role of the municipality and protest because the initial idea of Oosterwold was to organise the village independently. Moreover, some people are not willing to engage in projects to bring together people in Old Oosterwold and New Oosterwold, which is why the social gaps of the villagers will remain a problem in the future. Nevertheless, between the build-up block of New Oosterwold a thriving farmer community produces enough food to feed 10% of Almere city region. The farmers are digitally connected with the residents of their area and feel part of this urban community.

Room for everyone



Even before the second phase of the planning period in Oosterwold was scheduled, residents of Oosterwold started a cooperative to coordinate selling surplus vegetables at supermarket Plus in Almere. Community building became a more important and more central part of living in Oosterwold. By 2022, there were weekly meetings where residents visited each other and told the community about their plans and obstacles. The yield of urban agriculture increased, which is why in 2022 surpluses of vegetables and fruits grown in the gardens of Oosterwold were delivered to the local food bank. To improve communication and knowledge sharing within the community, the council launched a knowledge platform with a corresponding app called "Oosterwold Connect", as reported in a news article in 2023:

Council launches knowledge platform urban agriculture including brand new knowledge app

As a result of knowledge sharing and experience, yields from urban farming increased every year. As part of the self-organising character of Oosterwold, residents organised themselves and elected coaches to support in varying topics, such as agriculture and water management. These coaches were part of the Oosterwold community and supported through mandatory subscription to the cooperation. In this way, the cooperation could be run professionally and urban agriculture became a more prominent part of living in Oosterwold. Furthermore, an article in the local newspaper in April 2024 presented the newly elected ambassador for urban agriculture:

New generation Oosterwold residents warmly welcomed by ambassador for urban agriculture

The ambassador has the role to go door-to-door and talk to residents about their successes and obstacles regarding the agricultural use of their gardens. The ambassador also hosts training sessions to improve the quality of products. This new generation of residents became more diverse in terms of ethnic and cultural background, age, and experience with agriculture. One task of the ambassador was to welcome people from all backgrounds to Oosterwold and get them up to speed in both the community and practices around urban agriculture. The local food market grew more and more in 2025, becoming more diverse as a result of representation of more cultural backgrounds. The yields were firstly used for own consumption and then either sold at the local food market, centered at the public community place, or at the small supermarket of Oosterwold.

Cooperation for urban agriculture opens store in Almere centrum

The quality of the food supply chain of Oosterwold had now become increasingly professionalised. Simultaneously, the app "Oosterwold Connect" was connected to the existing knowledge platform and became the main communication and knowledge tool to adapt the supply and demand of food production from the residents of Oosterwold. The app helped to reduce fluctuations in the supply of different vegetables and fruits. Residents of Oosterwold accepted the remaining fluctuations which are caused by the semi-professional nature of their system. The village became known for their flexible handling of the local food market. However, communication tools used by the community did not reach all residents. They communicated via the knowledge app, Facebook, the website and the newsletter. However, some residents were not connected to these (digital) platforms. Traditional aspects of community building through shared public spaces and membership of cooperations therefore still remained important. In 2026 the following headline reached the news:

Cooperation urban agriculture welcomes its 1000th member

The cooperation for urban agriculture was the biggest cooperation in Oosterwold at that time. However, several other cooperations with more or less the same goals evolved alongside. This overload of cooperations was perceived as an obstacle for effective communication by the residents. New residents came to Oosterwold, bringing new ideas with them which they wanted to bring into action. A recurring issue was the lack of rules for the amount of vegetables and fruits that should be grown by the residents. Residents discussed possibilities to exclude 'free riders' and select new inhabitants based on their ideas of their participation in urban agriculture. However, since the residents wanted to keep the self-organising nature of Oosterwold with a high degree of freedom, they decided to not act upon this idea.

International food store ('toko') in Oosterwold now sells falafel made from self-made chickpeas

The headline above reached a national newspaper in August 2028. Since the Oosterwold community is known for its open-mindedness and openness towards diversity, more and more people with varying ethnic backgrounds and people with lower incomes took residence in Oosterwold. The opening of an international food store showed that there was increasing demand for international food products by the residents of Oosterwold.

As of today in 2031, Oosterwold remains a unique area within the Netherlands where a self-organising community grows their own foods and tries to make room for people with all kinds of different backgrounds. Of course there are still some quarrels between neighbours and disagreements about what should be produced each year, but overall there is a thriving community around urban agriculture that uses digital technology to increase the sense of community and share knowledge about urban agriculture in a local food chain.

6.5 Name and write the less detailed 'best case' and 'worst case' scenarios

See section 5.2. We have not discussed the other two scenarios during the workshops.

6.6 Conclusion

After elaborating the two transition pathways, we concluded the second workshop with a discussion about action perspectives for different stakeholder groups. This discussion was centred around the question: What can different stakeholders do to reach desired aspects of both pathways and avoid undesirable aspects of the pathways? To answer this question, we constructed a table with agreed upon actions and connected the actions to a stakeholder who could be (or in some cases volunteered to be) responsible.

Action	Stakeholder
Connect to a food bank to donate surpluses of food	One of Oosterwolds' residents was willing to take the initiative
Cooperation to facilitate and coordinate cultivation	Food cooperative that is starting up at the moment, they are working on a digital tool to facilitate this action
A "how-to" workshop around urban agriculture	Municipality, experienced residents, integrate in digital tool food cooperative
Clearer communication around urban agriculture • through different channels, e.g. digital platform of food cooperative	Municipality (already at purchase of land)
Processing facilities	Municipality, investment by residents

This concluding action plan shows that much of the conversation within Oosterwold (and therefore during the scenario workshop) is focused on the core of Oosterwolds' identity: urban agriculture and community building in a self-organising context. As a final reflection, we can therefore conclude that digital technology is primarily seen as a means through which Oosterwold can achieve its goals around urban agriculture and community building. Participants saw a promising role for digital technologie, especially to support knowledge exchange, connect people to each other and as a way to coordinate a more professional food supply chain within Oosterwold and between Oosterwold and Almere city.

13.2 Finland

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

SCENARIO WORKSHOP

BIOVALLEY FINLAND

UNIVERSITY OF JYVÄSKYLÄ

30.11.2021

JOUNI KAIPAINEN

DESIRA receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194.

SCENARIO WORKSHOPS REPORTING TEMPLATE

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H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Doc
File Name	WD 3.2 Report Biovalley Finland
Status	Final
Authors	Jouni Kaipainen
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

Contents

Introduction

1. Living lab summary

1.1 Name of LL

Biovalley Finland LL

1.2 Brief summary of LL

Biovalley Finland (BF) Living Lab examines how the bioeconomy and sustainable development can be promoted in the region of Central Ostrobothnia using digitalisation and circular economy methods. Circular economy (CE) is a focal sector in Finland but otherwise it can be seen as a means to a sustainable economy and society. In BF, digitalisation is also seen as a means, not an end. Bioeconomy is playing a vital role in maintaining the population in remote rural areas.

BF brings together 23 regional partners for collaboration, innovation, and research. As the BF project had been operating for a long time, there has been no formal selection process (for example based on a stakeholder analysis or interviews). By participating in the network, partners self-select themselves. In practice, all the major organisations in the region are involved in BF to some degree. But there are also national partners who are more interested in bioeconomy or chemistry sector, so BF is not only about regional development.

In Central Ostrobothnia there is a great on-going transformation in the energy sector. Using peat for energy is no longer profitable for the district heating system or industrial plants as the price of CO2 emissions permits are high. Solar energy is not yet ready to scale up, but lots of windmill parks will be built in different parts of rural Central Ostrobothnia. Green energy is a ‘Grand Challenge’ for the society. Digitalisation helps to monitor the system that uses very volatile energy sources.

Using hydrogen as an energy store is one way out. Hydrogen production with different techniques is taking big steps in Central Ostrobothnia. Woikoski Ltd already produces green hydrogen but Hycamite Ltd has a pilot plant under construction for a process that produces both hydrogen and high value active carbon with the help of catalyst chemicals. Also, in rural areas there are plans to make hydrogen from different biomasses.

1.3 LL participants

The stakeholders were asked to participate through email and include:

- Senior researcher (female) from Natural Resources Institute Finland, with a regional research centre in Kokkola.

- Development manager (male) from the Federation of Education in Central Ostrobothnia (KPedu) with an administrative department in Kpedu.

- Head of Industry in natural resources (female) also from Federation of Education in Central Ostrobothnia (KPedu) witha branch office in Kannus which is also a farm and a training place for students in natural resources sector.

- Executive director (male) at the association of Central Ostrobothnia in The Central Union of Agricultural Producers and Forest Owners (MTK). He represents an interest organisation but is also trying to get financing for his own biogas station for traffic purposes.

- Professor (female) at the University of Oulu/ Kokkola University Consortium Chydenius with research groups in sustainable chemistry in the region.

- Mrs. Anu Rantamäki (coordinator, communications), Mr Jouni Kaipainen (senior researcher, economics) and Mrs. Katja Ristiluoma (chemistry) represented the organiser, Living lab Biovalley Finland and Kokkola University Consortium Chydenius.

1.4 Timing of Scenario Planning (WP3) workshops

Biovalley Finland workshop took place in-person on the 25th of October 2021.

2 Scenario question

2.1 Draft scenario question

What will the bioeconomy in Central Ostrobothnia be like in 2031, given the progress of digitalisation and the circular economy?

2.2 Finalised Scenario question

What will the bioeconomy in Central Ostrobothnia be like in 2031, given the progress of digitalisation, circular economy, energy transition and RDI?

2.3 Methodology used to finalise scenario question

The workshop was held in-person and decided by the organizing team. A face-to-face meeting was thought to lead to a deeper engagement in the SP process than a virtual meeting. This decision may have influenced the willingness to participate of some members of the Biovalley network as the COVID-19 infections were rising in the region. This new wave of COVID-19 was unexpected, as the government had previously informed the public that an almost 80 % vaccination rate (two jabs for over 12 years old citizens) would be enough to stop the spread of coronavirus. One participant did ask for a virtual meeting, but the organizers thought that it would be too difficult to moderate a hybrid meeting effectively.

At the beginning of the event, the moderator welcomed the participants and briefly presented the Biovalley Finland activities. All the participants and moderators briefly introduced themselves and the facilitator of the meeting presented the objectives of the scenario workshop and the method used to create the scenarios.

After introductions, the original scenario question was shown on a PowerPoint slide. The participants started to discuss the situation in Central Ostrobotnia and concluded that the energy transformation was so huge that it could not be ignored and remained the focus of the Scenario question.

2.4 Relevant feedback on scenario question from participants

Participants saw that the future is not fixed or determined by the available technology. By investing enough in RDI activities, a different future alternative is possible. Natural resources are raw materials from which alternatives can be created if there is enough demand.

3 Relevant past events

3.1 List of relevant past events

Past events presented by the coordinators

- Netflix started
- Paris 2015 (COP 21)
- Precision agriculture

- Crimea takeover
- Trump
- Brexit
- COVID-19
- Tesla
- Digitalized forest data banks (including maps)
- digitalized cowsheds (cameras, sensors, AI models …)
- CAP negotiation rounds in EU
- Integration of the home office into a global digital network

Events/phenomena selected by the organisers: IoT, COVID-19, biogas production development, digitalisation of agriculture and forestry, Paris Climate Agreement, European refugee crisis, storms and extreme weather, Brexit, Trump as USA President.

Added to the images: Tesla's entry, wind power, labour shortage, agricultural farming changes (continuously covered farming, carbon sequestration), invasion of Crimea, changes in the use of peat.

3.2 Description past event activity

Past events, chosen as examples, were offered as printed pictures (about 10 items). The explanations for each picture were written on the back of each picture so that participants could check (in case the meaning was not obvious to the participants). Participants could choose the pictures they thought were the most important ones.

Participants could also name events that they thought were important but were missing from the pictures. One such event 'the change in consumer behaviour', surprised the workshop organisers. Political issues are easier to anticipate because CAP rounds have a direct impact on farmers. The Crimean takeover had a more indirect influence (Finnish farmers lost a growing export market where we were previously big players when the EU announced countermeasures and Russia forbid the import of many food products). After discussion, these events were inserted into the timeline provided.

3.3 Relevant feedback from participants

Overall, the majority of the participants found it difficult to believe that many common devices (IPhone, IPad, Android phones, Kindle) or technologies (4G, Bitcoin, blockchain) or services (Whatsapp, AirBnB, Spotify, Instagram, Snapchat) did not exist prior to 2006.

It was also difficult to assign a specific time to many applications or technologies. However with mobile phones and using the search engine Google, participants were able to find some signs of change happening at a specific time in the past.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

Keeping the countryside inhabited, ageing population, teleworking, coronavirus Level of education and Innovation (including social innovation, AKIS)
Energy transition (peat, wind and solar power, biogas), Control power (water and hydrogen) Digitalisation in forests, fields, and cowsheds (robots, artificial intelligence, Digital Innovation Hub (DIH)). Online stores. Construction and maintenance of infrastructure, accessibility, platforms.
Climate change: extreme weather, floods, drought, heat
Sustainability, Grassroots civic action to support carbon neutrality
Origin marking, short value chains or chain monitoring from producer to consumer
Energy and technology prices, indebtedness Corporate social responsibility in terms of the circular economy
Farm size, change of business model (family farm, company, organic)
Change flexibility (resilience), inequality Support policy, EU stimulus package, Extension and RDI input

4.2 List selected DOC

Social:

Distance work

Education, RDI

Technological:

Digitalisation

Energy transformation

Environmental:

Extreme weather conditions

Economic:

Profitability of farming

Political:

Juxtaposition of groups

4.3 Describe methodology to select DOC

Participants were able to choose DOCs already stated by the moderators or suggest other important items missing from the list. If a participant proposed a new item, a group discussion followed and a new DOC was added to the short list (such as the Juxtaposition of Groups and Profitability of Farming).

Deliberation and discussion of the proposed items was encouraged to enable the participants' contribution to the creation of DOC.

Farming is in a profitability crisis as input prices (fertilizers and energy) are rising very fast. This is due to falling natural gas supplies from Russia and the high prices of CO2 emissions. Farms are struggling to survive so they are not willing to accept any new economic challenges, even if new measures tackle climate change goals or other good causes. Digitalisation is understood to provide cost savings in the long-term, but current investments are only introduced if new solutions can help the profitability of the farms in the short term.

4.4 Relevant feedback from participants

Energy transition creates winners and losers very quickly. In rural areas, people who own peatlands are losing money quickly as the energy production from peat is only 10 % of what it was in the previous year. Landowners who can lease their land for creation of windmill parks are considered winners.

5 Matrix

5.1 Matrix description

STEEP DOC	Assumption 1 Best	Assumption 2	BAU	Assumption 3	Assumption 4 Worst
Distance work (S)	People combine near- and distant work permanently	Travelling and commuting traffic decreases.		Regional inequality raises again.	Monitoring office hours returns to workplaces.
Education, RDI (S)	Citizens know how to search latest knowledge	Media literacy gets better among students		Sustainability aims do not get favourable response from politicians, students, and researchers.	Reducing student skills to the lowest common denominator
Digitalisation (T)	Full digitalisation. Cheaper devices. Everyone can use efficiently. Fair data economy. Double transition when circular economy is backed by digital technologies.	Autonomous machines do heavy work in fields and forests. People and machines work together – using their unique strengths.		Artificial Intelligence and automated machines control almost everything.	Elites get rent from digital platforms and technologies. Large part of citizens is made redundant.
Energy transition (T)	All kinds of renewable energy sources are efficiently used.	Rural areas benefit from selling electricity, biogas or hydrogen to city dwellers and industrial plants.		No new uses are found for peatlands that are no longer used for energy production.	Energy production is big business. Rural dwellers do not get decent income from the use of their natural resources.

Extreme weather conditions (Env)	In the long run climate change is stopped.	People adapt to changing conditions in the short run.		Profitability of farming and forestry lowers as winds, floods and heat waves destroy crops and plant seeds.	Insufficient anticipation and use of precautionary measures lead societies to chaos.
Profitability of farming and forestry (Econ)	Renewable energy (solar, biogas, wind power) lower the cost of farming. Selling renewable energy and electricity creates new income for farms.	Farm and forest property structures are reorganised. Land consolidation schemas create smarter farms. Fragmentation of forest ownership stops.		Forests and farms are owned by city dwellers who do not understand rural circumstances.	Producer co-operatives are no longer competitive. Producing niche products for elites helps smaller farms and firms survive in rural areas.
Juxtaposition of groups (P)	There is enough fact-based information available. Participation of citizens is encouraged through digital technologies.	Rural and urban interaction increases. Symbiotic relationship is understood.		Rural and urban interaction decline. People live in their bubbles with like-minded (algorithms choose what is shown to them).	Click (social) media urges rural and urban citizens (and other groups in society) against each other. Inequality increases.

STEEP framework was used.

Social dimension gets two drivers of change. Flexible working including on-site and working from a distance is a significant driver of change as it affects many families and workers lives. With the help of advanced communication tools, the differences between a face-to-face and online meeting can be diminished. Skilled workers can now choose to live in the countryside. Employers' attitudes still prefer workers on-site but with Zoom and other videoconferencing tools, many employees are now rather routinely offered work contracts that allow them to work at least part of the week in remote locations.

Education and RDI reflect the capabilities that the population in Central Ostrobothnia has to offer for different organisations. RDI can also be used to change raw materials into useful inputs and products.

Digitalisation involves fast-developing technologies but usually the biggest impact is only realised after the population has found new uses for different tools already available.

Energy transformation has already started in Central Ostrobothnia as in only one year almost no peat is used for energy production. The biggest changes are still to come, as new ways to use solar energy are in development. If solar energy can be used directly (like in the process of photosynthesis) to break water into hydrogen, lots of storable clean energy will be available. Wind, hydro, and nuclear energy will then be mostly used as a transition period technology.

Extreme weather conditions can lead people to adapt to changing conditions or it can lead to ongoing chaos where one crisis follows another.

The profitability of farming and forestry is potentially under threat. Digital technologies can be used to help farmers, but often the efficient use of digital tools is only possible after the necessary infrastructure has been built. For example, precision agriculture is more efficient only after land consolidations are made.

A deepening juxtaposition of groups is possible if digital technologies are built to widen existing divisions in society. This may be a by-product of efficient and profitable digital business models. Despite plans to not make people live in distinct social bubbles, digital algorithms may worsen the situation.

5.2 Define 4 pathways/scenarios selected

First scenario was built on the changes to working lives including **working from a distance**.

Travelling and commuter traffic decreases (assumption 2, DoC S)

Citizens know how to search for latest knowledge (digital literacy) (assumption 1, DoC S)

People and machines work together (assumption 2, DoC T)

Rural areas benefit from selling via online purchases (assumption 2, DoC T)

People adapt to changing conditions (assumption 2, DoC Env)

Rural and urban interaction increases (assumption 2, DoC P)

The second scenario was built on **energy transition**.

Regional inequality rises again (assumption 3, DoC S)

Autonomous machines do heavy work in fields and forests. (Assumption 2, DoC T)

All kinds of renewable energy sources are efficiently used (assumption 1, DoC T)

Profitability of farming and forestry lowers as winds, floods and heat waves destroy crops and plant seeds. (assumption 3, DoC Env)

Producing niche products for elites helps smaller farms and firms survive in rural areas. (assumption 4, Doc Econ)

Rural and urban interaction increases. (assumption 3, DoC P)

Inequality scenario

Juxtaposition of groups (P): Assumption 4 (divisions grow across society).

Producer co-operatives are no longer competitive (assumption 4, Doc Econ)

Insufficient anticipation and use of precautionary measures lead societies to chaos. (assumption 4, DoC Env)

Reducing student skills to the lowest common denominator (assumption 4, DoC S)

Elites get rent from digital platforms and technologies. Many citizens are made redundant. (assumption 4, DoC T)

Knowledge based management scenario

Citizens know how to search for latest knowledge (assumption 1, DoC S)

People combine near- and distant work permanently (assumption 1, DoC S)

Full digitalisation. (assumption 1, DoC T)

In the long-term climate change is managed. (assumption 1, DoC Env)

Citizens know how to search for latest knowledge (assumption 1, DoC S)

5.3 Identify the 2 pathways that will be defined in more detail

The first scenario was built on the changes to working lives including working from a distance. When people combine near- and distant work, this can mix living in the rural area while working in the city. As more people cross the rural and urban divide, place-based prejudices are reduced. The juxtaposition of different groups in society is diminished as communication between places is increased. Virtual working environments use digitalisation to enrich people's communications. Digitalisation makes it possible for people to choose where they want to live. Energy is saved by people commuting to work less. Diversification (Multifunctional agriculture) is enabled as families can earn some income from crops and grass growing, forestry work and other distance work opportunities. Flexible working means not all work has to be full time nor all year round. Tourism can offer an additional income from renting summer cottages, which can be advertised on a specialised platform. An increase in domestic holidays mean less flying abroad. The air is cleaner and carbon emissions are much smaller. Income coming from various sources means resilience is increased particularly if weather conditions are harsh and volatile and there is an increase in uncertainty over projected weather forecasts. These changes result in a better quality of life and better equality between regions. However there are threats to cybersecurity since everything is dependent on ICT and fast network connections.

The second scenario was built on energy transition. It is directly connected to the profitability of agriculture and rural areas are now exporters of renewable energy (biobased products, biogas, solar energy) and electricity (wind power) fulfilling the needs of urban customers.

5.4 Methodology used to identify pathways

Technically:

The participants selected one assumption from the drivers of change they perceived to be important. They were then asked to look at other drivers of change for assumptions that would correspond to their selection. A pathway started to emerge and was marked with coloured Post-It labels (that were in-advance cut into pieces). The same process was used for the other pathways but different coloured Post-It labels were used.

As a process:

Participants were able to propose a new DOC and an assumption that (s)he thought was most important. Others came to look at the available alternatives to assess potential connections. If correlations were discovered (but maybe not a cause and effect -relationship) the workshop organisers put a mark highlighting any commonalities found. This process took place for all pathways.

5.5 Relevant Feedback from Participants

In effect, a snowball sampling method was used. Whilst the group did not oppose the method, the organisers are aware that a lack of opposition to new proposals may have been the result of some participants not wishing to offend any of the other group participants or stakeholders they represent more widely. Relevant feedback from participants

Building pathways was difficult for participants, despite seeing examples others had put together. It was difficult to see a DOC as part of a more holistic scenario. Scenario planning and sectoral thinking comes more naturally to officials who usually represent their own organisations.

6 Scenario Narratives

6.1 Name Scenarios

Distance work (better not best) scenario covers changes happening in professions and workplaces. Urban and rural areas become more linked as employees can more freely choose their living and working places.

Energy transition scenario (worse not worst) is needed because in 2031 we should have a broad mix of different energy sources which together can provide a supply of sustainable electricity (low carbon emissions with low prices). We need nuclear power, waterpower, hydrogen, biogas and natural gas, wood chips et cetera.

Inequality scenario

The socioeconomic pathway of inequality leads to a strong rural divide. Domestic food produced in bulk that has been built on producers' co-operatives in dairy production and in meat processing, can no longer compete in the globalised food market. Farms develop in different directions as some units make high value products for elites and some others have struggle just to survive.

Knowledge based management scenario

Knowledge is power. A good education system and strong RDI will keep the once provincial region along a strong and sustainable growth pathway. The Region of Central Ostrobothnia invests in developing green technologies which can later be sold to other countries in the world.

6.2 Write the 2 or 3 detailed scenario narratives

First scenario was built on the distance work. When people combine near- and distant work, this can mix living in the rural area while working in the city. As more of the same people are involved in this new rural and urban network, prejudice is reduced as the gulf between urban and rural areas is diminished. The juxtaposition of social and geographical groups are diminished as communication and access is widened. Virtual working environments use digitalisation to enrich people's communications. Digitalisation makes it possible for people to choose where they want to live. Energy is saved if people commute less. Multifunctional agriculture is encouraged since families can earn some income from crops and grass growing, something from forestry and something from long-distance work. Not all work is full time nor all year round. Tourism can offer another income from renting summer cottages, which you can advertise on a specialised platform. More domestic holidays mean fewer flights abroad. The air is cleaner and carbon emissions are reduced. Income coming from various sources is more stable especially if weather conditions are volatile and a high degree of uncertainty exists over long-term forecasts. All of these new developments means a better quality of life and better equality between regions. Of course, there are threats to cybersecurity if everything is dependent on ICT tools and faster network connections.

Automated machines can be used in the fields. Forest harvesters are almost like robots now as they use so many different digital technologies. A reliable mobile Internet connection makes it possible to manage the whole value chain from the factory so that the cutting of trees can be adapted to the needs of production.

Working from a distance saves energy. The air is cleaner when there is less commuting traffic. People are also healthier when they can walk the dog instead of sitting in public transportation or in a private car. Regional equality is easier to reach when jobs follow people. Cybersecurity forms a threat when all employees work from different locations but that can be handled with good advance planning and commercial protection services.

In the past people were afraid that using digital technologies and automated systems will lead to rising unemployment in rural areas. Now the whole situation has changed. An aging population means that social care and health demands are rising. An immigrant workforce coming from Ukraine and Belarus does a large share of blue-collar work on farms. When there is a shortage of workers in many rural areas, automating production becomes a necessity.

The second scenario was built on **energy transition.** It is directly connected to the profitability of agriculture if there is a connected change in the role of rural areas. Rural areas are exporters of renewable energy (biobased products, biogas, solar energy) and electricity (wind power) fulfilling the needs of urban customers. Landowners can earn more by leasing their land for windmill parks than what they could gain from forestry. Also, the price of wood energy has big effect on farm profitability as farmers can sell wood directly to households and keep the value added that comes from making firewood.

Advancing energy transition through digital technologies is a great opportunity to increase the sustainability of energy system in Central Ostrobothnia. Digital systems increase the efficiency of the system. For example Kiertoon!-project has gathered information about the available biomass in the proximity of the planned biogas producing facility. In the future, we could use the matching programme made by CircLean project (https://circlean-symbiosis.eu/) which also puts the sites on the map. Of course, there are other systems like BiomassAtlas which may also be useful in combining circular economy with digital solutions.

Using peat for energy production in Finland will (almost) stop in year 2022. Abandoned peatlands are ready to be used for making biomasses. Fast growing plants (like reed canary grass) grow well in peat. Also, substituting peat as a sleeping pad for cows or as a growth platform in greenhouses will require developing new products. Biogas production will produce solid waste that can be used as a sleeping pad for cow which means that giving up peat production will open up markets for other bio-based products.

In the short run we will be build more and more windmill parks onshore (and maybe offshore in the future). In the long run totally new kinds of solar power systems will emerge that produce hydrogen form the water. Using stored hydrogen when renewable energy production is low means that we must have automated and smart system that plans and controls the matching of demand and supply. Energy transition is not possible without digitalisation.

In Kokkola Industrial Park (KIP) many forms are making big changes into their processes. Yara Ltd, which makes chemicals used in making fertilizers, will stop using fuel oil. Soon the process will use natural gas, biogas, or LNG as an energy source. In the more distant future, the energy use may be based in hydrogen.

In KIP there are several hydrogen technologies in use. Woikoski Ltd makes green hydrogen by using electrolysis but clean production is also expensive (per unit of gas, m3 or ton). Hycamite Ltd. has built a pilot factory that uses catalysts to make “grey” hydrogen form natural gas (or biogas if it is available in sufficient volumes and in reasonable prices). Hycamite’s hydrogen does not do well in EU’s colour taxonomy, but its hydrogen is much cheaper. Hydrogen process also gives solid active carbon which is highly valued in different uses. So new product can be much more competitive in many dimensions, but the regulation system does not recognize its pros and cons correctly.

In rural areas there are also plans to make hydrogen from biomasses, but the process has not been proved to be commercially viable.

6.3 Name and write the less detailed ‘best case’ and ‘worst case’ scenarios

Inequality scenario (worst case)

The socioeconomic pathway of inequality leads to a strong rural divide. Domestic food mass production that has been built on a market dominating producers’ co-operatives (especially in dairy production and in meat processing) can no longer compete in globalised food markets. Elite production using niches can survive but it offers few jobs. Farms (as the rest of society) go into very different directions (a scissors development).

Forest harvesters have taken the market from lumberjacks. Forestry offers fewer jobs in rural areas as most jobs have been automated. More and more forest owners live in cities, and they know (or care) very little about the living conditions in rural areas. As ownership of forests gets more fragmented the level of theoretical knowledge and practical experience of forest owners is low. Big institutional owners usually form large integrated forests, means local citizens have little chance of having a say in how these nearby forests are handled. Big companies get all they information as a digital flow that they can follow from their computer screens. Places that are important to local people are not noticed anymore.

A divided road is ahead in digitalisation. Age, income, education, and rurality are linked to gaps in access. Small and rural communities have the largest gaps in broadband access and connection speeds are generally low. Mobile connection can complement missing fibre connections in some places but in remote areas shared bandwidth may not be fast enough to secure stable video connections.

Knowledge based management scenario (best case)

Knowledge is power. A good education system and strong RDI will keep the once provincial region in strong, sustainable growth. The Region of Central Ostrobothnia invests in developing green technologies which can later be sold to other countries in the world. Technology is still understood as a means to an end and the welfare of the citizen in the regions is the most important policy target.

Good media literacy helps to run democracy efficiently and include citizens in the decision making of their communities. Well-educated citizens are more immune to populist movements as they know how to search for latest knowledge and verify different stories. More and more skilled workers combine near and distant work permanently In Central Ostrobothnia as they no longer want to spend hours commuting to work in big cities.

Rural dwellers get decent income from the use of their natural resources. Windmill parks pay rent for the landowners but also the municipality gets a share from the land tax. Sometimes even the whole village gets development money as a compensation for the harms that the facility creates.

Digitalisation is essential if you want to take advantage of knowledge-based management. When almost all citizens can use digitalized services, the digital communication channels (social media, emails, and Internet pages) can be used to inform citizens daily. Of course, there are always some vulnerable groups whose needs still must be looked after by using face-to-face communication, but a special service for minorities does not cost too much when compared to gains that mainstreaming services gives.

13.3 Germany (Rhineland-Palatinate)

SCENARIO WORKSHOPS RHINELAND-PALATINATE (DE)

18.12.2021

MATTHIAS BERG, CHRISTOF SCHROTH

SCENARIO WORKSHOPS REPORTING TEMPLATE

Project name	**DESIRA | Digitisation: Economic and Social Impacts in Rural Areas**
Project ID	818194
H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Doc
File Name	WD 3.2 Draft reporting Template v1.2
Status	Draft
Authors	Matthias Berg, Christof Schroth
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

Contents

1. Living lab summary

1.1 Name of LL

Living Lab Betzdorf-Gebhardshain, Rhineland-Palatinate (Germany): Between Digital Villages and Online Access Act – Digital Transformation in Rural Areas

1.2 Brief summary of LL

The living lab (LL) in Rhineland-Palatinate is situated in the collective municipality of Betzdorf-Gebhardshain, which consists of 17 single municipalities. Betzdorf-Gebhardshain resulted from the fusion of the two formerly separated collective municipalities of Betzdorf and Gebhardshain in 2017 and struggles with problems typical for rural areas in Germany, such as depopulation due to limited job and educational opportunities. The LL explores the opportunities of digitalisation for intensifying exchange between local authorities, citizens, economy and institutions of civil society. The emphasis is put on the administrative perspective, since local administrations, especially in the rural regions of Germany, have not yet exploited the potentials of digitalisation. Even though it has a quite good digital infrastructure, this also applies to Betzdorf-Gebhardshain. For example, many processes in the local administration have not yet been digitalised. But this will change with the "Online Access Act"[1] (OAA) which will affect about 600 different administration services at all levels (from local to federal) that have to be offered digitally by the end of 2022. The OAA is especially challenging for rural administrations due to limited resources, low degrees of technical standardisation, as well as a high degree of disparity in the design of existing digital processes. But, apart from mastering the OAA, Betzdorf-Gebhardshain has the motivation to use digital processes to offer innovative which go beyond mere administrative services for the benefit of its citizens and the local economy. Thus, the living lab's focal question asks, how the local administration can cope with the internal and external challenges of the digital transformation and integrate citizens as well as other local actors into this process.

1.3 LL participants

Potential target groups of the scenario workshop included citizens, administration staff, local businesses, volunteers and any other persons interested in the topic. The workshop was promoted and announced in various ways in order to generate a sufficient number of attendants. This included announcements in the official gazette, on local online platforms as well as e-mail distribution lists.

The invitation generated a total of 8 registrations. Four participants had an administrative background, three registered as citizens and/or individuals doing volunteer work and one person defined himself as working in a local welfare institution. The participants' age range spanned from 17 up to 63 years.

[1] https://www.onlinezugangsgesetz.de/Webs/OZG/EN/home/home-node.html

Two thirds of the participants already had taken part in the previous workshop, one third were attending a LL workshop for the first time.

1.4 Timing of Scenario Planning (WP3) workshops

Due to a general situation of insecurity and slightly increasing Covid-19 infection rates in autumn, we decided to conduct the workshop online. Since we have had a good experience concerning the first workshop earlier this year with two consecutive days, we repeated this concept. After a first attempt to schedule the workshop at the end of September did not generate sufficient registrations, we polled possible dates via Doodle. Finally, the workshop was carried out on the 26th and 27th of October from 5pm until 8pm. The two parts were attended by 8 and 7 participants, respectively.

2 Scenario question

2.1 Draft scenario question

What will life look like in Betzdorf-Gebhardshain in 2031?

2.2 Finalised Scenario question

What will digital living (together) look like in Betzdorf-Gebhardshain in 2031?

2.3 Methodology used to finalise scenario question

We discussed the scenario question with our key stakeholders from the living lab in advance. In the invitation for the workshop we sent to possible participants we announced the question "How will life look like in Betzdorf-Gebhardshain in 2031?" According to the long relationship with Betzdorf-Gebhardshain, we were sure that this question should set up the frame for the workshop. But when we were preparing the workshop in detail, we realised that there was a need to point out the massive impact that digitalisation has on the local level. Thus, for the workshop itself, we changed the question slightly adding the terms "digital" and "together", indicating that digital communication might continue to change the way we interact. Also, we wanted to stress that it is necessary to discuss the way we live together as a more and more digitalised society.

2.4 Relevant feedback on scenario question from participants

As the timing (two times three hours in the evening) was very challenging, we did not explicitly ask for a feedback on the scenario question during the workshop. In general, we gave the participants several times the chance to ask questions during our presentation. As there were no questions about the scenario question, we assume that the question was formulated clearly and understandably.

3 Relevant past events

3.1 List of relevant past events

- 2011: tablet computers and online platform for local council in Betzdorf
- 2013: start of fiberglass infrastructure development in in Betzdorf
- 2013: more WhatsApp-messages than SMS in Germany
- 2014: 50 % of Germans own a smartphone
- 2014: Netflix available in Germany
- 2015: Betzdorf joins the project „Digital Villages“
- 2016: first Amazon delivery via aerial drone
- 2016: free Wi-Fi in the city of Betzdorf
- 2017: fusion of Betzdorf and Gebhardshain
- 2018: release of the communication app DorfFunk in Betzdorf-Gebhardshain
- 2019: release of the online tool LösBar in the administration of Betzdorf-Gebhardshain
- 2019: 5g is available on the German consumer market
- 2020: more than 1,000 DorfFunk users in Betzdorf-Gebhardshain

3.2 Description past event activity

Initially, we had planned to present one central event per year. The idea was to choose examples with direct connection to the experience of the participants' everyday lives. This was started by listing different types of past events; introductions of widely spread technologies and services, older technologies losing relevance, global as well as local developments, milestones and events, which are politically as well as technologically meaningful.

Since our LL focuses on interaction and exchange, we wanted to put an emphasis on digital communication services. However, we realised that most of the currently widely spread services go back further then 10 years. Thus, we presented introductions to the German market (Netflix, 5g) or constructed comparisons to other technologies (WhatsApp vs. SMS, diffusion of smartphones vs. cell phones). Also, the project "Digital Villages", which was carried out in Betzdorf-Gebhardshain and received a lot of attention locally, was cited multiple times.

The timeline was roughly presented and then discussed in detail among the participants. The guiding questions were how one can interpret the course of 10 years and if anything important was missing.

3.3 Relevant feedback from participants

The intention to focus on digital communication technologies and services with a high degree of diffusion was taken up by the participants. It concluded, that mobile technologies, especially smartphones, have taken an immense technological development during the past years and massively influence our daily lives. This goes along with an ever-growing number of mobile applications for different purposes – banking, travelling but also administrative issues. Also, it was discussed that social network sites have changed the way we communicate – while it was somewhat vague to define how far back the development of social media goes. In general, everyday technologies were discussed more intense than local (political) events.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

- Demographic Structure & Digital Acceptance
- Digital Apps/Services & Data Usage
- Economic Structure & Types of Work
- Actions Regarding Extreme Weather Events and Sustainability Guidelines[2]
- Local Administration Responsibilities and Privatisation
- Implementation Online Access Act (OAA)

4.2 List selected DOC

- Demographic Structure & Digital Acceptance
- Digital Apps/Services & Data Usage
- Economic Structure & Types of Work
- Actions Regarding Extreme Weather Events and Sustainability Guidelines
- Local Administration Responsibilities and Privatisation
- Implementation Online Access Act (OAA)
- Inward and Outward Migration

[2] Recall the 2021 floods that were very crucial in some parts of the North of Rhineland-Palatinate, but did not affect the Living Lab directly. See also https://en.wikipedia.org/wiki/2021_European_floods

4.3 Describe methodology to select DOC

We suggested the initial list of DOC already in September to our key informants who commented and made suggestions for improvements. Basically, we focussed on the STEEP categories Society, Technology, Economy and (local) Policy, which are strongly linked to our Living Lab's thematic orientation. Originally, we planned to omit the Environment category but the floods in the western part of Germany in 2021 induced us to deal with the topic during the workshop.

Due to the limited timeframe of our virtual meeting, we had to make a decision where to shorten the agenda. Finally, we decided to focus on the developments until 2031 and their implications for today, so we set up the initial DOC in advance and prepared a table in a Miro Board. After that, we presented the table including both, the DOC and the assumptions (see section 5 below) in one go.

4.4 Relevant feedback from participants

In the workshop, we gave the participants some moments to consider the table carefully and make suggestions for improvements. In particular, we asked if there is something missing in the list of the DOC and also if there is something redundant in the list. Finally, one participant suggested that inward and outward migration should be included as an additional driver of change because it reflects the overall economic situation quite well. After a short discussion, all participants agreed to add this DOC in the table.

Adding the DOC "Inward and Outward Migration" makes sense because this reflects the job situation in the Living Lab and how attractive the region is as place of residence. Furthermore, this extension takes up the fact that large numbers of commuters leave the region daily to work in other cities, what we have discussed in the context analysis.

5 Matrix

5.1 Matrix description

Basically, the left column (Assumption 1) represents a worsening, the second right column (Assumption 2) represents an improvement, the very right column (Assumption 3) represents a strong improvement in the scenario. In case we only found one improvement we merged Assumption 2 and Assumption 3 in one cell, leaving Assumption 3 empty. In some sense, the Business As Usual column can be seen as negative development, as usually new technologies bring an improvement, so no change is not really desirable. Furthermore, it is difficult to say if a change in the DOC "Responsibilities of the Local Administration and Privatisation" is positive or negative and depends on the subjective perspective. However, after speaking with our key informants we agreed to consider a loss of importance of the local administration as negative, while the autonomy of services can be referred to as positive.

DOC	Assumption 1	Business As Usual	Assumption 2	Assumption 3
Demographic Structure & Digital Acceptance	Increasing ageing & moderate acceptance of digital offers	Age structure does not change significantly & increasing acceptance of digital offers	Age structure does not change significantly & great acceptance of digital offers	Society is getting younger & great acceptance of digital offers
Digital Apps/Services & Data Usage	No further development of digital services & high restrictions on the use of data	Both moderate - no significant further development	Introduction of meaningful services & moderate data use for different actors	Introduction of meaningful services & productive data use for different actors
Economic Structure & Types of Work	Decrease of jobs in sector 2 without compensation from other sectors & concentration of employment in centres with intensive commuting	Decrease in jobs in sector 2, which is compensated by other sectors & no significant change in commuting pattern	Slightly more employment & flexible working	More employment through the establishment of highly innovative companies
Actions Regarding Extreme Weather Events and Sustainability Guidelines	Despite increase in heavy rainfall/drought and social pressure, no implementation regarding sustainability	Despite increase in heavy rainfall/drought and social pressure, only slow implementation in terms of sustainability	Despite (or due to) the increase in heavy rainfall/drought and social pressure, good implementation in terms of sustainability	-
Local Administration Responsibilities and Privatisation	Loss of importance of local administration and increase in private service providers for services of general interest	Continuation and partial privatisation of digital services	Great importance of local government and autonomy in provision of services	X
Implementation Online Access Act (OAA)	Implementation of the OAA failed technically and organisationally - few services implemented without being used	Implementation partly delayed with moderate use of implemented services	Implementation of the OAA goes smoothly and offers are actively used	X

Inward and Outward Migration	More emigration than immigration	No change	More immigration than emigration	X

5.2 Define 4 pathways/scenarios selected

Worse not Worst scenario: highlighted in red.

Better not Best scenario: highlighted in green.

Dystopia scenario: corresponds to the very left column.

Utopia scenario: corresponds to very right column.

5.3 Identify the 2 pathways that will be defined in more detail

5.3.1 Worse not Worst scenario

In this scenario, we assume that the potentially positive effects that digitalisation can have will not improve life in the region in 2031. Even though there might be more digital services in use, the acceptance by citizens – in particular of digital administrative services – will be very low. Also, the economy in the region suffers from structural change, as the 2nd sector (especially production plants for metal processing) remains more important than in other regions of Germany. This leads to more commuting to larger cities, which makes the region more and more unattractive. Furthermore, additional extreme weather events hit the region because nothing (or at least not enough) happened in terms of ecological sustainability. The implementation of the Online Access Act fails, meaning that the local administration cannot offer digital services as it was originally intended by the OAA. As a consequence, public actors more and more hand over their responsibilities to the private sector. Altogether, this leads to a scenario, where people leave the region and move to other areas with better job opportunities and a better provision of services of general interest.

5.3.2 Better not Best Scenario

In contrast, the Better not Best Scenario assumes, that by 2031 digitalisation has had an overall positive effect for the region, though not for all aspects. In general, digital apps/services have improved massively and citizens accept digital products, also meaning that data usage has become productive. Also, people are more flexible to work remotely, e.g. from their homes. However, the overall economic situation does not benefit the demographic structure resulting in a significant change. Several implementations in terms of sustainability will avoid (or at least reduce) floods as well as droughts. The Online Access Act will have been implemented successfully by 2023. Digital services of the local administration are expanded, well accepted and used actively. Also, policymakers, civil society institutions, welfare institutions and actors from the local economy benefit from an efficient local administration.

5.4 Methodology used to identify pathways

Before the workshop, we evaluated each pathway separately. For the Worse but not Worst scenario, we decided if the DOC should become worse or stay the same (business as usual) and chose the more realistic one. We did the same thing for the Better not Best scenario, choosing between improvement (Assumption 2) and strong improvement (Assumption 3).

We presented the pathways in the workshop using Miro and asked the participants for feedback, if we need to change the pathway or if we need to change an assumption. One participant suggested to change the DOC "Demographic Structure & Digital Acceptance" in the Worse not Worst scenario. After a short discussion we changed Assumption 1 from "Increasing ageing & moderate acceptance of digital offers" to "Age structure does not change significantly & increasing acceptance of digital offers", which seemed to be more realistic. Some participants stated that a successful implementation of the OAA by 2023 is not very realistic but agreed to progress with the suggested Better not Best scenario.

5.5 Relevant feedback from participants

- Both scenarios are "beautiful and fluid",
- one can "put oneself vividly into it",
- probably, the future will be a mix of both scenarios,
- both scenarios are consistent and plausible.

6 Scenario Narratives

6.1 Name Scenarios

Worse not Worst scenario: A grey day in our municipal community

Better not Best scenario: Life is good – The positive work-life balance in Betzdorf-Gebhardshain as an administrative employee

6.2 Write the 2 or 3 detailed scenario narratives

6.2.1 A grey day in our municipal community

26th July 2031. It is a very rainy day in summer in a small village in the municipal association of Betzdorf-Gebhardshain. Alex, 65 years old, is an unemployed widowed car mechanic who lost his job a few years ago. His company, which processed metal, filed for bankruptcy eight years ago because it failed to make the leap into digitalisation. He himself has not found a new job, at least not a permanent one, because of his lack of digital skills.

Today he is not doing well, so he wants to see a doctor and tries to find one on the Internet. However, he cannot find a doctor in the immediate vicinity and has no opportunity to get to the doctor: Alex has no car and there are no more bus or train connections in the village. Alex cannot be taken to the doctor by friends or acquaintances, either: as they could not find jobs in the region, they commute and cannot drop by spontaneously, and home office has not really become a standard, either. Unfortunately, the citizens' bus was abolished because there are too few volunteers.

Alex's children moved to big cities to attend university and stayed there. "There is no work for us here anyway with our qualifications," they say, "and if I look at the schools here, the children don't learn anything about digital skills. Not to mention the lack of technical equipment."

Alex tries to call the local administration, but can't reach anyone there, and there is no longer a service point on site. For reasons of rationalisation, the doctor's on-call service with home visits has also been eliminated. Telemedicine has not yet caught on in Germany either. Out of necessity, he takes a taxi and hopes that the health insurance will cover the travel costs. At least the doctor in town is open. The waiting room is not completely empty, but not totally overcrowded either. A gentleman of about 44 sits opposite to him in the waiting room. He is wearing a t-shirt that says "The main thing is that Alessio is doing well!"[3]. They start talking. The gentleman says that all he really needs is a referral to the tropical doctor because he wants to fly to Namibia for a few weeks. "If that was the only thing", he mumbles. He explains that he also needs a new passport. "I have to go to the office of the local administration. 10 years ago our politicians promised that this can be done via the Internet but nothing has happened, yet. When I look at Denmark, it's no problem there, but here with us..."

Finally, it's Alex's turn. The doctor diagnoses a summer flu, prescribes medication and orders two weeks of absolute bed rest. The pharmacy is just around the corner. Fortunately. Most of the shops in Betzdorf-Gebhardshain have closed: too much competition from the Internet. Now Alex has to wait about three hours until a school friend can pick him up and drive him home. To pass the time, he goes into town to a bakery. At least it's open, not like back in the days of Corona lockdowns. On the way there, Alex sees a protest demonstration led by populists. They want to exploit the displeasure of the people here. With success, at least if the results of the last state and federal elections are the reference...

It's just after 4 p.m., Alex finally gets home. "Lucky you," says his neighbour, who drove him home. "Fritz has almost no chance of getting out of the house any more. You need a smartphone for everything these days. For everything except the administration office. And Fritz, at the age of 75, can't dive into with the systems any more, either." "Yes," thinks Alex, "lucky again. Today at least." In any case, he is glad to be home again and hopes that his flu will soon be over. Two weeks later, he has recovered again and enjoys the late summer sunshine with his children and grandchildren.

6.2.2 Life is good

3 https://www.vip.de/cms/hauptsache-alessio-geht-s-gut-so-scherzen-promis-und-netzgemeinde-ueber-den-sohn-von-sarah-und-pietro-4049886.html

It is a sunny day in autumn. Alex is 25 years old and works at the municipal administration in Betzdorf-Gebhardshain. He is a trained administrative assistant. Since topics such as digital services made up part of his training, Alex could have also worked for a private company in the region, but he made a conscious decision to stay in government administration. Among other things, because the pay in both the administration and in the private sector is not excessively different and reflects his qualifications very well. This has also led to many of his school friends moving back to the region after graduation and either pursuing employment there, or working from home or a coworking space for companies scattered throughout Germany.

After getting up, Alex has breakfast together with his wife. Since she is pregnant and Alex is very busy, breakfast is delivered by a local food company today, after Alex had put it together the day before and ordered it online.

After breakfast, Alex sits down at his desk because he is in his home office today. Flexible working has become a standard solution and is supported by the employer. Of course, the town hall is still there, and a lot of his colleagues work there from time to time and it is also open to visitors. Alex first processes new applications for digital passports. He is only responsible for the final check and then forwards the digital document directly to the smartphones of the applicants. Due to the good processes and the consistently high acceptance of digital administrative services, such offers are actively used.

The background to this is the positive result of the Online Access Act, which was implemented almost 10 years ago. As a result, a dynamic has developed on the basis of which other services are also offered digitally but without the need for a legal obligation. But principally, the digitisation of administrative services has gone well. The necessary platforms are provided by the state, but the provision of services still takes place in the local administration. Most importantly, the administrative services that have been developed, are easy to use for everyone. For example, there is no need to re-enter personal data for each procedure. Rather, they are stored in an accessible way and are automatically entered into applications for many other services - but they are also stored in a highly secure way. Nonetheless, people who have problems for various reasons are offered assistance at the city hall. Alex always does this on Mondays and enjoys the direct contact with citizens.

During his lunch break, Alex attends his wife's doctor's appointment, which takes place online. The regular check-ups take place in the nearby medical practice - but the discussion of laboratory values, for example, can take place quite easily via webcam. Today, however, the two are connected to an expert for metabolic diseases in Hamburg, because some values of the last examination were suspicious. The expert gives the all-clear.

In the afternoon, Alex has another online appointment. A new service offered by the administration is to advise older people and their relatives on how to apply for special care services, such as robots, so that they can live in their own homes for as long as possible. Alex developed this offer with a colleague and is now testing its implementation. Alex has the early afternoon off. This is made possible by the new 32-hour week in the administration, which is based on a relief of routine work through digital services. As a result, there is more time to maintain the admittedly expensive infrastructure of the municipality on the one hand, and to deal with more complex problems and new services of the region for its citizens on the other.

So now Alex goes for a walk in the Westerwald. The woods are visibly recovering from the series of dry summers about 10 years ago. Due to climate change, there is still drought and heavy rainfall.

However, the municipality has identified ways and means to better deal with the climate situation and other crises. On the one hand, digital tools are a great help. On the other hand, Betzdorf-Gebhardshain also manages to meet the increasing demands for sustainable local governments (CO2 avoidance, accessibility, local supply of energy from renewable raw materials). During his walk, he takes photos that he posts on various social networks, which is no problem due to the seamless supply of 7G.

In the evening, a new museum opens in Betzdorf, which is financed by municipal surpluses, among other things. The title of the current special exhibition is "The paper age - passports in the course of time". Alex was involved in the conception of this exhibition and will offer a guided tour after the opening ceremony, as he is very involved as volunteer.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

6.3.1 A grey-grey decade in our municipal community (Dystopia)

Betzdorf-Gebhardshain, 2031. Germany has reached much improvement in technology the last ten years, in particular in the context of digitalisation. Even in the service area (education, public transport and so on), much jobs are done by robots and artificial intelligence systems. But the drawbacks of too much digitalisation are obvious today: social interaction is only kept realised though social media like Facebook or Twitter, meetings in person are more than rare and the majority of the people suffer seriously from loneliness. In terms of economy, almost all small companies (including bakers and supermarkets) disappeared because of Internet based competitors. Basically, those kinds of companies became bigger and bigger and many jobs disappeared in the last decade in Betzdorf-Gebhardshain. In other words, the unemployment rate is extremely high in Betzdorf-Gebhardshain. Many people – in particular those with good education and digital skills – left the region to find better jobs in urban centres. This made the situation even worse, as there are no professionals in the region and the location is not attractive for companies. Furthermore, there are no more doctors left in the region. Either, people must use tele medicine or drive a long distance into the city to see a doctor. In particular, elderly, financially disadvantaged people and people in need of care experience shortcomings in their daily life.

The local administration could not help at all: due to a lack of financial resources and a lack of commitment of the civil society to participate in the digital transformation in the administration, the implementation of the Online Access Act – by which digital services were supposed to become mandatory in 2023 – failed. One more reason that the situation in Betzdorf-Gebhardshain is crucial. Today, at least some digital services work, but in the meantime jobs in the local administration were rationalised. And those systems that run are even more complicated than they were before the process of digitalisation started in the administration because the technology is complicated and not user friendly.

Both, the bad economic situation and the failing administrative services have led to a situation where the whole region suffers. Finally, the overall bad economic situation was exploited by populist parties who achieved unimagined success in both, the federal and state elections in 2029. Also, traditional people's parties almost disappeared. There is an obvious need for action. But nobody knows how…

6.3.2 Life is perfect

Betzdorf-Gebhardshain, 2031. The trajectory of socio-technical developments throughout the past decade was more than positive. The local administration offers a comprehensive amount of reliable digital services, which are applied by citizens and other users willingly and regularly. Everyday issues can be dealt with easily. This has reduced visits to the city hall as well as waiting in queues massively. However, if necessary, one can get professional and personal support and assistance by competent staff. This option is primarily used by some elderly, in cases of very complex administrative issues and by people who have recently migrated and are still gaining knowledge about the new structures they live in.

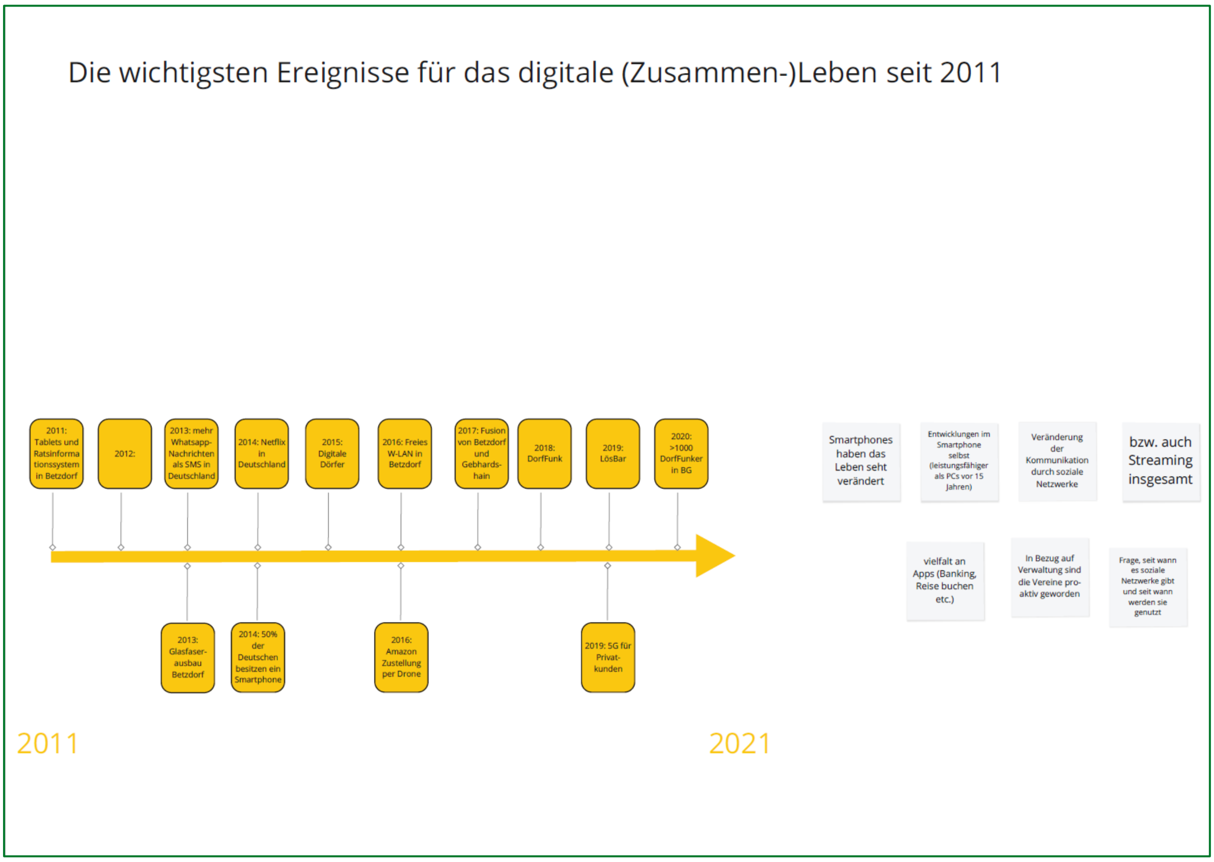
Basic administrative services are managed but not hosted by the local administration itself. Here, rather the federal state of Rhineland-Palatinate or the federal administration have defined standards, processes and now supply the services and platforms. Nonetheless, local administrative staff is in full knowledge concerning the technology as well as the processes.

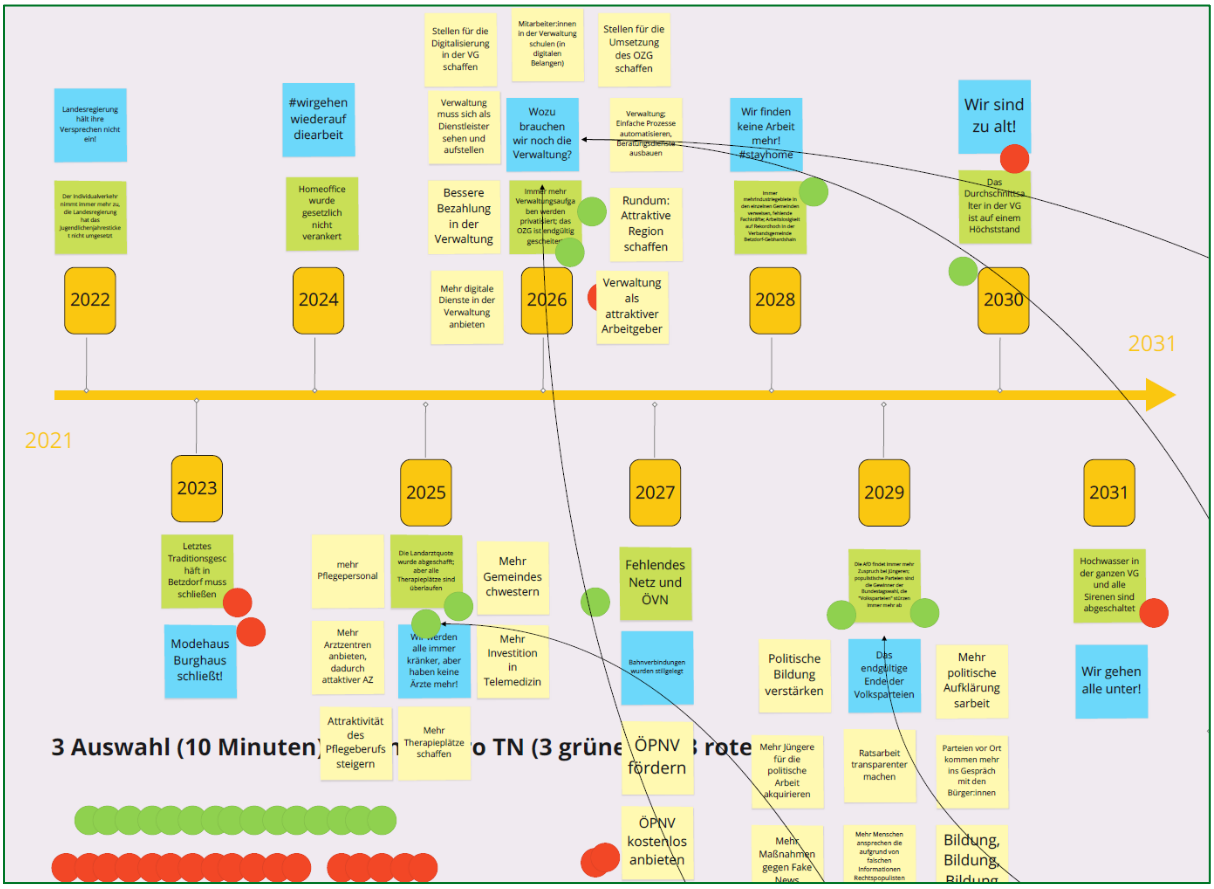
The mayor consequence of this structure is that the local administration has been relieved from routine work. The free resources are used to develop and offer services matching the local needs. One example is mobility: The very affordable monthly flat rate for regional public transportation includes not only trains and busses but also autonomous shuttles, picking up people at their homes to take them to the next bus stop or train station.

The medical sector has been completely digitalised, including consultation, treatment and emergency services. This does not mean that one is exclusively confronted with digital interfaces in case of sickness. Rather, medical treatment in general is more efficient. As a consequence, quality has improved and supply is broader. Also, digital technology in combination with local structures of care grant assistance in everyday live, so that elderly people are able to stay in their homes until the very last stages of their lives, without having to fear that falls or other accidents remain unrecognised.

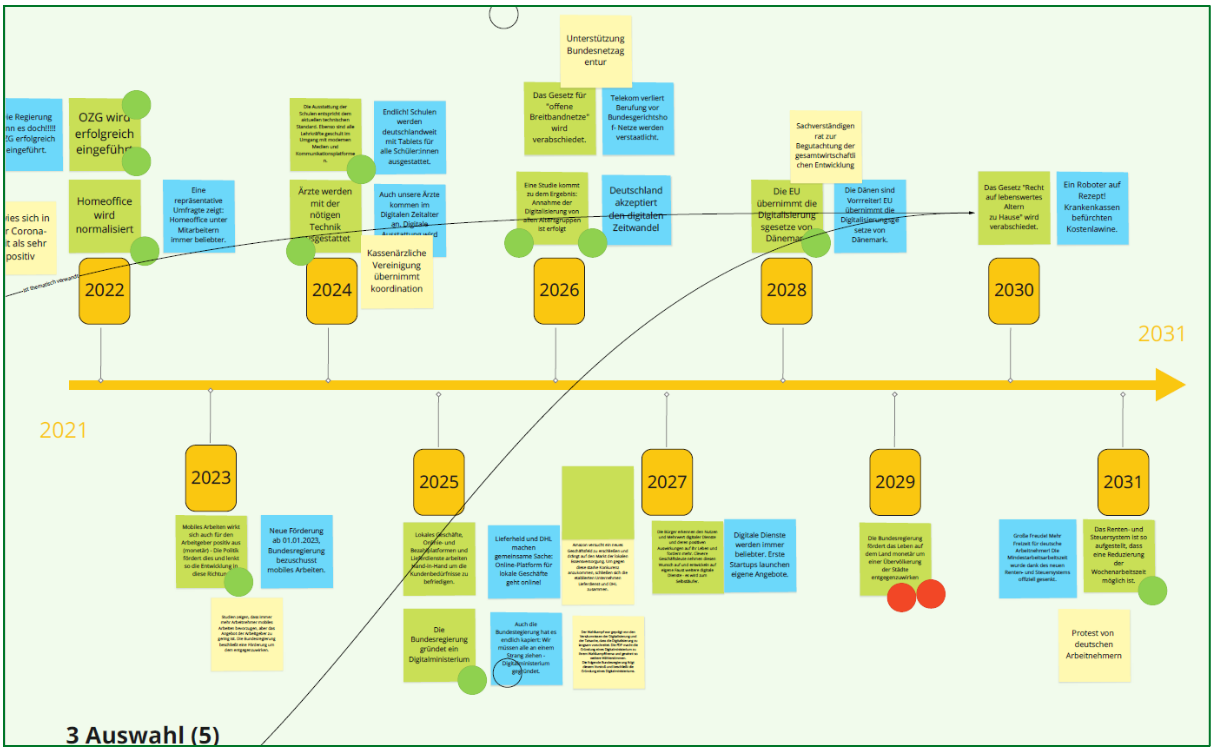
One key factor that has massively contributed to this situation is the innovative management of personal and public data. A central data monitoring application allows every individual to trace what institution or organisation stores or processes his or her data for what purpose. Not only is this application structured very comprehensibly, it is also very easy to manipulate permissions. This kind of transparency has caused a massive improvement of trust so that various service providers – public as well as private – are able to offer high quality and data driven services.

7 Some screenshots of the workshop

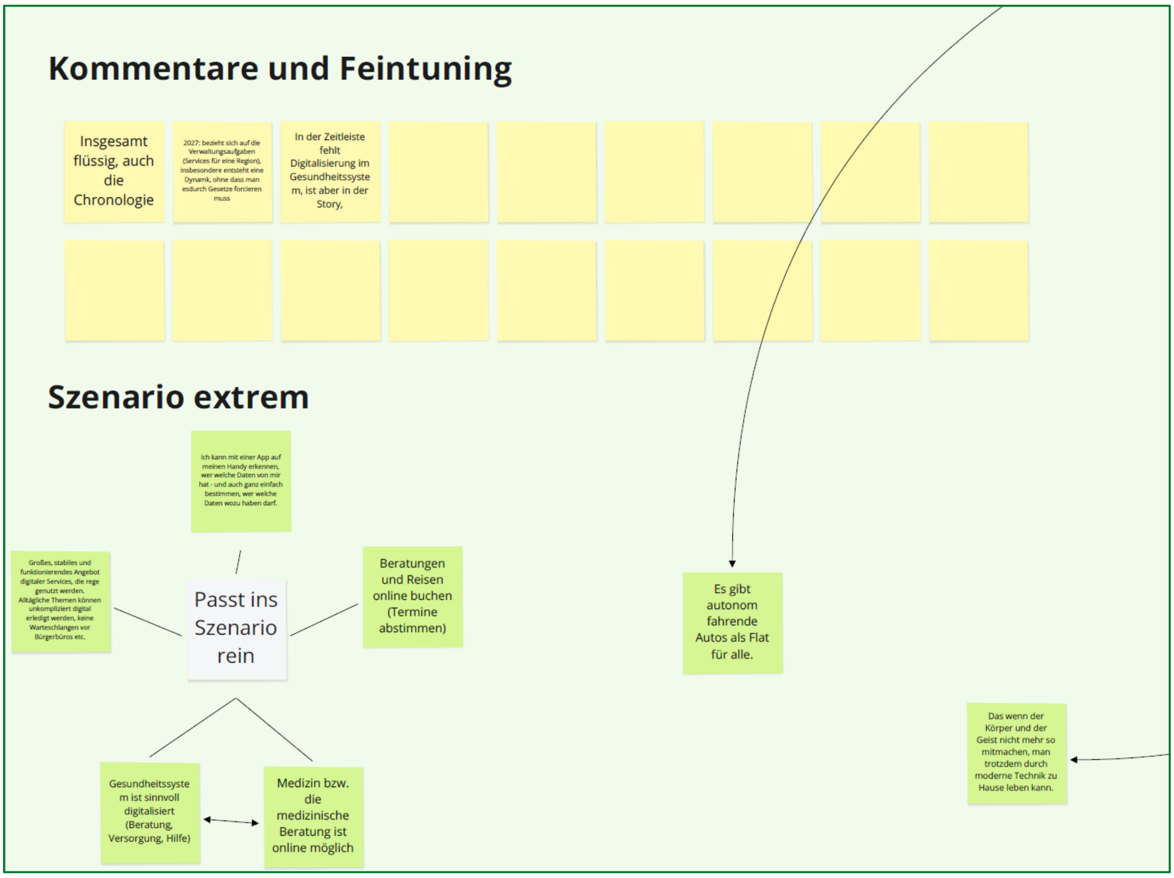

Die wichtigsten Ereignisse für das digitale (Zusammen-)Leben seit 2011
2011: Tablets und Ratsinformationssystem in Betzdorf
2012:
2013: mehr Whatsapp-Nachrichten als SMS in Deutschland
2014: Netflix in Deutschland
2015: Digitale Dörfer
2016: Freies W-LAN in Betzdorf
2017: Fusion von Betzdorf und Gebhards-hain
2018: DorfFunk
2019: LösBar
2020: >1000 DorfFunker in BG
2013: Glasfaser-ausbau Betzdorf
2014: 50% der Deutschen besitzen ein Smartphone
2016: Amazon Zustellung per Drone
2019: 5G für Privat-kunden
2011
2021
Smartphones haben das Leben seht verändert
Entwicklungen im Smartphone selbst (leistungsfähiger als PCs vor 15 Jahren)
Veränderung der Kommunikation durch soziale Netzwerke
bzw. auch Streaming insgesamt
vielfalt an Apps (Banking, Reise buchen etc.)
In Bezug auf Verwaltung sind die Vereine pro-aktiv geworden
Frage, seit wann es soziale Netzwerke gibt und seit wann werden sie genutzt



Stellen für die Digitalisierung in der VG schaffen
Stellen für die Umsetzung des OZG schaffen
Landesregierung hält ihre Versprechen nicht ein!
#wirgehen wiederauf dierbeit
Verwaltung muss sich als Dienstleister sehen und aufstellen
Wozu brauchen wir noch die Verwaltung?
Wir finden keine Arbeit mehr! #stayhome
Wir sind zu alt!
Homeoffice wurde gesetzlich nicht verankert
Bessere Bezahlung in der Verwaltung
Rundum: Attraktive Region schaffen
Das Durchschnittsalter in der VG ist auf einem Höchststand
Mehr digitale Dienste in der Verwaltung anbieten
Verwaltung als attraktiver Arbeitgeber
2022
2024
2026
2028
2030
2031
2021
2023
2025
2027
2029
2031
Letztes Traditionsgeschäft in Betzdorf muss schließen
mehr Pflegepersonal
Mehr Gemeindeschwestern
Fehlendes Netz und ÖVN
Hochwasser in der ganzen VG und alle Sirenen sind abgeschaltet
Modehaus Burghaus schließt!
Mehr Arztzentren anbieten, dadurch attaktiver AZ
Wir werden alle immer kränker, aber haben keine Ärzte mehr!
Mehr Investition in Telemedizin
Politische Bildung verstärken
Das endgültige Ende der Volksparteien
Mehr politische Aufklärungsarbeit
Wir gehen alle unter!
3 Auswahl (10 Minuten)
Attraktivität des Pflegeberufs steigern
Mehr Therapieplätze schaffen
ÖPNV fördern
Mehr Jüngere für die politische Arbeit akquirieren
Ratsarbeit transparenter machen
Parteien vor Ort kommen mehr ins Gespräch mit den Bürger:innen
ÖPNV kostenlos anbieten
Mehr Maßnahmen gegen Fake News
Bildung, Bildung, Bildung



Unterstützung Bundesnetzagentur
Das Gesetz für "offene Breitbandnetze" wird verabschiedet.
Telekom verliert Berufung vor Bundesgerichtshof. Netze werden verstaatlicht.
OZG wird erfolgreich eingeführt
Endlich! Schulen werden deutschlandweit mit Tablets für alle Schüler:innen ausgestattet.
Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung
Homeoffice wird normalisiert
Eine repräsentative Umfrage zeigt: Homeoffice unter Mitarbeitern immer beliebter.
Ärzte werden mit der nötigen Technik ausgestattet
Auch unsere Ärzte kommen im Digitalen Zeitalter an.
Deutschland akzeptiert den digitalen Zeitwandel
Die EU übernimmt die Digitalisierungsgesetze von Dänemark
Die Dänen sind Vorreiter! EU übernimmt die Digitalisierungsgesetze von Dänemark.
Das Gesetz "Recht auf lebenswertes Altern zu Hause" wird verabschiedet.
Ein Roboter auf Rezept! Krankenkassen befürchten Kostenlawine.
Kassenärztliche Vereinigung übernimmt koordination
2022
2024
2026
2028
2030
2031
2021
2023
2025
2027
2029
2031
Neue Förderung ab 01.01.2023, Bundesregierung bezuschusst mobiles Arbeiten.
Lieferheld und DHL machen gemeinsame Sache: Online-Plattform für lokale Geschäfte geht online!
Digitale Dienste werden immer beliebter. Erste Startups launchen eigene Angebote.
Die Bundesregierung gründet ein Digitalministerium
Protest von deutschen Arbeitnehmern
3 Auswahl (5)


Kommentare und Feintuning
Insgesamt flüssig, auch die Chronologie
2027: bezieht sich auf die Verwaltungsaufgaben (Services für eine Region), insbesondere entsteht eine Dynamk, ohne dass man esdurch Gesetze forcieren muss
In der Zeitleiste fehlt Digitalisierung im Gesundheitssystem, ist aber in der Story,
Szenario extrem
Ich kann mit einer App auf meinen Handy erkennen, wer welche Daten von mir hat - und auch ganz einfach bestimmen, wer welche Daten wozu haben darf.
Großes, stabiles und funktionierendes Angebot digitaler Services, die rege genutzt werden. Alltägliche Themen können unkompliziert digital erledigt werden, keine Warteschlangen vor Bürgerbüros etc.
Passt ins Szenario rein
Beratungen und Reisen online buchen (Termine abstimmen)
Es gibt autonom fahrende Autos als Flat für alle.
Das wenn der Körper und der Geist nicht mehr so mitmachen, man trotzdem durch moderne Technik zu Hause leben kann.
Gesundheitssystem ist sinnvoll digitalisiert (Beratung, Versorgung, Hilfe)
Medizin bzw. die medizinische Beratung ist online möglich


Was bedeutet das für heute?
Manche Veränderungen brauchen Zeit!
In manchen Feldern sind Impulse/Anreize von der Politik wichtig (z. B. mobiles Arbeiten)
Akzeptanz in der Bevölkerung/Offenheit fördern
Bildung (Politik, Verwaltung, als Person)
Plattformen für Austausch schaffen
breite Verständigung: Was wollen wir und wie wollen wir sein
Die Leute müssen sich einbringen!

13.4 Poland

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

SCENARIO WORKSHOPS

GEODESIGN IN RURAL POLAND (PL)

27.01.2022

PAULINA TOBIASZ-LIS, MARCIN WÓJCIK, KAROLINA DMOCHOWSKA-DUDEK, PATRYCJA GRZYŚ

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SCENARIO WORKSHOPS REPORTING TEMPLATE

Project name	**DESIRA | Digitisation: Economic and Social Impacts in Rural Areas**
Project ID	818194
H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Doc
File Name	WD 3.2 Draft reporting Template v1.3
Status	Draft
Authors	Paulina Tobiasz-Lis, Marcin Wójcik, Karolina Dmochowska-Dudek, Patrycja Grzyś
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

1. Living lab summary

1.1 Name of LL

Geodesign in Rural Poland

1.2 Brief summary of LL

Geodesign in Rural Poland Living Lab is focused on dynamic changes that recently have taken place in spatial planning, involving digitalisation with high potential to enhance participation and transparency of these processes. GeoDesign opens up new possibilities for spatial planning on the local scale. However, success in its implementation depends on a high level of digital skills by the stakeholders and awareness of local authorities, who should seek to cross the barriers beyond which a community can become a partner in the planning process.

The Living Lab Geodesign in Rural Poland is implemented in Poland's central region – the Lodzkie region (voivodeship), located between historical regions of Mazovia, Greater Poland and Lesser Poland, representing a middle-range situation in terms of socio-economic development and living standards. The Lodz region has a total area of 18 200 km2 and a population of 2,5 mln people, 62% of whom live in rural areas (2019). In terms of administration, it is divided into 24 counties and 177 local units (gminas), among which 133 are predominantly rural, 26 are urban-rural, and 18 are predominantly urban.

1.3 LL participants

Among potential participants of scenario workshops focused on the future of GeoDesign in Rural Poland, there were rural citizens, stakeholders at local (gmina) and regional (voivodeship) level of public administration, spatial planners and researchers with expertise in rural areas, spatial planning and GIS infrastructure. Workshops were first announced and promoted among these actors who participated in previous consultations over Needs, Expectations and Impacts discussed in WP 2 of DESIRA project. A further open invitation was spread to other potential participants in order to broaden the range of actors engaged in the research.

1.4 Timing of Scenario Planning (WP3) workshops

Scenario workshops were conducted along another event organised by the DESIRA team at the University of Lodz under the auspices of the Marshal Office (regional government). The two-day seminar, held in person in Swolszewice Małe (Poland) focused on innovative research in rural areas influenced by global challenges. The first scenario workshop was carried out before the seminar – on 21st October 2021 between 10 am and 2 pm, the second workshop started on 22nd October 2021 in the afternoon – after closing the seminar. Both parts were attended by 7 participants, however after collecting all outputs from these workshops, draft scenarios were the subject of additional discussions among LL experts carried online or on the phone.

2 Scenario question

2.1 Draft scenario question

The draft scenario question proposed to the participants during the first workshop was: "will spatial planning in rural areas of Poland look like in the increasingly digitalised age of 2031"

2.2 Finalised Scenario question

What will spatial planning in rural areas of Poland look like in the increasingly digitalised age of 2031?

2.3 Methodology used to finalise scenario question

Along our preparation for the workshop, in the summer 2021, we have collected materials on the scenario question was provided during a presentation together with the wordcloud presenting key words which describe the idea of GeoDesign in the process of participatory spatial planning. There was a discussion weather to include the concept of GeoDesign in our scenario question, but we agreed to remain with the more general and legible approach – without any specific ideas.

2.4 Relevant feedback on scenario question from participants

Not applicable, since we agreed on the final version of scenario question before the scenario workshop discussing and verifying its relevance via the individual stakeholder interviews, conducted online or on the phone.

3 Relevant past events

3.1 List of relevant past events

Below we provide the list of six past events that were used to explore the changes in mechanisms of spatial planning in Poland – starting from adjustments to conditions of a transformed political and governance system taking place in the early 1990s, introducing a new decentralised model of spatial planning through emergence of the idea of participatory planning and boosting digital transition in terms of spatial planning processes and data.

These events were presented as the milestones in the evolution of spatial planning paradigms in Poland that we used to open the first WP3 workshop (Figure 1). Participants didn't provide any additional events on the timeline but discussed their experiences connected with these provided in our list.

- 1990 - enfranchisement of local communities, with local government reactivated at the level of the commune (gmina)
- 1994 – new, decentralised model of spatial planning in Poland setting principles regarding the hierarchy in spatial planning and the primacy of the gmina in matters of local planning
- 1995–2003 further “course adjustments” to that model
- 2003 – according to the new Act on Spatial Planning (still valid), the gmina and citizens to become equal partners in a planning process foreseen to involve constant, ongoing negotiation and consultation
- 2009/2010 – EU’s INSPIRE Directive implemented in Poland’s domestic law initiated the country’s spatial information infrastructure and standards that favoured the unification of geospatial data to increase efficiency of their processing and dissemination
- 2020 - Act on Spatial Management and Planning obliged digitisation of all planning documents to ensure that uniform and unified sets of data are established. The universal availability and accessibility of planning data should incite public participation when it comes to the joint development of planning documentation using modern technology (online tools).

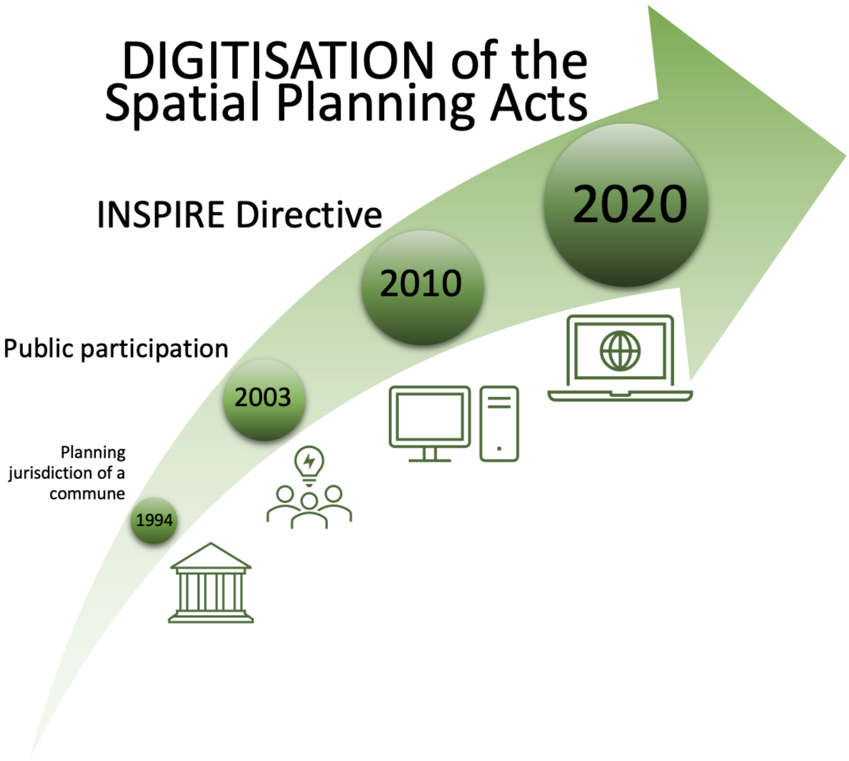


Fig. 1. Milestones in the evolution of spatial-planning paradigms

Source: Wójcik, Dmochowska-Dudek, Tobiasz-Lis, 2021

3.2 Description past event activity

The list of past events was selected to provide some key messages about the development of mechanisms in spatial planning in Poland starting from new, decentralised model of spatial planning being a direct response to political and economic transitions of the country in early 1990s; through participatory approach to spatial planning inviting local communities to actively take part in land management, especially in local scale; and finally focusing on digital technologies that can be regarded as a booster of GeoDesign concept in spatial planning today.

Participants didn't add any further key events on evolution of spatial planning mechanisms in Poland. However, they have contributed to the provided list by their individual experience of presented milestones and changes they have brought to spatial planning practice.

3.3 Relevant feedback from participants

Changes in mechanisms of spatial planning in Poland introduced to workshop participants (Figure 1) were perceived as exceptionally important for local communities, especially in rural areas under multifunctional rural regime having impact on dynamic land-use changes. They underlined the importance of participatory approach, stressing that by acquainting country-dwellers with the processes involved in planning, a basis is put in place for fuller trust in decision-making bodies at the level of the individual local authority. Digital technologies were described as a tool for smart rural development and the sustainability of local democracy—and is also important for the effective pursuit of an equal-opportunity policy. Broad access to new methods through which space is made subject to community negotiation is of key significance as the rural environment becomes not only more and more multifunctional, but also increasingly diversified in social terms.

Generally, there was less attention around digitalisation than around participation and transparency of spatial planning processes where digitalisation might be an important key to achieve certain goals of the above mentioned in the future.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

Before the workshop, Drivers of Change were listed as already existing, early signals - including not only technologies, but also changes in demography and social attitudes, legal changes, environmental changes and economic factors, the dissemination of which might make the future of spatial planning in rural areas of Poland different. We focussed on the STEEP categories: Society, Technology, Economy, Environment and Policy, trying to find such trends that are strongly linked to our Living Lab.

STEEP	DoC

Society	• Rural population decline and ageing • Migrations • Changing values, aspirations and lifestyles among country dwellers
Technology	• Connectivity in the rural areas • Digital literacy • Digital Apps/Platforms/Data Accessibility & Usage
Economy	• Spatial patterns of economic activity
Environment	• Environmental awareness
Policy	• Digital transition in spatial planning

4.2 List selected DOC

- Rural population change & Changing values, aspirations and lifestyles among country dwellers
- Connectivity in the rural areas & Digital literacy
- Digital Apps/Platforms/Data Accessibility & Usage
- Spatial patterns of economic activity
- Environmental awareness
- Digital transition in spatial planning

4.3 Describe methodology to select DOC

The initial list of drivers of change (DOC) were selected by the team conducting the Living Lab and leading the workshop. They were based on the list of DOC provided by the WP3 team in Scenario Planning Guidelines revised according to the information gathered in the WP2 research and workshop and over the previous research experiences conducted by us in rural areas of Poland, bearing in mind the scenario question.

We suggested the initial list of DOC already in September to our key informants who commented it and made suggestions for improvements. These were individual online or telephone consultations.

During the first workshop, participants were given the chance to discuss and improve the list of DOC by changing/adding/eliminating initial ones.

4.4 Relevant feedback from participants

After the discussion during the workshop, we merged three socio-demographic trends that will frame the future of rural areas in Poland, also in terms of spatial planning. Instead of initially separate *Population decline & ageing*, *Migrations and Changing values, aspirations and lifestyles among country dwellers* we decided that as they are interconnected, it will be wise to use *rural population change & changing values, aspirations and lifestyles among country dwellers* as one general driver of change. In our Living Lab focused on central Poland – Lodz voivodeship, we can consider different scenarios of these changes - on one hand *population decline and ageing*, due to *outmigration* addressing mainly remote rural areas and on the other hand *inmigration* driven by the process of suburbanisation is typical for rural areas in outskirts of big cities, influencing changes of socio-demographic patterns, values and lifestyles of old and new country dwellers.

Also putting together *Connectivity in the rural areas & Digital literacy* was widely discussed during the workshop as reflecting relations between the most important factors enabling success in carrying out digital transformation in spatial planning. According to participants of the workshop, these were well-chosen technologies and dedicated solutions, however, there was a strong agreement that digital literacy among citizens and public authorities is equally important. Participants stressed that even the best technology will not ensure success if people are not convinced and involved in the change.

5 Matrix

5.1 Matrix description

Basically, the left column (Assumption 1) represents a worsening, and the right column (Assumption 4) represents improvement in terms of digitalisation of spatial planning process.

DoC	Assumption 1 DYSTOPIA	Assumption 2 WOSRE NOT WORST	Assumption 3 BETTER NOT BEST	Assumption 4 UTOPIA
Rural population change & Changing values, aspirations and lifestyles among country dwellers	Rural population massive decline, ageing, values and lifestyles remain stable, traditional	Rural population systematic decline, values and lifestyles remain stable, traditional	Rural population is stable, ageing, values and lifestyles change	Rural population stable growth followed by changing lifestyles and values
Connectivity in the rural areas & Digital literacy	Decrease of connectivity; decrease of digital literacy	Problems of connectivity, limited development of digital literacy	Limited connectivity, growth of digital literacy	Growth of connectivity, growth of digital literacy

Digital Apps/Platforms/Data Accessibility & Usage	Digital Apps/Platforms/Data less accessible and not used	Digital Apps/Platforms/Data accessible but hardly used	Digital Apps/Platforms/Data hardly accessible but used	Digital Apps/Platforms/Data accessible and used
Spatial patterns of economic activity	Increasing agglomeration of economic activity accelerated by neo-liberal market economy	Increasing agglomeration of economic activity due to place-based approaches and evolutionary economics	Dispersal of economic activities away from current hubs, into rural and remote areas accelerated by neo-liberal market economy	Dispersal of economic activities away from current hubs, into rural and remote areas led by place-based approaches and evolutionary economics
Environmental awareness	No awareness, top-town driven activities	Growing awareness, top-down driven activities	Mixed attitudes, and activities on different levels and scales	Growing awareness, bottom-up driven activities
Digitalisation of spatial planning Acts	Further digital divide	Tools in hand, people not ready	People ready, tools are the problem	GeoDesign achieved

5.2 Define 4 pathways/scenarios selected

DoC that we've identified during our Scenario Workshops were expressed in the Matrix as a set of two dichotomous 'vectors', crosstabulation of which results in four Assumptions that might be considered as threads of our four future scenarios. Refering to experiences of spatial planning in rural areas of Lodz voivodeship – our Living Lab, we have defined four pathways of possible changes in the future:

- Dystopia scenario: corresponds to the very left column.
- Worse not Worst scenario: highlighted in yellow - left. This is the most plausible scenario for implementing GeoDesign model in spatial planning of rural areas in Poland.
- Better not Best scenario: highlighted in yellow - right. This is plausible scenario for implementing GeoDesign model in spatial planning of rural areas in Poland.
- Utopia scenario: corresponds to very right column.

5.3 Identify the 2 pathways that will be defined in more detail

The 2 pathways that were used for the second workshop were the second and third scenario. These were respectively the slightly positive (or better not best) and slightly negative (worse not worst) scenario.

5.4 Methodology used to identify pathways

Participants were split into two groups after the matrix (chapter 5.1) was made. These two groups were asked to develop rough scenario outlines using the drivers of change and corresponding assumptions. One group was given the task to develop more extreme scenarios (utopic and dystopic) while the other group was given the task to develop more nuanced scenarios (better not best and worse not worst).

The two groups were instructed on the focus of these scenarios (spanning the range of plausible futures) and that these outlines were going to be used to further develop the scenarios in the second workshop. Participants were also instructed to attempt to form a consistent scenario, where assumptions formed a somewhat sensible and logical combination.

5.5 Relevant feedback from participants

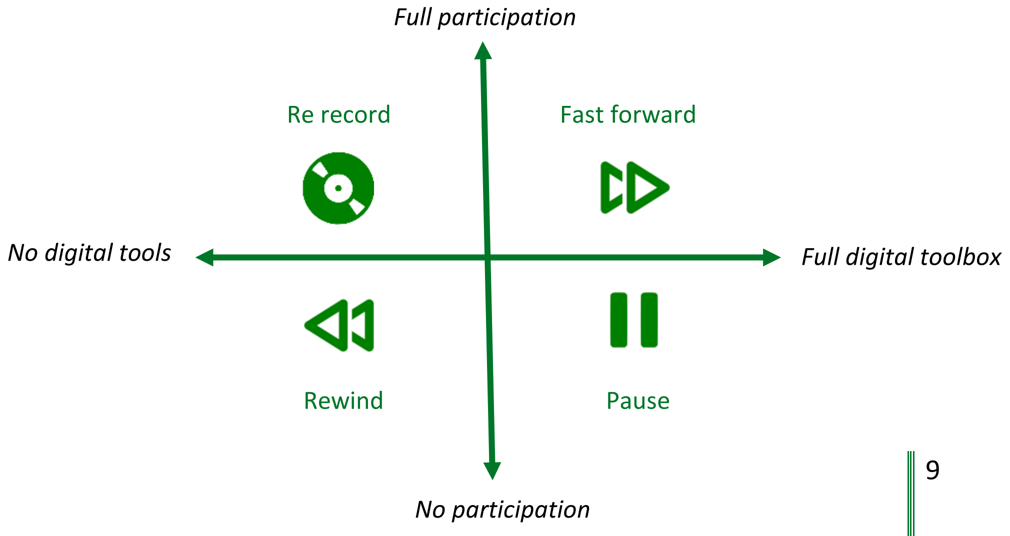
In general, participants had no difficulty with developing the outlines from the lists of assumptions as these were designed in the most convenient way to frame four more or less possible future scenarios. However, after discussing two most plausible pathways, participants agreed that probably, the future will be a mix of both scenarios,

6 Scenario Narratives

6.1 Name Scenarios

To name scenarios for future development of GeoDesign model for spatial planning in rural areas of Poland, we used symbols of reel-to-reel audio recorder controls: Play, Pause, Re-Record and Fast-Forward. We've considered possible configurations of two groups of the most influential drivers of change as discussed over the first workshop: social drivers focused on level of digital literacy and will to participate in spatial planning process and technological drivers covering various tools dedicated to participatory model of spatial planning, i.e.: internet connectivity, platforms, apps and their usage (Figure 2).

Fig. 2. Framework for scenarios of GeoDesign model in spatial planning of rural areas in Poland



6.2 Write the 2 or 3 detailed scenario narratives

6.2.1 Pause: full digital toolbox but no participation

Poland, like many European countries, has a strong regional character, i.e. social, cultural and economic features are spatially (regionally) diversified. This regional differentiation has very characteristic patterns which in the case of the technological development show great variation between the center and the periphery. The centers are predominantly urban in character (large cities and spheres of direct influence in the form of urban functional regions) and predominantly rural peripheries. The development scenario in the field of diffusion and implementation of technological innovations, in this case digitization of spatial planning processes, is based on a double dualism, i.e. demographic, social and territorial. Determining the basic trends leading to the consolidation of technological achievements and the transition towards universal digitization must consider social barriers, as well as relate to demographic issues (mainly aging) and psychological issues (mainly resistance to changes).

In terms of society, it should be borne in mind that the majority of rural areas in Poland will be subject to the process of depopulation. In some of the most peripheral rural communes, the situation will be very bad in this respect. The main factor will be the aging of local communities and the emigration of young people, especially well-educated. This will have a significant impact not only on the economic situation but also on the processes of adapting technological innovation. The IT infrastructure will be well developed and the digital management tools for local systems will be available and prepared for social participation in land management, including spatial planning. However, the problem will be the deepening dichotomy between technological development and social perceptions, and the willingness to accept and take advantage of the opportunities that digitization brings. Current low level of citizen-led development of local communities may be further undermined. In this respect, local elites, including the ruling elite, and their work to increase awareness of the benefits of digitization, will play a major role in this regard. This creates a group that will use information and digital tools to control processes of local development and spatial planning.

It is expected, that the social dualism described above, may have spatial implications and turn into territorial dualism, i.e. the benefits of digitization will make better use of better educated communities with greater potential to act whereas highly depopulated, remote rural areas, due to the weaking social potential, may « miss their chance ». Currently, communities located closer to the centers of growth, especially urban ones, are generally doing better in this respect. This spatial pattern will change, albeit quite slowly. Peripheral communes will also strive for broad social inclusion in the digitization process and broadening the stakeholder base in the field of fair spatial planning. Conscious of this process, the power elites and intellectual elites will be a factor breaking the peripherality, and digitization will be the key local game changer. Rural communes that achieve a sufficiently high level of development in this respect will enter the path of a balanced spatial policy. Communes that do not take advantage of these opportunities will plunge into planning chaos, especially in the field of social conflicts and the lack of skills to use digital tools to solve them.

The main issue in the future will be to accelerate the social process of adaptation to technological change by convincing local communities about the benefits of digitization in terms of understanding, controlling and changing spatial development and land management.

6.2.2 Re-record: Full participation but no digital toolbox

The spatial differentiation of rural areas in Poland is conditioned by many regionally shaped factors. On the one hand, these are purely economic conditions and express the dichotomy of predominantly urban and predominantly rural areas. On the other hand, the differences are the result of historical conditions, i.e. a better developed West and a less developed East, and cultural conditions as a heritage of regionalisms based on social features, i.e. an inherited willingness to be active and progressive or stagnation and learned helplessness.

It is expected that in the future the differences between individual rural areas will decrease, and one of the main factors responsible for this process will be the widespread implementation of digitization and its generally positive impact on many spheres of social and economic life. Identifying the basic trends in the field of digitization and its impact on land management and spatial planning processes is associated with breaking down demographic, social and psychological barriers.

In this still quite plausible future scenario, the rural population will be stable. The process of aging will slow down, mainly thanks to, inter alia, digital connectivity rural areas will become attractive places to live. Migrations of people from cities will also lead to the formation of new elites, open to technological innovations and aware of their role in the processes of social participation, including the one based on the digitization of the spatial planning process.

The IT infrastructure will be well developed and the digital management tools for local systems will be available and prepared for social co-management of processes, including spatial planning. The problem will be the technological change that will require constant adjustment not only in terms of society but also in terms of tools. Maintaining the IT base and tooling equipment will be very expensive, which will result in a very strong barrier to the further development of rural communes related to the availability of new technologies. Local communities increasingly aware of their role in the participation process will put increasing pressure on the development of digitization and social control over the management of municipalities. Local elites and their work to increase awareness of the benefits of digitization will play a major role in this regard. This creates a group that will use information and digital tools to control power in local development and spatial planning.

Rural space will be a diversified space, more and more distant from the spatial pattern based on the center-periphery dichotomy. Peripheral communes will also strive for broad social participation in the digitization process and broadening the stakeholder inclusion in the field of fair spatial planning. Aware of this process, the power elites and intellectual elites will be a factor breaking the peripherality, and digitization will be a key local game changer. Rural communes will form a spatial mosaic composed of various types of digital management.

The competitive advantage will be won by those local communities that are most open to innovations and changes and those that can afford this type of development, i.e. those that are able to capture spatially dispersed economic and social resources in their area.

6.3 Name and write the less detailed ‘best case’ and ‘worst case’ scenarios

6.3.1 Fast forward towards GeoDesign

In this, less plausible scenario (at least in the 2031 perspective), Poland is developing very quickly socially and economically. Interregional and intra-regional differences are constantly decreasing. Rural areas are an attractive place to live, which results in a shift of economic activity from urban centers to peripheral areas (counter-urbanization). The rural population is stable and is even increasing in some areas. In rural areas, new elites are being formed, consisting of active inhabitants, both indigenous and immigrant. Thanks to the great involvement of all stakeholders, the digitization of rural areas is growing. A participatory spatial management model, including spatial planning, is commonly used. Access to modern technologies and digital tools is universal. There is a full transparency of the spatial planning process. Local communities are eager to learn and look for new challenges. The growing awareness of the essence and importance of spatial planning in improving the quality of life leads to interest in GeoDesign projects, which increases digital skills and, consequently, leads to greater social cohesion and reduction of risks related to social conflicts over space.

6.3.2 Rewind to Analogue rural planning

In this, the least plausible future scenario, social and economic inequalities in Poland increase, and the internal and international political situation is unstable. The economic crisis is responsible for regional gaps between centres of development, i.e. urban areas and the peripheries, especially remote and predominantly rural areas. This leads to further depopulation of rural areas, their rapid aging and emigration of young and better educated people. Social passivity is on the rise, and elites are incapable of developing social capital. Under these conditions, local authorities cannot implement development strategies based on digitization. Applications and digital platforms are less accessible and little used. Lack of knowledge about digitization processes and the related civilization progress leads to a delay of rural areas in relation to better-developing cities. As a result, local communities are unable to control, evaluate and define spatial planning processes. This weakness is exploited by external players, such as investors, and rural space is a subject to intensive economic colonization and exploitation. Local communities, uninformed about threats and incapable of collective action, cannot defend themselves against often negative changes in their neigbourhoods. The result is a significant digital divide and the pauperization of rural areas.

7 Annex

Photographs from Scenario workshops:


Boosting the Potential for GeoDesign: Digitalisation of the System of Spatial Planning as a Trigger for Smart Rural Development
2018
2021
Zmiany w podstawowej funkcjonalności geoportali w gminach wiejskich województwa łódzkiego (niebieskie części diagramów oznaczają obecność danej usługi, szare części brak danej usługi).
„Europejski Fundusz Rolny na rzecz Rozwoju Obszarów Wiejskich: Europa inwestująca w obszary wiejskie”
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13.5 Latvia

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

DIGITAL MARKETING STRATEGY FOR BEEF CATTLE PRODUCTION SECTOR: LATVIA

15.12.2021

MIKELIS GRIVINS, EMILS KILIS, INGA BERZINA, RAIMONDS JAKOVICKIS

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SCENARIO WORKSHOPS REPORTING TEMPLATE

Project name	**DESIRA | Digitisation: Economic and Social Impacts in Rural Areas**
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H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Document
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Status	Report
Authors	Mikelis Grivins, Emils Kilis, Inga Berzina, Raimonds Jakovickis
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

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Introduction

1. Living lab summary

1.1 Name of LL

Digital marketing strategy for beef cattle production sector: Latvia

1.2 Brief summary of LL

The DESIRA living lab (LL) in Latvia aims to develop an innovative support system with the use of digital tools for the recognition and traceability of beef in order to improve and extend the market reach of Latvian cattle farmers. Specifically, the LL focused on a digital marketing strategy aimed at communicating the characteristics of Latvia's beef to consumers and farmers, and the reasons for the high price of high-quality beef.

The beef market in Latvia has numerous characteristics that make it an interesting case for a living lab approach. Although Latvian farmers can produce a substantial amount of organic beef, only a small number of consumers are ready to pay for high quality beef meat. Digital solutions could help beef farmers to communicate the positive social and limited environmental impact of cattle farming in Latvia and the high quality of beef produced by Latvia's farmers. Digital tools will aid in targeting consumers willing to pay extra for high quality meat: there is a niche market of consumers that are willing to pay for products of high quality with low environmental impact, but it appears to be difficult to reach this group using traditional forms of marketing.

The LL is coordinated by the Farmers' Parliament (ZSA), which is a non-governmental organization of agricultural producers in Latvia. The LL operates at the national level. The main actors are ZSA, Baltic Studies Centre (BSC) and a group of active organic beef producers from all over the country (Latvia). ZSA, with the support of BSC, decided to focus the work of the LL on using digital tools to promote the beef sector and establish a market for high quality ethically produced beef.

1.3 LL participants

The LL operates at the national level to establish a market for high quality responsibly produced beef meat. A list of participants was agreed upon during the initial meetings between ZSA and BSC. In order to achieve the desired outcomes, qualified and relevant stakeholders - experts were included in the network, including beef farmers, the Rural Advisory and Training Centre, Food and Veterinary service and Agricultural Data Centre experts, ZSA and BSC, and Local authority (The Latvian Association of Local and Regional Governments). Beef farmers were represented by the union "Beef breeders", Latvian Association of Beef Cattle Breeders, Animal Breeders' Association of Latvia, the cooperatives "Greenbeef.lv" and "Latvijas liellops", and the Beef Cattle Auction House.

1.4 Timing of Scenario Planning (WP3) workshops

Preparatory work was done in several online meetings in August 2021, with the seminar itself taking place on 24 August. The seminar was organised in Ērberģe, Latvia. All public health safety protocols were observed.

2 Scenario question

2.1 Draft scenario question

The finalised scenario question was developed prior to the workshop, based on a discussion about the various drivers of change that the participants could work with when developing their scenarios. Consequently, there was no specific draft scenario question, though there were variations of it developed during the discussion between BSC and ZSA. Rather, the final question emerged after the final list of drivers was selected.

2.2 Finalised Scenario question

The finalised scenario questions, which was presented to the participants was: *How to make use of the potential inherent in digital marketing for selling beef towards 2031?*

2.3 Methodology used to finalise scenario question

The finalised scenario question was devised within the core living lab group. The initial list of drivers of change, which was proposed by the research partner (BSC), was discussed in an online team meeting. The aim of the discussion was to make the scenario question sufficiently interesting to participants and encourage a lively exchange of ideas, while still keeping it relatively simple and clear.

2.4 Relevant feedback on scenario question from participants

The scenario question was used in the title of the seminar. Therefore, we can assume that the participants understood what kind of issues will be discussed in the workshop and that they agreed with the organisers of the workshop that the topic is important. However, some participants did stress that digital marketing is not a stand-alone activity – it is part of a system that consists of various digital and non-digital elements and considerations.

3 Relevant past events

3.1 List of relevant past events

Past events that are relevant to the sector include events that were organised within DESIRA as well as other projects.

Relevant DESIRA events include:

- On December 16, 2020, a discussion with beef cattle breeders was held. It included a discussion about digital solutions in the beef trade. From beef cattle breeders participated in the discussion: “Airene” Ltd, “Adams Farm” Ltd, “Kaldabruņa 2020” Ltd, Farm “Krikši”, “Rukši” Ltd, “Terūna” Ltd, “Tauri” Ltd and “Āboliņkalns” Ltd.
- On December 10, 2020, a conversation with beef cattle breeders on the online platform zoom was held. Topic: the needs of digital solutions in order to be able to offer beef to consumers more successfully. Participants from beef cattle breeders: “Airene” Ltd, “Adams Farm” Ltd, “Kaldabruņa 2020” Ltd, Farm “Jundas”.
- On October 22, 2020 a seminar for beef cattle breeders was held at Kandava Technical School on the possibility of selling quality beef in Latvia. A representative of the store chain "Sky" talked about sales opportunities. It is planned when the agreements with beef cattle weavers to supply meat to the Sky store chain will be concluded by the company Baltic Vianco. The seminar discussed various topical issues, such as nail care, nutrition and breeding.
- On September 23, 2020 Kaspars Ādams, the head of the company “Liellopu izsoļu nams” (Cattle Auction House), introduced the operation of the Auction House and how cattle are prepared for auctions, as well as how auctions take place, the owner showed barns with different breeds of cattle. There was an active activity in the auction house, the yard was full of cars with trailers, with which the owners had brought their cattle to the auction house, because the auction was planned the next day. At the same time, large 'cages' for transporting cattle to Europe.

Other events relevant to the sector

- Events organised as part of the initiative “Novada Garša” *(”The Taste of the County”*). The Novada Garša brand is a sustainable local food initiative that promotes the traceability and quality of food products of Latvian origin. Initiative aims to promote the best local producers, home producers and cooks. In general, over the years “Novada Garša” continues to bring various responsible institutions and the public to the same table in order to understand what is preventing greater availability of local food both in educational institutions and in shops. The COVID-19 pandemic and the attendant public safety measures have also impacted the sector quite drastically, leading to the growing popularity of home delivery services and online shops. While not all the entries in the list below were created is response to the pandemic, their prominence has increased as a result of it:
    - Cooperative “Greenbeef.lv” online shop https://greenbeef.lv/veikals/
    - Cooperative “Latvijas liellops” online shop https://galaspiegade.lv/product-category/liellopa-gala/
    - Company “Tirzas bullis”uses site https://tirzasbullis.lv/ for orders via *Whatsapp*
    - Company “Tauri” has developed an online shop https://negantigardi.lv/lv/product-category/galas-produkti/liellopa-gala-galas-produkti-bio/
    - Company “Kalēji” online shop https://siakaleji.lv/pakalpojumi/pasutit-galu/

- a Facebook page for beef breeders who sell meat online: https://www.facebook.com/latvijasliellops
- Farm "Kolumbi" Facebook page https://www.facebook.com/kolumbi.lv for orders using Whatsapp
- Other internet platforms: https://svaigi.lv/partika/gala-zivis/gala/liellopu-gala https://www.hereford.lv/

3.2 Description past event activity

Relevant past events were primarily chosen based on their importance vis-a-vis digital marketing in the food sector. Several of these were already widely known and primarily served the purpose of illustrating certain trends that were relevant for the scenario question. While some events were gatherings of people (both online and offline), others were highly significant turning points with wide-ranging societal impacts. It is important to note that events that failed to materialise (e.g., failure to start a joint online platform) were also discussed by participants - they were relevant precisely because the failures illustrated obstacles that would have to be overcome.

3.3 Relevant feedback from participants

No specific feedback.

4 Drivers of Change (DOC)

4.1 List initial set of DOC

See Table 1 below.

4.2 List selected DOC

See Table 1 below.

4.3 Describe methodology to select DOC

It was decided that the core living lab partners should agree on the final list of drivers before the workshop. This decision was based on the assumption (based on previous experience within the living lab) that trying to agree on the list of drivers with workshop participants might be time-consuming and potentially alienating, as enthusiasm for such activities is limited. This would make it much harder to reach the objectives of the workshop. Consequently, the DoC list was ready prior to the workshop. It was also agreed that if participants were to identify any other relevant DoCs, these could be added to the scenarios during the process.

The initial list of DoCs discussed by the living lab coordinators was much longer than the final list (see table 1). The decision to start with a higher number of DoCs was driven by the consideration that a discussion between researchers (BSC) and practitioners (ZSA) would yield a more coherent framework for developing a scenario. Using the recommended approach described in the methodology, the data gathered in the project and the practical insights of the partners, an initial set of drivers was developed. Initially, for each domain of STEEP a set of drivers was chosen. These drivers were then discussed among the project partners. This discussion aimed at supplementing the initial list with other potentially relevant drivers. This allowed creating a long-list of drivers affecting the high-quality beef sector.

4.4 Relevant feedback from participants

There was no feedback from the participants regarding the methodology. However, there was genuine interest from a couple of participants in the scenario method. On two occasions participants chose to use the break between sessions to approach organisers and ask questions regarding the benefits of the particular method.

5 Matrix

5.1 Matrix description

The drivers for developing future scenarios were selected before the seminar and this was done in multiple steps (see Section 4.3). The final list included in the matrix was developed following the methodological instruction that for each domain of STEEP one or two drivers should be identified.

Table 1. The selected drivers of change.

Domains	Initial list	Final list	Comments
S - Social	- Changes in food buying habits; - Diets fully or partially excluding products of animal origin; - Animal welfare; - New diets; - Digital skills; - Demographic changes (population size).	(1) New diets; (2) Animal welfare.	(1) Any changes will be much broader than just related to consumers' relations to meat. Most likely changes will affect values, relations to any new products, perspective on personal health, etc. (2) There are alternative sources of animal protein that are less affected by societal interest in animal welfare.
T - Technological	- Social media and social network web-based technology; - Connectivity; - Innovative digital solutions.	(3) Social media and social networks.	(3) Social networks are a subject of their own technological development. However, these networks are affected by habits of users and policies regulating them.

E - Environmental	- Extreme weather; - Prevalence of bovine diseases.	(4) Extreme weather; (5) Prevalence of bovine diseases.	(4) It is clear that there will be more cases of extreme weather. The scenario should question how exactly it will affect the sector. Additionally, it has to be taken into account that extreme weather will affect competing sectors as well. (5) Currently the sector is not suffering from bovine diseases. This makes this DoC more hypothetical.
E - Economic	- Solvency of the population; - Access to export markets; - Labour; - International competition.	(6) Solvency of the population.	(6) Even if the solvency of the population would remain as it is - it would still affect the sector. Also, there is a possibility, multiple trends could be observed simultaneously (some groups could become poorer while other - could become richer).
P - Political	- Support instruments targeting agriculture; - Support to new products/ alternative protein sources; - Environmental policies; - Support for local products.	(7) Support for environmentally friendly practices.	(7) The sector will be affected not just by absence or presence of support to environmentally friendly practices, but by the form these practices take as well.

5.2 Pathways/scenarios selected

For this workshop, it was decided that four scenarios would be optimal. Two of the scenario frameworks were developed before the workshop and two (the best case scenario and the worst case scenario) were developed during the workshop, based on the initial discussions. The other two scenarios were developed during the seminar, with the participants reimagining the scenario that they were working on. The table below outlines the first two scenario frameworks.

Table 2. Two scenarios developed during the workshop.

DoC	First scenario	Second scenario
(1) New diets	Consumption is much stronger linked to moral values. This has led to changes in dietary habits.	Consumers choose products based on their nutritional properties. This has facilitated the rise of functional food.
(2) Animal welfare	Animal welfare has become a significant social question. Enterprises working with animals and products of animal origin are under a constant pressure from consumers and agricultural policies to improve animal welfare.	Interest in animal welfare is dropping. This is a minor factor when products are chosen.
(3) Social media and social networks	Changes in policies related to personal data have made it difficult to advertise and sell products online. Costs of online marketing have significantly increased.	Social networks are becoming ever better equipped to the needs of small and medium enterprises.
(4) Extreme weather	The weather conditions are becoming ever more unpredictable and more unfavourable to farmers. However, there are new technological solutions that allow farmers with minimal losses to adapt to the new reality. Due to the unpredictable conditions the costs of products of plant origin are rising.	The weather conditions are becoming ever more unpredictable and more unfavourable to farmers. Farmers are not coping with the challenges created by weather conditions. However, these changes affect all agricultural sectors. Due to the unpredictable conditions the costs of products of plant origin are rising.
(5) Prevalence of bovine diseases	Beef cattle are not threatened by bovine diseases in Latvia.	New diseases, that so far were not considered dangerous to large carnivores, are spreading in beef cattles from around the world.
(6) Solvency of the population	Society maintains the same income level. Because of this price remains to be the central factor shaping consumers' choice.	Society's solvency increases. Population is willing to pay more for products with high added value.
(7) Support for environmentally friendly practices	State supports SMEs that operate in environmentally friendly ways. There are subsidies for areas managed with organic practices.	At the European level, taxes are raised on food produced with methods that are not produced using environmentally friendly methods. Subsidies are abolished.

5.3 Identify the 2 pathways that will be defined in more detail

The two scenarios developed prior to the workshop (see previous section) were defined in more detail by the participants.

5.4 Methodology used to identify pathways

The two scenario frameworks that were developed before the workshop were the result of collaborative work of researchers from Baltic Studies Centre and practitioners representing ZSA. It was decided that the workshop would be more productive if the statements for the two scenarios were developed before the workshop. However, to keep the participants as engaged as possible, it was agreed that participants can be encouraged to comment on the proposed scenarios, add extra statements to the scenarios or to change parts of the scenarios. It was also decided that the participants should be divided into two groups and each group should work with just one of the scenarios for the entire duration of the workshop to ensure continuity.

The statements for the scenario frameworks were developed in an iterative process. The initial list of statements was developed and shared with the team working on the scenarios. The team then discussed and refined the statements to be used in scenarios. The discussions also addressed the overall logic of the statements and how these statements could be linked into coherent scenarios. The goal of these discussions was to ensure that the statements and the way they were linked together would appear plausible, while also ensuring that none of the scenarios would automatically seem as significantly more desirable or more probable. Instead, in each scenario some welcome changes were accompanied by shifts that created new challenges to producers.

5.5 Relevant feedback from participants

The questions posed by workshop participants mainly related to the potential interlinkages between drivers and how feasible it is that the statements in the scenario frameworks could coexist in the same future. There were not many such critical remarks and none of them disrupted the seminar. However, they did provide interesting dynamics within the group. These doubts encouraged participants to offer each other possible explanations of how the states of affairs described in the statements could coexist.

6 Scenario Narratives

6.1 Name Scenarios

Two scenarios were given names by the participants. The first scenario was named *Vicious circle*, while the second one - *Penetrating niches*. The statements presented to the participants were discussed in relation to the opportunities they provide and the threats they pose, and the winners and losers that this generates. The framework for the scenarios is provided in the matrix above.

6.2 Detailed scenario narratives

6.2.1 Scenario one - Vicious circle

Opportunities. This scenario creates numerous opportunities, but participants noted that there is considerable uncertainty vis-à-vis the market for beef produced by Latvian farmers. In other words, the participants vacillated between Latvia as the main market and the export route. The choice of market was predicated upon a combination of different factors, some of which are described below, meaning that different development trajectories are possible, even in the same scenario.

As regards digital tools, the participants argued that opportunities will arise for new ways to communicate environmentally friendly farming practices to the public. For instance, producers could explore different ways of developing educational material. In the discussion, participants devoted considerable effort to discussing educational material that draws upon pop culture and well-known cultural references to create interest in potential viewers. An alternative would be a series of videos responding to questions that may appear foolish, so people are afraid to ask them out loud.

As regards digital advertising, the participants explored the idea of an advertising platform, which could compensate for the loss of Facebook and other social media networks as a space for marketing their goods. Ideally, this would develop into a full-fledged online sales platform where different producers could transparently sell their products, though this would require organisation and cooperation. An alternative proposal was a price comparison website for beef, but, again, the wide adoption of such a tool would be predicated upon producers embracing transparent business practices. Likewise, a number of logistical solutions would be required that allow producers to ship their product in small quantities. An example of this would be a parcel terminal with a built-in refrigerator to ensure that the product is safe for consumption, even if it is not picked up on the same day.

As regards content, producers of Latvian beef would have to find an angle that allowed them to present their product in an enticing way. Participants believed that framing Latvian meat as cheaper and produced in a more environmentally friendly manner (compared to, say, Argentinian beef) would be a viable strategy, though this would probably be a more appropriate approach in the case of export markets. The scenario also envisages that plant-based meat alternatives are still quite expensive, so emphasising the difference in prices will be important for beef producers. However, it is unclear whether local consumers would buy into the idea that Latvian beef is cheap. Overall, though, emphasising that the product is eco-friendly and affordable in response to growing public interest in this matter was a prominent theme in this scenario.

Obstacles. The main obstacle hampering the development of the beef sector in Latvia is a pervasive lack of trust. The public does not trust producers, so there is widespread scepticism as to the veracity of the claims being made about the meat and the farming practices. What is more, producers do not trust each other, which means that their ability to cooperate is severely compromised. As a result, individualistic solutions may be sought, but these are time- and resource-intensive. Participants noted that such mistrust will likely be partially justified, as there will indeed be dishonest farmers who conceal pertinent facts about their farming practices and the characteristics of the meat they sell.

The unwillingness to cooperate may hamper growth in several ways. Firstly, farmers would have to practise more individualistic marketing and distribution strategies. This would mean that they would likely remain tied to their region and could not produce enough meat for export needs. This would put producers in an awkward position. There is insufficient demand locally to encourage growth, but greater production capacity is necessary to satisfy external demand. The growing popularity of vegan and vegetarian diets can be a further obstacle to increasing local demand, especially as material touting the benefits of such diets becomes more prominent online.

Winners. The winners could be international society as a whole as competition between farmers leads to a greater volume of responsibly produced and high-quality beef at a reasonable price. Likewise, if Latvian farmers can cooperate and make use of digital tools, their businesses will grow and the sector as a whole will continue to develop.

Losers. The losers in this scenario would be individualistic farmers who gradually fall behind their colleagues who have managed to find ways to cooperate and benefit from the pooling of resources. However, increased cooperation would mean that combined production capacity would be sufficient to satisfy the requirements of international chains, so beef would likely become an important export product. This could potentially mean that the losers are local buyers who would have to pay prices comparable to what farmers can get from clients in richer EU countries. Likewise, beef producers in other countries would face stiffer competition as Latvian farmers would probably be able to offer the meat for a lower price.

6.2.2 Scenario two - Penetrating niches

Opportunities. Participants suggested that high-quality beef farmers would need to be proactive if they wanted to benefit from this future. The challenge of the future captured by the second scenario, as it was defined by farmers, is that there seems to be no natural market that high-quality farmers could benefit from. However, on the other hand, consumers are more interested in niche products in general and can pay for high-quality products. Also, the lower quality meat will become more expensive. So, the challenge facing the beef farmers is to find ways to convince consumers to pay for high-quality beef.

Participants identified several solutions that could help high-quality beef farmers benefit from the scenario. All these solutions are heavily interlinked. It was suggested that there would be a need for new products whose value can be easily communicated to consumers. This claim can be split into two separate lines of argumentation: claims regarding the product and claims regarding communication with customers. When it came to new products, farmers referenced products that had a longer shelf life (for example types of dried meat), lifestyle products (meat-based snacks for tourists), products with particular content (high level of iron or protein). **To develop these products, data is needed. Unfortunately, smaller farmers often lack access to data and lack the skills that could help them to understand the consumers.** Also, participants suggested that beef farmers should look for new collaborations with scientists and "*allow them to prove their worth*". Finally, participants also stressed that these new products should offer new experiences to consumers. **This was largely linked to new types of packaging and new materials added to the product – virtual stories, QR codes leading consumers to basic information about the piece of meat they have purchased, etc.** In other words – the need to sell new experiences could be used to reinvent the link between the consumer and the farmer.

The scenario would demand from farmers a well thought through strategy on how they communicate with consumers. Firstly, this is because the scenario implies that farmers will have to target selected lifestyle groups. Secondly, this would involve a mix of (i) private and public online communication as well as (ii) private consultations in-person. **The primary task of farmers will be to communicate the properties of their product and the ways it can be prepared. This will require a mix of digital tools – websites, instructions, posts in social media.** However, this will also demand a more personal approach. It was suggested that if one is selling an expensive product, there needs to be a personal touch which justifies the price. Participants seemed to be in agreement, that this would mean that there are at least some meetings with consumers in person. One of the suggestions was to establish a steak cooking club that would offer its participants guided experiments with high-quality beef. **The need for personalised communication also means that farmers would need to use digital tools in a way that creates a feeling of personalised communication (also, it was suggested that this would be important when selecting which instruments farmers can use).** However, it has to be mentioned that at least one participant recounted experiences when **long-time clients were clinging to their original communication model (using WhatsApp) despite more sophisticated instruments being available.** In her eyes, to the customers the WhatsApp group represented a more personal relationship, thus allowing these consumers to feel more special.

During the seminar, some out of the box solutions were proposed. **Participants suggested that QR codes could be printed on products and across their farms so people could easily link to audio explanations regarding the farm and create a connection between the product and a particular farm. It was also suggested that augmented reality could be used to transform farm visits into a game where, for example, different breed of beef cattle have to be collected.** Solutions related to augmented reality could also help farmers to link farming with rural tourism.

Much of the proposed communication envisioned the use of digital tools. However, as was admitted by some of the participants – their digital skills are not at a level that would allow them to communicate with consumers. Those of them who were trying to maintain communication on their own reported that it was time-consuming and caused stress. Participants agreed that if digital communication is chosen as a path by a farmer, then probably a specialist could be hired. However, there were some doubts as to whether a farmer could afford this on their own which led to the conclusion that farmers could cooperate to hire a person who could conduct these tasks.

Cooperation was one of the most commonly suggested opportunities. Cooperation could help to hire the specialist in charge of digital communication. However, it was also claimed that having a cooperative also meant that each partner would bring some skills. If one of the members is good with this, he or she might be excused from other tasks while taking responsibility for maintaining online communication. Participants agreed on the potential of cooperation but disagreed on how realistic it would be to create new cooperatives. However, they did agree that there was genuine interest among farmers in various cooperation forms.

Cooperatives could also help to resolve logistical issues. The biggest problem farmers face is that often they have to deliver small purchases to consumers living far away. Cooperation would allow organising logistics in a way that ensures that the farmers located closest to the consumer could deliver the purchased goods. **This would, however, require a system that would link all farmers in a system allowing farmers to link purchases with particular farms as well as to follow the amount of produce available in each farm.** This would also require farmers to agree upon joint product standards.

Obstacles. There were significantly fewer threats identified. Still, many of the identified challenges would require substantial work to overcome. Also, very few of them were linked to any digital solutions.

New diseases were mentioned by some participants. Participants discussed that any new diseases would be devastating to farmers. This is because most, if not all, high-quality beef farmers are organic farmers and thus cannot use antibiotics. This would substantially limit farmers' ability to fight diseases. Yet, on the other hand, if these farms are trying to convince consumers that they can pay more for high-quality beef, then they need to maintain farms open to visitors. From the perspective of disease contraction, this openness can be very dangerous.

The situation described by the scenario would also support conventional farms which means that cheaper products of lower quality would be easily available. Competition for consumers might drive meat prices down, thus counteracting the final driver of the scenario (conventional food is made more expensive via new taxes on food with substantial shadow prices).

Participants were also concerned by the ongoing population decline. Latvia’s market is already small and is not able to consume the products produced by its farmers. Consequently, trying to penetrate international markets might be the only option for farmers. Yet, selling a high-quality product abroad might be significantly more challenging. And there are a number of reasons for that – language barriers, logistics, global competition, losing some of the appeal of the product (abroad the product will not be local anymore), etc. This could be one of the most prominent threats of the future.

New diets were also considered a threat. If people will abandon the consumption of beef, this would mean that the sector would need to reorient to some completely different products. Participants were also afraid that interest in animal welfare would vanish. For many of them, animal welfare, integration in the local environment, and using highly diverse biologically certified pastures are the factors that account for the product’s quality. If, for example, society loses its interest in animal welfare, that would mean that these farms lose one of the factors that helps them justify the price they ask for their products.

Finally, participants expressed some fears regarding the increasing distance between consumers and producers. This is the reason why it might be hard to maintain a discussion between a farmer and a consumer. Yet it is important to maintain this conversation. This helps to get the information from consumers on what they need. However, it also helps farmers to ensure that consumers are willing to give them a second chance and talk with farmers if something goes wrong.

Winners. This scenario would be beneficial to those who are producing relatively inexpensive mass production. Also, consumers will feel that they are benefiting from the scenario. However, the extent of these benefits is debatable. They will certainly get access to relatively inexpensive food (and from the particular scenario, it seems that this is something consumers might be looking for). The downside of this is that the main initiative to push the more sustainable products into markets would be left on the shoulders of producers (who have only limited resources that can be allocated for any type of marketing).

Most likely large retail chains will benefit from the particular situation as well. Being the main outlet channel for relatively inexpensive food and owning many of the brands producing such food, these actors will benefit from this scenario in multiple ways.

For farmers to benefit from this scenario, they will have to cooperate – mainly to ensure more targeted communication with consumers and to support producers sharing similar visions of the food system. Food enthusiasts will most likely also benefit from this situation. Additionally, it could be that it might be easier in the particular scenario to initiate change.

Losers. Small farmers producing high-quality products will be among the losers in this scenario. Left on their own they will struggle to find some outlet markets and to convince farmers to pay more for the product they sell. This will force these farmers to intensify. Additionally, they would need to deal with animal diseases. Without public support and regular income farmers will not be able to address these challenges.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

The initial scenarios were characterised by considerable uncertainty, and participants imagined that multiple conflicting and countervailing trends would operate simultaneously. Ultimately, therefore, the best case scenario would be the one with the fewest losers, while the worst case scenario would create the fewest winners.

Best case. Farmers make use of digital tools, start believing in themselves and are able to cooperate. This makes digital tools affordable, as the farmers can split the bill. Their joint efforts lead to transparent business practices and high-quality educational material that allows them to successfully market their product. While vegan and vegetarian diets become more popular, the Latvian consumer is better informed about beef, farming and life in the countryside, so s/he is willing to pay a higher price for locally sourced meat, which stimulates local demand. This is further strengthened by the relatively high prices of plant-based meat substitutes. Courier and package delivery services invest in new parcel terminals that make shipping perishable products easier, which contributes to the growth of direct sales. via online shops. Farmers invest in breeding stock. The growth in local demand allows the sector to grow and produce enough beef for export. However, their costs remain comparatively low so their product is competitive in export markets, while simultaneously being attainable for local buyers.

Worst case. While farmers still make use of digital tools, they find it difficult to cooperate, meaning that marketing and logistical solutions remain expensive, keeping costs up. Furthermore, a lack of skills makes the use of digital tools a time-consuming task. This makes competition with plant-based meat alternatives difficult as animal rights are becoming increasingly important to consumers and beef producers do not have an edge in terms of price, and more and more people start consuming meat alternatives. What is more, production volumes are low so farmers are unable to export their product, selling their product to a niche market of consumers locally.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.6 Germany (Lake Constance)

Scenario workshops

Lake of Constance, Germany

Kirsten Gaber, Dr. Christine Rösch

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Table of Contents

1. Living lab summary

1.1 Name of LL

Lake Constance Region, Germany

1.2 Brief summary of LL

Fruit production in the Lake Constance Region is facing several socio-economic and environmental challenges. As Germany's 2nd largest fruit producer[4], characterised by small- to medium-sized family farms, this region is not only crucial for European fruit supply but is also a popular tourist destination and lies on Germany's largest drinking water reservoir[5]. Current environmental challenges such as increasing weather extremes through climate change, decreasing active ingredients in plant protection products (PPPs), and declining biodiversity are pressuring the farmers to adapt their current practices. Similarly, socio-economic challenges, including a reliance on seasonal workers, changing consumer preferences, and competitive market prices, further pressure the fruit farmers. Digitalisation is considered to become increasingly important in future fruit production. Among others, autonomously driving tractors, spraying drones, or fruit harvesting robots are currently being tested. However, the digital tools available for fruit production lack essential factors, such as clear data security leading to mistrust and a lack of uptake from the intended users. It is currently unclear how stakeholders in the regional fruit supply chain perceive digital technologies and how they could impact the challenges described.

1.3 LL participants

Different stakeholders were identified along the value chain for fruit production in the Lake Constance Region. These stakeholders were clustered into six groups:

(1) Fruit farmers (Integrated Production and organic production systems);

(2) Advisors for fruit cultivation and the application of plant protection products (PPP);

(3) NGOs and GOs responsible for nature protection, agricultural and consumers interests;

(4) Researchers in the field of agriculture and digitalisation;

(5) Fruit wholesalers or marketers; and

(6) Developers of agricultural machinery and digital innovations.

A total of 34 stakeholders from these six groups were identified. The criteria for selecting the stakeholders for the scenario planning workshop included an interest or stake in the digitalisation

[4] Obst vom Bodensee Vertriebsgesellschaft mbH. "Pome," 2015. https://www.obst-vom-bodensee.de/index.php?pome.
[5] https://www.bodensee-wasserversorgung.de/startseite.html

along the fruit production value chain in the Lake Constance region. Table 1 displays the gender characteristics of the participants in the workshop (n=9) and their allocation to the different stakeholder groups.

Table 1: Participating stakeholder characteristics

	Number of participants from this group	
	male	female
Advisors for Fruit Cultivation and the Application of PPP	2	0
Researchers in Agriculture and Digtalisation	2	2
Representatives of Nature Protection and Agriculture NGOs/GOs, Consumer Groups	1	0
Developers of Agricultural Machinery and Digital Innovation	1	0
Fruit Farmer	0	1

1.4 Timing of Scenario Planning (WP3) workshops

The timing of the Scenario Planning workshops was suggested to run between August and October of 2021. However, this period is the peak harvest time for fruit production in the Lake Constance region. Based on consultation with experts within the LL and from our own experience from the last LL activities, conducting a workshop with enough heterogeneous stakeholders would not be possible during this time frame. Therefore, it was agreed to conduct the workshop after the harvest period in mid-November. It was decided to conduct one workshop rather than two to avoid the risk that participants would only invest time for one workshop and not come back for a second workshop at a later stage. The response to our invitations showed that there was very little interest in participating. The reason for this was that the topic of the workshop was too academic for most participants. Nevertheless, we managed to get sufficient participants to run the scenario workshop successfully, even among participants with already busy schedules.

Due to Germany's ongoing COVID-19 pandemic situation, it was decided to hold the workshop virtually via Zoom. The workshop was held on November 22nd. Even with this ‘late’ date, many contacted participants could not participate due to other commitments. Approximately 35 stakeholders and experts were contacted via email and telephone, and in the end, 9 participants took part in the workshop.

2 Scenario question

2.2 Draft scenario question

How will sustainable, digitalised fruit production be in 2031?

2.3 Finalised Scenario question

How can digitalisation contribute to sustainable fruit production in 2031?

2.4 Methodology used to finalise scenario question

The final scenario question was derived from the focal question of our LL: "How can digitalisation contribute to the sustainability of fruit production in the Lake Constance Region?" From the viewpoint of the stakeholders, fruit production is not considered or described as being digitalised, either in the present focal question or for a future scenario. In order to reflect this view appropriately, the question was altered to be rather about how digitalisation as a technical transition can contribute to sustainable fruit production. This is because digitalisation in this agricultural sector is still under development and it is not certain that fruit production in the region will become digitalised, nor if digitalisation will be beneficial for fruit production. Therefore, we phrased the scenario question carefully to keep digitalisation and fruit production separate and show that digitalisation is a technical transition expected to lead to improved sustainability in this agricultural and fruit sector. The LL coordinators decided on this final scenario question, and then the Hutton team agreed upon it before the workshop took place.

3 Relevant past events

3.2 List of relevant past events

- Stakeholder identification and clustering
- Stakeholder contact and invitation to participate
- F2f or digital (via Zoom) interviews of selected relevant stakeholder
- Interview participant contact for online survey
- Conducting the online survey
- Participant contact for scenario workshop

3.3 Description past event activity

The past activity for WP2 was intended as a workshop, but due to the COVID-19 Pandemic and the timing of the workshop, it was decided to instead conduct individual interviews with an interview guideline created to collect the relevant information. This was a successful adaptation to the task, and 28 interviews were conducted between August and November 2020 for the WP2 NEI activity. These interviews were conducted either f2f or virtually, dependent upon the personal preference of the interviewed stakeholder. Each interview was around 1 hour long and recorded with consent. A slight preference was given to the virtual interview option: 15 of the 28 participants engaged virtually, while 13 participants preferred to conduct the interviews f2f.

3.4 Relevant feedback from participants

Concerns over data security regarding the interview methods and the DESIRA project website were mentioned by one particular participant, who described himself as militantly against digitalisation. It was crucial to consider his perspective, as most other stakeholders were neutral or proponents of digitalisation. This participant recognized that the DESIRA website was, at the time, not data secure and also preferred not to take part in the WP2 online survey (due to the insecure platform used) as well as an in-person interview with an anonymised recording of the interview. All of his technical concerns were forwarded to the DESIRA technical team. As a result, the website security has been subsequently improved.

The overall impression from the interview series was that the participants were either neutral towards digitalisation, positive but unsure of specifics, or active proponents of the digitalisation of fruit production. Most stakeholders seemed to have more of an opinion on the environmental impact from digitalisation than the societal, as the latter was not always as easy to connect to digitalisation. We believe this is partly due to the marketing of digital tools, which are almost always associated with efficiency and therefore cost-efficiency and environmental savings. However, the ideas of societal impact, such as job reduction through automatization, feel a bit further away, as the development of fully-automized technologies for fruit production is much further behind other technical developments. Another major take-away related to social challenges was that most stakeholders felt a huge disconnect between consumers and food production. It was often mentioned that consumers are currently so unaware of what happens to their food. It is considered unlikely that digitalisation would positively influence the current public opinion of fruit production in the region.

4 Drivers Of Change (DOC)

4.2 List initial set of DOC

(1) Society: individual behaviour of farmers (trust, acceptance, usage of tools)

(2) Technology: limitations of technology based on farm size (e.g. many small parcels of farms, cost-benefit challenge higher for small farms)

(3) Economic: job satisfaction and appeal

(4) Environment: biodiversity

(5) Policy: subsidies for digital tools

4.3 List selected DOC

The initial DOC set (above) was approved by the participants during the workshop to be the final DOC set.

4.4 Describe methodology to select DOC

Each DOC was chosen from the results of the interview series conducted last year for the WP2 activity. Specifically, the most frequently mentioned challenges or topics related to our focal question were collected into a STEEP/Drivers of Change table (Table 2). This was possible due to the qualitative method of assessing the interview results, specifically Qualitative Content Analysis (Mayring 2000) using MaxQDA software, in which the responses from the following interview questions were coded and analysed:

What are the main environmental challenges of fruit growing in the Lake Constance region?

- *Do they differ from those of organic fruit growing?*
- *Are there differences according to farm size?*

What are the main socio-economic and social challenges of fruit growing in the Lake Constance region?

- *Do they differ from those of organic fruit growing?*
- *Are there differences according to farm size?*

Do you think that digitalization can help to overcome the environmental challenges described previously? (if yes, which ones and how)

Do you think that digitalization can help to overcome the socio-economic and social challenges described previously? (if yes, which ones and how)

Using the STEEP methodology as a guiding checklist, the most often named socio-economic and environmental challenges with fruit production and digitalisation in the region were sorted according to STEEP category into the draft STEEP/DOC table. Together, we as living lab coordinators decided the green boxes are the best fitting DOCs for our scenario question and also the drivers that could be the most elaborated into different assumptions.

Table 2: Drivers of Change draft list for our Living Lab

STEEP	**Drivers of Change**				
Society	individual behaviour of farmers (trust, acceptance, usage of tools)	social acceptance of farming and different farming systems			
Technology	digital infrastructure	digital tools available in fruit production	cost of tools	data security	limitations of technology based on farm size

Economic	seasonal workers	Business succession	job satisfaction and appeal	market competition	
Environment	weather extremes	biodiversity	climate change	use of PPP	
Policy	rules and laws governing the use of digital tools	subsidies for digital tools	CAP		

A morphological box was drafted based on the DOCs and sent to an agricultural transition and sustainability expert, PD Dr Rolf Meyer. He worked with us to improve our assumptions and phrasing of the DOCs. With his feedback, we created the final morphological box for our workshop (see **Errore. L'origine riferimento non è stata trovata.** in the Annex). A German version of the box was developed to provide German-language scenarios for the participants.

4.5 Relevant feedback from participants

Participants did not provide feedback on the methodology of the DOC. Feedback was provided to each assumption of the scenarios, which is described in section 6.4.

5 Matrix

5.2 Matrix description

We created three assumptions per DOC (see Table 1): Assumption 1 was worse but not worst, Assumption 2 was "business as usual" (BAU), and Assumption 3 was better but not best. As the DOCs were created based on responses from stakeholders during the WP2 interview series for this LL, so were the assumptions. For instance, many stakeholders find biodiversity protection to be a significant challenge in the Lake Constance Region regarding fruit production. The detailed responses they provided during the interviews provided information for the BAU assumption, and the LL coordinators then adapted assumptions 1 and 3.

5.3 Define 4 pathways/scenarios selected

Scenario 1: positive socio-tech, negative environmental trade-off

> Society: Assumption 3: Digital technologies are part of education and widely available. The benefits associated with them are known and accepted. Their use has increased significantly. Data security and sovereignty are regulated, and users are not disadvantaged.

Technology: Assumption 2: For businesses in the rather small-structured Lake Constance region, the application of digital technologies is problematic due to the unfavourable cost-benefit ratio. Their use is slowly increasing but is still limited.

Economic: Assumption 3: The use of low-cost digital technologies reduces the need for labour. Fruit production in family farms and farm succession become more attractive for young people. This has a positive effect on the preservation of small family farms.

Environment: Assumption 1: Biodiversity continues to decline due to the concentration on a few varieties, more high-tech cultivation and an increase in interventions, such as using inputs to protect production from climate-related weather effects.

Policy: Assumption 3: Different digital technologies and fields of application are promoted through user-friendly and straightforward application procedures. Small family farms also benefit from this.

Scenario 2: positive environmental side, negative socio-economic

Society: Assumption 1: The acceptance of digital tools is low. Users do not trust the security and sovereignty of data but are partly forced to digitise by the market.

Technology: Assumption 2: For businesses in the rather small-structured Lake Constance region, the use of digital technologies is difficult due to the unfavourable cost-benefit ratio. Their use is slowly increasing but is still limited.

Economic: Assumption 1: The seasonal demand for labour in fruit production remains high, and it is becoming increasingly difficult to find workers. Due to the increased workload, farm successions are uncertain, and larger enterprises are taking over small farms. The number of family farms is declining.

Environment: Assumption 3: The increased use of digital technologies for precise crop protection control and application of inputs allows for broader diversification, a reduction in the application of crop protection products and greater biodiversity.

Policy: Assumption 1: There is little government financial support for developing and using digital technologies. Their use is economically preconditional and only possible to some extent or not at all on small farms.

Scenario 3: mostly BAU despite positive tech assumption, however a negative environmental change

Society: Assumption 2: The use of digital technologies is heterogeneous. Knowledge transfer is not part of the training. Individual acquisition of expertise is expensive and time-consuming. "Laggards" in the use of digital technologies, e.g. in communication along the supply chain, cannot keep up with the market's demands and are left behind.

Technology: Assumption 3: The needs of small businesses are taken into account in the development of digital technologies. Farm size is not a limiting factor in the use of digital technologies. Farms can choose from a wide range of offers with different functions and prices. Many farms can benefit from digitalisation.

Economic: Assumption 2: Temporary labour demand remains high, but recruitment is feasible. Interested farm successors are uncertain about the financial perspective. Larger farms take over small farms without successors. The number of family farms is declining slightly.

Environment: Assumption 1: Biodiversity continues to decline due to the concentration on a few varieties, more high-tech cultivation and an increase in interventions, such as using inputs to protect production from climate-related weather effects.

Policy: Assumption 2: The promoted use of digital technologies is unevenly distributed among farms. The application for subsidies is complicated and time-consuming. They are not recognised in the context of national funding programmes aimed at, e.g. biodiversity or climate change.

Scenario 4: negative tech and economic assumptions despite positive policy change

Society: Assumption 2: The use of digital technologies is heterogeneous. Knowledge transfer is not part of the training. Individual acquisition of expertise is expensive and time-consuming. "Laggards" in the use of digital technologies, e.g. in communication along the supply chain, cannot keep up with the market's demands and are left behind.

Technology: Assumption 1: Digital technologies are not geared to the needs of small and medium-sized enterprises. They can hardly afford the expensive technologies, which are presumptive in terms of application. The cost-benefit ratio makes their use possible only in larger enterprises or in the case of inter-firm use.

Economic: Assumption 1: The seasonal demand for labour in fruit production remains high and it is becoming increasingly difficult to find workers. Due to the increased workload, farm successions are uncertain, and larger enterprises are taking over small farms. The number of family farms is declining.

Environment: Assumption 2: Due to societal demands, biodiversity concerns in fruit production facilities are being given more significant consideration. Biodiversity is neither endangered nor promoted by digitalisation.

Policy: Assumption 3: Different digital technologies and fields of application are promoted through user-friendly and straightforward application procedures. Small family farms also benefit from this.

5.4 Identify the 2 pathways that will be defined in more detail

Scenarios 1 and 2 were chosen to be worked on in the workshop. We find these the most feasible scenarios and highlight the challenges or fears most identified by stakeholders. Specifically, scenario 1 entails overall positive changes in society and the economy, while the environment experiences a negative change. This is feasible if the development of digital tools does not prioritize environmental sustainability issues such as increased biodiversity, and instead focuses on economic gain and therefore targets larger farms, leaving behind the smaller farms which tend to have higher biodiversity and plant variability. Scenario 2, on the other hand, envisions negative societal, economic and policy changes while experiencing a positive environmental change. This is feasible if policies are not created to support the purchasing of digital technologies in this agricultural sector. If training is not supported, however, the environmental benefits of digitalisation are recognized within the sector and used to create a positive change.

5.5 Methodology used to identify pathways

The four scenarios were chosen to have the most heterogeneity possible among the assumptions as well as between the scenarios. However, it was important to consider the feasibility of each arrangement of assumptions. For instance, in scenario 1, a negative societal assumption is present: low acceptance of digital tools, lack of trust, and partial forcing to digitalise. We could have randomly chosen a combination to keep the rest of the assumptions heterogeneous, but some assumptions would not make sense with this negative societal assumption. For example, an optimistic economic assumption (use of digital technologies reduces the need for labour) would not make sense in a scenario with the negative societal assumption. That being said, scenario 1 includes an optimistic environmental assumption requiring digital technologies, despite the negative societal assumption of low acceptance. In this case, we consider the other crucial part of the negative societal assumption: users are partially forced to digitalise by the market. Only in this sense can we consider the optimistic environmental assumption together in scenario 1. This is important to consider because most positive assumptions require the acceptance and use of digital technologies, but some assumptions match better together than others. Our method was to randomize the three assumptions per driver of change as best as possible but ensure that the assumptions were logical when put into a scenario.

5.6 Relevant feedback from participants

Participants did not provide feedback on the matrix methodology.

6 Scenario Narratives

6.2 Name Scenarios

Scenario 1 was most often referred to as Scenario 1 during the workshop for ease. Using PowerPoint slides (see Figure 1 and Figure 2), we explained that this scenario is mainly made of better, not best, assumptions. Internally, we referred to this scenario as the positive socio-economic, negative environmental trade-off scenario. Similarly, Scenario 2 was referred to as 'scenario 2' during the workshop. Scenario 2 was mostly made of worse but not worst assumptions, and referred to internally as the positive environmental, negative socio-economic trade-off scenario.

Figure 1: Powerpoint slide describing the differences in the assumptions

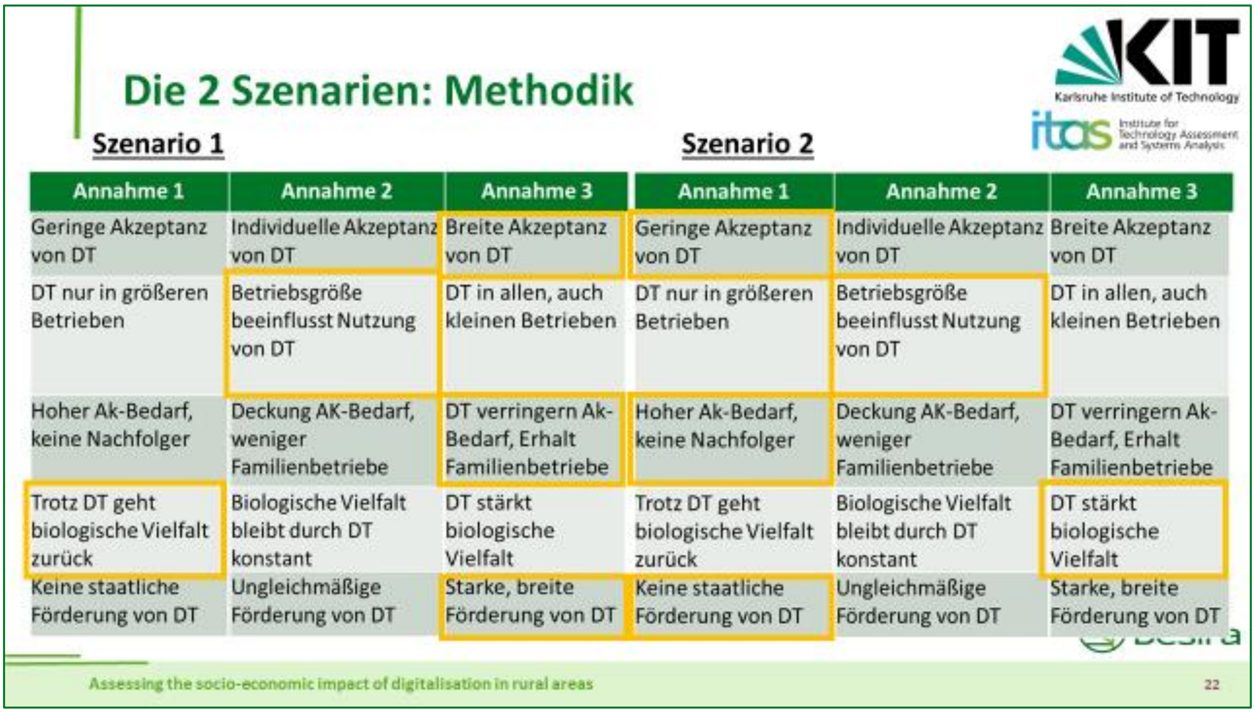

Figure 2: Powerpoint slide describing the heterogeneous yet plausible constellation of assumptions per scenario

6.3 Workshop Warm-Up

To warm-up for the scenario workshop, we used Mentimeter to ask participants two icebreaker questions:

(1) What comes to your mind spontaneously regarding the topic digital fruit farming?

The responses to this question are as follows and can be found in Figure 3 in the annex:

- island solutions; sensors; quality; technology; gps; apps; automation; future; farm management information systems; efficiency; machine thinning; technical challenge; transparency; arable land index; data networking

(2) How could digital fruit production look in the future?

The responses to this question are as follows and can be found in Figure 4 in the annex:

- without manual workers; specific applications; more technology; problems with digital infrastructure; protected; automated; market competitive; more effort for organization; fewer seasonal workers; pesticide-free; automation; higher mechanised; the future of Germany

6.4 Write the 2 or 3 detailed scenario narratives

6.4.1 Scenario 1

In scenario 1, the positive socio-technical but negative environmental trade-off scenario, it is assumed that digital technologies are part of education and are widely available. The benefits associated with these digital technologies are known by society and accepted. The use of these technologies has increased significantly from 10 years ago. Data security and sovereignty are regulated, and users are not disadvantaged through this. The general perception among stakeholders was high uncertainty of these assumptions since practice shows a different picture, being that we are currently quite far from the technologies functioning on-farm. Stakeholders agreed that technologies do not work at present, and if they do, often not 100% of the time, and therefore a lot must change in the next ten years to see any increase in the use of digital tools in the area. One specific recommendation was that politicians must move ahead to create structures that allow for a positive digitalised experience. This could have already been implemented years ago, which is why some stakeholders believe Germany is lagging behind other countries in digital agriculture. If the structure is created, other drivers will get on board. Stakeholders were indecisive about the responsible party for data security: some argued that the government must develop political guidelines for data security. Others argued that only private companies have ensured data security thus far and will continue to be responsible for this challenge. It is uncertain how this factor should progress towards this assumption in the next ten years. In the backcasting exercise, stakeholders agreed that training on the use of digital technologies and improved data security are absolute must-haves leading up to 2031. A stakeholder mentioned that another critical point towards adequate training are the teachers: if they do not believe in digitalization or are not digital-natives themselves, they will not be motivated or competent to teach this topic.

Regarding the technology, it is assumed that for businesses like those in the small-structured Lake Constance Region, digital technologies are problematic due to the unfavourable cost-benefit ratio. Therefore, the use of these tools is slowly increasing but is still limited. Due to this assumption, stakeholders found that the farmers are both winners and losers in this scenario. Stakeholders generally agreed that the winning and losing depends on how much freedom the farmers are given to introduce the digitalised solutions, specifically if they are forced to do so by society or if they choose to adopt for proven and understood economic gain. A representative from an NGO mentioned that those farmers who will use the technologies are the winners because they can save a lot of documentation effort. On the other side, the farmer is also a loser because everything they do becomes more transparent and more punishable by an agricultural regulatory office. In the Lake Constance Region, the cultural landscape challenges the already complicated topic of digitalised fruit production as frequent and numerous agro-tourists could interfere with autonomous technologies. Autonomous robots must be fenced-in at present due to the legal framework, but tourists are irritated by the reduction of the landscape they have access to. Stakeholders found that an unpredictable part of this assumption is the digital infrastructure needed for any farmer to use the tools. Politicians need to be made aware, and consequently act upon the numerous broadband gaps in the region. The digital tools require adequate data transmission, so this is seen as a critical first step towards any sort of acceptance rate increase. A researcher argued that progress in this challenge could also be made through private commitment and not rely only on politicians to respond. Citizens groups or private people could be engaged to act on this challenge, and it could therefore be repaired faster than through a political route. In the backcasting exercise, a stakeholder mentioned that orchards must be designed now to have rows that machines can operate in to accommodate the developing technologies.

In this scenario, low-cost digital technologies reduce the need for labour. Fruit production in family farms and farm succession has become more attractive for young people, which positively affects the preservation of small family farms. Some stakeholders doubted this assumption, such as the NGO representative, because he felt that the price of a digitalised machinery for harvest would cost the same as his fleet of seasonal workers. Still, if the machine were to break down, he would be without workers at all. Stakeholders see this assumption also mean a change in the job description of a fruit farmer: theoretically, in this assumption, less time is needed for fieldwork, and more time is spent with technology, the computer or data handling. This has positive and negative effects. The NGO representative knows farmers to be active people who would not enjoy sitting at home and watching their tractor drive. However, stakeholders also found this assumption to be optimistic regarding the intense harvesting seasons and current challenges to acquiring seasonal workers due to the global pandemic. Reliable seasonal workers are an issue for farmers even without a pandemic; stakeholders mention that they know of farmers who deal with destructive and untrustworthy seasonal workers each year.

On the other hand, this scenario assumes that biodiversity continues to decline due to the concentration on a few varieties, more high-tech cultivation and an increase in interventions, such as applying inputs to protect production from climate-related weather effects. Stakeholders agreed that this assumption is possible, for instance, when the current situation with mandatory fencing for autonomous robots continues into 2031. Therefore, less movement for wildlife between farms is possible. For the ease of autonomous tools, it could be that parcels of land become bigger to reduce the required amount of fences and barriers between different small orchards, but this is not beneficial for biodiversity either as it promotes large uniformly managed orchards. Small areas with fringe structures and hedges increase biodiversity. Stakeholders hoped for an environmental situation in which the spot farming concept from precision farming allows for a greater variety of plants in a given area, which would increase biodiversity. Some stakeholders, however, found this assumption to be unrealistic for 2031, given the new Biodiversity Strengthening Act from the German government, in which agriculture must work towards increased biodiversity. Another stakeholder recalled hearing from a farmer that it is unclear whether autonomous vehicles can currently be used for plant protection applications in Germany. The political regulations must be clear and well communicated to the public.

Finally, regarding the political assumption in this scenario, different digital technologies and fields of application are promoted through user-friendly and straightforward application procedures. Small family farms also benefit from this. Stakeholders commented on the high prices of the available technologies and considered this assumption to benefit society. A researcher suggested that digitalized technologies enable easier sharing of the tools between farmers, which would reduce the investment cost per farmer because they automatically log when, where, and how much work was conducted. Another researcher suggested that this sharing would require more organisation among farmers, which could be an opportunity or a barrier.

6.4.2 Scenario 2

In scenario 2, the positive environmental but negative socio-economic scenario, it is assumed that the acceptance of digital tools is low. Users do not trust the security and sovereignty of data but are partly forced to digitise by the market. The technology developer agreed that an enormous challenge, even today, is the willingness of the farmers and employees to accept the potential of digitalisation. This could very likely still be an issue in 2031. One stakeholder perceived that this assumption does not address the consumer acceptance of digital technologies, which is also a critical part of the overall acceptance and use of digital technologies. He feared the use of robots in fruit farming could lead to even less acceptance of conventional fruit growing if consumers are against digital technologies. To change this negative assumption with low acceptance, an advisor and the technology developer encouraged ‘pioneer farms’ to demonstrate the tools to their peers and colleagues. This should occur sooner rather than later over the next ten years to promote acceptance, but should also be done continuously as new technologies emerge. Education and training on digital technologies should be mainstream in the coming years. Generally, the stakeholders believe that digital technologies will be more present in 2031 than in the described scenario, however, not always through increased trust or acceptance, but perhaps through force.

This scenario assumes that the use of digital technologies is difficult for businesses in the rather small-structured Lake Constance region due to the unfavourable cost-benefit ratio. Their use is slowly increasing but is still limited. The stakeholders recognized that small businesses are the losers in this scenario. However, an advisor was critical of this point. He mentioned that he believes the current development of technologies will create a situation in 2031 where even small- and medium-sized farms will be able to afford the technologies. The farmer added a critical point to this assumption: the digital technologies must consider the legal ramifications of the region and landscape and adequately explain these to users. Specifically, the farmer was concerned about adding fences to her orchard to keep autonomous technologies in and unwanted on-lookers or dogs out. This is an extra effort and investment cost that she would have to consider. This point is relevant for all farmers but particularly relevant in the LakeConstance Region, where agro-tourism is favourable and the orchards are relatively small and separated by small streets or other physical barriers. An advisor agreed on the issue of unclear legal terms for robots in agriculture: he was convinced that other countries are farther along with the development and legalisation of autonomous driving technologies than Germany. The technology developer also agreed that this is an ongoing uncertainty that should be solved by 2031-

the use of unmanned technology means that the machines need a directive, frequent updates, and all questions around the user's liability must be answered.

The technology developer mentioned that some technologies could perform multiple activities, offering a more significant cost-benefit than technologies that can only perform one task. However, these technologies do not yet exist for horticulture. He generally considered very few applications for robots in fruit growing thus far and is uncertain of how this assumption will look in 2031. The stakeholders mentioned the digital infrastructure as an uncertainty in this scenario but agreed that this infrastructure is critical for the region's actual use of digital technologies.

Regarding the economic assumption, this scenario assumes that the seasonal demand for labour in fruit production remains high, and it is becoming increasingly difficult to find workers. Due to the increased workload, farm successions are uncertain, and larger enterprises take over small farms. The number of family farms is declining. The farmer mentioned that as long as she can sell her products at the weekly market, the situation is still manageable. Still, if weekly markets are no longer existing due to a decline in family farms, she would have to sell her products through the wholesale market, and it would be hard for her to make a profit. An advisor mentioned that the issue with seasonal workers is not new, and all farmers face this problem. Therefore, he cannot imagine that digital technologies will be present in fruit farming in the future, simply because this is the way to solve the issue of seasonal farmers. The farmer sees an opportunity in this assumption to improve employee satisfaction and relieve the burden on the farming family. Stakeholders mentioned that if digital technologies are a standard part of fruit farming, it will be challenging to find suitable employees who are trained well to use the technologies profitably. These employees may also require higher wages than other seasonal workers due to their higher qualifications. Otherwise, the technologies must be developed in a user-friendly way that anyone can handle the technology, with or without special training.

Regarding the environment, it is assumed that the increased use of digital technologies for precise crop protection control and application of inputs allows for broader diversification, a reduction in the application of crop protection products and greater biodiversity. Due to this assumption, stakeholders largely agreed that the winner of this scenario is the end-consumer because the product would become cheaper through more efficient on-farm practices. Furthermore, the end consumer can purchase products with fewer chemicals, which is a definite benefit for society. However, an advisor argued that this assumption could not be interlinked with an increase in biodiversity simply through of digital technologies. He believes that biodiversity is influenced by many other factors and is, therefore, more complex than just its relation to digital technologies. Stakeholders like this assumption within the scenario and are hopeful that this becomes a reality but are unsure generally of the exact path to reach this assumption. During the backcasting exercise, an advisor mentioned that for this assumption to be realised in 2031, mechanical tillage should be regulated by robots or autonomous technologies. Current political demands to reduce herbicide application in orchards are working towards this reality.

Finally, this scenario assumes that there is little government financial support for developing and using digital technologies. Their use is economically preconditional and only possible to some extent or not at all on small farms. The stakeholders did not respond in great detail to this assumption. However, stakeholders mentioned that the winners are large companies who work efficiently with large areas and can therefore invest more money into digital solutions. A researcher agreed with this. When performing the backcasting exercise, an advisor mentioned that the investment cost is the most significant obstacle for using and accepting digital tools in agriculture. He noted that it is possible that the prices themselves are not too high but that the farmers believe they are and therefore do not wish to acquire the technologies.

6.4.3 Scenario Fine-Tuning

We also used Mentimeter to conduct the fine-tuning of the scenarios. We asked participants: what must be adjusted in scenario 1? What must be adjusted in scenario 2? The results are as follows and can be found in Figure 5 and Figure 6 in the Annex:

(1) Scenario 1

- Create legal framework conditions
- Digital technologies also enable the cultivation of other varieties and only promote high-tech cultivation.
- Legal framework for data protection, use of autonomous vehicles in orchards, spot farming in fruit growing is favoured by digital technologies and improves biodiversity. promotion only as a transitional solution

(2) Scenario 2

- smaller businesses can also be expected to benefit from digital technologies, as apps and drone applications promise cost-effective and powerful support
- Due to rising minimum wages and increasing bureaucratisation, many companies will cease production.
- data protection will be clearly regulated in 2031 and scepticism will hopefully be reduced.
- if higher turnover can be achieved through higher biodiversity, because customers appreciate the natural, the scenario is ok after all

6.5 Name and write the less detailed ‘best case’ and ‘worst case’ scenarios

The stakeholders assessed two extreme scenarios: dystopia and utopia. To evaluate the scenarios in a timely manner, we explained the scenarios in plenary and asked for their feedback. Additionally, we asked them to explain which assumptions they found the most plausible and which they found the least convincing.

6.5.1 Extreme scenario 1: Dystopia

The stakeholders first assessed the dystopian scenario (see Table 3). Generally, stakeholders had varied responses to the assumptions. One stakeholder, an NGOs/GOs and Consumer Group representative, found the economic assumption to be the most plausible and realistic. Another advisor described the technology assumption to be the most convincing. When asked to elaborate, he explained that even now, the digital technologies applicable for medium and small farms do not meet the needs of the farm manager, and due to this, the small farms will decline in coming years while the larger farms will prosper and become even more digitalised. On the other side, the fruit farmer and technology developer mentioned that the society assumption is the least plausible of the assumptions because even now, everyone purchases their bus tickets via an app nowadays, and they, therefore, believe that the scepticism will be gone by 2031. The NGOs/GOs and Consumer Group representative spoke up again and mentioned that he couldn't anticipate the policy assumption being the reality in 2031. He believes that current challenges in fruit production will create the need for funding for digital tools. This is not the case now, he added, and the technology developer agreed, but the current situation of little or complicated funding schemes cannot continue as it is. A researcher commented on the biodiversity assumption, finding this point to be improbable because so much research is already going on to improve environmental conditions through digital technologies in agriculture.

Table 3: Extreme Scenario 1: Dystopia

Drivers of Change		Scenario Assumptions	Stakeholder feedback:
Society	individual behaviour of farmers (trust, acceptance, usage of tools)	The acceptance of digital tools is low. Users do not trust the security and sovereignty of data, but are partly forced to digitise by the market.	Least plausible for farmer, technology developer
Technology	limitations of technology based on farm size (e.g. many small parcels of farms, cost-benefit challenge higher on small farms)	Digital technologies are not geared to the needs of small and medium-sized enterprises. They can hardly afford the expensive technologies, which are presumptive in terms of application. The cost-benefit ratio makes their use possible only in larger enterprises or in the case of inter-firm use.	Most plausible for advisor, NGOs/GOs and Consumer Group representative
Economic	job satisfaction and appeal	The seasonal demand for labour in fruit production remains high and it is becoming increasingly difficult to find workers. Due to the high workload, farm successions are becoming uncertain and small farms are being taken over by larger enterprises. The number of family farms is declining.	Most plausible for technology developer

Environment	biodiversity	Biodiversity continues to decline due to the concentration on a few varieties, more high-tech cultivation and an increase in interventions, such as the use of inputs to protect production from climate-related weather effects.	Least plausible for researcher
Policy	subsidies for digital tools	There is little government financial support for the development and use of digital technologies. Their use is economically preconditional and only possible to some extent or not at all on small farms.	Least plausible for NGOs/GOs and Consumer Group representative

Finally, stakeholders assessed the second extreme scenario, utopia (Table 4). Overall, stakeholders were happy to read this scenario, and it ended the workshop on a comfortable, uplifting note. One stakeholder even stated that they found this scenario to be very refreshing and beautiful. The technology developer and a researcher considered the economic and policy assumptions plausible. However, the society, technology, and environmental assumptions were more strongly debated among the stakeholders. Beginning with the society assumption, the NGOs/GOs and Consumer Group representative described it as the least plausible of this scenario's assumptions because he believed that individual behaviour is not easy to change over time. However, a researcher and the technology developer found this assumption to be the most plausible based on the current progress towards digitalisation in agriculture. All three of these stakeholders found the technology assumption to be the most reasonable and ideal. However, an advisor and the NGOs/GOs and consumer group representative agreed that it is unlikely that digital technologies for small farms will be cost-effective in the future. It could be that the technologies can only manage farms starting at a large area. Still, it could also be that technologies can only work on a limited area, in which case the small farms are not necessarily worse-off. These uncertainties remain for the future but should be considered in the development of digital tools.

Table 4: Extreme Scenario 2: Utopia

Drivers of Change		Scenario Assumptions	**Stakeholder feedback:**
Society	individual behaviour of farmers (trust, acceptance, usage of tools)	Digital technologies are part of education and widely available. The benefits associated with them are known and accepted. Their use has increased significantly. Data security and sovereignty are regulated and users are not disadvantaged.	Most plausible for technology developer, researcher, least plausible for NGOs/GOs and Consumer Group representative

Technology	limitations of technology based on farm size (e.g. many small parcels of farms, cost-benefit challenge higher on small farms)	The needs of small businesses are taken into account in the development of digital technologies. Farm size is not a limiting factor in the use of digital technologies. Farms can choose from a wide range of offers with different functions and prices. Many farms can benefit from digitalisation.	Most plausible for NGOs/GOs and Consumer Group representative, technology developer, researcher. Least plausible for advisor
Economic	job satisfaction and appeal	The use of low-cost digital technologies reduces the need for labour. Fruit production in family farms and farm succession become more attractive for young people. This has a positive effect on the preservation of small family farms.	Most plausible for technology developer, researcher
Environment	biodiversity	The increased use of digital technologies for precise crop protection control and application of inputs allows for broader diversification, a reduction in the application of crop protection products and greater biodiversity.	Most plausible for technology developer, researcher, least plausible for farmer
Policy	subsidies for digital tools	Different digital technologies and fields of application are promoted through simple and user-friendly application procedures. Small family farms also benefit from this.	Most plausible for technology developer, researcher

Figure 3: Mentimeter question results

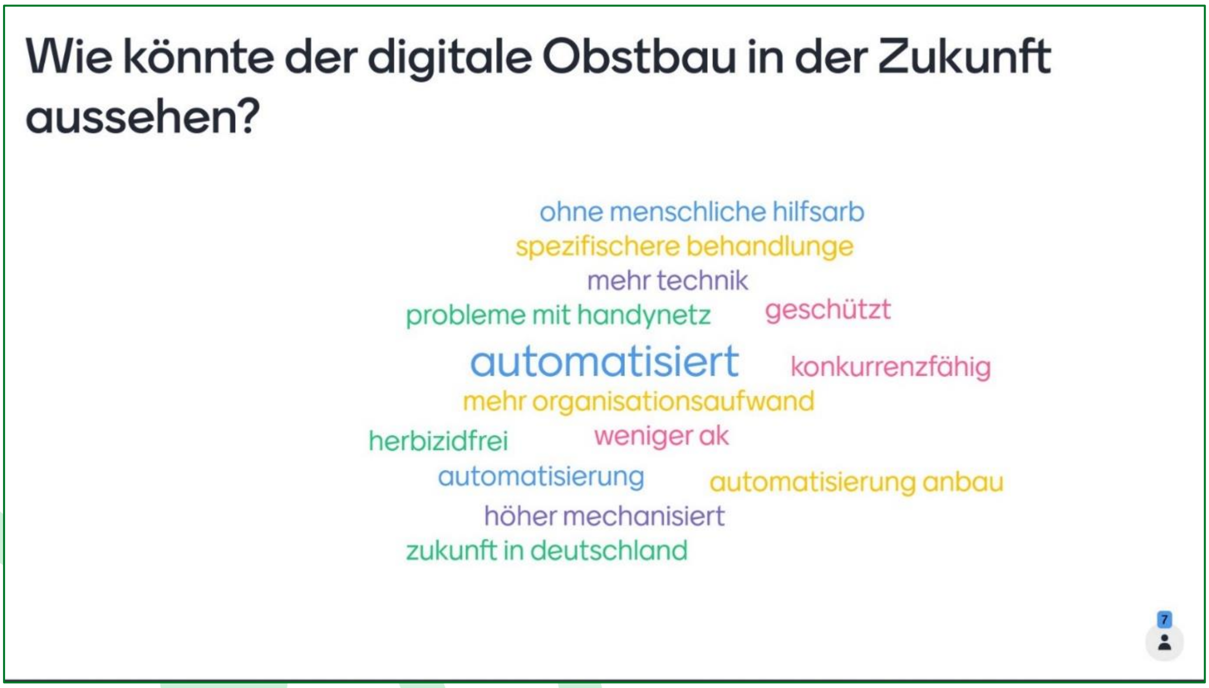

Figure 4: Mentimeter question results

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Figure 5: Mentimeter question results for Scenario 1

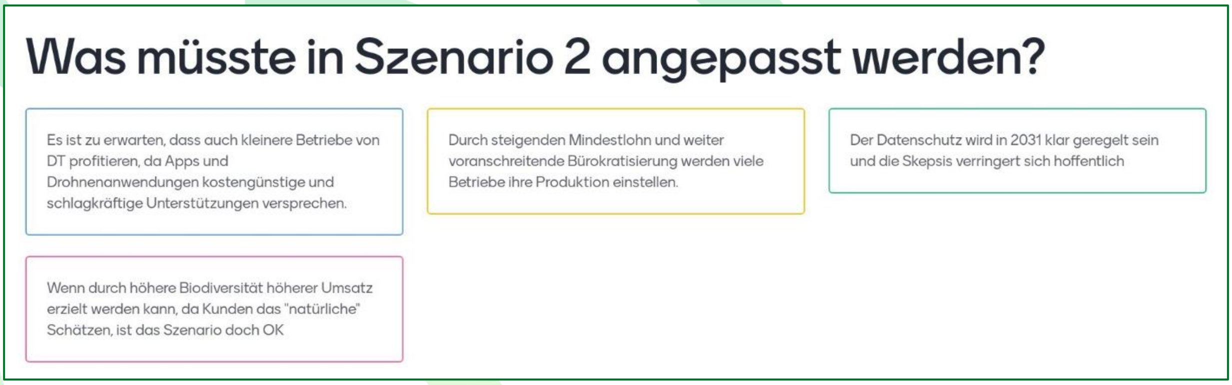

Figure 6: Mentimeter question results for Scenario 2

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13.7 Austria

SCENARIO WORKSHOPS

09.11.2020

SCENARIO WORKSHOPS REPORTING TEMPLATE

Project name	**DESIRA | Digitisation: Economic and Social Impacts in Rural Areas**
Project ID	818194
H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Word Doc
File Name	WD 3.2 Draft reporting Template v1.2
Status	Draft
Authors	Clemens Rendl, Sebastian Vogler
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Introduction

The European Union Timber Regulation (EUTR) which entered into force on the 3rd of March 2013, prohibits the placing of illegally logged timber and derived products on the European market. While forestry is a domain which undergoes, and partially has already undergone, a process of digitalisation, the level of digitalisation within the implementation of the EUTR is rather low, reviewing the operations of the authorities and the operators alike.

This document reports the proceedings in trying to answer the following question: "What will timber tracking look like in 2031 in Europe?". To get an insight into this topic, a promising start-up was involved. The output generated are four scenarios, describing various components of the elaborated system. To achieve this, a STEEP approach was utilized. The resulting scenarios range from the extreme dystopian and utopian perspectives to more realistic scenarios, with a positive and a more negative spin of events. To achieve those results, virtual meetings were held. The small group of participants allowed a very open and flexible structure of meetings and discussions. As a tool to document the outcomes and to share the prepared work, online slides were used. This tool efficiently enabled the workshop facilitator and participants the flexibility to edit or add content collaboratively during the workshop.

Chapter 1 briefly introduces the topic and sets the scene for further content. The focal question of this activity is described in Chapter 2. To ease and enable a fruitful discussion and to further introduce the topic, relevant past events are introduced in Chapter 3. Chapters 4, 5 and 6 deal with the generation of drivers of change (DOC), STEEP analysis and the formulation of four scenarios.

1. Living lab summary

1.1 Name of LL

The name of the Living Lab is: “Round Wood Traceability in Austria”.

1.2 Brief summary of LL

Austria has a strict, long-existing forest law guaranteeing sustainability: the word sustainability originates from the domain forestry itself and is defined as guaranteeing more growth than felling. Nevertheless, to fulfil the yearly demand of roundwood, timber is acquired from the European and international market. This poses the threat of placing illegal deforested products on the European market, which is what the EUTR is tackling; illegality is not only defined as cutting down endangered tree species, but also breaching national forestry laws. The focal question dealt within this living lab is phrased the following way: “*How can digitalisation support and enforce the adoption of the European Timber Regulation (EUTR) concerning imported round wood in Austria?”*

The effects of digitalisation impacts the availability of information and the way information is exchanged and communicated. Digitalisation allows information to travel faster; generally speaking, transparency counters clandestine activities. Contrarily, an abundance of information needs efficient data filtering, storage and distribution. Forestry is a domain which is experiencing a high degree of technological advancement, only, the institutional circumstances are not there yet, for technological innovation to gain importance when tackling illegal logging.

1.3 LL participants

The two entities involved in this activity are the workshop coordinator and a start-up. The start-up, BeetleForTech, offers a solution for seamless roundwood traceability. They develop a global timber tracking network to secure provenance of resources, a solution for simpler compliance and advocacy of sustainable forestry worldwide. Their work is closely linked to the focal question of this activity.

1.4 Timing of Scenario Planning (WP3) workshops

Two workshops were held in week three of January 2022. Both took place virtually. During both workshops, online slides were used to present the topics of the workshop, to take notes and to write down the output of the discussions on-the-fly. The usage of online slides allowed all the participants to simultaneously view and edit the presented slides.

2 Scenario question

2.1 Draft scenario question

Two draft questions were proposed to the participants. The draft questions proposed to the LL participants were:

- "What will timber tracking look like in 2031 in Europe?"
- "Which digital technologies will be applied to assist the European Timber Regulation (EUTR) in 2031?"

2.2 Finalised Scenario question

The final focal question of the scenario workshop was agreed to be:

"What will timber tracking look like in 2031 in Europe?"

2.3 Methodology used to finalise scenario question

The two draft scenario questions were discussed during the first virtual workshop. To discuss and agree on a final scenario question, online slides were used, as described in Chapter 1.4, which allowed editing on-the-fly. The initial discussion evolved around the question whether the words "Europe" and "EUTR" should be included the question. It was argued that there is a need to mention Europe as a continent, since trade of wood and wood products also happens between other continents. Secondly, it was argued to not include the term EUTR, since it would limit the action of timber tracking only to the framework of the EU Timber Regulation.

2.4 Relevant feedback on scenario question from participants

No relevant additional discussion or feedback evolved while discussing the scenario question.

3 Relevant past events

3.1 List of relevant past events

Past relevant events related to the focal question are:

- Satellite systems (1972, Landsat 1)
- Availability of mainstream Internet (1990s)
- N-American Timber Wars (1990s)
- sustainability, Austrian forest act (2002)

- RFID (beginning of 21st century)
- IoT (beginning of 21st century)
- Mainstream availability of GPS in smartphones (2005)
- Twitter (2005)
- Blockchain technology (2008)
- GMES/Copernicus (2008/2014)
- AI & big data (2010s)
- Introduction of the EUTR (2013)

3.2 Description past event activity

To discuss relevant past events, a slide was prepared by the organizer with a selection of the events shown in Chapter 3.1. The events were introduced briefly and then discussed by the participants, whether additional events shall be added or other events discarded. Moreover, additional items were added dynamically during the subsequent conduction of the workshop. These include RFID, IoT and AI from the list in Chapter 3.2. The usage of online slides as a tool to document the workshop output and discussions turned out to be an efficient and effective tool.

3.3 Relevant feedback from participants

Having slides to work with dynamically to capture notes and input was appreciated by the participants.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

The DOC that were selected by LL coordinators and provided to participants are shown in the table below.

STEEP	DOC				
S	consumption awareness	NGOs • activities • number	societal demand (health, environment)	global population growth (pressure on rural areas); urbanization	
T	digital technologies • AI • blockchain • Twitter	open data availability	innovation	technology affordability	

E	consumption (awareness)	global roundwood trade, demand	labour force availability	commodity prices	labour cost
E	conservation areas	species extinction	biodiversity	environmental conditions (soil, water, atmosphere)	
P	“green” governments	political stability	forestry as key SDG element / international climate pledges	EUTR legal framework	

Table V. Initial DOC

4.2 List selected DOC

The final DOC that were selected are shown in the table below.

STEEP	**DOC**				
S	consumption awareness	NGOs • activities • number	societal demand (health, environment)	global population growth (pressure on rural areas); urbanization	housing need
T	digital technologies • AI • Blockchain • Twitter • IoT - global connectivity	open data availability	innovation	technology affordability	architecture
E	consumption (awareness)	global roundwood demand (usage of roundwood) & trade	labour force availability	commodity prices	labour cost
E	biodiversity	species extinction	conservation areas	environmental conditions (soil, water, atmosphere)	scarcity of commodities (e.g., concrete)
P	“green” governments	political stability	forestry as key SDG element / international climate pledges	EUTR legal framework	

Table VI. Final DOC

4.3 Describe methodology to select DOC

The table shown in Chapter 4.1 including the initial set of drivers of change (DOC) was prepared by the workshop organizers before the workshop and presented virtually through screen sharing during the workshop using slides. The initial set of DOC were explained and discussed. Each DOC was evaluated and reformulated, when necessary. Moreover, additional DOC were elaborated and added. The changes were done on-the-fly, visible to all participants.

4.4 Relevant feedback from participants

No relevant additional feedback evolved while discussing of the DOC.

5 Matrix

5.1 Matrix description

The matrix below is the result of the activity performed during the second virtual scenario workshop. Based on the final list of STEEP DOC as seen in Chapter 0, eight drivers of change were selected in a participatory way, which posed to be the most important and fulfilled the characteristic to be a critical uncertainty. They are listed in the first column. Two drivers each were selected from the domains social, technological and political. One driver was selected from the economic domain. The initially selected two drivers from the domain environmental were eventually summarized into one driver of change. The DOC themselves are described in the second column of Table VII. Columns three to six elaborate four assumptions.

Columns three to six of Table I include four different assumptions. Assumption I is similar to a dystopia, painting a negative future of each of the selected DOC. Assumption II describes the business as usual (BAU) scenario, with the least deviation of the current situation of each driver. Assumption III describes a positive spin of events, describing a more positive outlook of the selected drivers of change. While Assumption IV is close to a utopia, which could also be described as a conservation approach to the environment, it is considered to be an extreme and hence less realistic.

STEEP DOC	Description	Assumption I	Assumption II (BAU)	Assumption III	Assumption IV
social consumption awareness	the awareness of European consumers regarding the origin of wood, similar to the awareness to the origin of food; e.g., wood planted, grown, harvested and processed sustainably vs. wood from endangered wood species'; enabled through digital media	mass produced wood products are preferred over sustainable wood products; reduction of awareness of the issue of the origin of wood	wood has a lower social significance than food; the origin of wood is not as important as the origin of food; number and quality of certifications remain the same	wood is as socially significant as food; the origin of both is of importance to society more robust certifications exist; origin of wood is discussed more often in public, media	no wood is consumed whose origin cannot be determined; wood products are ranked by certifications
social societal demand in Europe (health,	the demand of the European	societal demand for sustainability	the societies demand for sustainability affecting forests and	the society increasingly shows more	conservation evolves to be the new dogma

environment, sustainability)	society for more sustainability through e.g., conservation and protection of forests and a more efficient usage of the forest resources	and forests decreases heavily	forest products stagnates	interest in the topic of sustainability, resulting in positive effects for forests and forest products	for society when it comes to forests; reforestation is supported
technological digital technologies (AI, blockchain, Twitter, IoT)	availability and implementation of digital technologies used in the process of tracing wood or wood products, e.g., blockchain		the application of digital technologies for wood traceability stagnates; technologies remain expensive and not suitable for mass-application	more funding is available for the invention or development of digital technologies; political obstacles are minimized when implementing new technologies	an existing or new technology evolves to be an affordable, globally implemented digital game changer applied to wood traceability
technological open data availability	the open and free access to data related and relevant to wood traceability, e.g., wood species distribution, felling, other practices		the level of open data relevant for wood traceability doesn't change; the concept and ideas behind open data are refused	open data is used more widely amongst industry players; more private and public entities rely on and participate to open data initiatives	data from forestry and timber industry become open data; open data becomes a globally accepted standard for the industry
economic European roundwood demand (usage) & trade	the European demand for roundwood, based on the various usages of roundwood, e.g., housing, construction, furniture	the demand for roundwood increases dramatically which results in less sustainable practices and more illegal trade	the demand and trade of roundwood stagnates	the European demand reaches a level which enables more sustainable practices	the demand adapts to the idea of sustainability
environmental biodiversity & conservation areas	the status of biodiversity and measures taken to preserve it	biodiversity declines rapidly posing threats to nature and humans	biodiversity declines at a constant speed	measurements are taken to halt the loss of biodiversity	biodiversity fully recovers and partially increases in some areas / regions
political forestry as key SDG element /	the role of forestry in international climate pledges, e.g.,	climate pledges do not take a holistic approach;	the role of forests in a global climate system is acknowledged	the importance of forestry in a holistic approach to tackle a	forestry is getting a great amount of attention and is seen as having a

international climate pledges	forestry and reforestation as a tool for carbon sequestration	forestry is not considered to play a significant role in the management of climate change		changing climate is secured	major role to play in the fight against climate change
political green governments	the presence, power and influence of green political European parties in governments to shape and push a sustainable, green agenda	the importance of sustainability decreases on the political agenda	political parties with a sustainable agenda are occasionally part of the government	the significance of political parties with a green agenda increases	the number of environmentally friendly governments increases; sustainable topics are efficiently implemented on a political level

Table VII. Morphological Box populated with eight drivers of change (DOC), a description and four assumptions

5.2 Define 4 pathways/scenarios selected

The framework of the four selected scenarios is defined by the concepts of utopia and dystopia. Utopia and dystopia are the positive and negative extremes of the thought experiment, trying to answer the focal question of the scenario workshop.

The selected drivers of change are a diverse set of critical uncertainties from all five domains. The dystopian picture drawn hence describes a pessimistic and negative outlook of each driver. To refer to the workshop's focal question, it is assumed that forests are exploited unsustainably, with long-lasting damages for the environment and humans. In contrast, the core of the utopian perspective are conservation and reforestation. Based on the assumptions of utopia and dystopia, it is possible to diminish extreme assumptions and define two additional pathways. One pathway is better than the dystopia, the other one is less optimistic than the utopia.

Following, the four pathways are referred to as:

- Overexploitation (Dystopia)
- Exploitation
- Sustainability
- Conservation (Utopia)

The pathways are constructed based on the following governing factors of change visible in Figure 5-1. The Exploitation pathway is defined by the selection of the red cells of the matrix. The Sustainability pathway is defined by cells with the colour green. The remaining two pathways are defined as the selection of the remaining cells, left and right to the cells which define the Exploitation and Sustainability pathway respectively.

In the Overexploitation scenario, the origin of wood products is not relevant to society's consumption behaviour, cheap mass products are preferred over sustainable products. In the same manner, the societal demand for sustainability and forests is declining sharply. Since a decline of technologies is highly unrealistic, the scenario described here excludes the technological domain. Also, since currently no open data is used by the timber industry, the second technological driver is omitted as well. Economically, the demand for roundwood increases dramatically which results in less sustainable practices and more illegal trade. This corresponds to the circumstances also part of the Exploitation pathway described later. As a consequence to overexploitation, biodiversity declines rapidly posing threats to nature and humans. The role of forests and forestry in the attempt to manage a changing climate is close to non-existing. This is also reflected by the lack of green parties in governments or a green political agenda.

The dogma of the Conservation pathway is reforestation and conservation. No wood is consumed whose origin cannot be determined. In addition, wood products are ranked by certifications. From a technological point of view, an existing or new technology evolves to be an affordable, globally implemented digital game changer applied to wood traceability. This assumption also corresponds to the Sustainability pathway described later. In terms of data availability, data from forestry and timber industry become open data. Open data becomes a globally accepted standard for the industry. As a result of conservation and reforestation, biodiversity fully recovers and partially increases in some areas and regions. In international climate pledges, forestry is getting a great amount of attention and is seen as having a major role to play in the fight against climate change. Likewise, the number of environmentally friendly governments increases. Both political drivers correspond to the Sustainability pathway.

STEEP DOC	Assumption I	Assumption II (BAU)	Assumption III	Assumption IV
social consumption awareness	mass produced wood products are preferred over sustainable wood products; reduction of awareness of the issue of the origin of wood	wood has a lower social significance than food; the origin of wood is not as important as the origin of food; number and quality of certifications remain the same	wood is as socially significant as food; the origin of both is of importance to society more robust certifications exist; origin of wood is discussed more often in public, media	no wood is consumed whose origin cannot be determined; wood products are ranked by certifications
social societal demand in Europe (health, environment, sustainability)	societal demand for sustainability and forests decreases heavily	the societies demand for sustainability affecting forests and forest products stagnates	the society increasingly shows more interest in the topic of sustainability, resulting in positive effects for forests and forest products	conservation evolves to be the new dogma for society when it comes to forests; reforestation is supported
technological digital technologies (AI, blockchain, Twitter, IoT)		the application of digital technologies for wood traceability stagnates; technologies remain expensive and not suitable for mass-application	more funding is available for the invention or development of digital technologies; political obstacles are minimized when implementing new technologies	an existing or new technology evolves to be an affordable, globally implemented digital game changer applied to wood traceability
technological open data availability		the level of open data relevant for wood traceability doesn't change; the concept and ideas behind open data are refused	open data is used more widely amongst industry players; more private and public entities rely on and participate to open data initiatives	data from forestry and timber industry become open data; open data becomes a globally accepted standard for the industry
economic European roundwood demand (usage) & trade	the demand for roundwood increases dramatically which results in less sustainable practices and more illegal trade	the demand and trade of roundwood stagnates	the European demand reaches a level which enables more sustainable practices	the demand adapts to the idea of sustainability
environmental biodiversity & conservation areas	biodiversity declines rapidly posing threats to nature and humans	biodiversity declines at a constant speed	measurements are taken to halt the loss of biodiversity	biodiversity fully recovers and partially increases in some areas / regions
political forestry as key SDG element / international climate pledges	climate pledges do not take a holistic approach; forestry is not considered to play a significant role in the management of climate change	the role of forests in a global climate system is acknowledged	the importance of forestry in a holistic approach to tackle a changing climate is secured	forestry is getting a great amount of attention and is seen as having a major role to play in the fight against climate change
political green governments	the importance of sustainability decreases on the political agenda	political parties with a sustainable agenda are occasionally part of the government	the significance of political parties with a green agenda increases	the number of environmentally friendly governments increases; sustainable topics are efficiently implemented on a political level

Figure 5-1. Four identified pathways

5.3 Identify the 2 pathways that will be defined in more detail

The two pathways explained in this chapter are the Exploitation and Sustainability pathways. They both exclude the assumption of extreme, i.e., unrealistic developments of critical uncertainties.

The concept of the Exploitation pathway follows the idea of making use of the commodity forest in a non-sustainable way. As a consumer good, wood has a lower significance than food – the origin of wood is not as important as the origin of food. This circumstance is reflected by the assumption that the societal demand for sustainability affecting forests and forest products stagnates in view of the next decade. The technological component of this pathway is defined the following way: there are no advancements in the application of digital technologies for wood traceability. Technologies for timber tracking remain expensive and not suitable for mass-application. Similarly, the amount of data used in the timber industry following the idea and concept of open data remains on an almost non-existence level. In contrary to the usage of open data, the demand for roundwood increases dramatically which results in less sustainable practices and more illegal trade. As a consequence, biodiversity declines at a constant speed. On an international level, when defining climate goals and pledges, the role of forests is underestimated and not considered. In the Exploitation scenario, the role of green governments is ambivalent. Either, the importance of sustainability effecting timber trade is not part of the governments' agenda, or, political parties with a sustainable agenda are only occasionally part of the government and don't achieve an effect.

The idea of the Sustainability pathway evolves around the principle of less consumption than regrowth or regeneration. In this context, wood is as socially significant as food – the origin of both is of importance to society. Similar to how the food industry functions, more robust certifications exist for timber products. Consequently, the origin of wood is discussed more often in public and the media. Society shows increasingly more interest in the topic of sustainability, resulting in positive effects for forests and forest products. Technologically, an existing or new technology will evolve to be an affordable, globally implemented digital game changer applied to wood traceability. Open data is used more widely amongst industry players, more private and public entities rely on and participate to open data initiatives. In this optimistic scenario, the demand in Europe reaches a level which enables more sustainable practices. On top of this, measurements are taken to halt the loss of biodiversity. When taking actions to deal with and mitigate the changes in the climate, forestry is getting a great amount of attention and is seen as having a major role to play. This evolution is reflected by the number of environmentally friendly governments. The number of green parties in governments increases, hence, sustainable topics are efficiently implemented on a political level.

5.4 Methodology used to identify pathways

To identify the different pathways, Table VII was discussed, asking the questions: "What is a realistic better scenario than business as usual, but not the best?" and "What is a realistic worse scenario than business as usual, but not the worst?". The two questions were stated in relation to the focal question of the scenario workshop: "What will timber tracking look like in 2031 in Europe?". Each DOC was discussed line by line. To visualize and discuss the matrix online slides were used. Online slides allow to easily modify the matrix, take notes and colour cells to define the different pathways.

5.5 Relevant feedback from participants

The STEEP approach was highly valued, it was considered to be an efficient and user-friendly tool to get the job done.

6 Scenario Narratives

6.1 Name Scenarios

The four pathways are referred to as:

- Overexploitation (Dystopia)
- Exploitation
- Sustainability
- Conservation (Utopia)

The scenarios are introduced in Chapter 5.2 and 5.3. The detailed scenarios to be considered are Exploitation and Sustainability, as they exclude extremes.

6.2 Write the 2 or 3 detailed scenario narratives

The narrative of the Exploitation scenario involves generating a profit at the expense of others. Another aspect of the scenario can be described as tension. Tension already exists between nature and the actors. It is further intensified due to climate change as a predetermined element. Looking at the STEEP domains, the social, economic and political components are closely intertwined. The evolution of the ecological component, in turn, is a result of the three previous components, coupled with the presence of the technological component. In this scenario, consumption dominates at the expense of the environment. Society's interest in and demand for sustainable wood products and forests does not change in the future. How wood products are produced, from which wood they are made, remains hidden, because the demand for sustainable wood is not high enough, and the wood industry does not act on its own or change its principles and way of working. To make matters worse, the demand for wood is increasing, which means that sustainable practices are declining, and illegality is being promoted. As a higher level of consumption dominates, there is no opportunity to spotlight the forest as part of a holistic solution to climate change. The few green parties in government either lack clout or fail to achieve a majority. An even more pessimistic view would be that sustainable issues are completely losing importance in the political discourse. Only the technology component appears to be viewed in a more differentiated way. It is updated independently of developments in the topic under discussion, but in turn is not itself promoted and driven by internal dynamics. It is stuck and remains a costly solution applied in isolated cases.

The SCP in present can be described in the following way: The socio-domain of the SCP is composed of the entities dealing with timber, the countries involved and the supervisory authorities. The cyber-domain includes digital technologies used to perform checks on legality. The physical domain comprises all the elements of the forests and timber. Currently, the SCP can be viewed as a struggle of economic interest versus natural interest (physical domain), with a referee, the national EUTR authority trying to keep things in order. In 2031, the prospect of the actors of the socio-domain involved in the scenario discussed here does not change. What changes instead is the environment, the physical domain, as it comes under increasing pressure. The pressure may have future effects, such as the constant loss of biodiversity, that are currently impossible or difficult to assess. The technological and political drivers of change in this scenario are missing and unable to come to the aid of the physical component. The last resort for assistance are supposedly drastic but largely useless measures such as the designation of nature conservation zones.

In this scenario, nature is on the decline. It reacts with the loss of biodiversity and starts to develop a human adverse environment. Winners are clearly the economic entities of the SCP. In addition, increasing demand is driving illegally. The consumers are winning in terms of costs, since they are offered commodities for low prices, reflecting the increasing demand. On the other hand, they are offered mass-produced products with potentially less quality. The authorities on the other hand are losing, as their resources, time and money, are further cut. They struggle to deal with the workload and do not manage to make a lasting change. One possibility is provided by the component of digital technologies. Although no change is to be expected within the system from this component, it cannot be excluded that technological development arrives from another, extraneous system. This external technological advancement could have a positive effect on the discussed situation here, enabling to lessen the prospect of the negative extent.

The Sustainability scenario on the other hand has a positive spin. The core of this scenario represents a sustainable approach to nature, which has a positive impact on the issue of wood tracking. In our current society, the issue of the origin of food is more important than the origin of our wood. The issue of origin is raised and discussed more in the media when the commodity is food. In the scenario described, the origin of food and wood is equally relevant to the consumer. This is reinforced by the presence of multiple certificates, similar to those for fish products, for example. Parallel to this, the demand develops. Sustainability is also emphasized in production, which allows not to remove more than grows back. But not only the consumption of wood is an issue, but also the preservation of forests and nature. The topic of sustainability is becoming more and more important in society. This in turn has a positive effect on nature. The reduction of biodiversity is decreasing. Also on political level the forest moves more into the centre. Forests are receiving more attention, and their potential for limiting climate change is being recognized and promoted. The general focus on sustainability is reflected in the presence of political parties in government that pursue a green agenda. The last essential element is the development of technology. It has a positive feedback effect. It is promoted from the political side, and it is profitable for nature and economic activity. New industries develop on the basis of new technological developments. Further development goes hand in hand with the open data initiative. The concept is becoming more and more important for the wood industry, numerous private and public institutions participate and profit from it.

In this scenario, the cyber and physical components of the SCP change. The cyber component gains momentum, existing technologies are advanced, and new technologies are developed. It is driven by the removal of bureaucratic barriers and technological innovation. The physical component benefits from this development, as it now has more room to breathe. The social domain must be viewed in a differentiated way. On the one hand, new, more efficient technologies make the authorities' work easier. They can take more effective action against remaining illegal activities. For the consumer, a shift in focus to sustainability means an increase in costs on the one hand, but higher quality and a more sustainable, healthier life on the other. Companies also have to reorient themselves to a certain degree. They must be prepared to jump on the 'sustainability' bandwagon and make it work for them. This means opportunities as well as challenges, potentially financial challenges for consumers and industry, which can be seen as opportunities at the same time.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

The Overexploitation (Dystopia) and Conservation (Utopia) scenarios have been introduced in Chapter 5.2 and can be described the following way: in the Dystopia, sustainability in relation to forests is disappearing from the picture altogether. On the one hand, this is due to shifting consumption patterns in society, coupled with a dramatic increase in demand for wood. The forest's potential as a carbon sink is not acknowledged and utilized in the fight against climate change. There is a failure to consider the forest as part of an overall climate system. In the daily political discourse, sustainability and forest management come last. The result of all this is that biodiversity is rapidly deteriorating, which puts further pressure on the forest as a resource. Nor does technology provide a remedy. It is not declining, but it is stagnating. For the SCP, this means that illegality is flourishing. Authorities are coming under increasing pressure and can no longer fulfil their mandate.

The dogma of the conservation path is reforestation and conservation. Wood of unknown origin is not consumed, in addition, wood products are ranked by certificates. From a technical standpoint, existing or new technologies are evolving into affordable, globally distributable digital technologies that will be game-changers for wood traceability. This assumption is also consistent with the Sustainability scenario described in Chapter 6.2. In terms of data availability, timber and forestry data are becoming open data; open data is becoming the industry standard. As a result of conservation and reforestation, biodiversity is fully restored and in some areas and regions it partially increases. Forestry is a major focus of international climate commitments and is considered to play an important role in combating climate change. Likewise, the number of environmentally friendly governments is increasing; both political factors align with the path of sustainable development.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.8 Switzerland

WEED MANAGEMENT IN SWISS ORGANIC VEGETABLE GROWING

02.02.2022

SYLVAIN QUIÉDEVILLE

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Authors	Claire Hardy, Dominic Duckett, Leanne Townsend, Heidrun Moschitz, Boelie Elzen
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

Table of contents

1. Living lab summary

1.1 Name of LL

Weed management in Swiss organic vegetable growing.

1.2 Brief summary of LL

The Swiss DESIRA Living Lab (LL) focuses on how digitisation and the use of robots can support Swiss organic farming, with a particular focus on weed management. In organic farming, weed control is a major issue and determines the yield potential of crops. The research question around which the activities of the LL are organized is as follows: "How to control weeds effectively and efficiently in Swiss organic farming?"

Before starting the Living Lab activities per se, a preliminary workshop (April 2019) with researchers and advisors involved in organic farming, and with the organic farmers' association, was organised. At that stage, the following key (potential) challenges and questions were identified:

- Change in knowledge and skills requirements (farmers and employees):
  - Increasing requirements in education and training
  - Threshold to become a farmer might increase due to increased knowledge needs
  - Reduction of personal observations of plants reduces experience-based know-how
- Increased dependencies:
  - Data ownership issue (in particular if contractors are involved)
  - Loss of autonomy in decision making (power "delegated" to data and algorithms)
  - Increasing dependency on tech firms
- Effectiveness of weed control and effect on yield potential:
  - Will focus shift from preventive measures to application of technology?
  - Who pays the costs of learning with an immature technology?
- Machinery cost and efficiency of the process:
  - Potentially high machinery cost per hectare but with supposedly decreased labour cost
  - Potentially higher dependency on external companies (e.g. with costly contract machine work)
  - Potential effect on costs and benefits of the whole process
- Effect on labour market and workforce at farm:
  - Loss of working places
  - Decrease in strenuous physical work
  - Potentially more expensive employees (tight labour market on skilled people)
- Change of perception of the profession as a farmer and for the (organic) agricultural sector:
  - Less people on farms, "*farms without farmers*"
  - Tension between the image of "nature" and the increased application of technologies
- Potential ethical concerns and debates based on values embedded in organic agriculture

Starting from this preliminary workshop, the purpose of the LL is to initiate a process of actively addressing these challenges in the organic sector, current and future ones, to engage in a discussion about how to reconcile such technologies with organic ethical values, and to get a clearer picture of the organic sector's demands on the technology.

1.3 LL participants

The types of stakeholders involved in the LL are as follows:

- Organic farmers
- Farmers' organisations
- Digital technology companies
- Research and education institutions (e.g., universities, public research body)
- Value chain actors (retailers, sellers)
- Policy bodies

Note that before the first LL workshop, in relation to WP2, 4 interviews were conducted with experts on vegetable farming to better understand the context of the LL. In addition, 13 answers were collected from the Wp2 online survey; and a first LL workshop (wp2) focusing on past and current situation was conducted on December 1st, 2020, with 11 stakeholders involved in the sector. 6 additional interviews were conducted after the LL workshop, including 3 experts and 3 farmers, in order to complement the analysis for Wp2.

Table 8 specifies the range of stakeholders involved in the second and third workshops (Wp3). We found the workshops successful, however we have suffered from a certain lack of participation as only 6 people could make it to the first workshop, and 4 to the second. In fact, the workshops were conducted online, and two people very shortly canceled their participation before the first workshop, and again two other people canceled on the morning of the second workshop (that took place in the afternoon). Most probably, this was the consequence of conducting the workshops online. 25 people were invited, which was much larger than the scope of the original lab group.

Therefore, the approach was adapted to that specific situation. Particularly, in the second workshop, both scenarios (main ones) were discussed with the entire group and not in separate break-out rooms. In the end, we found that the limited number of attendants was fine, as it allowed everyone to speak quite a lot, and we think that it was easier to moderate.

Table 8: Type of stakeholders and their attendance at the second and third workshop

Type	Number of people attending the 2nd workshop	Number of people attending the 3rd workshop
Organic farmers	1	0
Farmers' organizations	2	1

Digital and education institutions	3	2
Policy bodies	0	1
Total	**6**	**4**

1.4 Timing of Scenario Planning (WP3) workshops

Two workshops were conducted, one on the 8 of November 2021 and the other on the 11 of November 2021. Each workshop lasted about 2.5 hours long. Due to the Covid-19 situation, both workshops were conducted online using Zoom and Padlet.

2. Scenario question

2.1 Draft scenario question

How will weeds be managed in Swiss organic vegetable farming in the increasingly digitalized age of 2031?

2.2 Finalised Scenario question

How will weeds be managed in Swiss organic vegetable farming in the increasingly digitalized age of 2031?

2.3 Methodology used to finalise scenario question

Phone calls were made to 4 LL members including 2 experts and 2 organic farmers to ask for their feedback, and the question was then further validated at the first workshop by the participants. After a general presentation of the project to the participants of the 1st workshop (most were new compared to the previous WP2 workshop), the drafted scenario question was proposed to the attendance and accepted as such.

2.4 Relevant feedback on scenario question from participants

LL members contacted by phone were very enthusiastic about the question and thought it is very relevant and exactly the question we should be asking. No specific feedback was provided by the participants at the workshop. All participants agreed on the question, most probably because the question was broad enough so that it did not constrain the possible future related to the management of weeds in organic farming in Switzerland. It must be reminded that the focal question of the LL was and still is "*how to effectively and efficiently control weeds in organic farming?*" The scenario question is more or less the focal question but applied to the future.

3. Relevant past events

3.1 List of relevant past events

The list of relevant past events used at the workshop are as follows:

- 2010-2021: Declining labour availability.
- 2010-2021: Organic sector development.
- 2010-2021: Increasing use of digital tools.
- 2014-: Resource Efficiency Contributions (implementation of Swiss programme).
- 2017: Foundation of the Swiss Future Farm (at Agroscope, a research institute).
- 2017: Increasing use of "pulled robots".
- Desira Workshop 2020 (LL activity): Analysis of the past and current situation for (digital) weed control in organic vegetable growing.
- 2018-2021: Research project: Use of robots for efficient weed control: FiBL, HafL, Agroscope, Fondation Rurale Interjurassienne.
- 2020: "Digital Switzerland Strategy": Enable equal participation for all and strengthen solidarity; ensuring security, trust and transparency; further strengthen people's digital empowerment and self-determination; securing added value, growth and prosperity; reducing the ecological footprint and energy consumption.

3.2 Description past event activity

The above past events were used as example to trigger the upcoming discussions related to the possible future of weed control in the Swiss vegetable organic farming sector.

- 2010-2021: Declining availability of labour. In the past 10 years, there has been a decline in the availability of manual labour on farms. This has been one of the factors triggering digitalization and the idea of using robots to control weeds.
- 2010-2021: In the last 10 years, there has been a substantial development of the organic vegetable production and market in Switzerland. The area of organic vegetable production has grown steadily from 2010, reaching currently about 23% of the total vegetable production. The organic vegetable market, measured in terms of per capita consumption, has also grown continuously with a share of 23% of sales of organic vegetables in total vegetable sales in Swiss retailers in 2019.
- 2010-2021: In the last 10 years, there has been an increasing development and uptake of digital tools by Swiss farmers, including in relation to weed control.

  - Use of "pulled robots". In 2017, so-called “pulled robots” were in use on about 30 Swiss vegetable farms. The robots used included brands such as Removeed, Robovator, Robocrop, and Steketee.

- 2014-: Resource Efficiency Contributions: Since 2014, digital technologies with a proven positive effect on the sustainable use of natural resources and or the efficient use of means of production have been financially supported by public resources. Examples of production methods that are financially supported via these payments are for instance no-till and the use of precise application techniques for pesticides.
- 2017: Foundation of the Swiss Future Farm (at Agroscope, a research institute). The Swiss Future Farm is Switzerland’s demonstration farm for smart farming practices and Switzerland’s competence centre for digital and data-based sustainable agriculture. It aims to make smart farming tangible and has the following three objectives: 1) making digitalisation tangible for practical applications, 2) supporting research and development, and 3) enabling knowledge transfer. The core task of the Swiss Future Farm is the transfer and exchange of knowledge involving all partners, which is done in joint events and in events organised by the individual partners for farmers and other interested stakeholders, advisory services and researchers.
- Desira Workshop 2020: First Workshop organised with members of the LL. As already known, it consisted of analysing the past and current situation for (digital) weed control in organic vegetable growing. It was considered as a milestone as it allowed some of the stakeholders to better understand what is at stake, what are the areas of impacts, and most importantly, to develop exchanges among the “digital community”. This, in turn, is likely to impact on both future research and digitalization trend.
- 2018-2021: Research project: Use of robots for efficient weed control: FiBL, HafL, Agroscope, Fondation Rurale Interjurassienne.
- 2020: "Digital Switzerland Strategy": In the frame of that strategy, the charter was launched in 2018 under the aegis of the Federal Office for Agriculture FOAG. The Charter contains 12 guidelines on the use of digital data and applications in agriculture and food production. By the end of 2021, it had been signed by more than 110 institutions in the industrial, agricultural, processing, retail and administrative sectors related to the Swiss agri-food system. The community of those who signed the Charter strives to create a shared understanding, promote cooperation, identify further areas where action is required and ultimately contribute to implementing Switzerland’s digitalisation strategy.

3.3 Relevant feedback from participants

No specific feedback was provided by the workshop participants.

4. Drivers Of Change (DOC)

4.1 List initial set of DOC

Table 9 outlines the initial set of DOC. They are divided into the 5 STEEP categories. The last two columns specify the assumptions made for the positive and negative scenario, respectively.

Table 9: List of initial set of DOC

STEEP	Driver	Positive	Negative
Social	Society's opinion on the use of robots	More positive	More negative
	Availability of qualified workers	Higher	Lower
Political	Political pressure to reduce or not the use of pesticides	Wished reduction	No change
	Privacy and transparency	Clear legal terms	No change
Technological	Entry and maintenance costs	Lower	Stable
	Ratio cost - efficiency/performance of digitized weed control	Better	No change
Ecologics	Resource use through (or thanks to) the use of digital tools (compared to today - for digital use)	Lower	Higher
	Weeds are becoming increasingly resistant or unresponsive to available synthetic pesticides	Hardy weeds	No change
Economics	Selling prices for organic vegetables	Stable	Lower
	National and international competitive pressure	Stable (only international)	Higher

4.2 List selected DOC

Table 10 outlines the selected set of DOC. They are divided into the 5 STEEP categories. The last two columns specify the assumptions made for the positive and negative scenario, respectively. When no assumptions are made for a given DOC (e.g. ‘privacy and transparency’ in the negative scenario), the later DOC was not selected.

Table 10: List of selected DOC

STEEP	Driver	Positive	Negative
Social	Society's opinion on the use of robots	More positive	
	Availability of qualified workers	Higher	Lower
Political	Political pressure to reduce or not the use of pesticides	Wished reduction	
	Privacy and transparency	Clear legal terms	
Technological	Entry and maintenance costs	Lower	
	Ratio cost - efficiency/performance of digitized weed control	Better	No change
Ecologics	Weeds are becoming increasingly resistant or unresponsive to available synthetic pesticides	Hardy weeds	
Economics	Selling prices for organic vegetables	Stable	
	National and international competitive pressure	Stable (only international)	Higher

4.3 Describe methodology to select DOC

The DOC have been selected based on WP2 reports and the identified factors influencing the socio-cyber-physical system or that appeared important in relation to that system. In the first WP3 workshop and in each break-out room, the stakeholders were asked to (1) review the relevance of each driver, (2) select the most relevant ones, and (3) review and eventually revise the hypothesis made to each driver. Participants were also free to suggest any other drivers that they thought must be tackled but that were not yet on the list.

4.4 Relevant feedback from participants

The DOC on resource use was dropped as it was not clear for participants what the relationship between digitalization and energy use actually is. Participants wished to tackle all DOC in the positive scenario whilst only 3 DOC were tackled in the negative scenario. Otherwise, the assumptions were all found appropriate and no change was made.

5. Matrix

5.1 Matrix description

Table 11 outlines the final set of DOC. They are divided into the 5 STEEP categories. The last two columns specify the assumptions made for the positive and negative scenario, respectively.

Table 11: Matrix

STEEP	Driver	Positive	Negative
Social	Society's opinion on the use of robots	More positive	
	Availability of qualified workers	Higher	Lower
Political	Political pressure to reduce or not the use of pesticides	Wished reduction	
	Privacy and transparency	Clear legal terms	
Technological	Entry and maintenance costs	Lower	
	Ratio cost - efficiency/performance of digitized weed control	Better	No change
Ecologics	Weeds are becoming increasingly resistant or unresponsive to available synthetic pesticides	Hardy weeds	
Economics	Selling prices for organic vegetables	Stable	
	National and international competitive pressure	Stable (only international)	Higher

The DOC have been selected based on WP2 reports and the identified factors influencing the socio-cyber-physical system or that appeared important in relation to that system. In the first WP3 workshop and in each break-out room, the stakeholders were asked to (1) review the relevance of each driver, (2) select the most relevant ones, and (3) review and eventually revise the hypothesis made to each driver. Participants were also free to suggest any other drivers that they thought must be tackled but that were not yet on the list. But no other DOC was added. We describe below the different DOC:

- **Society's opinion on robots**: The opinion of the society on robots, not only agriculture related robots, but in general, may influence farmers' decision to adopt robots but also decisions and activities on robots' development. For the positive scenario, the hypothesis was made that in 10 years the societal opinion on robots would be more positive. This DOC was not selected for the negative scenario.
- **Availability of qualified workers**: The development and adoption of robots by farmers requires specific skills and IT qualified workers. There is currently a lack of IT qualified workers, particularly on farms. In the positive scenario, the hypothesis is made that there will be more qualified workers

available in the future while the negative scenario assumes that there will be less qualified workers available in the future.

- **Political pressure to reduce or not the use of pesticides**: The political pressure to reduce the use of pesticides can lead conventional farmers to consider alternative solutions, including digital based solutions. This political pressure is assumed in the positive scenario. Even though we focus on the organic sector, they are synergies between the conventional and organic sector in the sense that robots being developed for the conventional sector can be a source of inspiration for the organic sector and also lead to economies of scale easing investments.
- **Privacy and transparency**: It was assessed that, currently, there is a lack of clarity in terms of the legal terms related to digitalization in agriculture and for robots in particular. The positive scenario states that those legal terms will be clearer in 10 years. This driver was not assessed in the bad scenario.
- **Entry and maintenance costs**: Entry and maintenance costs were seen as a barrier to adoption. The positive scenario makes the reasonable assumption that such costs will get lower. This driver was not considered in the bad scenario.
- **Ratio cost-efficiency/performance of digitized weed control**: The efficiency and performance of the digital tools used for weed control is a key driver of adoption. The positive scenario states that that ratio costs vs. efficiency & performance will improve whilst the bad scenario keeps the current situation unchanged. It would not be realistic to assume a decrease of that ratio as it would go very much against empirical observations showing that, usually, the costs tend to decrease as the technology develops. This also did not appear realistic in this LL as such because substantial research is being conducted and real testing is being implemented.
- **Resource use through (or thanks to) the use of digital tools**: The use of digital tools is controversial in terms of resource use. It is not clear whether it improves the situation or not as the use of the tools themselves can use quite some energies. Because the relation is not clear, and that participants did not find it very relevant, this driver was dropped in both scenarios.
- **Weeds are becoming increasingly resistant or unresponsive to available synthetic pesticides**: This driver is an indirect one. The underlying mechanism is that the more difficult it is to control weeds in conventional farming by using pesticides, the more incentives it provides to develop alternatives, including robots. Obviously, there are spill overs arising from the conventional sector, where robot development in conventional feed into the organic sector (idea, structure development, etc).
- **Selling prices for organic vegetables**: The selling prices for organic vegetables obviously influence the profitability of the sector. This, in turn, can influence the digitalization trend, including in relation to weed control tools. The positive scenario makes the assumption that these prices will remain stable. An increase in prices (in real terms) does not seem very realistic given the pressure from international market and that Swiss prices are already very high in international comparison. This is why we considered "same price" to be a realistic positive scenario.
- **National and international competitive pressure**: This driver is very much associated to the previous one. Since the international selling prices were not hypothesized to be higher (in real

terms) in 10 years in the positive scenario, it appeared reasonable to make the assumption that the market pressure will remain stable in the positive scenario. As for the negative scenario, the hypothesis was made that the market pressure will increase. Eventually, this could be associated to a decrease in Swiss prices, but this driver was not selected for the bad scenario. The assumption of higher market pressure was made in the bad scenario, building on the fact markets might become more liberalized and/or that the Swiss agricultural policy might become less protective in terms of custom taxes.

5.2 Define 4 pathways/scenarios selected

I. Good scenario

In the good scenario, the opinion of the society on robots, not only agriculture related robots, but in general, is significantly getting more positive. The rationale is that it may influence farmers' decision to adopt robots but also decisions in terms of investments on the development and test (experiments) of robots. In addition, there will be more qualified workers available in the future, which may ease both the development and adoption of robots or other complex digital tools by farmers. At the same time, there will be a political pressure for further reducing the use of pesticides in the conventional sector, which may indirectly affect the organic sector. In fact, this scenario would likely lead conventional farmers towards the use of (more) digital tools, which would in turn affect the organic sector through spill over effects. Furthermore, the legal terms regarding the use of digital tools, e.g., robots that could hurt careless walkers, will be clearer. This can also affect positively on the digitalization trend. Then, the entry and maintenance costs, which are a barrier to adoption, are expected to decrease. This is usually what we observe as technologies are being "democratized". In the same vein, the ratio cost-efficiency/performance of digitized weed control is expected to improve. Furthermore, the selling prices for organic vegetables, that can obviously influence the digitalization trend, are assumed to remain stable; and the market pressure is also expected to remain stable. Moreover, weeds will be more resistant or unresponsive to available synthetic pesticides, which is likely to lead conventional farmers to find alternative solutions including digital based ones. This, in turn, will positively affect the organic sector (spill overs).

II. Bad scenario

In the bad scenario, there will be fewer qualified workers available in the future, which may undermine both the development and adoption of robots or other complex digital tools by farmers. In addition, it was assumed that the ratio cost-efficiency/performance of digitized weed control will remain unchanged. As already mentioned, it would not be very realistic to assume an increase of that ratio with an increase in cost and/or a decrease in efficiency/performance as it would contradict empirical observations. Furthermore, it was assumed that the market pressure will increase, which could be due to a certain liberalization of the markets and/or of the Swiss agricultural policy.

III. Very good scenario

The same drivers as for the good scenario are used, except that each of them are assumed to be more positive. For instance, the opinion of society on robots would be very high in that scenario.

IV. Very bad scenario

The same drivers as for the bad scenarios are used, except that each of them are assumed to be even worse; however, the driver on the opinion of the society was added.

For instance, there would almost no qualified workers available in that scenario.

5.3 Identify the 2 pathways that will be defined in more detail

The two pathways that will be defined in more details are the so-called 'good scenario' and 'bad scenario' specified in the last section.

5.4 Methodology used to identify pathways

The methodology used was based on the conduct of two workshops. The goals of the first WP3 workshop were to (1) agree on 2 plausible scenarios as combination of different assumptions about the various drivers of change, and (2) develop scenario narratives. Then, the goals of the second WP3 workshop were to draw (1) implications of scenarios for current actions, and (2) validate the scenario parameters and implications. Table 12 and Table 13 respectively presents the stepwise approach followed in each of those workshop.

Table 12: First workshop and methodology used

Time	Length	Cum'	Session/Topic	Method, Material, *Comment*	Goal
13:30	5'	5'	Welcome and Introduction	Welcome by the DESIRA team	Welcome
	10'	15'	Getting to know each other and Getting into the topic	Short personal presentation (background) + e.g. "My dream regarding digitalisation in XXX is…" "My nightmare regarding digitalisation in XXX is…" (1 min each)	Participants know background of all and warm up for discussion Collect any relevant inputs for best/worst case scenario at the end of session 2
	10'	25'	Presentation of the agenda Introduction to scenario planning: Goal of SP in DESIRA Its role for the further project Scenario question Repeat goal for the day	Presentation of agenda and clarifications if needed Presentation from DESIRA team (ppt via Zoom) Clarification questions from participants	Agreement on agenda All have an understanding of the purpose of the workshop(s) and their potential contribution Agreement on scenario question

Time	Length	Cum’	Session/Topic	Method, Material, *Comment*	Goal
	15’	40’	Timeline of past developments	Timeline with graphical material and major milestones relevant to the SQ (technology development, policy milestones,…)	Make people understand how changes in ten years can be
	15’	55’	Introduce draft scenario outlines Questions for clarification	Explain the two draft scenario outlines, and the process how we got there: Explaining drivers of change and the assumptions made.	All participants understand what the two scenarios are and how they were developed
	15’	70’	Break (10-15’)		
	55’ (max65’)	125’	Developing scenario outlines	2 breakout groups, sufficiently heterogeneous; one scenario each. The groups discuss the draft scenarios, make amendments on the assumptions and DOC where necessary to keep them consistent and plausible. Each group filled in a template on Padlet containing: Provisional scenario name (2-5 words) Who are the winners and losers? What are the challenges and opportunities? What uncertainties are present? What predetermined elements exert influence?	Creating two plausible scenarios that include all relevant aspects and perspectives of each participant The scenario name should be something apt and catchy for a wider audience – shorter is usually better
	20’(or10’)	145’	Sharing scenario outlines	A spokesperson from each group (or the chair of the group) will present the key features of their scenario to the wider group with Q and A Discussion in plenary, fine-tuning (anything missing? Disagreements?)	All learn about each scenario and can give their input
	5’	150’ (2h30)	Wrap-up and explain next steps	In session 2 we will ask what it would take to reach at those possible futures	Joint closure of the session
16:00			End of session 1		

Table 13: Second workshop and methodology used

Time	Length	Cum’	Session/Topic	Method, Material, Comment	Goal
13:30	10’	10’	Welcome and Introduction	Welcome by the DESIRA team	Welcome

Time	Length	Cum'	Session/Topic	Method, Material, Comment	Goal
	15'	20'	Bringing back the results of session 1	Present the scenario narratives with their main parts PPT	Participants recall the different scenarios
	10'	35'	Clarification questions, further inputs to narratives	Ask participants for clarification questions and general feedback. More detailed discussions will take place in the following session.	Clarification of narratives, and identification of interesting points
				For "better but not best'" scenario: *"Consider what would be needed to happen in order for the 2031 future scenario to happen"* *For "worse but not worst" scenario:* *"Consider what would be needed to happen in order for the 2031 future scenario to be mitigated"* *Draw a timeline in each backcasting session / on miro* *Write short version of scenario to year 2031* *Mark years in between (roughly)*	
	50'	85'	Explain backcasting timeline Backcasting 1: "good scenario"	Suggest headlines that illustrate different events, political decisions or else leading to the future Decide what you like about the scenario and what you would like not to happen: use the voting system Suggest policies or ideas that will support achieving the scenario or that mitigate risks described in the scenarios: use cards in another colour	Get the full picture of the scenarios and understand their implications for today
	15'	100'	Break		
	45-50'	145-150'	Backcasting 2: "bad scenario"	Suggest headlines that illustrate different events, political decisions or else leading to the future Decide what you like about the scenario and what you would like not to happen: use the voting system Suggest policies or ideas that will support achieving the scenario or that mitigate risks described in the scenarios: use cards in another colour	Get the full picture of the scenarios and understand their implications for today
	10-15'	160'	First ideas on extreme scenarios: worse and best	Quick exercise for extreme scenarios: In plenary, participants should imagine the best and the worst possible scenario. Let the group quickly discuss which would be the best and worst, but still plausible scenario. As quickly about ideas/policies that can support the "dream" scenario or mitigate the "nightmare" scenario	Develop a rough idea about best and worst case scenarios Have fun and hear more arguments of the participants regarding the scenarios

Time	Length	Cum'	Session/Topic	Method, Material, Comment	Goal
16h15	5'	165' (2h45)	Closing	The next step will be to develop digital stories.	Closing the workshop Outlook
16:15			End of session 2		

5.5 Relevant feedback from participants

No specific feedback was provided by the workshop participants. Everyone agreed on the agenda of the day in each workshop.

6. Scenario Narratives

6.1 Name Scenarios

For analytical purpose only, the 'better but not best' scenario is called 'good scenario' whilst the other main scenario is called 'bad scenario'. In practice the 'good scenario' is named '**Small is beautiful!**' whilst the bad scenario is named '**Back to dairy industry**'.

6.2 Two detailed scenario narratives

I. Good scenario: Small is beautiful!

The society will be increasingly open towards digitalization and robots in the future. In other words, there will be an increasing recognition/acceptance of digitization. This will happen by showing to them that less pesticides is needed using good examples. People will also be more open because it will become clear that digitization in agriculture brings advantages in other areas of life, e.g., on autonomous driving. Furthermore, there will be a 'trivial' reason for this evolution, which is that more and more people will be 'digital natives'; in other words, a growing number of people will have grown up in a largely digitalized world, thus increasing digital literacy and the 'hunger' for digital tools. Having said that, it has also been mentioned that the increasing recognition/acceptance of digitization is not the most important DOC and that economic factors are probably more important.

Also, there will surely be a change in the availability of the skilled workforce. The manual labour will decrease and the number of skilled workers will increase. However, it is not entirely clear whether these skilled workers will be actually available for agriculture and vegetable growing in particular. It is expected that these workers would rather be active in support functions outside of agriculture (in an advisory role). At the same time, the labour costs of skilled workers will require more added value in agriculture.

Then, the political pressure for less pesticide will increase, which is already going in that direction. But this increased pressure may also be at the expense of the differentiation between what is organic and what conventional agriculture is. In other words, people may not consider organic to be different to conventional any longer. That said, the organic sector is expected to benefit from the broader development of technologies (cheaper and faster development) that takes place in the conventional sector.

Data protection is and will remain an important theme. There is already resistance to tech giants, which means that such issues are expected to get better. This hope is also supported by the fact that the Swiss legislation is based and/or inspired from the legal situation that applies in the EU (and not in the USA).

Costs will decrease with a certain critical amount. Cost-efficiency is always better developed than the technology itself. It has been the case with many digital products, as a result of the fact that they are used more and in a broader area of work. In that respect, organic farmers will also benefit from the further development occurring in conventional production.

Weeds, including invasive ones, will be even more resistant to pesticides in the future. This will have an indirect influence on weed control in organic farming, in combination with social pressure for mechanical weed control.

Finally, the international pressure will remain stable and vegetable prices will remain stable. The market pressure will remain stable thanks to the introduction of digital technologies. By the way, another important factor leading to the adoption of robots is the high labour costs.

These positive changes will ease the development of robots and digital tools as well as their adoption by farmers. The robots developed are expected to be relatively small ones, which are easier to manipulate and more reliable. The increased adoption by farmers will be of particular importance for smaller farmers, which have less financial capacities. Smaller farmers will be the big winners (small is beautiful!). It will be made possible for smaller farmers as cooperation among them is likely. In other words, they can share some of the costs, learn from each other, and share the labour. The small size of Swiss farms as well as the diversity of soils make it difficult for machines to operate. But the technology will evolve and become more suitable to the Swiss conditions and to small fields. This includes being able to deal with slopes, including in mountain areas. This evolution will be favoured by a steady or even increased amount of money invested into new and/or adapted digital tools to control weeds.

Several benefits will occur along the pathway. Technology companies will make more money but will also have to invest more. Farmers will produce better quality products (due to less competition from weeds) using less manual labour, which will at the same time increase their economic return. Swiss soils will be less polluted due to the decrease in the use of pesticides on conventional farms. In fact, there will be synergies and spill overs between the conventional and organic sector in terms of the development and use of robots and other digital tools dedicated to weed control. Soils will also be less compacted by the use of heavy machines. Robots are lighter than tractors and other heavy equipment. More generally, this digital trend is expected to protect more the environment, however it must be noted that the question of resource use (fuel, oil, etc) was not specifically discussed. The DOC on resource use was dropped because it was not found very relevant and the relationship with digitalization could be clearly established. Nevertheless, it has been highlighted that electric drivers are being promoted, thus reducing the consumption of natural resources. Furthermore, due to the increasing use of digital tools and robots, both manual labour and physical stress will be reduced. Moreover, consumers will be offered higher quality products for the same price. Finally, the trade will also benefit as the production can be planned more easily. This improved planning actually applies to the whole supply chain.

This scenario, however, does not come without any challenges and issues. First of all, there is a risk of 'addiction' in terms of the use of digital tools. There is also a certain cost of investment for farmers, especially smaller ones. But they often share robots or other technologies with other farmers. At the same time, those who do not want to adopt the new technologies will 'fall behind'. There will be a 'push' from tech suppliers on leasing and renting. On the one hand, this will reduce entry costs but on the other hand it will increase dependency of farmers choosing this option. This issue of dependency also applies to the question of data protection. Farmers are interested in the manufacturer having the data, but they also want data sovereignty i.e. that data remains with the farmer. The farmers choosing the option of renting or leasing will primarily be smaller farmers. There will be a need to consider small and bigger farms differently from a policy standpoint.

Moreover, technical development is uncertain and the hacking protection may be disastrous. Devices must be secure (legally compliant). Big robots will have to always be monitored. They are not self-driving and have limited decision-making skills. As the conditions (weather, soil, what the robot has to do) can vary widely, robots have to be very adaptable. This will be an important challenge. Otherwise, it would require different robots for different conditions, which is not an ideal option from an economic viewpoint.

The guidelines or ideas that may support the achievement of the scenario and reduce the risks are as follows:

- Communicate the advantages of digitization in agriculture (fewer workers, more domestic production, etc);
- Different representation of agriculture in advertising (digital representation) – Currently, mainly large distributors have a tendency to communicate on the original image of agriculture;
- Innovation promotion (already done in Switzerland);
- As the conditions (weather, soil, what the robot has to do) can vary widely, robots have to be very adaptable
- Need to consider small and bigger farms differently from a policy standpoint
- Make the legal environment open to innovations (willingness to take risks);
- Integrate digital specialists in teaching, consulting and agricultural journalism
- Public discussion of data protection policy (what do you want to protect and how?)
- Organic farming to be further developed
- Robots contracting would be particularly attractive for small businesses
- Small businesses that do not want to digitize have to orientate themselves differently (gastronomy, tourism, direct marketing, etc.).

II. Bad scenario: Back to dairy industry

The development and adoption of robots by farmers requires specific skills and IT qualified workers. There is currently a lack of IT qualified workers, particularly on farms. Here it is assumed that there will be even less qualified workers available in the future. In addition, agriculture can hardly pay for skilled workers – The competition against other industries is too important and agriculture is not attractive enough for these people. Also, the ratio cost-efficiency/performance of digitized weed control will remain unchanged. In other words, the digital tools will not outperform alternatives when adjusting for the cost evolution. Then, the national and international competitive pressure will increase due to more liberalized markets.

Despite the negative nature of the scenario, some benefits will occur along the pathway. First of all, if the robots and other digital tools are not outperforming alternatives or promising enough, it will open opportunities for alternative innovations and combined processes (e.g. electricity, physical barriers and sprays, remote sensing, DSS, forecast models, etc). These opportunities will particularly apply to the young entrepreneurs who are known to be more innovative and more open to innovation. In order to remain competitive, precision farming may be further developed in parallel. More generally, the potential for innovation in agriculture is stimulated, and previously unexploited potential becomes both more mature and profitable. This will also increase opportunities for students and training: Going back to the 'roots', the question to be asked will be: How can I mechanically control the weeds? This is in fact an opportunity to gain knowledge or 'technical know-how' that has been lost over the past decades due to the use of herbicides that does not require much of this knowledge.

In addition, a 'provocative' benefit is that it will be easier for farmers since they would not have to deal with complex digital tools and robots. They can continue doing what they do the best. But it does not mean that digitized weed control will be the norm in 25 years. It is believed that the challenges associated to this scenario may still lead to long-term changes, but this is a much more gradual evolution, a very step-by-step process of change. Sometimes, smaller steps are actually better than big ones.

Furthermore, less investments will be required since it would not be profitable to do so. In this scenario, there is also no new technology actor entering the market as it is not promising. This has the positive side effect that existing tech companies are consolidating their position on the market. Even though they will not necessarily make more money, they will not be losing much. Moreover, pesticides and herbicides suppliers will profit from the 'digital crisis': The use of pesticides will be perceived as an easier way to continue dealing with weeds. Yet, the trade and consumers will benefit from a more liberalized market. At the same time, this will be an opportunity for land-political transformation, for an optimal allocated use of the landscape and thus for protecting the environment.

This scenario, however, will obviously lead to substantial challenges and issues. First of all, it will be very difficult for Switzerland to withstand international pressure, thus undermining the viability of the organic vegetable sector. Most impacted farmers will be smaller ones, quite logically, as opposed to the positive scenario where they are the ones benefiting the most. This will lead vegetable production to be relocated abroad. There will be more pressure from the World Trade Organization and there will be a dismantling of border protections (tariffs, quotas, etc). The reduced profitability of the Swiss vegetable sector is leading to more difficulties for technology or machinery companies in advancing innovations because there will be fewer users. It is also believed that this situation will lead to a certain specialization in niche, specialty and high-priced products.

Consumers benefit from lower prices but there is no more regionality of the food and control becomes less possible, leading to less transparency; distance to production becomes even greater. It will be challenging to keep customers around when they will realise that the Swiss production has become even less competitive in Europe and that they can buy much cheaper food from abroad. This lack of competitiveness will be even more evident once customers have fully integrated the "true cost of food" which includes the cost of side effects induced by the use of pesticides. That said, there is an uncertainty as to whether this concept of "true cost of food" will be appropriately communicated, so paradoxically, this might not be a problem.

The international point of view or global influence of Swiss agricultural research is becoming less important; there will be less space for manoeuvre and a greater pressure to innovate at home. The need for other solutions / other innovations to maintain the competitiveness and viability of the sector will worsen the financial situation of the some companies. In effect their debt will increase as higher investments will be needed in order to maintain the production. There will be a specialization pressure to produce what is the most profitable at given locations; which will actually be an opportunity for the dairy sector to re-gain in importance. This can also be a driver for political transformation, with changes in the use of the landscape, making productions more efficient. In other words, this will likely lead to a more optimised land use. Production will be closely adapted to the locations, and the use of the space will be optimized. This might lead to negative impacts on the environment, but it is unclear – It depends on which production is going to be replaced.

Future generations would be 'losers' as well as farmers who have already invested (but the technology does not bring any progress). However, it is not that many businesses that will be affected; it will mainly concern companies that have made pre-investments (which currently does not hold up, what it costs). This is primarily a concern for the most innovative farmers.

The guidelines or ideas that may support the achievement of the scenario and reduce the risks are as follows:

- Reduce the approval of synthetic pesticides or herbicides - Innovative alternatives (and breeding!) must be encouraged
- Reconnection of town-countryside and producer/manufacturer-customer as well as rethinking the marketing strategy in order to increase acceptance in agriculture and increase awareness of the society
- Increase efficiency, but the way of doing it remains a question mark
- Support for new innovations by agricultural research (FiBL, Agroscope etc.)
- Further training for optimized crop management for farmers
- Promote the diversification of farms with direct payments
- Research projects in practice (where e.g., the federal government assumes the costs of investments)
- Promotion of innovations by taking into account the conditions in Switzerland:
    - Protection of the Swiss market (tariffs, etc),
    - Maintain the goal of a high domestic supply,
    - Support organic vegetable prices,
    - Make the attractiveness of agricultural robotics visible e.g., in training, internships, companies.

6.3 Name and write the less detailed ‘best case’ and ‘worst case’ scenarios

Due to limited time in the second WP3 workshop and to the fact that it was conducted online, rather limited insights have been collected on both the very good and very bad scenario.

I. Very good scenario: Impossible is not Swiss!

The society will be very much open towards digitalization and robots in the future, and there will be a rapid technological progress.

Also, the manual labour will decrease and the number of skilled workers will increase considerably. These skilled workers will be available for agriculture and vegetable growing in particular. The labour costs of skilled workers will require more added value in agriculture, which will be the case.

The political pressure for less pesticide will increase considerably. The organic sector is expected to benefit from the broader development of technologies (cheaper and faster development) that takes place in the conventional sector.

Data protection will be a very important theme. There is already resistance to tech giants and such issues are expected to get much better. The legal framework will be very well clarified with respect to liability and data protection.

Costs will decrease considerably. Cost-efficiency is always better developed than the technology itself. It has been the case with many digital products, as a result of the fact that they are used more and more and in a broader area of work. In that respect, organic farmers will also benefit very much from the further development occurring in conventional production.

Weeds, including invasive ones, will be very resistant to pesticides in the future. This will have an indirect influence on weed control in organic farming, in combination with social pressure for mechanical weed control.

Finally, the international pressure will be less important, which will be due to the great innovations taking place in Switzerland. The vegetable sector is becoming more profitable and there is enough money for investments. Investments are made at low cost.

II. Very bad scenario: Digital nightmare

The development and adoption of robots by farmers requires specific skills and IT qualified workers. There is currently a lack of IT qualified workers, particularly on farms. Here it is assumed that there will be almost no qualified workers available in the future. In addition, agriculture will not be able to pay for such skilled workers – The competition against other industries is very high and agriculture is not attractive for these people.

Also, the ratio cost-efficiency/performance of digitized weed control will increase. In other words, the digital tools will become less performant when adjusting for the cost evolution.

Then, the market pressure will very much increase due to more liberalized markets and a Swiss agricultural policy that will become less protective in terms of custom taxes.

This situation will be leading to:

- An absence of technical progress
- Machines are still not adapted for Switzerland (Swiss vegetable growing at a disadvantage)
- A decline in vegetable growing in Switzerland

In addition, it was imagined that there will be an anti-technology mood in society and a ban on autonomous devices.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.9 Greece (Trikala)

SCENARIO WORKSHOPS

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Scenario workshops reporting template

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1. Living lab summary

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

1.1 Name of LL

Sustainable Water Management Living Lab

1.2 Brief summary of LL

Water is a resource of high importance for the region of Trikala, as water streams both directly affect the primary sector (agriculture, animal husbandry) and the tertiary sector (tourism), as well as recreational activities and the overall wellbeing and sanitation of the citizens in the prefecture. The Sustainable Water Management Living Lab operates in the region of Trikala which largely faces no water scarcity issues. The amplitude of water resources in the region can cover the agricultural and everyday needs of citizens. However, local authority representatives have realized that the current water management practices are sub-optimal and inadequate to ensure a mid-long term sustainable use of water resources for the region.

The most prevalent needs highlighted during the course of this Living Lab are the following:

- Increasing the collaboration between the regional water management authorities
- Reducing the fragmentation of roles and responsibilities in the monitoring and management practices of water supplies
- Need for a revised regional/national regulatory framework
- Increasing the level of public awareness of sustainable water management practices
- Emphasizing the adoption of digital tools to amplify administrative coordination and raise public awareness

The Municipality of Trikala has witnessed a gradual uptake of smart services for improving the daily life of its citizens, however water management in the region requires attention by the regional, and municipal authorities as well as administrative agencies.

1.3 LL participants

A variety of participants contributed during the preparatory activities and the scenario development workshop. Different actors already involved in the Living Lab (i.e. during the NEI activities and workshop) significantly contributed to the formation of the scenario question, DOCs and timeline exercise. Furthermore, several new interested individuals were selected based on their experience, relevance with the LL context and expertise. The LL's scenario development engulfed a multitude of actors that come from the fields of policy making, farming, research and innovation, agronomists, Trikala's public administration agencies, as well as environmental and sustainability researchers.

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1.4 Timing of Scenario Planning (WP3) workshops

One face to face scenario development workshop was conducted on the 3rd of December 2021. The event was hosted at the National Kapodistrian University of Athens providing the additional option for remote participation to alleviate potential in-person exclusion due to Covid-19. The event took place from 10:30 to 13:00 CET and counted 13 participants (eleven participated in-person and two joined virtually) that contributed to the development of the future scenarios that will be described in more detail throughout this report.

2. Scenario question

2.1 Draft scenario question

'How can digital tools impact the management of water resources in relation to Trikala's farming, rural & urban needs in 2031?'

2.2 Finalised Scenario question

The Scenario question remained the same since the LL participants agreed that the scope of the question served the purpose of the workshop well.

2.3 Methodology used to finalise scenario question

The Initial Living Lab's focal question *'How can digital tools impact the management of water resources in relation to Trikala's farming rural & city needs in the next decade?''* served as a basis for the development of the scenario question. The scenario question is articulated with the aim to create a future vision in the next ten years. A future expression of the focal question was prepared and presented in draft to the Living Lab's stakeholders as a first step to commence the scenario development activities. The draft scenario question was circulated to the actors of the past NEI activities as well as to relevant individuals that showed interest in participating in the forthcoming scenario development activities. After providing a period of fifteen-days for stakeholder's feedback on the scenario question, the conclusion was that the scenario question did not require any changes.

2.4 Relevant feedback on scenario question from participants

In both the preparatory stage and during the scenario development workshop the stakeholders of the Living Lab and participants of the workshop approved the scenario question.

3. Relevant past events

3.1 List of relevant past events

The events listed below are laid out in rough chronological order.

- Period of 2000-2004 First innovation and digital actions leading to the ‘award’ the city of Trikala as the first digital city of Greece
- Participation of Trikala to EU research projects
- ICT facilities that in-house R&I are established in the region
- Realisation that ICTs are underutilised when it comes to providing solutions and services to the local governance of the region
- 2014 inception of the Smart-Intelligent transformation that will put citizen’s need to the fore and use ICTs as tools to strengthen the regions’ governance and public services
- First sensors to monitor water quantity and quality are installed in selected spots of Lithaios riverbanks.
- 2018, launch year of EU’s Digital Cities Challenge initiative, including Trikala’s participation facilitating the further promotion and development of ICT solutions tailored on the region’s needs
- 2020, adoption of a smart watering metering system initially from the municipality of Trikala and subsequently adopted also by the 3 smaller municipalities of the prefecture
- 2019,Trikala is the first Greek region to run a 5G pilot project that is expected to provide a significant boost in remote management systems in the upcoming years.

3.2 Description past event activity

The selection of past events was based on the relevance of historic milestone events to the Living Lab’s focal and scenario questions at the regional and national level. . The focal and scenario question of this Living Lab concern past, present and future events that have affected or might affect water management practices in the region, while in parallel investigating the level and impact of digital to analogue transition. Having as a reference the work that was conducted during the Needs Expectation and Impact Appraisal activities and supplementing this work with a dedicated meeting with the Living Lab’s contact point, we concluded to the definition of nine milestone events that best depicted the historical context that instigated or affected the digital technology uptake in the region’s water management practices. These events were included as checkpoints in a thirty-year timeline (roughly 2001-2031) enabling the time lapse visualization of the agricultural evolution in the region and introducing the scenario development concept to the workshop’s participants.

3.3 Relevant feedback from participants

For the finalisation of the past events selection, input and feedback received from the participants of the previous LL NEI workshops was also taken into consideration. Discussions with the participants that revolved around topics such as,

the collection of water related data and data management practices,

inefficiencies of the existing water management and irrigation network,

possible solutions to regional needs that can be achieved through joint actions of the local governments and citizens,

helped us to better understand and define the existing gaps in water management and subsequently compile the list of the selected past events.

4. Drivers Of Change (DOC)

4.1 List initial set of DOCs

Below is a list of the initial Drivers of Change (DOCs) that were identified by the Living Lab coordinators during the past NEI and Scenario Development activities:

- Expression of interest from young productive workforce originating from the region to be resettled under suitable conditions.
- Prospect of reversing the age structure in the primary sector with a parallel restructuring-modernisation of exploitation methods.
- Low level of digital skills amongst Trikala's population deems the adoption of Digital solutions both as a challenge and opportunity, necessitated by the need of sustainable water usage.
- Digital solutions for better water management practices can lead to the further inclusion of women in the decision-making processes coupled also with their further involvement in social -agricultural and other business activities traditionally occupied by men.
- Increase of the degree of user's engagement and overall civil satisfaction from Trikala's social services is a focal axiom in Trikala's 'smart' transformation.
- Existing capacity and digital infrastructure in the region support the deployment of plans for integrated sustainable development actions.
- Trikala's Smart city agenda focusing on the introduction of digital solutions to measure, monitor and enhance Trikala's performance.
- Spotted gap and identified need by the local authorities to facilitate timely provision of information exchange for integrated water management actions.
- Evolving culture of bringing together different groups of people to co-create digital tools that provide sustainable solutions to address local challenges.

- Local Innovation hub 'GiSeMi HUB', focusing on IoT and AI applications as well as the development of digital services.
- Willingness to introduce new mechanisms to the local Organizations of Land Reclamation (OLR) that will strengthen the water usage monitoring and enable more efficient financial administration.
- Strong dependency from shared water resources of the primary sector economic activities creates the need to minimise the negative externalities (e.g. residuals from agriculture affecting animal husbandry & vice-versa).
- Initiation of the new ΕΣΠΑ partnership agreement of development framework 2021-2027 supported by the European Social Fund and European Regional Development Fund.
- 2021-2027 European Rural Development Funds funnelled through the financial management of CAP to the eligible beneficiary regions/orgs/stakeholders.
- Intensification of local production to ameliorate the worker's income is putting pressure on the natural resources necessitates the establishment of control mechanisms.
- Spotted need to monitor and reduce the excessive amount of irrigation water spillage.
- Alteration of the region ecological habitats, flora and fauna handicapped by the lack of established solutions for environmental protection and sustainable resource management.
- Implementation of the Inter-Local Cooperation Plan "Integrated Pesticide Packaging" which concerns the search for ways to optimally manage the used pesticide packaging and the drastic reduction of water pollution.
- Municipality of Trikala is the 1st district in national level to sign the 'European Circular Cities Declaration'.
- The city of Trikala through the 'CIRC4FooD' project, studies and develops a pilot on agri-food systems inspired by the circular economy methodologies and tools that combine rainwater harvesting, while reducing the environmental footprint.
- Region's strong tendency to adopt innovative ICT solutions.
- Willingness of the region's water management agencies to establish data sharing and collaboration routines.
- Alignment with the objectives of the new CAP for 'Fostering sustainable development and efficient management of natural resources such as water, soil and air'.

4.2 List selected DOC

From the Drivers of Change list described in the previous section, all twenty-three were signified by the Scenario development workshop participants as important factors for instigating the LL SCP system’s change. Therefore, twenty-three drivers were kept and incorporate into the Morphological

Box ‘assumptions’. An initial driver ‘’Create agroecosystem multifunctionality and add ecosystem services to the region’’ was discarded from the initial set of drivers.

The final list of drivers that serve as assumptions in the formation and completion of the morphological box includes the following six drivers:

External

- Change of the demographic profile of Trikala's rural areas as a result of the resettlement of young productive workforce originating from the region.
- Administrative and technical restructure of the irrigation management system.
- New CAP on 'Fostering sustainable development and efficient management of natural resources such as water, soil and air'.

Internal

- Collaboration processes between the region's water management agencies and authorities.
- Transferring the Smart Trikala's city approach in the rural & agricultural settings.
- Local Innovation hubs and Trikala's participation in EU projects.

4.3 Describe methodology to select DOC

As a first step for assembling the initial list of 23 Drivers of Change, a detailed review of the NEI report, workshop meetings notes and post-evaluation meeting with the Living Lab’s Contact Point (eTrikala and GiSemi Hub) took place. The main elements and driving forces of the SCP system were identified, described, and elaborated extensively while conducting the Needs Expectation and Impact appraisal activities.

During the initial identification of DOC, the following criteria were applied:

- Drivers can affect positively or negatively the system
- Motives, interests, and aims of the actors in the system cause implications and shape the dynamics of the system
- Identify the areas where the coupling of the needs and expectations with digital transformation of agriculture is taking place or can take place in the future
- Take into consideration the current and future external forces of the system and envisage the evolution of the internal roles of the system

As a follow up, for the further categorization and expression of DOC, the STEEP analysis was followed to ensure that the drivers were covering a wide range of the system’s domains. Aiming for the formulation of approximately 5 drivers for each STEEP category, the first draft of 23 Drivers of Change was presented to the Scenario Development workshop participants. After the DOC presentation, with the use of an online form, the participants were asked to review, rank, as well as provide feedback, to the initial DOC set. The review process and ranking of DOC results were used to identify the convergence around crucial concepts of change and base the further clustering and categorization to three internal and three external drivers respectively.

4.4 Relevant feedback from participants

Feedback was received via the disseminated google forms to the participants and processed before proceeding to the formation of the morphological box.

5. Matrix

5.1 Matrix description

The morphological box is consisted of four columns and ten rows that contain the core content of the future scenario-pathway creation. The first column consists of the sub-set of drivers of change that were described in section 4.2 of this report and form the basis on which the range of assumptions-projections of a positive, negative or relatively unchanged (BaU) future is built on. Therefore, each row contains a selected driver that acts as the factor of future change followed by three projections that range from positive to negative. In each row, the two highlighted cells (red and green) indicate the selected option of the participants for a possible negative (red) or positive (green) future regarding the specific driver. The sum of the green highlighted cells forms a complete positive future scenario pathway and similarly the sum of the red highlighted cells forms a complete negative future scenario, both scenarios though having as a common denominator the six (three internal and three external) drivers of change previously selected for envisaging the two future states.

Assumptions	Plausible positive	Bau Assumption	Plausible negative
External Drivers			
Change of the demographic profile of Trikala's rural areas because of the resettlement of young productive workforce originating from the region.	New local businesses develop new tools and services for water management and irrigation	Population re-established in the region are involved in a wide range of activities. Not all of them involved in the primary sector.	Unpredictable impact of the mix of existing population and newcomers to the digital water management. High risk to increase the digital divide gap in the region.
Administrative and technical restructure of the irrigation management system.	Rural Development Plans support the modernisation of the OLRs.	Centralised directives for OLR management without following co-decision making processes.	Water irrigation is taken over by private companies.
New CAP on 'Fostering sustainable development and efficient	The completion of Rural Development Programmes and EAFRD funding programmes leave a stock of	CAP is localised through the Rural Development Programmes. Alignment	Lack of organised transition period after the completion of the CAP 2021-2027 into concrete regional development actions.

management of natural resources such as water, soil and air'.	water resource management initiatives and actions.	with region's needs and problems.	
Internal Drivers			
Collaboration processes between the region's water management agencies and authorities.	Establishment of data sharing processes and platforms that favour transparency and further data analysis.	Individual water management plans across a multitude of public agencies. Coordination among agencies suffers from Lag and difficulty to establish flexible communication routines.	Separate hardware and software procurement plans. Lack of whole scale interoperability plans and transparent procedures leads to vendor locking.
Transferring the Smart Trikala's city approach in the rural & agricultural settings.	Water management authorities implement smart irrigation plans. Farmers and citizens receive the analysis of useful data visualised and displayed in way that are informative both on economic and environmental decision making.	Difficulties to Integrate the remote water management system with the e-Government management systems.	Inadequate support regarding the techno-financial, cultural, and behavioural aspects for facilitating smart solutions in the regional public authority routines and citizen life.
Local Innovation hubs and Trikala's participation in EU projects.	Water related technologies are becoming a focal interest for Trikala's participation in future EU projects and R&D actions of the local incubation centres.	New public-private partnerships provide the finalised IoT & ICT products-services to the interested stakeholders.	Further adoption of tools and services require resource-intensive investment and regional planning. Innovation actions become self-referenced and in conjunction with the change of the demographic profile public inclusion to the innovation outcomes is not safeguarded.

Table 5.14 Morphological Box & Scenario Pathways

5.2 Define 4 pathways/scenarios selected

Four pathways were developed for the purposes of the scenario development activities of this Living Lab. Two articulated scenario pathways are developed and encapsulated in the morphological box (Table 5.1), fully developed by the participants of the scenario development workshop. The aim was to create two complete future pathways having as base of reference the internal and external drivers that were selected as assumptions for envisaging the future. As a result, one positive and one negative pathway was highlighted out of the range of options included in the morphological box. These two pathways should be regarded as the better (positive) and worse (negative) case scenarios and serve as a backbone where the LL's SCP system strengths and deficiencies as well as threats and opportunities are projected in the future through the prism of a digital future in agriculture. Two additional scenarios are developed by the coordinators of the scenario development workshop aiming to articulate the extreme future projections of a utopian (best case) and dystopian (worst case) future. The outline of the two 'intermediate' scenarios of the morphological box as well as an extensive narrative exposition of all four scenarios will be analyzed in the following sections of this report, showcasing a whole spectrum of different better or worse 'futures' in respect with the digital transformation of agriculture in the context of this Living Lab.

5.3 Identify the 2 pathways that will be defined in more detail

The Morphological Box was used to engulf the combinations of assumptions in a matrix form and provide a practical layout to showcase the sum of the building blocks that form the two highlighted scenario pathways. As it can be observed in the 5.1 section figure, two scenario outlines were created in total during the workshop with the green cells representing the outline of the positive scenario and the red cells representing the outline of the negative scenario.
The *positive* pathway revolves around a future where a family takes a decision to relocate from Athens in the region, planning to utilise the land in their possession and get involved in the agricultural business. Their introduction into Trikala's rural environment and initiation of agricultural activities is facilitated by the digital developments that have been introduced in the region and gradually accumulated during the last two decades. ICT tools and infrastructure have provided a significant boost to the digital capacity of the region, strengthened the public inclusion mechanisms in the decision-making process at local level, and enabled new crucial services to the local farmers and business, creating space for new agricultural value chains, and overall speeding up the Smart Transformation process of the Trikala region.
The *negative* scenario revolves around a future where a digital future in Trikala is reached in a high degree. However, digitalisation and the Smart evolution of the region have shaped negative synergies for the society and agriculture in the region. The scenario is narrated through the eyes of a young farmer relocated in the rural region of Trikala in 2017 opting to start a new cultivation and facing the first negative impacts of digitalisation when the regional authorities plan the further adoption of digital solutions for resource management and more specifically on water usage. The diversified demographic profile in the region in conjunction with the inability of public authorities to deploy an integrated digital transformation plan forms a significant obstacle for the further adoption of ICTs to promote sustainable practices and ultimately leads to a dysfunctional Smart transformation that does not promote inclusion, transparency, and focused adoption of digital solution to serve the water management needs and sustainability of the region.

5.4 Methodology used to identify pathways

In continuation of the DOC consolidation, a sub-set of six drivers were selected and divided into two categories of internal and external with respect on their endogenous or exogenous impact on the SCP system. The set of these six drivers served as the assumption basis on which the participants of the workshop formulated the range of positive and negative future projections-expressions of the morphological box. Each driver was transposed in a ten-year future timespan and led to five future projection outcomes ranging from plausible positive, positive, Business as usual, negative and plausible negative. After the completion of the morphological box's content and definition of the whole range of future options of the SCP system, given the specific set of internal and external drivers, the participants of the workshops were split into two groups (trying to maintain role diversity to a greater extent) with one group having the objective to formulate a negative future pathway and the other group a positive pathway. Open team discussions followed applying a majority option selection where consensus could not be achieved, the groups highlighted one choice per driver creating a complete negative pathway (sum of the red highlighted cells) and a complete positive pathway (sum of the green highlighted cells) respectively. Subsequently the groups had some more time to review the whole pathway they created and add narrative further developing their future projection choices.

Finally, a person from each team was selected to present the team's pathway, brainstorming process and narrative to the rest of the workshop's participants.

5.5 Relevant feedback from participants

No relevant feedback was received from the participants.

6. Scenario Narratives

6.1 Name Scenarios

The following names were given to the four distinct future scenarios that were developed for the purposes of the scenario development activities:

Worst case scenario – Dystopia: *Common goods in private disposal.*

Best case scenario - Utopia*: Digital vision - citizen adoption – focused public administration, the trifecta of data driven water.*

Better than Business as usual scenario-Positive: *Reformation of Rural life through Smart-Digital transition.*

Worse than Business as Usual scenario - Negative: *A 'not-so-smart' implementation of smart transition.*

6.2 Write the 2 or 3 detailed scenario narratives

(Negative) A 'not-so-smart' implementation of smart transition

My name is P.

I am a graduate agronomist and aspiring young farmer of twenty-seven years old. In 2017 I relocated from the big city that I used to live in, to the rural side of Trikala's region. The main reason behind my decision for moving into Trikala's region was the, almost two decades now, smart culture that the region has built through various digital and modern interventions and solutions that affect several aspects of the citizen's life. This fact seemed like a promising prospect for achieving the plans that I have for my agricultural business involvement. Unfortunately, my experience the past three years where I live the life of farmer and producer, is not what I expected. Though the region continues its active involvement and support for the adoption and development of smart-digital actions and solutions heavily focused in the water management and other aspects of agricultural business and citizens life, the decision-making process is strictly top-down structured. This means that the public authorities in the region follow and deploy the region's development agenda for farming, agriculture, and digital uptake without however ensuring the inclusion of the citizen's-farmer's-producers in the decision-making process. Our exclusion from the decision-making process causes a friction among us younger and older in age farmers. In the rural and agricultural regions of Trikala resides a diverse mix of people that vary from younger individuals, newly involved into the farming business with a strong willingness to support new agricultural methods, to older people born and raised in the region that follow traditional agricultural practices. Water is one of the most important agricultural resources and one that we use communally, and to safeguard a sustainable agricultural ecosystem in the region besides the modernization of agricultural processes also the local farmer's collaboration is essential. In this front, the government agencies of the region follow an administrative approach result in the widening of the regions digital skill gap. We younger farmers are able to follow the digital transition actions that aim to optimize water management practices and that translate into regional policies or directives, leaving however the less digitally capable farmers in a difficult spot to adapt. This whole situation also translates into tense relations among us, who beside citizens are also actors operating in the same regional supply chain, ultimately harming the overall agricultural development of the region. Moreover, another important obstacle for the facilitation of Smart water management services that I have observed is the severe lack of intra collaboration, communication, planning and practice among the region's public administration and water management agencies. The digital technologies and interventions that often bring new water management practices are for the most part developed and introduced from private sector technology providers and research institutions that form public-private partnerships with the government agencies of Trikala. In that regard, the regional authorities and water management agencies are mainly entitled for facilitating the public adoption and citizen use of the digital practices designed for the sustainable resource management. Without them assuming an active role in the design process to allow tailor made solutions that fit the region's needs, the gradual and cohesive evolution of digital service adoption is becoming more difficult. This in turn leads to newly introduced services being heavily market driven and ultimately not very useful or practical for covering the citizen's needs, and moreover creates a technological lock-in to practices and methods of the past impeding the transition to new smart solutions. By examining water resource management from a macro view, it is safe to state that smart digital solutions play an integral role to achieve sustainable water usage, however the introduction of digital solutions and adoption, needs to set a solid framework from the public sector that will enable a continuous citizen training and education program as well as the display of clear short and mid-term economic-social and environmental benefits. Moreover, the same support must be provided at the municipality level across the prefecture of Trikala. The three smaller municipalities that account for most of the rural and agricultural landscape of the prefecture have never been able to follow the pace of Smart transformation actions adopted in the municipality and city of Trikala. The deployment of horizontal support actions must aim the restructure and modernization of the public sector agencies operating in the smaller municipalities. Trikala is now suffering from a vast fragmentation of water management practices across various public agencies and coupled with the lack of technical and economic support, results to a landscape that is lacking from meaningful sustainable water management actions. The absence of an integrated digital service adoption plan leads also to partial and uneven citizen support, underutilized tools that are products of self-referenced innovation process, and services that are primarily benefitting market deals and secondarily improving the citizens everyday lives, ultimately creating inequalities and citizen's exclusion from public services that are dependent from individual digital literacy levels, skills, and capabilities.

(Positive) Reformation of Rural life through Smart-Digital transition

My name is P.

I originate from a small village that is located in the rural area of Kalampaka, one of the most well-established small towns in the region of Trikala. After the Covid-19 pandemic, I started contemplating my relocation from the city of Athens back to my home village, and finally after almost a decade we took the decision and moved in with my family. My plan is to change career and make a new start getting involved with agricultural production, exploiting a sizeable piece of land that I have in my possession near in the outskirts of my village.

To our surprise, we found that the whole region of Trikala has made big progress in the adoption and deployment of digital tools and especially on services focused on water management for irrigation and other agricultural uses. Hubs and research institutions that operate in the region are viewed as important innovation cluster and along with the local governance support and successful public-private partnerships, the region has managed to nurture the shift towards a circular economy model.

Public-private fundraising subsidies has created incentives for local businesses to move from linear to circular business models and more importantly citizens are appreciating these multilateral agreements seeing them as a foundation for Trikala's sustainable development. A prime example is the closure of many small, obsolete and not economically viable OLR's (Organisations of Land Reclamation) and the subsequent assignment of irrigation water management-monitoring and control of large areas in the region to a private SME that took over the task of the development of a unified irrigation control and water supply system, as well the establishment of smaller individual close loop water treatment systems were needed. As a result, an adequate number of remote sensors are installed in strategic positions in the region, remote water meters installed in the main and tributary rivers as well as in the major water catchment basins. The sensors provide continuous valuable data on the overall water levels- quality of irrigation water- foreseeable risks for riverbank flooding, as well as weather and meteorological data for mitigating the agricultural risks.

Fortunately, the local governance facilitates the inclusion of new farmers in the region by offering educational programs and financial and technical support measures so that the new farmers catchup in quick fashion with the average digital levels and enjoy the public digital services. Moreover, new environmental standards have brought regulatory measures to safeguard a minimum water quality for the aquifer of the region and prevent citizens and farmers alike from needles water overconsumption. Minimum water level standards ratified by the public water management agencies are now feasible to reach and to monitor through the use of ICT tools and established intra-agencies collaboration routines and data exchange protocols and processes. Additionally, the access to new GIS and technologies and more sophisticated processing of geospatial data has led to the founding of a technical department dedicated to the mapping and appraisal of uncharted natural waterways, wells, lakes, and small rivers, ensuring that the water needs of the region can be covered and water is handled in a sustainable manner.

The regional agenda for smart transition combined with the public support of the vision for digital transition has pushed the local water administrative agencies to take actions that will improve water quality and protect the freshwater reserves. An indicative example worth mentioning is a milestone initiative to restore the river water from micropollutants and microplastics than mainly come from agricultural residuals which was launched in the last decade. Originally starting from the municipality of Pyli, the installment of waste receptors specifically designed for the disposal of pesticide and agrochemical packaging for the local farmers to use was introduced. This good practice combined with the broader regional uptake of digitalization that allowed tools like open online platforms and information dashboards to be commonly used by the public as well as the frequent public and school education programs, expanded the installment of dedicated waste receptors throughout all the municipalities of the region.

In a similar fashion, the local administrative agencies are considering future actions to exploit wastewater as a key source of energy and nutrients and perceived as valuable raw materials that could be used through a circular model back into the agricultural production. These types of actions induce new requirements related to circularity and sustainable supply chains prompting a shift in the region's agriculture. With advances in agricultural methods and sensor technology, the rural areas are capable to transform into closed-loop agricultural systems of vertical farming, which use water more efficiently while at the same time boosting the circular economy. Moreover, the national Rural Development Programmes and more specifically the CAP (Common Agricultural Policy) strategic plans have triggered an upgrade in the digital capacity of the rural areas in the region providing localised actions and the financing of tailored solutions of local needs, ultimately leading to the reduction of social, technical, and financial pitfalls that have affected rural communities in the past.

In conclusion, all the aforementioned facts played a pivotal role for me and my family in order to quickly manage to balance our cultivation needs. We managed just after the first year to have sufficient production yield while at the same time we had the opportunity to relocate form the Athens and obtain a different and more desired life and future for us and our children.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

Common goods in private disposal (Dystopia)

2031 has found the region of Trikala in the most awkward transition period in the region's recent history. The living conditions in Greece's big city centres have significantly deteriorated for many people due to the continuing crisis that makes job finding more difficult added with the increased frequency in extreme weather phenomena (floods, fires) that have rendered many areas of the cities' outskirts unable to inhabit. Many people that originate from the region of Trikala have relocated and this trend is expected to continue also in the years to come. However little attention is paid from the local governance agencies to sustainable resource management. The lacklustre waste management puts a significant strain on the region's natural ecosystems and more specifically in the hydrological ecosystem services and water resources in the region. Extreme weather affects the region more frequently and most commonly experiencing river overflows, that causes severe damage in agricultural fields. The local government and water management administrative agencies focus on short term crisis management actions rather than deploying preventive plans to mitigate the effects of climate change and human pollution in the aquifer. The circular economy of Trikala has not advanced to its full potential, while the business's-producer's-consumer's behaviour and actions are extremely focused in providing services for tourism often undermining business options that could communally benefit the local market and society. This results in a halt to the development of sustainable consumption and production. The administrative authority's inability to establish smart water management routines and mechanisms leads to an increasing water scarcity, that in turn leads to the increase of water price. Individuals with economic capacity and prosperous actors pay to secure their own high-quality water supply, while smaller producers and consumers have constant conflicts with the local water administration agencies over water ownership and water fares. The conflicting interests provide an opportunity for private enterprises to take over the water market initiating the gradual privatisation of water resources taking advantage of the financial and administrative incapability of the public sector to safeguard common goods for the citizens.

Ultimately, water becomes a corporate asset introducing private ownership rights on water sources such as rivers and freshwater reservoirs while water becomes an object of political speculations across the four municipalities of Trikala's prefecture. Due to water scarcity, investments focused on water reuse gain increasing support from both local authorities and citizens and partial financing comes from private companies in exchange for a share of revenue and future rights for resources recovered through the water treatment process. Investment needs coupled with the local government's lacklustre interventions and the citizens individualistic mindset led to the total collapse of the democratic use of water in the region.

Digital vision - citizen adoption – focused public administration, the trifecta of data driven water (Utopia)

The Smart transformation of Trikala counts already more than 25 years of development. ICT technologies and digital solutions have been utilised with a human centred approach and provide a valuable resource in the disposal of the regional authorities and water management agencies to provide high quality services for the general public in the region. The wide coverage of 5G internet enabled the gathering of high-quality data focused on the information accumulation for sustainable water management are widely used and shared between the water management agencies and regulatory bodies of the region. Furthermore, the FAIR use of data has increased the transparency in the administrative and local governance action, holding the administrative institutions accountable while in parallel strengthening the citizen's trust in Trikala's future strategic development and digital transformation plans. The further adoption of ICT tools and fast uptake of digital services across all four municipalities of the region has played a major role in facilitating the direct engagement of citizens in the decision-making process. New agricultural production technologies and water-efficient precision agriculture have scaled up while an increased public interest in water has created the need for many rural communities to have collective decision-making mechanisms on water management. Access to water has improved in most of the rural and agricultural areas of the prefecture and more high-end technologies are examined from the water management institutions to increase the range of services that will enable more farmers having access to modern wastewater treatment ultimately supporting the water needs of irrigation-based agriculture and food production. Moreover, digitalization uptake in the region has stimulated new growth and fostered a local innovation culture which helps research and education infrastructures and innovation hubs that operate in the region to invest in R&D, training and education. Local water companies develop utilities tailored on the local needs and deliver creative solutions for urban and rural areas thanks to the new private investments and liaison with external experts. Finally, the Municipality of Trikala has intensified its involvement in European Green Deal initiatives and opts to apply in the upcoming future new green and blue bonds as key financial tools for funding new water infrastructure and establishment of new modern water storage solutions that will strengthen the sustainable use of water resources in the region.

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13.10 Greece (Trilofos)

LL DIGITAL SERVICES FOR RURAL AND FARMER COMMUNITIES SCENARIO WORKSHOPS

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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Contents

1. Living lab summary

1.1 Name of LL

LL Digital Services for Rural and Farmer Communities

1.2 Brief summary of LL

This Living Lab operates geographically in the area of Trilofos, a village and community belonging to the municipality of Katerini, located in Northern Greece.

This region of Greece has a long tradition with tobacco cultivation. In the recent years the position of the local farmers in the supply chain has been weakened, mainly due to the production limitation system EU has applied to tobacco and the suspension of any subsidies to tobacco growers. At the same time the economic risk and dependency from the local tobacco distributors-retailers is being increased.

The Living Lab delves to the identification of digital services and functionalities and propose digital solutions and ways to implement them to a group of experienced farmers that are gradually transitioning from tobacco to leek cultivation.

A synopsis of the main needs identified during the lifespan of the Living Lab entail the following:

- Strengthen the position of farmers in the supply chain
- Explore digital solutions that will benefit the agricultural process and attract more-younger individuals in the agricultural business
- Train the digital technology users to fully utilize the technologic solutions and ensure a self-sustainable use of the introduced solutions in the future.

1.3 LL participants

For the actualisation of the scenario development activities a variety of participants contributed both during the stage of the preparatory activities and the scenario development workshop. A number of already involved actors of the Living Lab that participated during the NEI activities and workshop contributed significantly to the formation of the scenario question, DOCs and timeline. Furthermore, several new interested individuals were selected based on their experience, relevance with the LL context and expertise, to take part as scenario planners and contributors to the other preliminary activities. The LL's scenario development engulfed a multitude of actors that come from the fields of agricultural extension services, farming, advisory and consultant services, agronomists, digital infrastructure providers, as well as environmental and sustainability researchers.

1.4 Timing of Scenario Planning (WP3) workshops

One face to face scenario development workshop was conducted on the 11th of November 2021. The event was hosted in the facilities of the National Kapodistrian University of Athens providing the additional option for remote participation to alleviate potential f2f exclusion due to covid-19. The event took place from 11:15 to 14:00 CET and counted 11 participants that contributed to the development of the future scenarios that will be described in more detail throughout this report.

2 Scenario question

2.1 Draft scenario question

How digital services & Functionalities have shaped the agricultural processes? Have digital interventions contributed to boost the local/rural economy and in what ways?'

2.2 Finalised Scenario question

How have the technologies of the past decade impacted the agricultural processes and the local economic development of Trilofos?

2.3 Methodology used to finalise scenario question

The Initial Living Lab's focal question *'How to develop new digital services and functionalities for rural communities based on utilization of existing agricultural infrastructures and tools. How can these services support economy and farmers' income in rural communities?'* served as a basis for the development of the scenario question. The scenario question is articulated with the aim to create a future vision (ten year from now timespan). A future expression of the focal question was prepared and presented as a draft scenario to the Living Lab's stakeholders as a first step to commence the scenario development activities. The draft scenario question was circulated to the actors of the past NEI activities as well as to relevant individuals that showed interest in participating in the forthcoming scenario development activities. After a fifteen-day period dedicated to the scenario question assessment, the scenario question was slightly altered and rephrased to state in a more direct way the scope of the scenario development activities.

2.4 Relevant feedback on scenario question from participants

In both the preparatory stage and during the scenario development workshop the stakeholders of the Living Lab and participants of the workshop approved the scenario question.

3 Relevant past events

3.1 List of relevant past events

The events listed below are laid out in a rough chronological order.

- 2002-2005 Peak of the cuttings on the subsidization of the tobacco cultivation from the EU.
- Enactment of the increased taxation in tobacco production business. (Tobacco cultivation is by tradition a family business and the labor costs are not extracted from the production costs, hence the final product is fully considered as taxable net profit)
- Ratification of the Pan European antismoking laws and campaigns
- Bankruptcy of major tobacco retailers that left unpaid depts to the tobacco producers
- Boosting initiatives of ICT development and agro-nutritional fields in the 2014-2020 Rural Development Project supported by the National Structural Funds
- Previous unsuccessful attempts of cultivating other crops apart from tobacco
- Collaboration of American Farming School with the group of pioneering farmers
- Establishment of the LoRa-Wan network and remote sensors in the fields to monitor the plantation of leek crops
- Successful production of the first batch of Leeks and collection of the yield.
- Integrated ICT tools and services utilisation allows flexibility and resilience in the agricultural practice and agricultural business.

3.2 Description past event activity

The selection of past events was based in the following criterion. The relevance of milestone historic events of regional and national scale with the Living Lab's focal question and scenario question. The focal and scenario question of this Living Lab revolve around past, present and future events that have affected or might affect the agricultural practice and business in the region, while in parallel investigating the level and impact of digital to analogue transition. Having as a reference the work that was conducted during the Needs Expectation and Impact Appraisal activities and supplementing this work with a dedicated meeting with the Living Lab's contact point, we concluded to the definition of ten milestone events that best depicted the historical context that instigated the adoption of digital technologies in the region's agriculture. These events were included as checkpoints in a thirty-year timeline (2000-2030) enabling the time lapse visualization of the agricultural evolution in the region and introducing the scenario development concept to the workshop's participants.

3.3 Relevant feedback from participants

For the finalisation of past events selection, input and feedback received from the participants of the previous LL NEI workshops was also taken into consideration.

4 Drivers Of Change (DOC)

4.1 List initial set of DOCs

List of the initial Drivers of Change (DOCs) that were identified by the Living Lab coordinators during the past NEI and Scenario Development activities:

- Opportunity of farmers to prolong-evolve the cooperation with innovation facilitators
- Stain on the relationship of farmers/producers-tobacco retailers
- ICT solutions available are suitable to incentivize the local younger individuals to get involved in the agricultural business
- Amelioration of the working conditions (reduction of Work intensity and workhours) and upgrade of the image-lifestyle of farming business
- Perceived importance to gather and process agricultural data that will safeguard the successful plantation of new crops
- Demonstrated added value of the sensors in monitoring the agricultural process and leading to a satisfactory outcome
- Expression of interest to examine more digital technologies (blockchain, food tracking technologies etc) that can further supplement and upgrade the production and distribution processes.
- Continuing cooperation with AFS provides the possibility to upscale the provision of digital infrastructure to a wider geographic range and or individual farmers
- Level of the agricultural income
- Immediate need to reduce the economic risk pertained to the monoculture of tobacco
- Diversification of the product that that will lead to the introduction in new markets and the formation of new networking and collaboration possibilities
- Bolster the business competitiveness of the agricultural businesses in the region
- 2021-2027 European Rural Development Funds funnelled through the financial management of CAP to the eligible beneficiary regions/orgs/stakeholders
- Fully exploit the utilisation of the agricultural fields
- Optimise the use of agrichemical products water resources in the crops & fields

- Deviate from the traditional tobacco monoculture and experiment with polyculture plantations for better nutrient and soil utilisation and overall sustainable agriculture
- Create agroecosystem multifunctionality and added ecosystem services to the region
- Reduce the input of agrochemical products
- Strengthen the farmer's/producers position in the supply chain and widen/upgrade the existing distribution networks.
- Foreseen perspective to create collaborations among local producers-retailers- food processors- restaurant owners
- Alignment with the objectives of the new CAP for 'Fostering sustainable development and efficient management of natural resources such as water, soil and air'
- Upgrade the local entrepreneurial capacity and explore the possibility to create a local brand/identity
- Create new more efficient and mutually profitable value chains in the region

4.2 List selected DOC

From the list of Drivers of Change described in the previous section, out of the twenty-four initial DOCs the twenty-three of them were signified by the Scenario development workshop participants as important factors for instigating the LL SCP system’s change. Therefore, twenty-three drivers were kept as selection pool out of which the Morphological Box ‘assumptions’ would originate. The initial driver ‘’Create agroecosystem multifunctionality and add ecosystem services to the region’’ was the only driver that was discarded from the initial set of drivers.

The final list of drivers that serve as assumptions in the formation and completion of the morphological box includes the following six drivers:

External

- State on the relationship between farmers and tobacco retailers
- ICT solutions as a mean to incentivize the local younger individuals to get involved in the agricultural business
- Diversification of the agricultural products

Internal

- Level of the agricultural income earned from digitised agriculture.
- Digital technology adoption to further supplement and upgrade the production and distribution processes.

- Continuing cooperation of Technology providers and farmers/producers.

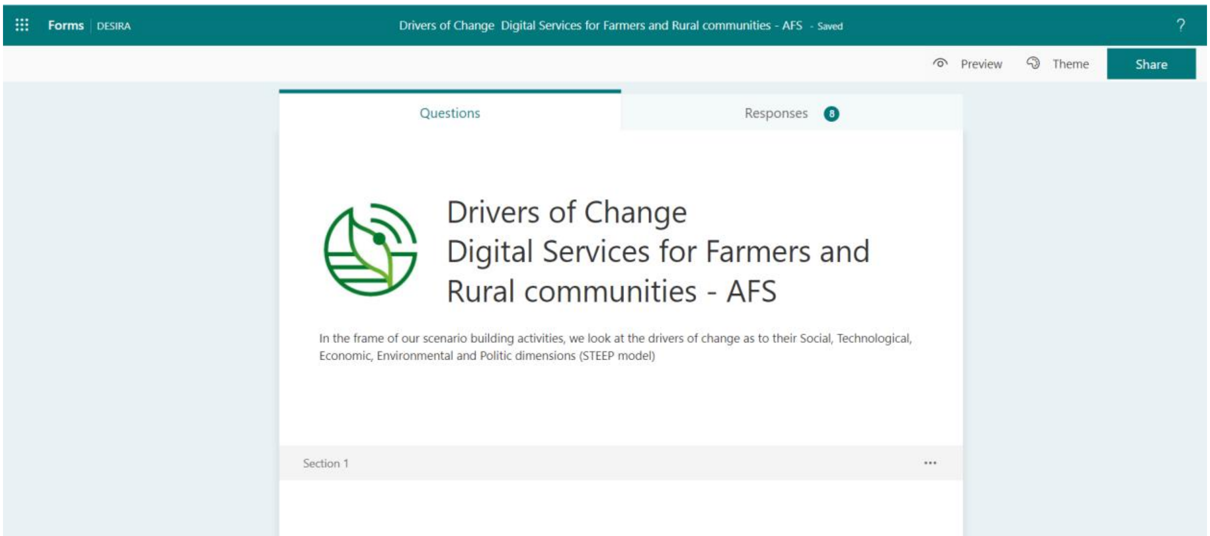
4.3 Describe methodology to select DOC

As a first step for assembling the initial list of 24 Drivers of Change, a detailed review of the NEI report, workshop meetings notes and post-evaluation meeting with the Living Lab's Contact Point (American Farming School) took place. The main elements and driving forces of the SCP system were identified, described, and elaborated extensively while conducting the Needs Expectation and Impact appraisal activities.

During the initial identification of DOC, the following criteria were applied:

- Drivers can affect positively or negatively the system
- Motives, interests, and aims of the actors in the system cause implications and shape the dynamics of the system
- Identify the areas where the coupling of the needs and expectations with digital transformation of agriculture is taking place or can take place in the future
- Take into consideration the current and future external forces of the system and envisage the evolution of the internal roles of the system

As a follow up, for the further categorization and expression of DOC, the STEEP analysis was followed to ensure that the drivers were covering a wide range of the system's domains. Aiming for the formulation of approximately 5 drivers for each STEEP category, the first draft of 24 Drivers of Change was presented to the Scenario Development workshop participants. After the DOC presentation, with the use of an online form, the participants were asked to review, rank, as well as provide feedback, to the initial DOC set. The review process and ranking of DOC results were used to identify the convergence around crucial concepts of change and base the further clustering and categorization to three internal and three external drivers respectively.



Picture 1. LL DOC Evaluation Form

4.4 Relevant feedback from participants

Feedback was received via the disseminated google forms and processed before proceeding to the formation of the morphological box.

5 Matrix

5.1 Morphological box description

The morphological box is consisted of six columns and ten rows that contain the core content of the future scenario-pathway creation. The first column consists of the sub-set of drivers of change that were described in section 4.2 of this report and form the basis on which the range of assumptions-projections of a positive, negative or relatively unchanged (BaU) future is built on. Therefore, each row contains a selected driver that acts as the factor of future change followed by five projections that range from positive to negative. In each row, the two highlighted cells (red and green) indicate the selected option of the participants for a possible negative (red) or positive (green) future regarding the specific driver. The sum of the green highlighted cells forms a complete positive future scenario pathway and similarly the sum of the red highlighted cells forms a complete negative future scenario, both scenarios though having as a common denominator the six (three internal and three external) drivers of change previously selected for envisaging the two future states.

Scenario Pathway Morphological Box 1

Assumptions	Plausible positive		Bau Assumption		Plausible negative
External Drivers					
State of relationship between farmers-producers and tobacco retailers	Further Digital tools usage for enabling new deals that would in turn increase the tobacco market competitiveness.	Formation of a strong local farmers union to ensure provision of the products in the market through profitable deals.	The tobacco retailers will continue to leverage the price of tobacco.	Tobacco retailers aggressively push forward their supply chain advantage opting to achieve even more profitable deals from the tobacco trade.	Tobacco cultivation is vastly degraded as an agricultural business option for the new generations.
ICT solutions used for the incentivization of the local younger individuals regarding their	A significant number of individuals that reside in the region are attracted by the	Digital tools deployed in the fields attract the attention of younger individuals of	A limited number of young individuals who already possess/have inherited land and	ICT adoption and support requires cost and possibly new personnel that some	Younger generations turn down the option of getting

involvement in the agricultural business.	digital transition of agriculture and are willing to get involved and experiment with new agricultural and farm management practices.	the local community.	equipment decide to get involved in the new agricultural processes.	cultivations might not be able to assure.	involved with agriculture.
Diversification of the agricultural products.	More local farmers start experimenting with the adoption of agricultural digital tools. The technology uptake opens up new opportunities and forms new value chains.	introduction in new markets and formation of new networking and collaboration possibilities.	Farmers will continue producing leaks and crops other than tobacco and will be able to gradually form new collaborations and enter into new markets.	Digital tools enable the diversification of products though at the same time increase the business risks for a successful product rebranding and maret share aquisition in new markets.	Remain economically dependent from the tobacco sales.
Internal Drivers					
Continuing cooperation of Technology providers and farmers/producers.	Formation of new market opportunities where more technology providers and business consultants offer tailored services to the producers while competition keeps the prices reasonable.	Technology providers offer new possibilities for upscaling the provision of digital infrastructure to a wider geographic range and more individual farmers.	The collaboration continues steadily with a limited number of new farmers onboarding.	Uncertainty of finding a suitable business model - direct economic funding to support the digital developments in the region.	The collaboration of farmers-technology providers will fail to progress into a mutually economically sustainable and profitable state. Ultimately, the technology providers will withdraw their support on the digital transformation of the region.
Level of the agricultural income earned from digitised agriculture.	Increase in the farmers income provides a strong incentive to continue their involvement with digital tools and attracts new individual fostering a wider	No significant increase in the agricultural yield. New services however keep the pioneer farmers engaged and eager to	Tax increase on the small amounts of extra income earned through the adoption of small-scale digital interventions reduces the economic effectiveness of	The vast majority of farmers in the region will assess the cost-effectiveness and act accordingly on	Limited income earned from the agricultural products enough to keep the same level of involvement with digital tools for as long no economic

	experimentation culture in the agricultural activities.	experiment with additional digital tools and services.	digital investment and makes digital transition less appealing to the interested parties.	onboarding or rejecting.	investment must be done from the farmer's part.
Digital technology adoption to further supplement and upgrade the production and distribution processes.	Digitalisation opens new business opportunities.	Upscaling the digital tools currently used on the fields.	Additional digital technologies are inapplicable for the current digital maturity state of the system and are perceived as possible options to be examined in the future.	Uncertainty and mistrust on the future use of digital tools for agricultural purposes.	No actual interest shown for expanding the entrepreneurial activities leading in no future expanding of the digital services.

5.2 Define 4 pathways/scenarios

Four pathways were developed for the purposes of the scenario development activities of this Living Lab. Two articulated scenario pathways are developed and encapsulated in the morphological box (fig 5.1), fully developed by the participants of the scenario development workshop. The aim was to create two complete future pathways having as base of reference the internal and external drivers that were selected as assumptions for envisaging the future. As a result, one positive and one negative pathway was highlighted out of the range of options included in the morphological box. These two pathways should be regarded as the better (positive) and worse (negative) case scenarios and serve as a backbone where the LL's SCP system strengths and deficiencies as well as threats and opportunities are projected in the future through the prism of a digital future in agriculture. Two additional scenarios are developed by the coordinators of the scenario development workshop aiming to articulate the extreme future projections of a utopian (best case) and dystopian (worst case) future. The outline of the two 'intermediate' scenarios of the morphological box as well as an extensive narrative exposition of all four scenarios will be analyzed in the following sections of this report, showcasing a whole spectrum of different better or worse 'futures' in respect with the digital transformation of agriculture in the context of this Living Lab.

5.3 Identify the 2 pathways outlined in the Morphological Box

The Morphological Box was used to engulf the combinations of assumptions in a matrix form and provide a practical layout to showcase the sum of the building blocks that form the two highlighted scenario pathways. As it can be observed in the 5.1 section figure, two scenario outlines were created in total during the workshop with the green cells representing the outline of the positive scenario and the red cells representing the outline of the negative scenario.

The *positive* pathway revolves around a future where the farmer communities located in the region will be able to build on the existing digital development of the region and transition in a future where they would be able to upscale the digital infrastructure utilised, boost the overall capacity building of the region by increasing their digital skills and competence, attracting younger individuals in the farming business, expanding the infrastructure and services and overall create new value chains in which they will possess an upgraded role, foster an innovation culture in the region and more importantly increase their agricultural income and ameliorate their working conditions.

The *negative* scenario revolves around a future where the transition to a digital future cannot be reached. The further development and adoption of ICTs is difficult either because of a lacking concrete business plan to support the provisions of digital services and infrastructure or because of the inability of the local communities to adapt to a digital agricultural environment, create win-win collaborations with technology providers based on trust, or inability to foresee the added value of digital tools in their agricultural practices.

5.4 Methodology used to identify pathways

In continuation of the DOC consolidation, a sub-set of six drivers were selected and divided into two categories of internal and external with respect on their endogenous or exogenous impact on the SCP system. The set of these six drivers served as the assumption basis on which the participants of the workshop formulated the range of positive and negative future projections-expressions of the morphological box. Each driver was transposed in a ten-year future timespan and led to five future projection outcomes ranging from plausible positive-positive-Business as usual-negative-plausible negative. After the completion of the morphological box's content and definition of the whole range of future options of the SCP system, given the specific set of internal and external drivers, the participants of the workshops were split into two groups (trying o maintain role diversity in the greater extent) with one group having the objective to formulate a negative future pathway and the other group a positive pathway. Open team discussions followed applying a majority option selection where consensus could not be achieved, the groups highlighted one choice per driver creating a complete negative pathway (sum of the red highlighted cells) and a complete positive pathway (sum of the green highlighted cells) respectively. Subsequently the groups had some more time to review the whole pathway they created and add narrative furtherly developing their future projection choices. Finally, a person from each team was selected to present the team's pathway, brainstorming process and narrative to the rest of the workshop's participants.

5.5 Relevant feedback from participants

No relevant feedback was received from the participants.

6 Scenario Narratives

6.1 Name Scenarios

The following names were given to the four distinct future scenarios that were developed for the purposes of the scenario development activities:

Worst case scenario – Dystopia: *Digitalisation throws out of business producers that are unable to follow*

Best case scenario - Utopia: *Digital services in the Trilofos region support sustainable agriculture and resilient society*

Better than Business as usual scenario-Positive: *Digital farming practices change Trilofos' agricultural focus*

Worse than Business as Usual scenario - Negative: *Digital solutions in Trilofos' agriculture fail to lift-off leaving the farming community wandering about the future*

6.2 Write the 2 or 3 detailed scenario narratives

Digital solutions in Trilofos' agriculture fail to lift-off leaving the farming community wandering about the future (Negative)

The year 2031 has found the rural region around the city of Pieria significantly changed from what it was a decade ago.

A region that once was in the forefront of Greek tobacco cultivation now showcases a different landscape regarding the cultivation options of the people who still are involved in the agricultural business.

Already from the start of the past decade prevalent signs of tension emerged between tobacco producers and tobacco retailers, a fact that stained a long-lasting collaboration that for many years ensured the economic viability of the tobacco production business. Once the state's subsidies for tobacco cultivation stopped the farmers income became more dependent from the business terms that the tobacco retailers were setting regarding buying prices, way and timing of fulfilling the transactions while at the same time controlling the tobacco distribution channels. The tobacco farmers that never in the past sought their repositioning across the supply chain now faced big risks in selling their product without being able to bargain the price in their own terms. As a consequence, the last decade brought the vast degradation of tobacco cultivation In the region and deemed it a non-viable occupation option for the young generation that is willing to inhabit the region.

The economic degradation of the tobacco production business forced several individuals farmers from the local community, that were not willing or not capable to leave the agricultural business, to start thinking of new types of crops and new ways of agriculture trying also to catch the wave of digital transformation actions that sprung up in the region in the form of private partnerships with technology providers and agricultural business consultants that would introduce new digital tools to the agricultural process. Beyond however a limited number of farmers that were immediately willing to accept a new risk of investing time and resources (in terms of land and money) for new ICT infrastructures and services and accept the inclusion and involvement of new actors in the agricultural production cycle, the vast majority of local farmers assess laggardly the costs and benefits of the outcomes of the digital transition while showing overt mistrust in the agricultural advisors and infrastructure providers that gather and process the data of their cultivations.

Nonetheless, the long agricultural tradition of the region is still strong and keeps the individuals who possess land-fields and agricultural equipment occupied in a different agricultural context that however lacks a strong local agricultural identity. Farmers, in order to ensure adequate yield and relieving the risks of monoculture that they faced the past years with tobacco production, have now slowly started the adoption of ICT tools in the form of farm-management software and remote agricultural advisory services to help them cultivate a wide range of fruits and vegetables that can flourish given the climate conditions of the region. The vast diversification of produced goods that initially aimed in the alleviation of risks related with monoculture has now brought new risks that are related with the reduction of the negotiating capacity of the region as a prominent producer. This has led in the regions lost ability to create a strong unified local brand of a high-demand and high-quality agricultural product. In turn the diminished and diversified agricultural yields, and decoupled interests of the farmers operating in the region obstructs the potential development of a strong farmers union that could act as a body that will safeguard their interests and claim an upgraded position in the local food value chains.

Inevitably, the widening of the broadband services in the rural areas, that occurs at a national and pan-European scale, changes the local resident's interactions with the public services, businesses, governance and social interactions in a holistic manner that cannot leave agriculture unaffected. ICT technologies have gradually crept into the agricultural production process and are replacing with a certain pace the traditional methods of production and distribution processes. The new agricultural digitized status-quo though is accompanied with a high level of social uncertainty in the future of the region's agriculture. Digital tools have now become a standard, and the future of agriculture seems coupled with the use of ICT's and more specifically with the local's capacity to adapt to the technological changes and demands that will ensure their competitiveness in the product markets. Moreover, digital transition along with better monitoring has also brought stricter control on inputs-outputs, finances, quality control, and overall ratification of a new regulatory scheme on smart & green agriculture. This new state of play has brought opposition from individuals that were able to exploit the lack of control regarding water charges, quality and volume of agrichemicals used, untracked revenues from sales. Stricter financial and quality control will directly lead to the compliance with national and European standards as well as higher levels of taxable income that in turn might lead to the cuttings of subsidies and cuttings in the state's financial support.

Finally, the digital uptake of agriculture in the region creates new opportunities for agricultural consultants and service providers, creating a new market in the region. The rapid pace of introduction of digital solutions and fierce competition of agricultural consultants on one hand lowers the cost of consultant services for the farmers on the other hand impedes the formation of long-lasting partnerships among technology providers-producers and consultants. This in turns leads to issues regarding data agricultural ownership, licensing for the use of technology and overcomplicated b2b terms and agreements that restrict the farmers in the agricultural production and product distribution. Additionally, the intensification of service and technology offers, lead to a forceful digital transition of agriculture which is not followed by the necessary capacity building in the region, which subsequently leads to the increased dependency of farmers from technology providers and agricultural consultants.

In retrospect the farmers of the region have traveled a decade's journey, aiming to upgrade their position in the agricultural businesses and disentangle from their unfavorable position in the value chain of tobacco market only to conclude ten years after detained from digital tools and without a clear identity in the agricultural markets.

<u>Digital farming practices change Trilofos' agricultural focus (Positive)</u>

Farming machinery and ICT's work in tandem after the passing of a difficult decade through which the farmers around the rural region of Pieria were struggling to reposition their agricultural businesses in way to ensure their economic viability before the coming of the digital revolution that has been closing since the past half century.

The tobacco production business showed a steady decline reaching a bottom low around the years 2005-2008, years that signified a massive relinquishment from producers that tried to enter into more profitable types of cultivation. Several farmer communities of Central Macedonia, a region that once was in the forefront of tobacco production, were heavily dependent from tobacco cultivation and struggled before finding a sustainable pathway for the future.

The need for altering from tobacco cultivation pushed the local farmers to start experimenting with the adoption of new digital tools in agriculture that would in turn enable them to cultivate different crops while also minimizing the production risks. Initially, in small scale farmers produced leek and where willing experimented various types of fruits and vegetables that could flourish in the region. This fact slowly led to the detachment from tobacco monoculture and the introduction of the local producers in new food market supply chains. The new business opportunity enabled from the adoption of digital methods in agriculture along with their long experience in the agriculture business quickly led to the formation of a strong local farmers union, opting to ensure profitable deals with the provision of the products to the new markets. In contrast with the recent past, were the farmers experienced a steady decline of their agricultural yield and increased production risks, now the use of ICT tools and agricultural data gathering – processing has on one hand, significantly reduced the risks of experimenting with new crops which builds to an overall innovative culture in which farmers can work more flexibly, and on the other hand has led to the significant increase of their income, a fact that by its own provides a strong incentive for continuing the farmers involvement with new digital tools and methods.

The successful implementation of digital infrastructure network and sensors on the fields and the overall positive short-term impact shown related with income increase and production quality created a trend among younger individuals that reside in the region to get involved in agricultural activities. A business option which nearly a decade ago seemed obsolete and completely unappealing now evolves in parallel with the general digital trajectory of modern living and is able to keep young people in their birthplaces while providing them the means and incentives to continue the regions agricultural tradition in a new modern context. The new generation of farmers is expected to reduce the digital gap and utilize digital tools and services in a greater degree aiming to upgrade the farm management practices used in the region while expanding the distributions channels of the products and continue experimenting with new cultivation types and new cultivation methods.

The rampant pace of digital transformation is nowadays clearly visible in the region. A decade ago a small scale Long Range Wide Area network along with a limited amount of sensors were established to monitor 5 hectares of second-grade (soil and position wise) land fields of a small group of farmers that wanted to experiment with supplementary crops in addition to their main tobacco yield. Sensors across the region are now used as commonly as tractors, ploughing and harvesting machinery, uncertainty of weather conditions is alleviated in a great extent, logistical operations of product distribution and contact with retailers has been eased in a great extent. Data collection and availability is commonly perceived as a crucial factor for better decision making while sharing information has slowly becoming a standard interaction in the region. There are signs of an infant information network that facilitates interactions with the local actors of tourism and food service and food processing sectors. The convergence in the interests of the actors from primary-secondary-tertiary sectors of the local economy up-springs thoughts for the further upscaling and extension of digital technologies with the adoption of food tracing and block- chain technologies to work as a foundation on the creation of a common and distinct local brand in the region, ultimately shaping new value chains and upgrading the regions entrepreneurial capacity.

The agricultural digital transformation process acts as the trailblazer to create a common innovation culture and build the capacity to expand the business, and in extent, social boundaries of the region. Farmers nowadays can deal with more complex information and proceed to more elaborate decision-making processes, this along with the overall success of digitalization of agriculture has led to an increased level of ICT expertise which subsequently leads to more focused and tailored service provision coming from external consultants and technology providers, elevating the overall technological readiness and digital profile of the region. Diverse knowledge, digital skills to operate new technologies, handling information from various sources, liaising with new actors in the agricultural business to create value chains and remain flexible in when it comes to finding or generating new resources while adapting to changing conditions, are some of the new values that ensure the future of the region's sustainable agriculture but also the sustainability of the region through agriculture.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

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Digitalisation throws out of business producers that are unable to follow (Dystopia)

At the midst of the transition towards the 4th industrial revolution the, in general, aging population of the remote rural areas around the city of Pieria is experiencing a radical change regarding the viability of agricultural business of the region, putting into question the traditional agricultural methods and long tacit knowledge and experience of agricultural practice acquired during the past century.

Digitalization has become an integral part on various aspects of living, affecting social interactions and becoming imperative for basic business tasks. The local society residing in the rural areas around Pieria, tobacco producers by tradition, are experiencing severe difficulties in adjust their agricultural practices to the new norm that indicates the use of digital tools for monitoring and managing agricultural production and distribution, in order to remain competitive in the production markets. The tobacco markets continue to shrink, resulting in gradually less favorable market deals with the tobacco retailers, a fact that pushes the farmers to transition towards other forms of cultivation. However, due to the lack of knowledge in other types of cultivation and the prevalent digital skill gap that characterizes the region, the attempts for transition entail high risk of failure. To tackle the predicament that the regions farmers are in, the development of digital skills would need to be achieved through private partnerships with technology providers and agricultural consultants. The cost of this service provision will be tailored to the individual farmers who are able to financially support them, leaving the less financially capable farmers behind. This in turns entails a grave danger of increasing or leading to unemployment, as well as the abandonment of the agriculture and land-fields. Ultimately, the devaluation of land will attract the prosperous-digitally ready agricultural actors in the market, to buy the land-fields leading to the further accumulation of land capital. For the medium scale farms that are able to afford the extra cost of using digital infrastructure and adopting digital tools, trust will be a major barrier in the collaboration that they build with technology and business consultants. Firstly, rights on data ownership and technology terms of use as well as the information distribution inside the local social networks are factors that will put into test the successful establishment of win-win partnerships, while secondly the need for short term results of digitalization in the agricultural income increase will determine the future of those private partnerships that appear as the only conductors of digital transition of agriculture in the region.

Digital services in the Trilofos region support sustainable agriculture and resilient society (Utopia)

In the year 2031 digital technologies have been introduced in multiple facets of everyday life both in remote and urban areas, in this context digitalization has also radically transformed the state of agriculture in the rural regions around the city of Pieria that traversed a long transition period for readjusting their agricultural practices in the contemporary standards.

The decoupling of the region's agricultural activity form tobacco and increased diversification of cultivation types and opened more technological options for agricultural practice that ultimately lead to upgrading the digital skill level of local farmers. At the same time more opportunities appear that allow the inclusion of more farms in the digital agricultural network and furthermore incentivize the involvement of younger individuals who are attracted from the use of new modern tools and methods in the agricultural practice. Subsequently, this allows profitable collaborations and the creation of Socio-Cyber-Physical system's synergies that fosters a stable environment in terms of local social networks, information, knowledge sharing and agricultural practice management that ensure small farms survival.

A vast number of local farmers has now embraced the adoption of digital technology and tools and a variety of farms in terms of scale coexist in the region, diverse in focus and in market margins as well as in levels of technological autonomy. Collaborations with a range of external technology providers and agricultural consultants are part of the mix and digitalisation is used to create direct links between producers and consumers alleviating the recent deficiencies faced in the tobacco market where retailers could force trade deals by leveraging their position in the supply chain.

The digital evolution of agriculture in the region has led in the geographic diversification as measure adopted by the local farmers for managing risk. Risk management and managing uncertainty have become integral business factors taken into consideration when deploying the agricultural business plan.

Digitalization has contributed to the decoupling of the strict relation between land fields and agricultural business and the region has reached a state where technology has facilitated a more creative use of the land property, agricultural equipment, and human skills. This results in the expansion of the farming entrepreneurial activities through collaborations with local actors from the food service, food processing, tourism sector that in turn leads to the formation of integrated value chains that upgrade the regions entrepreneurial outlook which now is capable to offer services that derive form the interconnection of various local industries.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.11 Croatia

SCENARIO WORKSHOPS

CROATIA

20.12.2021

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Introduction

1. Living lab summary

1.1 Name of LL

DigiFarmTour - Digital solutions for connecting local agriculture and tourism in the Adriatic region of Croatia

1.2 Brief summary of LL

In the Croatian Adriatic Region, the Living Lab explore how to connect sustainable small farmers to tourists and consumers, consisting of experts from interested sectors involving public institutions, tourist board, hoteliers, private renters, local administrations, local farmers, farmer organisations and LAGs. This region along the coast of Adriatic Sea, is a touristic area covering four (out of six) counties from Istria to Dalmatia. The whole land area of Croatia is divided into 21 county (20 counties + capital city area). In 2019, 75% of tourists visiting Croatia stayed in the area of the Living Lab[6].

Croatian agricultural production is characterised, as in most European countries by a large number of small family farms. One third of farms is specialised in permanent crops (mostly olives and grapes), the other third in animal husbandry (mostly sheep), and the last third are mixed farms. The majority of small family farms are rarely market oriented and with low level of development.

To enhance sustainability and development of agricultural sector in this area, an opportunity arises in creating a connection between agricultural producers and tourist service providers or directly with consumers and tourists. The main challenge is to find out how digitalisation could support the creation of short supply chains, and to foster coordination among tourist service providers when planning the tourist offer at local and regional levels by using and (re)testing existing digital tools.

1.3 LL participants

The workshop was attended by 14 members of the Living Lab, namely representatives of the Ministry of Agriculture, the Institute of Agriculture and Tourism, the ICT sector, farmers and the tourism sector.

The main goal of establishing the Working Group is to determine the importance of digitalization in connecting local agriculture and tourism in the Adriatic region, and the activities of members will be carried out by organizing and conducting workshops.

[6] https://www.htz.hr/sites/default/files/2020-07/HTZ%20TUB%20HR_%202019%20%281%29.pdf

1.4 Timing of Scenario Planning (WP3) workshops

During the preparation phase several contacts either through email or directly were made with the members of the LL to define the timing and the format (online or live) of the workshop. More intensive contact as well as preparation was with the Institute for Agriculture and Tourism from Poreč. As the most important part of the LL were the producers the timing was optimised for their availability. Chosen time was in the last days of tourist season in Croatia when most of the work in olive orchards were finished, preparation for harvest were in the beginning phase and COVID-19 measures allowed organisation of the workshop in person.

We held both workshops on the same day on September 24 in Poreč from 9:30 - 17:00 h as proposed by the DESIRA team and we managed to accomplish all the set goals. More details on the methods and conclusions in the text below.

2 Scenario question

2.1 Draft scenario question

- How will digitization improve local food purchases in the tourism settings by 2031?
- How digital technologies will improve the promotion and sale of local agricultural products in the tourism market by 2031.

2.2 Finalised Scenario question

Living Lab agreed on more elaborate version.

How digital technologies will improve the promotion and sale of local agricultural products in the tourism market by 2031.

2.3 Methodology used to finalise scenario question

During the preparation of the workshops several meetings was held either face-to -face (core DESIRA team in MofA) or online (with the members of DESIRA from the Institute for the agriculture and tourism in Poreč). Beside the organisational setup of the workshops several discussions on the scenario question took place. The two proposal of the questions were prepared one by MofA and the other by IPTPO teams and the proposal was then communicated with the rest of the LL. Finally, a more extensive version of the question was agreed. So, on the day of the workshop, we already had an agreed Scenario question.

During the first part of the workshop, just after the introduction and opening the final approval of the scenario question was asked from the participants.

2.4 Relevant feedback on scenario question from participants

During the selection of the final scenario question a discussion on the connection between agricultural production and tourism sector was held with all LL members participating. Sever topics were addressed such as: digitalization of tourism sector, sale of products through digital channels, differences in just digital marketing and marketing and sales over different platforms (social media, dedicated webpages, etc.).

3 Relevant past events

3.1 List of relevant past events

2006.

- Preparation of Croatia for entering EU

2011.

- Increasing number of agricultural products with a protected EU quality label,
- Continuous growth of tourist traffic,
- Strong increase in the use and influence of social networks,

2012.

- Mass use of smartphones and increase of space coverage by wireless Internet,
- The Google Play application is emerging and more intensive development of mobile applications is beginning

2013.

- Croatia's accession to the EU (open market, EU)

2015.

- Istria web marketplace application launched
- The Istrian Web Market Association (Poreč Institute) was established with the aim of promoting and selling local agricultural products directly

2019.

- Launch of 5G network

2020.

- COVID-19 pandemic
- Development of various online sales channels agricultural products (social networks, etc.)
- ValFresco Direkt project launched - online system of preparation and delivery of food and ready meals

2021.

- Slowdown of the development of online sales channels agricultural products
- Adaptation of the tourism sector to epidemiological measures
- 99% RH covered by mobile signal

3.2 Description past event activity

At the beginning of the workshop all present participants in the LL were given the task of writing past events from their sector of interest, then we compared all the past events and fitted them into a common timeline, some recurring ones we dropped out or fitted into a common timeline. Then that timeline was cross checked with references that was conducted during the Needs Expectation and Impact Appraisal activities, we concluded to the definition of 17 milestone events instigated the adoption of digital technologies in the region's agriculture.

3.3 Relevant feedback from participants

Previous LL NEI workshops was also taken into consideration for the finalisation of past events selection.

4 Drivers of Change (DOC)

4.1 List initial set of DOC

Social:

- Raising awareness of food quality and the way it is produced
- Demographic issues, stay and resettlement of young people / families in rural areas
- Change the general view of agriculture and change the nature of work for young people from rural areas
- Cooperation

Technological:

- “Connectivity and Broadband Infrastructure”

- "Online Market Places" – platforms
- Delivery of food products - distribution

Economical:

- Small production volumes of Rural producers
- Sustainable agriculture
- Extension of the tourist season through additional facilities (local gastronomic events)
- Competition from resellers of non-local products

Ecological:

- Sustainable agriculture,
- Extensive agriculture of higher financial yield
- Climate changes

Political:

- Legal business frameworks of PGs
- Governmental support
- Food traceability and quality control

4.2 List selected DOC

Social:
• Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)
• Individual tourism with special preferences
• Demographic issues, stay and resettlement of young people / families in rural areas
• Increased concern for health and food production
Technological:
• Delivery of agricultural products from producer to buyer
• Connecting real and virtual life
• Development of laboratory-produced food
• Digitization of agriculture
Economical:
• Agricultural resources and products market
• Income
Ecological:
• Climate changes
• Preserved environment

•	Increasing the number of eco-labelled products
Political:	
•	Legislation in agriculture
•	The situation in the region
•	Reducing the EU's influence over the national level

4.3 Describe methodology to select DOC

Drivers of Change were selected based on STEEP methodology as we have formed each STEEP segment with a member in LL who intimately knows the problematics and opportunities in that segment.

4.4 Relevant feedback from participants

Given the above fact, a large number of LL participants have a multidisciplinary understanding of DOC. The nature of the tourism sector as well as food production depends a lot on various sociological, economic and ultimately political factors that are very unstable at this time and change almost daily.

5 Matrix

5.1 Matrix description

The matrix below describes the most important external and internal drivers that will influence process of connecting local agriculture and tourism in the Adriatic region of Croatia in future. Positive DOC are coloured blue, negative red and some are white as the DOC can go in both directions.

DigiFarmTour - Digital solutions for connecting local agriculture and tourism in the Adriatic region of Croatia				
DRIVERS OF CHANGE	**ASSUMPTIONS**			
	1	**2**	**3**	**4**

I	Social				
1	**Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)**	High demand for local products from a sustainable and ecological production system	Local products are not particularly valued and sought after as there is no guarantee of origin and traceability	Local branded products are expensive, production is limited and available to a small circle of customers	distrust of state institutions
2	**Individual tourism with special preferences**	Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (e.g., wine tourism) and are extremely interested in local agricultural products.	Tourists have limited knowledge of destination characteristics and clearly defined interests and have little interest in local agricultural products.	Tourists want an "all inclusive" offer and do not show much interest in the origin of agricultural products, which makes it difficult to sell local, more expensive products	Tourists do not trust the quality and origin of local agricultural products
3	**Demographic issues, stay and resettlement of young people / families in rural areas**	They will not be burdened by the past like generations that remembers communist cooperative agriculture	Young people are more motivated	Young people have no knowledge and experience because they came from urban areas	Young people make better use of new digital technologies
4	**Increased concern for health and food production**	Food produced in a specific way - functional food - is increasingly valued	Stratification of society		

DRIVERS OF CHANGE		ASSUMPTIONS 1	2	3	4
II	**Technological**				
1	**Delivery of agricultural products from producer to buyer**	Digital technologies and drones enable easy, fast and cheap delivery to the destination	Delivery to the customer is a bottleneck in the development of online shopping		
2	**Connecting real and virtual life**	New technology enables a virtual feeling of staying in a destination and tasting local products from your own home	Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)		
3	**Development of laboratory-produced food**	Reducing the environmental impact of agriculture	Prevails over traditional production, job loss and centralization of production		
4	**Digitization of agriculture**	Development of marketing applications of agricultural products	Dispersion of the system due to too many applications	Greater control of traceability, will increase trust in institutions	Greater traceability control and difficulty in mastering new skills for older people

DRIVERS OF CHANGE		ASSUMPTIONS 1	2	3	4
III	**Economical**				
1	**Agricultural resources and products market**	Tourism employs predominantly foreign labour, from less developed countries, resulting in a low level of quality of the tourist offer.	Consolidation of holdings through the use of uncultivated agricultural land results in an increase in holdings and the total volume of production	Liberalization of the market of all agricultural resources affects the placement of local products	
2	**Income**	Adriatic Croatia has established itself as a destination for elite tourism and is mostly visited by tourists of high purchasing power.	It is dominated by mass tourism in which more expensive local products are difficult to sell.	Due to the health-political situation, the tourism sector is not stable, so earnings are not stable either	Diversification ensures successful business and high income of small farms

DRIVERS OF CHANGE		ASSUMPTIONS			
		1	2	3	4
IV	**Ecological**				
1	**Climate changes**	Innovations have contributed to the fact that weather disasters do not affect agriculture and tourism	Climate change is hitting farmers hard, and production is only possible with prevention measures (irrigation), so overall production is declining	The rise in temperature allows us to extend the holiday season to the pre- and post-season when we are visited by a significantly larger number of tourists	Introduction of new agricultural crops
2	**Preserved environment**	Adriatic Croatia is a unique oasis of preserved and unpolluted nature	Ecological production of agricultural products and ecological practices in tourism are dominant	Inadequate care for the environment has resulted in environmental degradation resulting in negative impacts on agriculture and tourism	
3	**Increasing the number of eco-labeled products**	Greater added value	Limited production	The emergence of a large number of certified organic products	A large number of different certificates

DRIVERS OF CHANGE		ASSUMPTIONS			
		1	2	3	4
V	**Political**				
1	**Legislation in agriculture**	Adequate agricultural policies contribute to increasing the number of agricultural holdings and total production	Prolonging large producers requires that small farms be allowed to produce only for their own needs	Small farms survive thanks to large state aid	Effective control guarantees the origin and traceability of the product
2	**The situation in the region**	The area is very shaky and uncertain, which affects the large decline in tourist traffic	Increased influx of migrants	The Adriatic region is one of the safest and most peaceful areas in the Mediterranean	
3	**Reducing the EU's influence over the national level**	Adaptation of the law to national specifics	Less support and funding from EU funds		

5.2 Define 4 pathways/scenarios selected

Scenario 1: Rural idyll (Most positive)	
DRIVERS OF CHANGE	**ASSUMPTIONS**
Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)	High demand for local products from a sustainable and ecological production system
Individual tourism with special preferences	Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (e.g., wine tourism) and are extremely interested in local agricultural products.
Demographic issues, stay and resettlement of young people / families in rural areas	They will not be burdened by the past like generations that remembers communist cooperative agriculture
Increased concern for health and food production	Food produced in a specific way - functional food - is increasingly valued
Delivery of agricultural products from producer to buyer	Digital technologies and drones enable easy, fast and cheap delivery to the destination
Connecting real and virtual life	New technology enables a virtual feeling of staying in a destination and tasting local products from your own home
Development of laboratory-produced food	Reducing the environmental impact of agriculture
Digitization of agriculture	Greater control of traceability, will increase trust in institutions
Agricultural resources and products market	Consolidation of holdings through the use of uncultivated agricultural land results in an increase in holdings and the total volume of production
Income	Adriatic Croatia has established itself as a destination for elite tourism and is mostly visited by tourists of high purchasing power.
Climate changes	Innovations have contributed to the fact that weather disasters do not affect agriculture and tourism
Preserved environment	Adriatic Croatia is a unique oasis of preserved and unpolluted nature
Increasing the number of eco-labeled products	Greater added value
Legislation in agriculture	Adequate agricultural policies contribute to increasing the number of agricultural holdings and total production
The situation in the region	The Adriatic region is one of the safest and most peaceful areas in the Mediterranean
Reducing the EU's influence over the national level	Adaptation of the law to national specifics

Scenario 2: Digitally coloured rural life (DCRL) (better not best)	
DRIVERS OF CHANGE	**ASSUMPTIONS**
Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)	Local branded products are expensive, production is limited and available to a small circle of customers
Individual tourism with special preferences	Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (e.g. wine tourism) and are extremely interested in local agricultural products.
Demographic issues, stay and resettlement of young people / families in rural areas	Young people have no knowledge and experience because they came from urban areas
Increased concern for health and food production	Food produced in a specific way - functional food - is increasingly valued
Delivery of agricultural products from producer to buyer	Delivery to the customer is a bottleneck in the development of online shopping
Connecting real and virtual life	Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)
Development of laboratory-produced food	Reducing the environmental impact of agriculture
Digitization of agriculture	Greater control of traceability, will increase trust in institutions
Agricultural resources and products market	Liberalization of the market of all agricultural resources affects the placement of local products
Income	Diversification ensures successful business and high income of small farms
Climate changes	The rise in temperature allows us to extend the holiday season to the pre- and post-season when we are visited by a significantly larger number of tourists
Preserved environment	Ecological production of agricultural products and ecological practices in tourism are dominant
Increasing the number of eco-labeled products	Limited production
Legislation in agriculture	Adequate agricultural policies contribute to increasing the number of agricultural holdings and total production
The situation in the region	The Adriatic region is one of the safest and most peaceful areas in the Mediterranean
Reducing the EU's influence over the national level	Less support and funding from EU funds

Scenario 3: Elite, local, ecological, digital tools (ELEDA) (Worse not worst)	
DRIVERS OF CHANGE	**ASSUMPTIONS**
Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)	Local branded products are expensive, production is limited and available to a small circle of customers
Individual tourism with special preferences	Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (eg. wine tourism) and are extremely interested in local agricultural products.
Demographic issues, stay and resettlement of young people / families in rural areas	Young people have no knowledge and experience because they came from urban areas
Increased concern for health and food production	Stratification of society
Delivery of agricultural products from producer to buyer	Delivery to the customer is a bottleneck in the development of online shopping
Connecting real and virtual life	Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)
Development of laboratory-produced food	Prevails over traditional production, job loss and centralization of production
Digitization of agriculture	Development of marketing applications of agricultural products
Agricultural resources and products market	Tourism employs predominantly foreign labour, from less developed countries, resulting in a low level of quality of the tourist offer.
Income	Due to the health-political situation, the tourism sector is not stable, so earnings are not stable either
Climate changes	Climate change is hitting farmers hard, and production is only possible with prevention measures (irrigation), so overall production is declining
Preserved environment	Ecological production of agricultural products and ecological practices in tourism are dominant
Increasing the number of eco-labeled products	The emergence of a large number of certified organic products
Legislation in agriculture	Effective control guarantees the origin and traceability of the product
The situation in the region	The Adriatic region is one of the safest and most peaceful areas in the Mediterranean
Reducing the EU's influence over the national level	Less support and funding from EU funds

Scenario 4: Great Depression (Most negative)	
DRIVERS OF CHANGE	ASSUMPTIONS
Raising awareness about food quality and production methods (promotion aimed at the creators of social change - influencers)	Local products are not particularly valued and sought after as there is no guarantee of origin and traceability
Individual tourism with special preferences	Tourists do not trust the quality and origin of local agricultural products
Demographic issues, stay and resettlement of young people / families in rural areas	Young people have no knowledge and experience because they came from urban areas
Increased concern for health and food production	Stratification of society
Delivery of agricultural products from producer to buyer	Delivery to the customer is a bottleneck in the development of online shopping
Connecting real and virtual life	Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)
Development of laboratory-produced food	Prevails over traditional production, job loss and centralization of production
Digitization of agriculture	Greater traceability control and difficulty in mastering new skills for older people
Agricultural resources and products market	Tourism employs predominantly foreign labour, from less developed countries, resulting in a low level of quality of the tourist offer.
Income	It is dominated by mass tourism in which more expensive local products are difficult to sell.
Climate changes	Climate change is hitting farmers hard, and production is only possible with prevention measures (irrigation), so overall production is declining
Preserved environment	Inadequate care for the environment has resulted in environmental degradation resulting in negative impacts on agriculture and tourism
Increasing the number of eco-labeled products	A large number of different certificates
Legislation in agriculture	Small farms survive thanks to large state aid
The situation in the region	The area is very shaky and uncertain, which affects the large decline in tourist traffic
Reducing the EU's influence over the national level	Less support and funding from EU funds

5.3 Identify the 2 pathways that will be defined in more detail

The names of the two future scenarios that represent better but not the best and other that represent worse but not the worst scenario were the following: "Rurally colored digital life (DCRL)" and "Elite, local, environmental, digital tools (ELEDA)", we elaborated into two groups, which we then presented to each other.

5.4 Methodology used to identify pathways

Living Lab was divided into two groups and 4 scenarios were defined of which two draft scenarios that are 'probable positive scenario' and 'probable negative scenario'. The names of the scenarios were as follows: "Rurally coloured digital life (DCRL)" and "Elite, local, ecological, digital tools (ELEDA)". The groups worked out the elaboration of individual scenarios and jointly summarised the main elements of the draft scenario and discussed it. After that, each group made a timeline of future events to realise their scenario.

5.5 Relevant feedback from participants

Participants concluded that in the future, digital solutions will play a key role in linking local agriculture and tourism, and we all agreed on the main directions for development.

6 Scenario Narratives

6.1 Name Scenarios

The four names of the scenarios are, in order of most positive to most negative:

1. Rural idyll
2. Digitally coloured rural life (DCRL)
3. Elite, local, ecological, digital tools (ELEDA)
4. Great depression

6.2 Write the 2 detailed scenario narratives

We developed two scenarios: one better not best “Digitally coloured rural life”, and one worse not worst “Elite, local, ecological, digital tools (ELEDA)”. We outline the scenarios and describe how participants saw the development of these scenarios under the chosen assumptions.

1. Digitally coloured rural life (DCRL)

In the case of DCRL, a young couple decides to change their lifestyle and replace the urban environment with a rural one. Good conditions and various incentives give them the courage to decide to live in the countryside. The idea is to make a living from the products they produce on their own land. They also want to offer their products on their future farm through tourist and catering services since the area they live in is already placed on the touristic maps and is becoming more and more popular. The source of income through diversification of their farm within a good economic and political situation offers them security and promises a high standard.

As young people taught to live in the city, where they were born and grown up, without any practical knowledge of rural life and sustainable agriculture they do not have enough practical and theoretical knowledge or even an idea of how difficult and challenging life in rural areas is regardless of the positive parameters present. The idea of a rural lifestyle without stress and everyday crowds seems ideal to them.

Coming to the countryside and to the rural environment they face a multitude of unexpected situations mostly due to unpreparedness and lack of knowledge for rural conditions. Immediately after arriving and realizing that they their knowledge is not sufficient, practical as well as theoretical about life in rural areas and food production, they seek some advice and apply to the local agriculture advisory service that is free and offer tailor made advice based on their needs. As part of the advisory package, they receive all relevant information from the production and processing of their own products to the registration of tourism and hospitality technical and legislative activities. As part of the advisory service, they found a partner who will work with them to solve all the challenges they face and also get in touch with other producers with similar problems Thanks to all that they have more courage and feel like a part of a community and certain safe net.

In 2031. The Croatian Adriatic coast is known as one of the safest places in the Mediterranean, and with the help of an application that offers tourists all the necessary information, it has established itself as a place of elite tourism. Combined with preserved nature and cultural heritage, tourism on smaller rural households with flavours and aromas of local products is a very profitable activity. With the return of more and more young people to rural areas, the rural part of Adriatic Croatia is reviving, neglected villages are being restored and gaining a newly discovered identity. Living in such a space is pleasant and gives people a sense of satisfaction and relieves them of the daily worries and frustrations of living in big centres.

The products of rural farms are in high demand and relatively expensive and can only be afforded by a certain number of people due to limited production. Producers of agricultural, food products and providers of various services on farms in rural areas are connected in a network of digital services that allows them access to specific information, services (e.g. harvests machines, production robots, distribution with cargo drones etc.) and contacts of all relevant factors of agri-rural-tourism sector.

Such families have the security and desire to raise their children in a well-organized rural area. The second generation no longer has pioneering problems like their parents and can dedicate themselves to raising the quality of work and life.

Thus, we have successfully revived the rural area, preserved the culture and heritage of the rural areas and ensured a better quality of life for its inhabitants. Rural life is no longer stigmatized as less valuable and people in rural areas do not feel isolated or unappreciated because of their way of life but instead see their way of life more meaningful and fulfilled than in urban and suburban centres.

Scenario 2: Digitally coloured rural life (DCRL) (better not best) **Future timeline**	
DRIVERS OF CHANGE	**ASSUMPTIONS**
Now	Agricultural land is owned and used by Croatian producers and holdings (Local branded products are expensive, production is limited and available to a small circle of customers)
2022	**Liberalisation of the market of the Croatian agricultural land** (Liberalization of the market of all agricultural resources affects the placement of local products)
2024	**Adequate advisory assistance to producers of organic local products** (Young people have no knowledge and experience because they came from urban areas)
2024	**More and more people are deciding to change their lifestyle and engage in food production in rural areas** (Food produced in a specific way - functional food - is increasingly valued)
2024	**Good health and political situation** (The Adriatic region is one of the safest and most peaceful areas in the Mediterranean)
2025	**Strategic approach of the Croatian Tourist Board - Emitting tourism market** (Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (e.g., wine tourism) and are extremely interested in local agricultural products.)
Till 2026	Limited production - Till new law on the right to purchase land for all Eu citizens
2026	**Satellite tracking of crops and guaranteed traceability through digital applications** (Greater control of traceability, will increase trust in institutions)
Till 2027	**Cargo drones take over distribution**

	(Delivery to the customer is a bottleneck in the development of online shopping)
Till 2027	**The new way food industry has not yet positioned itself and is not profitable enough for the general population** (Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)
2027	**New more Earth friendly way for food production on greater scale, which follows official policy** (Reducing the environmental impact of agriculture)
2028	**Legislative and digital conditions have begun to yield full results** (Adequate agricultural policies contribute to increasing the number of agricultural holdings and total production)
2028	**Incentives play an increasingly smaller role in the financial construction of farmers** (Less support and funding from EU funds)
2028	**Legislative and digital conditions have begun to yield full results** (Diversification ensures successful business and high income of small farms)
2029	**The organic local food industry has positioned itself on the market and become a major player** Ecological production of agricultural products and ecological practices in tourism are dominant
2030	**In the case of Croatia, the change in temperature has no significant consequences, even vice versa** (The rise in temperature allows us to extend the holiday season to the pre- and post-season when we are visited by a significantly larger number of tourists)

2. Elite, local, ecological, digital tools (ELEDA)

With the implementation of a new law that allows all EU citizens to buy land in the Republic of Croatia come large companies but also a number of small producers looking for fertile healthy land for agricultural production. Due to the war and other socio-political factors, a large part of the Croatian agricultural land has been uncultivated for over 30 years, where the production of high-quality organic products is possible.

As the Croatian tourist board has been trying for years to present Croatia as a safe country for a full life experience, the aspirations have finally come true. Due to the Covid pandemic that has left its mark on a form of tourism. Tourists no longer seek centres and crowded places Tourists 'holiday perceptions have changed, and they are now looking for smaller places with more indigenous offerings from landscapes, local food to different traditional activities.

Thus, in addition to food production, new farmers returning to life in rural areas see their opportunity to earn money through some form of agri-tourism. Most people who decide to move to rural area and engage in agriculture are not so skilled in agriculture and need advice and knowledge. The question is how much they will be able to get the requested information from various advisors or consultants and how much it will cost them

The Covid pandemic has left its mark on tourism sector. Tourists are now looking for smaller places with an indigenous experience, which brings various providers of tourist and catering services to rural areas. In the absence of a comprehensive development strategy in the agri-rural-tourism sector, exclusively tourism companies are coming to rural areas along with farmers, wanting to take advantage of the trend in tourism. That professional tourist companies are unfair competition for farmers who also want to host tourists and offer them an indigenous experience of life in a rural area, and offer products of their own economy and on-site production

Such exclusively tourism systems do not develop life and do not revive rural areas and their heritage, but only work during the tourist season and the rest of the year are closed and those areas are “dead” again. Basically, there are all the prerequisites for the formation of a tourism network of food production and revitalization of rural areas but all these individual parts are not connected meaningfully through a common strategy.

We can learn from the situation in Southeast Asia, where all local tourism is exclusively run by large hotel chains and the local population is just an auxiliary workforce and tertiary sector workers with a certain often unfair salary. Local economy does not benefit much from such tourism as we could see now that due to Covid these areas has missed two tourist seasons, yesterday's lively tourist places collapsed like towers of cards, leaving people in severe poverty.

The danger in absence of a comprehensive rural development strategy is that these rural areas do not exist without tourism.

With the arrival of foreign and domestic companies but also individuals in rural areas that have been abandoned so far, villages and life in them are revived. People of various backgrounds are trying to create communities where they will form a rural idyllic life. After the initial enthusiasm, , some of them return from where they came from and some still try to live their rural dream.

Due to health-socio-political insecurity they cannot achieve the desired standard and feel deprived towards people in urban areas. The second generation is thinking about leaving the rural environment and does not feel proud or special because they are engaged in agriculture and live a rural life.

Scenario 3: Elite, local, ecological, digital tools (ELEDA) (Worse not worst) Future timeline	
DRIVERS OF CHANGE	**ASSUMPTIONS**

Now	**Till new law of on the right to purchase land for all Eu citizens** (Local branded products are expensive, production is limited and available to a small circle of customers)
2024	**Adequate advisory assistance to producers of organic local products** (Young people have no knowledge and experience because they came from urban areas)
2024	**The existence of promotional distribution applications but without wider integration** (Development of marketing applications of agricultural products)
2024	**Good health and political situation** (The Adriatic region is one of the safest and most peaceful areas in the Mediterranean)
2025	**Strategic approach of the Croatian Tourist Board - Emitting tourism market** (Before arrival, tourists have a lot of information about the specifics of the destination, clearly defined interests (e.g. wine tourism) and are extremely interested in local agricultural products.)
2025	**People with some kind of modified diet think of themselves differently than the rest of the population** (Stratification of society)
2026	**Satellite tracking of crops and guaranteed traceability through digital applications** (Effective control guarantees the origin and traceability of the product)
2026	**Due to the unfavourable health and political situation, the tourism sector is not stable, so the interest of participants in food production is not stimulating enough for a larger number of people.** (Tourism employs predominantly foreign labour, from less developed countries, resulting in a low level of quality of the tourist offer.)
Till 2027	**Cargo drones take over distribution** (Delivery to the customer is a bottleneck in the development of online shopping)
Till 2027	**The new way food industry has not yet positioned itself and is not profitable enough for the general population** (Expensive technologies and equipment are available only to the richer layer of people (both on the supply and demand side)
2029	**The organic local food industry has positioned itself on the market and become a major player** (Ecological production of agricultural products and ecological practices in tourism are dominant)
2029	**Legislative and digital conditions have begun to yield full results**

	(The emergence of a large number of certified organic products)
2028	**Incentives play an increasingly smaller role in the financial construction of farmers** (Less support and funding from EU funds)
2030	**New food sources** (Laboratory-produced food prevails over traditional production, job loss and centralization of production)
2030	**Food production is becoming even more expensive** (Climate change is hitting farmers hard, and production is only possible with prevention measures (irrigation), so overall production is declining)

6.3 Name and write the less detailed ‘best case’ and ‘worst case’ scenarios

1. Rural idyll

With the arrival of a young family on the estate of their ancestors and the decision to start a new different life away from the city crowds and continuously looking at the clock and counting minutes, they discover that their first neighbours also came a few months ago from another city with the same desire as them.

The desire to live a more fulfilling life, more in line with human nature, has given courage to many people and families and they have changed their priorities and made a turnaround in understanding life.

In large urban areas where there is a different style and pace of life compared to the rural one, many, especially young people, have a desire to spend their lives in a different way that will make them more fulfilled and satisfied. The main driver is the growing level of stress that people in urban areas have to deal with on a daily basis. In the past, the outflow of people to urban areas promised a more comfortable life, easier work and more opportunities.

While such a life in the city turned from possibilities into obligations and stress, life in the countryside became easier, isolation disappeared, and due to mobility and a new way of working in a digital environment, it become very tempting to move in rural area.

Due to the positive situation in the economy, agriculture and the political climate, many families and individuals have decided to return to the estates of their ancestors or buy one. With their arrival they found a positive entrepreneurial climate for dealing not only with agricultural occupations but also with many other occupations. Due to working from home and doing business online, the opportunities in rural areas are almost equal to those in cities with much easier daily obligations.

In rural areas there is a fast and stable internet connection, there are institutions such as kindergartens, nursing homes, health facilities and shopping centres that are easily accessible. There are also political and economic measures that facilitate the formation of the development of economy with financial and advisory measures. So anyone who decides to settle in a rural area feels comfortable and safe.

Rural areas and neglected villages come to life and become small communities with their own characteristics, customs and traditions. Rural areas are revived and re-created and life in rural areas is beautiful and satisfying.

2. Great depression

Due to bad events that have hit the eastern Adriatic in a relatively short time, people are looking for ways to live their lives better and offer their children better opportunities,

After earthquakes, pandemics, a large influx of migrants from around the world fleeing even worse situations, young people are looking for a way out by moving to the estates of their ancestors.

The change of place and even more the way of life from the urban to the rural area requires a lot of effort, nerves and money. Every step in the process is exhausting from bureaucracy to logistics.

When they finally come to the place of their dreams and desires for a better life, they encounter new problems that you could not even imagine in the city, from poor infrastructure of roads and utilities to a bad and unstable internet signal. The absence or hard-to-reach service institutions create a sense of isolation and second-class citizens a feeling.

Due to all these circumstances, the choice of occupation is limited, so the only option is to engage in primary agriculture.

The lack of a clear policy and economic strategy for rural development does not offer them any financial or advisory assistance in solving problems.

Climate change has made severe weather events very common and the production is unstable and unreliable. To be a successful producer farmers must use all available technology (irrigation, frost protection nets, frost hunters, etc.) which s very expensive and unaffordable to most of them. Market is very demanding with everybody want only perfect products and demand supply through all the season. Profit from the production is low, money for the investments in needed equipment is absent and the division between rich and successful and poor is significant.

Although life in urban centres has become less comfortable, unstable and increasingly stressful. There are still only a few who decide to change and move to a rural area, and from those who have decided to do so remain only the most persistent ones. The village was and remains a place of hard life and work.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.12 Italy (wood-energy traceability)

SCENARIO WORKSHOPS REPORT

DIGITALISATION AND WOOD-ENERGY TRACEABILITY IN ITALY

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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Introduction

Illegal logging is a significant global problem associated with deforestation, climate change, and biodiversity loss with significant negative economic, environmental, and social impacts. In response to this phenomenon, European Union has imposed traceability verification, whose implementation could be somehow affected by the uptake of digital solutions in the coming years.

Since Italy is the first importer of wood-energy biomass worldwide where tons of firewood without clear traceability are imported every year, we have established a Living Lab (named "wood-energy traceability in Italy") involving stakeholders and key informants, aimed to answer the following question: "How will digitalisation transform traceability in the Italian forestry and wood-energy sectors by 2031?".

Accordingly, an open and participatory forecasting exercise was carried out in order to answer this question. It was based on two on-line scenario workshops held between September and October 2021, where LL participants elaborated scenarios related to the use of digital technologies for traceability purposes in the Italian wood-energy sector in 2031.

Our LL was able to identify two main (intermediate) scenarios characterised by different and plausible evolutions of socio-economic, environmental, political and technological drivers. Then, two extreme scenarios (evoking "utopian" and "dystopian" situations) were also depicted.

This report describes in detail the entire path followed in order to come up with the elaborated scenarios, from the definition of the scenario question to the elaboration of the scenario narratives, passing through the definition of the drivers of change and the identification of plausible future pathways.

This work contributes to the discussion exploring and shedding light on possible evolutions of the wood-energy sector in the next decade, with particular attention to the transformation induced by (possible evolutions of the) digitalisation process as a whole, providing food for thoughts for stakeholders and policymakers.

The structure of the scenario report is the following: section 1 briefly describes LL composition and how scenario workshops were managed, section 2 shows how the final scenario question was identified, section 3 reveals relevant past events used to inspire the elaboration of future scenarios, section 4 illustrates divers of change that were then used in section 5 to define a matrix for the identification of the scenarios. Lastly, section 6 contains participatory narratives of both intermediate and extreme scenarios.

1. Living lab summary

6.4 Name of LL

Wood-energy traceability in Italy

6.5 Brief summary of LL

Illegal logging accounts for up to 30% of the global logging. It significantly damages both the legal market and public treasury, feeding tax evasion and creating opportunities for money laundering. Consequently, every year in Italy (which is the first importer of firewood worldwide), tons of timber without a clear traceability are imported. In order to foster production of wood from legal sources, the European Union has enacted the European Timber Regulation (EUTR – Reg. n. 995/2010), prohibiting illegal timber from being placed on the European market. The EUTR imposes European economic operators (e.g. forest owners/companies, wood and paper processors and importers) to exercise "due diligence". This latter implies the provision of specific and reliable information on timber supply (e.g. country of harvest, tree species, quantity, supplier, trader and compliance with applicable legislation) when timber products are introduced in the EU market. In more details, such a system strongly relies on data flows allowing both assessment of risk and introduction of measures for risk mitigation. At the-state-of-the-art, this procedure is mainly based on traceability verification through documents (desk audit) according to a so called "paper-based approach".

6.6 LL participants

In addition to PEFC Italia and University of Perugia, a total number of 11 organisations took part in our scenario workshops (11 stakeholders in the first workshop and 10 in the second one). These are organisations representing different sectors: enterprises, research, services, communication and consultants.
More in detail, the involved organisations are:

- Santini enterprise (Enterprise)
- CONAIBO National Coordination of Forestry Enterprises (Forest company representative)
- MEEO (Digital services)
- Extrasys (Digital services)
- AIEL (Services)
- Freelance professional (Services)
- RePlant – University of Tourin (Research)
- Edmund Mach Foundation (Research)
- CNR (National Research Council) (Research)

- AUSF (Confederation of University Associations of Forestry Students of Italy)
- Compagnia delle Foreste (Communication)

6.7 Timing of Scenario Planning (WP3) workshops

We had two 3-hour online workshops that took place according to the following schedule:

- First scenario workshop – September, 21 (3-6 PM);
- Second scenario workshop – October, 21 (9-12 AM).

In both cases, we used the Google Meet platform, taking advantage of the "Jambord" tool in order to increase animation and participation in specific activities.

During the first workshop we dealt with the following topics and carried out the following activities:

- introduction an ice-breaking;
- focal question setting up;
- past event activity;
- presentation and discussion of drivers of change (DOC);
- development of two future scenarios (working in two different groups).

During the second workshop we dealt with the following topics and carried out the following activities:

- sharing of the main results of the first workshop (scenario question, storyline, selected DOC and presentation of the two developed scenarios);
- backcasting;
- windtunnelling.

In order to facilitate online activities, we shared working documents (related to scenario question, storyline, DOC, scenario narratives, questionnaire for the definition of the two extreme scenarios) with participants in advance.

7 Scenario question

7.1 Draft scenario question

Following an internal discussion among LL coordinators between July and August 2021, we elaborated a rough version of the scenario question, as follows:

How digital tools might strengthen the wood-energy supply chain traceability in Italian market by 2031 to comply with the EU timber Regulation (EUTR)?

The WP3 leader was contacted for some feedback, we were recommended to: i) keep the question more neutral, without anticipating a possible impact (so replacing the verb "strengthen" with "transform"), ii) to directly refer to wood-energy sector instead of explicitly referring to a specific policy for traceability. However, even if we largely accepted these feedbacks, we decided to maintain a clear reference to traceability, so as to better define the boundaries or our forecasting exercises.

Thus, as a result of such a first validation process with the WP leader in early September 2021, we were able to propose the following draft scenario question to LL participants for further validation during scenario workshops:

How will digital tools transform Italy's wood-energy sector traceability by 2031?

7.2 Finalised Scenario question

As a result of the activities carried out during the two scenario workshops, our LL participants agreed upon the following finalised version of the scenario question:

How will digitalisation transform traceability in the Italian forestry and wood-energy sectors by 2031?

7.3 Methodology used to finalise scenario question

In order to finalise the scenario question, we adopted a participated and interactive co-production activity with the participants in a remote modality (using Google meet platform). In more detail, during our first scenario workshops we allowed an open discussion (about 20 minutes) after having presented the draft scenario question. All the participants were able to interact with coordinators to share ideas, provide feedback and elaborate on the proposed scenario question.

After the first meeting, we had one month to reflect on the feedback and come up with a revised version of the scenario question.

Lastly, at the beginning of the second scenario workshop, we presented a new version of the scenario question for a sort of compliance check with LL participants. Having received no further feedback, then the scenario question was considered as finalised.

7.4 Relevant feedback on scenario question from participants

Participants provided several relevant feedbacks that allowed to better target the scenario question to the scope of the LL as well as to tailor it on participants' expertise.

Main feedback was threefold, as follows:

i) One participant remarked that it was worth considering also forestry so as to avoid discussion exclusively focusing on biomasses (firewood, woodchips and so on). In this regard, there was extensive agreement on the need to include an explicit reference to forestry, so as to consider peculiarities related to the forestry areas in Italy (e.g. geographical location and related demographic and socio-economic trends in inner areas);

ii) A long debate considered the opportunity to explicitly refer to technology rather than digital tools. In the end participants agreed on the necessity to refer on (the holistic concept of) digitalisation so as to include and evaluate socio-economic and environmental aspects and implication related to the uptake of digital technologies;

iii) Lastly, another participant remarked how referring to traceability in the scenario question we paved the road for investigating and analysing socio-economic and, especially, environmental sustainability issues related to carbon sequestration.

8 Relevant past events

8.1 List of relevant past events

Here following the main relevant past events related to our LL are listed (in bold font the additions suggested by the LL participants).

- **Before 2010 - Structural funds programming, with presentation of digitalisation projects for forests and wood supply chain.**
- 2010 - Regulation 995/2010 (EUTR) approval; **ENplus certification.**
- 2011 - Italy is the world's leading importer of firewood, the fourth importer of pellets and one of the top ten importers of wood chips.
- 2012 - The Regulation 607/2012 has been published regarding the DDS methods and the frequency and nature of the checks on the control bodies.
- 2013 - EUTR enters into force.
- 2014 - In Italy, a specific law (Legislative decree n. 178 of October 30, 2014) establishes obligations to which operators selling timber and derived products are required and defines penalties; **Local trademark "Wood Forest Model of the Florentine Mountains" (traceability managed by municipalities).**
- 2015 – First 21 investigations carried out by the Italian Law enforcement agency with first administrative offenses.
- 2016 - PEFC inserts the EUTR rules as mandatory in the Chain of Custody standard.
- 2017 - Communication campaigns on EUTR carried out by PEFC, FSC, public administrations and monitoring organizations; **Evolution in the legislation on the consumption of wood fuels.**
- 2018 - The number of checks and penalties related to EUTR increases: 577 only in the second half of 2018; **RED II (Renewable Energy Directive) (environmental and emission sustainability).**
- 2018 to date – Spreading of E-invoicing, Portals and databases, Use of social networks, Innovative projects for traceability.
- 2019 - The UN Environment World Conservation Monitoring Center (WCMC) report states that there are about 20,000 importers of wood and derivatives in Italy.
- 2020 - Italian forests and wood companies are mainly located in mountain areas, where depopulation and aging are increasing (according to ISTAT in just five years there was a decline of 1.8%); **LIFE Foliage project to homogenize and computerize administrative practices.**
- 2021 - EUTR national register is established. 5 Monitoring Organizations operate in Italy; **AIBO FVG launches the first APP project for traceability with photos of timber loads.**

8.2 Description past event activity

The past events activity was carried out before and during the first online workshop. To clarify, in order to make participants more comfortable with the workshop topics, we sent, via e-mail, a first draft of our timeline (see fig. 1). The timeline we prepared was referred to the presentation of "10 years of traceability in the forest-wood-energy sector in Italy: the main stages". Together with some punctual main events related to traceability and EUTR implementation, we identified two main trends (reported in the two orange clouds).

Figure 1 - Draft of our timeline around our scenario question

During the first workshop, the storyline presentation was the second participatory activity. We showed the main events of our storyline (5 minutes) using Google Jamboard and asked participants to insert sticky notes (15 minutes) with feedback.

Just after the first workshop and during the second workshop, we showed our modified storyline, highlighting (in green colour) the inputs we received from LL participants (fig 2).

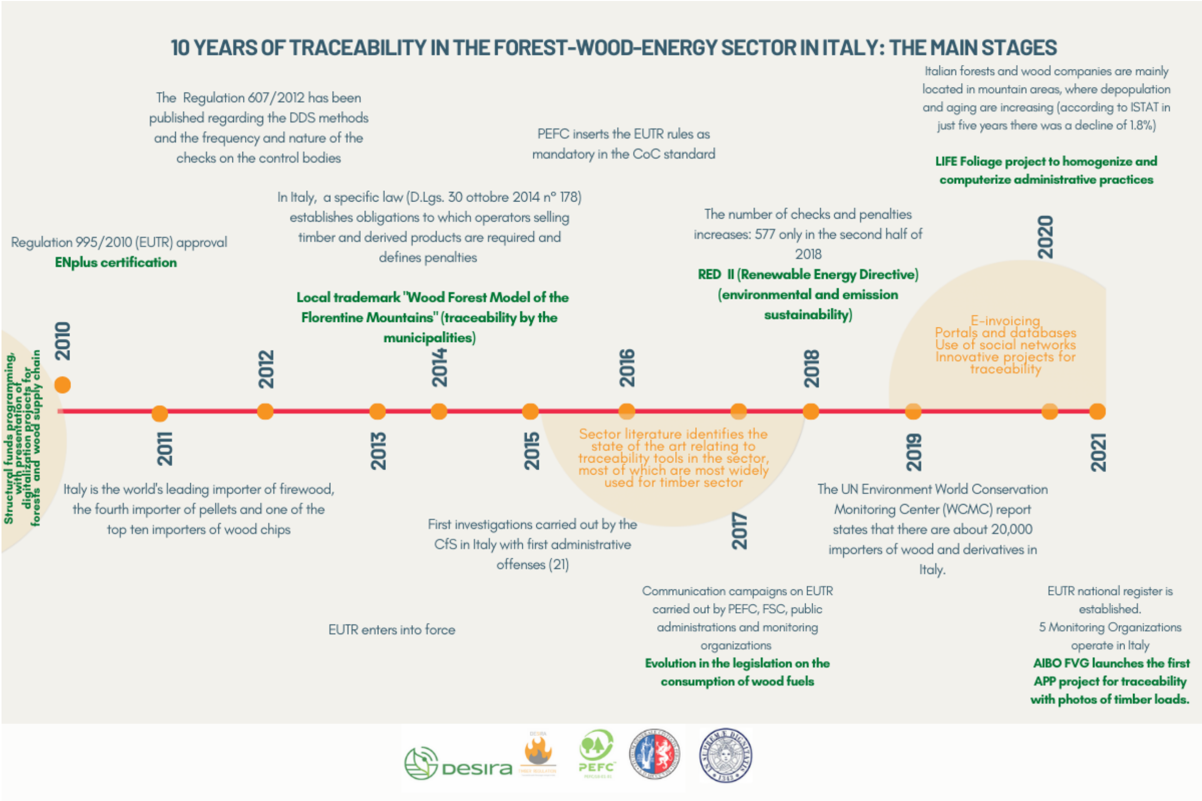

Figure 2 - Validated timeline around our scenario question

8.3 Relevant feedback from participants

The feedback we received are mainly related to three aspects:

i) Traceability doesn't correspond "only" to EUTR and legality issues but also to other aspects, such as "quality" of raw and final products. With this regard, the group decided to add to the storyline the ENplus[7] certification and the presence of the Local trademark "Wood Forest Model of the Florentine Mountains" (traceability managed by municipalities).

ii) Legislation regarding forest-wood-energy sector is referred also to the RED II (Renewable Energy Directive) concerning environmental and emission sustainability and to the evolution in the legislation on the consumption of wood fuels.

iii) Some specific projects funded also by Structural funds programming play a strategic role in this sector (some examples: LIFE Foliage for homogenising and computerising administrative practices; AIBO FVG app for traceability using photos).

[7] An independent certification scheme for wood pellets, guaranteeing quality from production to delivery and combating fraud along the entire supply chain.

9 Drivers of Change (DOC)

9.1 List initial set of DOC

LL coordinators identified an initial set of critical uncertainties that can play the role of DOC.

After a validation with some LL participants (specialists in the field of digital technologies applied in the forestry sectors and with expertise in forecasting and scenario exercises) the following table 1 was provided to LL participants for an open discussion during the first scenario workshop.

Table 1 – List of initial DOC

DOMAIN	DOC			
Social	Demographic trends in mountain areas	Digital literacy	Cooperation (among stakeholders) for Cascade use of wood	Public control and privacy related issues
Technological	Digital infrastructure and connectivity	Availability of digital solutions and multisource data		
Economic	Demand for carbon-neutral product and additional services led by environmental awareness	International trade and illegal import	Black market (internal) and fiscal incentives	Local and sustainable supply of wood for energy purposes
Environmental	Resilience of forests to climate change and extreme weather events	Sustainable and local supply of raw material		
Political	EUTR enforcement	EAFRD and ESIF subsidies for forestry, digitalisation, extension services		

What emerges is that we identified 14 among social, technological, economic, environmental and political drivers of change, as follows.

9.2 List selected DOC

As a result of the open discussion with LL participants during the first scenario workshop, we all were able to agree upon a final list of DOC. Table 2 contains this list of selected DOC arranged by single domain (changes are highlighted in bold characters).

Table 2 – List of selected DOC

DOMAIN	DOC			
Social	Demographic trends in **inner and** mountain areas	Digital literacy	Cooperative **attitude** (among stakeholders) for cascade use of wood	Public control and privacy related issues
Technological	Digital infrastructure in **inner and** mountain areas	Availability of digital solutions and multisource data	**New sources of renewable energies**	
Economic	Demand for carbon-neutral products and services	**Trade dynamics along the forest-wood-energy supply chain**	**Supply of wood biomasses for energy purposes**	
Environmental	**Climate change and extreme weather events (fires, droughts, floods)**			
Political	**Enforcement** of public policies for wood traceability **(EUTR)** and renewable energy sources (RED)	**Subsidies and fiscal incentives for digitalisation, extension services, afforestation and uptake of alternative source of energy**	**Lobbying against forestry management and renewable energies**	**Local initiatives for a participated use and management of renewable energy sources**

What emerges is that we lastly selected 15 drivers among social, technological, economic, environmental and political ones, adding to the original version two more DOC for the political domain, one more DOC for both social and technological domains and eliminating one DOC to the environmental and economic domains respectively.

9.3 Describe methodology to select DOC

We again fostered a participated and interactive co-production among participants in a remote modality (using Google meet platform). In more detail, during our first scenario workshops we allowed 20 minutes of open discussion after presenting the DOC, followed by an hour and a half of group activity using the Google Jamboard to get written feedback from participants.

Thus, we allowed all the participants to provide feedback and elaborate on the initial list of DOC, proposing amendments and improvements in both oral and written modalities.

Then, we had one months to reflect on the feedback, so as to come up with a revised version of the list DOC.

Lastly, we shared a revised list of DOC during the second workshop (highlighting in green and red colours, respectively, additions and eliminations from the original list of DOC) to stimulate further discussion and to cross-check our desk activity with LL participants.

Having received no further relevant feedback, then the list of selected DOC was considered as validated and final.

9.4 Relevant feedback from participants

Participatory activities allowed participants to provide feedback on the initial list of DOC. We got useful indications and insights that largely affected the final version of DOC. Main indications are listed and described as follows:

- As regards the social domain, participants proposed only some minor changes. They suggested to refer to "**attitude to cooperation**" rather than "cooperation", since this latter could be seen more as an economic concept rather than a social one.
- With regard to the technological domain, one participant with a long expertise in this field, wondered if "**digital infrastructure in inner and mountain areas**" should not be seen as a relevant DOC instead of "connectivity" looking at 2031. Our LL agreed on better focusing on the former critical uncertainties rather than the second one. Moreover, the same participant, suggested to explicitly refer to "**new sources of renewable energies"** (such as those used in heating systems for buildings, facilities, offices, factories and so on) that could eventually co-exist or compete with wood biomasses for energy purposes.
- As far is the economic domain concerned, some LL's member remarked that "**illegal import**" and "**black market**" could be respectively included into the broader concepts of "**trade dynamics along the forestry-wood-energy supply chain**" and the "**supply of biomasses for energy purposes**" for analytical purposes, so avoiding to mainly (if not only) on negative features related to trade and supply of these products in Italy. Moreover, as for the latter driver, another participant recommended to avoid assuming (and suggesting) that **local supply** of biomasses for energy purposes is always sustainable (or, at least, more sustainable than **international supply**) by definition. Our LL largely agreed on all these feedbacks and proposed to revise the DOC accordingly.
- Concerning the environmental domain, participants suggested to avoid using the term "**resilience**", because considered too vague and generic and not explicitly referred to this domain. Therefore, our LL therefore decided to only identify "**climate change and extreme weather events**" as critical uncertainty in the environmental sphere.
- As for the political domain, some participants highlighted the need for considering the presence of lobbies and/or interest groups that are against any form of forestry management and anthropic intervention in forestry areas, also related to the uptake of renewable source of energy. Even if other participants remarked that these types of pressures could be addressed by means of specific communication campaigns for a sustainable forestry management, after a large debate our LL unanimously decided to consider "**lobbying against forestry management and renewable energies**" as a critical uncertainty in the political

domain. The LL recognised that these interest groups, affecting election results and policymakers' activities, could negatively impact on the uptake of renewable resources with indirect consequences in terms of carbon neutrality. Moreover, other participants identified the collective use and management of energy resources in local communities by means of participatory initiatives as another possible critical uncertainty. As a result, our LL agreed on identifying "**local initiatives for a participated use and management of renewable energy sources**" as another DOC in the political domain. Lastly, some participants remarked the need for considering not only policies for traceability in the forestry-wood-energy sector but also to include other public interventions in the field of renewable source of energy, that could affect the uptake of wood biomasses for energy purposes (such as the **Renewable Energy Directive** – RED – in Europe).

10 Matrix

10.1 Matrix description

A preliminary version of the morphological box, including from 2 to 4 assumptions for DOC identified in each domain, was elaborated. After the first scenario meeting, we reviewed the list of DOC and some assumptions based on LL feedback.

Then, during the second scenario meeting we asked again participants to validate our new version of the morphological box, triggering a discussion aimed to improve the matrix in terms of targeting, contents, internal consistency and plausibility.

As a result, our LL came up with a final matrix formed by 3 assumptions for every domain, with the only exception of the environmental one that was largely streamlined (see table 3 with changes highlighted in bold characters). Assumptions were inserted in the matrix with a specific rationale: starting from a “business as usual” (“BAU” assumption, in the middle) a less optimistic assumption was placed on the left and a more optimistic one on the right.

For each assumption, contents were discussed and agreed with participants during open discussions using Google Jamboard facilitated by LL coordinators both in plenary and group sessions.

Table 3 – Morphological box: finalised version of the matric (changes compared to the initial version are highlighted in bold characters)

DOC	Ass 1	Ass2 BAU	Ass 3
SOCIAL Demographic trends/Digital literacy/Cooperative attitude for cascade use of wood/ Public control and privacy related issues	Negative demographic trend in inner and mountain areas and poor digital literacy, exacerbate individualism **and poor cooperative attitude** of economic actors along the wood-energy supply chain. Uptake of digital technologies accentuates the mistrust towards public authorities and sensitive data management. This phenomenon triggers internal (employer versus employee) and external (control authorities versus operators) conflicts in forestry companies.	Negative demographic trends and low digital literacy persist in inner and mountain areas and the lack of digital literacy in inland areas, **in addition to a scarce cooperative attitude for the cascading use of wood biomasses for energy purposes**. Uptake of digital solutions generates mistrust towards public authorities and sensitive data management, with low levels of acceptance of public control as a consequence.	Negative demographic trends in inland and mountain areas slows down, while both digital literacy and the **cooperative attitude of economic actors for a cascade use of wood resources for energy purposes increase among operators**. Doubts related to sensitive data management are generally overcome, increasing the acceptance of public control among forestry operators.
TECHNOLOGICAL Digital infrastructure in inner and mountain areas/digital solutions and multisource data/new sources of renewable energies	Digital divide worsens and prevents an effective uptake of digital technologies and the generation of multi-source data that allow traceability of biomasses for energy purposes. **Use of new sources of clean energy lags behind.**	Digital divide persists in inner areas compared to urban areas limiting the uptake and use of digital technologies and the generation of multi-source data that allow traceability of biomasses for energy purposes. **Moderate use and uptake of new sources of clean energy.**	Diffusion of digital infrastructure **in mountain areas**, which allows the spread of new digital technologies and the generation of multi-source data for traceability purposes along the wood-energy supply chain. **Wide spread of new sources of clean energy.**
ECONOMIC Demand for carbon-neutral products and services led by environmental awareness/international trade dynamics / Supply of wood biomasses for energy purposes	Demand for products and services with zero or low environmental impact lags behind. At the same time, the share of imported products with an unknown origin increase, fuelling illegal activities in the wood-energy sector. **In absence of any kind of improvement in terms of buildings and plants' energetic performance, the supply of wood biomasses for energy purposes does not take off.**	Demand for products and services with zero or low environmental impact does not increase. **Wood products continue to be generally consumed (especially as regards firewood) because of a slow process of improving the energetic performances of plants and buildings.** Consequently, import of untracked biomasses for energy purposes continues.	Demand for traced and certified products with zero or low environmental impact increases in Italy, with positive implications for the import of legal biomasses for energy purposes. **The demand for these biomasses increases because of the improved energetic performances of buildings, plants and boilers.**
ENVIRONMENTAL Climate change and extreme weather events	Climate change effects (fires, floods and droughts) are increasingly evident and devastating, with strong repercussions in cities and along the coastal strips but also in inner and mountain areas.	Climate change effects continue causing frequent extreme whether events **(such as fires, floods and droughts).**	
POLITICAL Enforcement of EUTR and other policies for renewable energies/Subsidies and fiscal incentives/Lobbying against forestry management and renewable energies/ Local initiatives for a participated use and management of renewable energy sources	Low level of enforcement of the EUTR **and other policies that fosters traceability and use of renewable energy,** because of a low level of digitalisation of procedures. Public resources for financing investments in technologies and initiatives for digital education in forest areas decline. **Strong pressures of lobbies and local committees against clean energy hinder the diffusion of tax incentives in the forest-wood-energy sector. Furthermore, they prevent local initiatives aimed at fostering a participatory use of energy resources.**	Inclusion of digital technologies for the application of the EUTR and **other policies related to the use of renewable energy in Italy**. Public resources for investments in technologies and digital education in forestry areas are stable, **whereas tax incentives in the forest-wood-energy sector do not take off. Lobbying against the use of clean energy slows down the diffusion of local initiatives aimed at fostering a participatory use of energy resources.**	High level of enforcement of the EUTR **and other policies that fosters traceability and use of renewable energy,** because of complete digitalization of procedures. High levels of public investments for digital infrastructure and digital education in forest areas thanks to public resources **and tax incentives. At the same time, thanks to local initiatives aimed at fostering a participatory use of energy resources, lobbies and local committee's hostile to the affirmation of renewables lose their influence.**

10.2 Define 4 pathways/scenarios selected

Scenario workshops activities allowed our LL to clearly define four different, coherent, plausible and relevant pathways related to the scenario question, passing from a "best case" (utopian) scenario to a "worst case" (dystopian) scenario through two intermediate scenarios.

Initially based on LL coordinators' proposals, scenarios were then identified and fine-tuned according to participants' feedback, as follows:

- In the "best case" (utopian) scenario, all the identified critical uncertainties evolve in a desired way, at least according to LL's participants;
- In the "worst case" (dystopian) scenario all drivers of changes coherently evolve in an undesired way looking at 2031, based on LL's participants' preferences;
- In the remaining scenarios, respectively named "better not best" (BnB) and "worse not worst" (WnW) scenarios, different combination of assumptions referred to critical uncertainties were elaborated to define plausible intermediate pathways between the utopian and the dystopian scenario, ensuring internal consistency and high level of relevance.

In our case, the BnB scenario was obtained as a combination of plausible assumptions to depict a sort of ongoing digital transition in 2031. In a context of enduring climate change, this scenario is characterised by good level of digital competencies in inner areas, a moderate level of public investments for clean energy, digital education and digital infrastructures paving the road for a better enforcement of traceability policies and for participatory initiative to manage energy at local level, fostering the use of traced biomasses for energy purposes and limiting the influence of lobbies against clean energy.

On the other hand, the WnW scenario represent a plausible situation of weak digital transition in a context of increasing climate change, with low public and private investments in digital technologies, scarce diffusion of digital infrastructures and low level of digital education in inner areas due to negative demographics trends. Moreover, lobbying activities against clean energy slow down "carbon neutrality" with low energetic performances of building and low demand (and supply) of traced biomasses for energy purposes as a consequence.

Next section provides more detailed information on these two intermediate scenarios as a result of an in-depth discussion in our LL.

10.3 Identify the 2 pathways that will be defined in more detail

LL's participants were intensively involved in the identification and definition of the above-mentioned intermediate scenarios, one so-called "better not best" and another one so-called "worse not worst". Henceforth these two pathways are described in detail and reported in table 4.

As for the former scenario (identified in table 4 with green panels), it matches assumptions from different domains depicting a plausible optimistic pathway for 2031, far away from utopia but certainly different from the "starting point" (that is the "business as usual" in 2031). Here, the social domain is mainly characterised by a stable demographic trends in inland and mountain areas, paving the road towards more cooperative attitudes of economic actors for a cascade use of wood resources for energy purposes. Due to an increasing level of digital literacy among population, doubts related to sensitive data management are generally overcome, increasing the acceptance for a public control for traceability and transparency among forestry operators. As climate change causes frequent extreme whether events (such as fires, floods and droughts), an increasing demand for traced and certified products and services with zero or low environmental impact positively affect the use and import of legal biomasses for energy purposes in Italy. In an economic and technological context where sources of clean energy gains momentum, the demand for wood biomasses increases because of the improved energetic performances of buildings, plants and boilers. Moreover, diffusion of digital infrastructure in inner and mountain areas fosters the use of new digital tools for collecting and processing multi-source data for traceability purposes along the wood-energy supply chain. In the political and administrative field, the uptake of digital technologies allows a faster and more efficient enforcement of the EUTR and other policies related to the use of renewable energy in Italy. Public resources for investments in technologies and digital education in forestry areas keep stable, whereas tax incentives in the forest-wood-energy sector do not take off. However, lobbying activities against the use of clean energy slow down the diffusion of local initiatives aimed at fostering a participatory use of energy resources.

Concerning the "worse not worst" scenario (identified in table 4 with orange panels matching assumptions from different domains), negative demographic trends and ageing persist in inner and mountain areas in inland areas, exacerbating a scarce cooperative attitude for the cascading use of wood biomasses for energy purposes. Moreover, a low level of digital literacy fosters mistrust towards public authorities and sensitive data management, with low levels of acceptance of public control for traceability and transparency purposes, as a consequence.
Despite climate change effects (fires, floods, droughts…) are increasingly evident and devastating, with strong consequences for cities, along the coastal strips and in inner and mountain areas, demand for products and services with zero or low environmental impact lags behind and there is only a modest use and uptake of new sources of clean energy. In absence of any kind of improvement in terms of buildings and plants' energetic performance, the supply of wood biomasses for energy purposes does not take off. At the same time, the share of imported products with an unknown origin increase, fuelling illegal activities in the wood-energy sector. Digital divide persists in inner areas compared to urban areas limiting the uptake and use of digital technologies and the generation of multi-source data that allow traceability of biomasses for energy purposes. As a consequence, in the political and public domain, because of a low level of digitalisation of administrative procedures an inefficient level of enforcement of the EUTR and other policies that fosters traceability and use of renewable energy still persists. Moreover, tax incentives in the forest-wood-energy sector and public resources for

financing investments in technologies and initiatives for digital education in forest areas decline, also because of strong pressures of lobbies and local committees against clean energy and the uptake of digital technologies. Furthermore, these pressures prevent local initiatives aimed at fostering a participatory use of energy resources.

Table 4 – Morphological box: identification of 2 pathways (BnB in green and WnW in orange)

DOC	Ass 1	Ass2 BAU	Ass 3
SOCIAL **Demographic trends/Digital literacy/Cooperative attitude or cascade use of wood/ Public control and privacy related issues**	Negative demographic trend in inner and mountain areas and poor digital literacy, exacerbate individualism and poor cooperative attitude of economic actors along the wood-energy supply chain. Uptake of digital technologies accentuates the mistrust towards public authorities and sensitive data management. This phenomenon triggers internal (employer versus employee) and external (control authorities versus operators) conflicts in forestry companies.	Negative demographic trends and low digital literacy persist in inner and mountain areas and the lack of digital literacy in inland areas, in addition to a scarce cooperative attitude for the cascading use of wood biomasses for energy purposes. Uptake of digital solutions generates mistrust towards public authorities and sensitive data management, with low levels of acceptance of public control as a consequence.	Negative demographic trends in inland and mountain areas slows down, while both digital literacy and the cooperative attitude of economic actors for a cascade use of wood resources for energy purposes increase among operators. Doubts related to sensitive data management are generally overcome, increasing the acceptance of public control among forestry operators.
TECHNOLOGICAL **Digital infrastructure in inner and mountain areas/digital solutions and multisource data/new sources of renewable energies**	Digital divide worsens and prevents an effective uptake of digital technologies and the generation of multi-source data that allow traceability of biomasses for energy purposes. Use of new sources of clean energy lags behind.	Digital divide persists in inner areas compared to urban areas limiting the uptake and use of digital technologies and the generation of multi-source data that allow traceability of biomasses for energy purposes. Moderate use and uptake of new sources of clean energy.	Diffusion of digital infrastructure in mountain areas, which allows the spread of new digital technologies and the generation of multi-source data for traceability purposes along the wood-energy supply chain. Wide spread of new sources of clean energy.
ECONOMIC **Demand for carbon-neutral products and services led by environmental awareness /international trade dynamics / Supply of wood biomasses for energy purposes**	Demand for products and services with zero or low environmental impact lags behind. At the same time, the share of imported products with an unknown origin increase, fuelling illegal activities in the wood-energy sector. In absence of any kind of improvement in terms of buildings and plants' energetic performance, the supply of wood biomasses for energy purposes does not take off.	Demand for products and services with zero or low environmental impact does not increase. Wood products continue to be generally consumed (especially as regards firewood) because of a slow process of improving the energetic performances of plants and buildings. Consequently, import of untracked biomasses for energy purposes continues.	Demand for traced and certified products with zero or low environmental impact increases in Italy, with positive implications for the import of legal biomasses for energy purposes. The demand for these biomasses also increases because of the increased energetic performances of buildings, plants and boilers.
ENVIRONMENTAL **Climate change and extreme weather events**	Climate change effects (fires, floods and droughts) are increasingly evident and devastating, with strong repercussions in cities and along the coastal strips but also in inner and mountain areas.	Climate change effects continue causing frequent extreme whether events (such as fires, floods and droughts).	
POLITICAL **Enforcement of EUTR and other policies for renewable energies/Subsidies and fiscal incentives/Lobbying against forestry management and renewable energies/ Local initiatives for a participated use and management of renewable energy sources**	Low level of enforcement of the EUTR and other policies that fosters traceability and use of renewable energy, because of a low level of digitalisation of procedures. Public resources for financing investments in technologies and initiatives for digital education in forest areas decline. Strong pressures of lobbies and local committees against clean energy hinder the diffusion of tax incentives in the forest-wood-energy sector. Furthermore, they prevent local initiatives aimed at fostering a participatory use of energy resources.	Inclusion of digital technologies for the application of the EUTR and other policies related to the use of renewable energy in Italy. Public resources for investments in technologies and digital education in forestry areas are stable, whereas tax incentives in the forest-wood-energy sector do not take off. Lobbying against the use of clean energy slows down the diffusion of local initiatives aimed at fostering a participatory use of energy resources.	High level of enforcement of the EUTR and other policies that fosters traceability and use of renewable energy, because of complete digitalization of procedures. High levels of public investments for digital infrastructure and digital education in forest areas thanks to public resources and tax incentives. At the same time, thanks to local initiatives aimed at fostering a participatory use of energy resources, lobbies and local committee's hostile to the affirmation of renewables lose their influence.

10.4 Methodology used to identify pathways

Scenarios were identified on a “learning by doing” basis, as a result of a highly participated exercise of co-generation among LL’s participants in a remote modality (using Google meet platform). During the first workshop, after a wide-open discussion aimed to define DOC and assumptions using Google Jamboard, participants were split for more than an hour in two groups (working in virtual rooms), so as to preliminary identify two plausible intermediate scenarios (“BnB” and “WnW”) and elaborate respective narratives (reported in section 6) in an open debate.

Afterwards, LL’s coordinators worked for about one month in order to revise participants’ feedback and contributions in preparation for the second workshops.

This latter, again arranged in a remote modality, allowed to fine-tune the scenarios identification and their narratives, by means of a backcasting exercise. Here, working in the same two groups of the first workshop, participants were first asked to propose and write down (using Google Jamboard) evocative title for newspapers or magazine referred to policies, events or intermediate steps that should occur from 2021 to 2031 to realise the scenario they had previously defined. Then, an open discussion of about an hour was moderated in order i) to make participants declare what they do like/dislike of the identified scenario and ii) to better define and think of policies and events aimed to foster or lighten positive or negative effects of a given scenario. Lastly, a sort of stress test (or “wind tunnelling exercise”) of each scenario was arranged in a final plenary session, where participants cross-checked which of the policies or events proposed for a given scenario were also suitable and feasible for the other one.

Lastly, based on the final version of the morphological box, we asked participants to fill in a short questionnaire (using Google forms) in order to match assumptions on DOC and identify two extreme (“utopian” and “dystopian”) scenarios.

10.5 Relevant feedback from participants

As a general approach, working on our initial proposal of intermediate scenarios, LL’s participants initially evaluated and analyse: i) the relevance and the reliability of any selected assumptions on DOC as well as ii) the internal consistence of each scenario, looking at whether and how combination of assumptions were or not consistent.

As a result, their feedback mainly focused on the description of the selected assumptions for each proposed scenario (see section 4.4.) rather than on the identification of new or different pathways. In this regard, we noticed that our LL highly converged from the beginning on the initial proposals of intermediate scenario.

However, once we elaborated relevant feedback on DOC and assumptions received during the first scenario, we were able to arrange a new version of both the matrix and the identified pathways. These latter were then fine-tuned in the second workshop with table 4 as a final result.

11 Scenario Narratives

11.1 Name Scenarios

We propose LL's participants two preliminary evocative names for BnB and WnW scenarios, respectively:

- "Traceability: towards a digital transition" and
- "Digitalisation for traceability: a missed chance".

At the end of the second workshops, after we fine-tuned and cross-checked both intermediate scenarios, we asked participants of both working groups to think and write down in a specific Google Jamboard some possible memorable names or keywords.

Based on their contributions, we were therefore able to elaborate final versions of the names incorporating participants' feedback, as follows:

- The BnB scenario has been named "**Digitalised and transparent forestry-wood-energy supply chains: a path towards a sustainable forest bioeconomy**"
- The WnW scenario **"Digitalisation for traceability in the forestry-wood-energy sector: a postponed chance**".

11.2 Write the 2 detailed scenario narratives

Working in groups, LL's participants were asked to answer some guiding questions to elaborate scenario narratives. Then, these latter were fine-tuned in a plenary session at the end of the second workshop.

Henceforth, final versions of the scenario narratives are arranged and presented based on the above-mentioned questions so as to foster readability. Here below, the narrative of the BnB scenario, named "Digitalised and transparent forestry-wood-energy supply chains: a path towards a sustainable forest bioeconomy", is reported.

Who are the winners and losers?	In a scenario of digitalised and transparent forestry-wood-energy supply chains, winners are certainly companies able to take advantage of clean energy sources in mountain areas. Such a transition in the forestry sector, for example, is also supported by large technological operators (big tech) investing in the digital transition. At the same time, local communities may take advantage of these new opportunities to foster endogenous development with positive reverberations on employment level and socio-economic vitality in inland areas. Young generations also act as proponents of such a transformation. However, this is particularly true for those graduated (in particular in IT subjects) trained and specialized, whereas only a marginal support (if not a mild opposition) is expected by those less educated, more often residing in

	inner areas. Losers (and opponents) include 'old-style' entrepreneurs promoting and marketing firewood for energy purposes accustomed to managing the wood-energy sector in an outdated way, as well as supporters of fossil energies. These actors may converge and collude around common interests and stances, fostering and arranging national and/or local committees to fiercely oppose policies and interventions of digital transition of the forest-wood-energy sector in support of consolidated economic interests. Lastly, also public employees with lower levels of digital education may oppose digitalisation of administrative processes slowing down policies implementation.
What are the challenges and opportunities?	In a scenario of digitalised and transparent forestry-wood-energy supply chains, the use of tracked forest resources for energy purposes generates greater added value along local energy supply chain and positively contributes to a better image of internal areas and to promote tourism. Furthermore, digital transition contributes to increasing the attractiveness of rural areas for workers and families from urban areas. In this regard, one of the main challenges in this scenario is to stop the brain drain from inland and mountain areas to the urban areas, offering work and training opportunities and those who decide to live in inland areas. Digital education and long-life training of operators represent fundamental challenges milestone also in order to protect users' privacy. Indeed, there is no chance for digital security, without digital literacy because "the person is the first means to protect privacy".
What uncertainties are present?	In a scenario of digitalised and transparent forestry-wood-energy supply chains, significant elements of uncertainty are still at stake. First and foremost, radical technological innovations for building heating systems may positively or negatively affect the forestry wood-energy sector. Moreover, doubts related to the exposure of public and private dataset and portals to cyber-attacks or to infiltration of criminal activities in the sector persist. Lastly, uncertainties related to digital education and digital training of economic operators in the forestry sector and public employees are relevant.

What predetermined elements exert influences (DOC, assumptions) elements exert influence?	The potential conflict between local forest products or those coming from abroad is not without consequences. In fact, the assumption that the local product as sustainable and the international product is certainly able to influence the results in the elaboration of the scenarios. It must also be considered that there are sometimes intrinsic and endogenous connections among drivers of change: in this scenario of continuous climate changes, these latter undoubtedly influence a change in the use of forest resources for energy purposes (i.e. building heating systems).
Which other social, normative and policy dynamics could (positively and negatively) intervene? What is like to live in this version of the future? How will relationships change in local communities?	A scenario of digital transition exacerbates the migratory flow of young graduates in the short run (due to an urban job market that is highly attractive for IT graduates and much less attractive for those who are not in education, training or employment). Moreover, because of a larger uptake of technologies, digital mass media persist in generating a distortive and bucolic "narrative" about life in inland and forest areas, producing a sort of fracture between expectation and desire of urban population and needs of indigenous population of inland areas. This narrative distortion may contribute to further hinder a mutual recognition (of different lifestyles, needs and expectations), triggering socio-economic and political conflicts between mountain and rural communities and those residing in urban areas.
Which could be the gender impact?	In a scenario of digital and ecological transition there is a greater involvement of women that take care of digital procedures related to traceability and transparency. Women are more prepared and accurate than men in managing and administering sustainability policies.
How could blockchain technology be applied in order to ensure traceability?	Blockchain is not almost exclusively used in the financial sectors anymore, triggering wider affordability and accessibility of this technology. As a consequence, even if it does not represent an automatic solution for traceability in the forest-wood-energy blockchain is applied in the forestry sector as a method of data protection.

Here below, the narrative of the WnB scenario, named "Digitalisation for traceability in the forestry-wood-energy sector: a postponed chance", is reported.

Who are the winners and losers?	In this scenario, winners are those companies operating illegally in the black market. These actors keep a low profile, continuing to operate in "grey areas" in their respective markets. Other winners are big organisations able to absorb small forest companies

	that are going to disappear (because of the lack of employee's turnover and entrepreneurial renewal and difficulties in accessing the market). Losers are those above-mentioned SMEs that would like to change their organisation, but have no opportunity to do so as well as those companies unable to incorporate technological solutions and information flows in their business. Among losers there are also communities in inner areas, where continuing depopulation leads to a wide lack of supervision and protection of the territories. Moreover, civil society is considered as a loser as well, because of the loss of opportunities for using carbon neutral technologies and solutions in favour of a continued use of non-renewable sources (methane).
What are the challenges and opportunities?	In a scenario of not-digitalised and not-transparent forestry-wood-energy supply chains, the main opportunities are related to the introduction of new technologies: in such a negative scenario, even the introduction of a small innovation already consolidated and widely used in other contexts, could bring some advantages in a relatively simple way. It will be also important the ability to grasp the innovation produced in other sectors and adapt to forestry sector those technologies already available and consolidated. Another key challenge and opportunity is linked to the ability of boosting cooperation, bringing together the various actors along the supply chain. In particular, the ability to enhance the use of industrial by-products for energy purposes would be a key challenge. With regard to the characteristics of the combustion plants, another key challenge is related to the need of shorten the distance between innovation of plants and systems on the one hand and lack of infrastructures (e.g. internet) in mountain areas on the other hand. Promoting and supporting lifelong training would be a crucial challenge both to adequately renew trained personnel/operators both to increase basic digital knowledge, even in small companies and organisations.
What uncertainties are present?	In this scenario, with regard to the political domain a key uncertainty is represented by pressures and requests coming from civil society (mainly people living in Cities) far from mountain areas dynamics and with many "preconceptions". These pressures may indirectly support fossil fuels and nuclear energy and discourage biomass for energy internal production, import and consumption for quality-air issues. Another uncertainty is linked to the effective ability to adapt and integrate the forestry-sector to the new digital technologies. This fact can in some contexts affect the permanence of some companies in the market. We also mentioned the ability to enhance the wood product for energy purposes, since in this scenario even with large quantities of material, there is no structured supply chain. This is due to a de-industrialization of the

	sector which leads to less availability of residues which are valorised in the energy supply chain. In this regard, a key uncertainty relates to the real ability of forestry companies to reorganize themselves by networking. In the end, it has to be noticed that in the Italian forestry sector, when someone retires, there is often no adequate renewal. Whit this regard, having adequately training personnel able to replace skills and knowledge of those retired represents a crucial uncertainty as well.
What predetermined elements exert influences (DOC, assumptions) elements exert influence?	Cascading use[8] of wood which is a key element making possible to enhance multiple products by working at the organization level and need for integration of the various sectors and links in the supply chain. A decreasing demographic trend is certainly an element that exerts a great influence. This latter could be mitigated thanks to the diffusion of a greater connectivity in order to promote remote job opportunities and consequently better socio-economic conditions in internal areas.
How do you imagine everyday life?	This scenario is a "disaster", for those people living in mountain areas due to few opportunities for developing business, start-ups and finding jobs. The new generations move to cities, increasing the abandonment of the territory and the loss of traditional socio-cultural traditions.
How could blockchain technology be applied in order to ensure traceability?	Not applicable in this scenario with too many gaps and problems to address.

11.3 'Best case' and 'worst case' scenarios

Based on the finalised version of the matrix, our LL also identified two extreme pathways, namely the "best case" (utopian) and the "worst case" (dystopian) scenarios for 2031. Henceforth, they are described in details adding descriptive elements we were able to catch from the debate during participatory activities.

The "best case" scenario is named "Forests for Future: a dream called circular, digitalised and sustainable wood-energy supply chains", matching different keywords or tentative title proposed by participants thanks to a questionnaire on Google forms. This scenario is characterised by an inversion of the negative demographic trends in inner areas along with an increase of the level of digital literacy that brings to a higher acceptance of public control on traceability mechanisms and a wider

[8] Cascading use is a strategy to use raw materials in chronologically sequential steps as long, often and efficiently as possible for materials and only to recover energy from them at the end of the product life cycle. Cascading use of wood might contribute to more resource efficiency and consequently to reduce pressure on the environment.

cooperative attitude for a cascade use of wood resources for energy purposes among economic operators. At the same, digital endowment in terms of infrastructure increases in mountain and inner areas, paving the road for on field digital applications and solutions for traceability in the wood-energy sector (including generation and use of multi-source data). Moreover, a raising demand for carbon neutral product and services stimulate the diffusion of clean energies and traced (legally imported) biomasses for energy purposes, also thanks to improved energetic performances of buildings, domestic boilers and industrial plants. However, climate change in 2031 still persists menacing local populations with frequent fires, flood and droughts in both urban and mountain areas. Lastly, in a context of increasing public resources and tax incentives for investments in digital infrastructure and initiatives for digital education, digital transition in public administration allow to speed up the implementation of public policies for traceability and clean energies. At the same time, initiatives for a participatory use of energy resources at national and local level reduce the influences of lobbies against the use of clean energies.

Again, inspired by LL's participants, the "worst case" scenario's name is "Escape the (exploited) forests: a nightmare paved with good intentions". In this scenario, demographic trends in inner areas strongly worsens, exacerbating issues of poor digital literacy and individualism, that hinder cooperation for a cascade use of forest biomass for energy purposes. In such a context, forestry operators and local populations fear public control over sensitive data, triggering societal conflicts. At the same time, digital gap increases, preventing the uptake of digital solutions for traceability in the forestry sector. Likewise, the uptake of clean energy lags behind, because of a low demand for products and services with zero or low environmental impacts. Both phenomena cause the import of illegal firewood and biomasses in Italy, with a scarce energetic performance of buildings and industrial plants as a consequence. Climate change deploys all its devastating effect with negative consequences for local populations, also in inner and mountain areas. Lastly, missing digital transition brings to a low and weak enforcement of public policies for traceability and the use of clean energy. Public resources for investments and digital education are lacking, while lobbies and local committee fiercely oppose against the uptake of renewable source of energies hindering a participatory use of energy resources at local level.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.13 Italy (Toscana Nord)

SCENARIO WORKSHOPS

30.11.2020

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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1.1. Living Lab Toscana Nord

Living Lab “Toscana Nord” is in the DESIRA Italian Living Lab in the domain of rural areas.

1.2. Brief summary of Living Lab Toscana Nord

The Living Lab Toscana Nord has been organized around the activity of land and water management carried out by the local public authority Reclamation Consortium “Toscana Nord” (www.cbtoscananord.it). The Reclamation Consortium “Toscana Nord”, created in 2012, when such activity moved from the local level of Municipality Unions to a larger scale, is responsible for the management of an area of around 360.000 ha including both mountain and plain areas. In particular, the Reclamation Consortium “Toscana Nord” is managing a pilot activity in mountain areas that directly involves a network of farmers in the land monitoring and management to provide them an integrative income and increase the efficiency of removing obstacles on upstream little watercourses with the aim of preventing flood and landslides downstream. A previous experience was developed in 2014 by some of the farmers involved in this network with a WEBGIS supporting the communication of the maintenance works done by the public administration with the support of the farmers.

1.3. LL participants

The Living Lab has been built around a network of actors, both internal and external to the public institution Reclamation Consortium “Toscana Nord” which is defining the activity of the Living Lab. Actors internal to the public institutions are: the president, the director with responsibility of the land management of mountain areas, the IT experts, the technicians responsible for the practical management of the maintenance works carried on by the farmers, the technicians responsible for the management of alert messages from citizens more in general etc. Actors external to the public administrations are individual farmers and forest managers with experiences in maintenance works of mountain watercourses, representatives of citizens associations active on land management, the IT company which developed the experience of WEB GIS etc.

The number of participants is not clearly defined, but the core group has been created in the work of WP2, when more than 8 in-depth interviews on the functioning of the socio-cyber-physical system have been carried out and some other actors participated in the WP2 workshop in January 2021.

The management of the Living Lab is carried out with a two-level approach: a couple of key contacts are willing to exchange information more often with the DESIRA research team and to discuss them, before involving the whole group of actors in workshops and other project activities.

1.4. Timing of Scenario Planning (WP3) workshops

A first meeting was held in September 2021 with the person responsible for the management of mountain areas. She acted as the key contact for the DESIRA project from the beginning and supported the identification of the scenario question and the identification of actors to be involved in each workshop.

The scenario planning workshop took place in a face-to-face meeting on the 28 of October 2021. The meeting was held on Viareggio, at the main office of the Reclamation Consortium “Toscana Nord” so that all actors from mountain areas could participate.

2. Scenario question

2.1. Draft scenario question

The first scenario question was: *How can better communication among citizens, stakeholders and public administration make ordinary land management in marginal rural areas more effective? And how can digitalization facilitate the information flows between actors/tools involved in this process?*

2.2. Finalised Scenario question

The final scenario question used for the discussion during the scenario workshop on the 28th of October 2021 is: *How will the ordinary land management in mountain areas of the Reclamation Consortium “Toscana Nord” be managed in 2031? What role will digital technologies play in this process?*

2.3. Methodology used to finalise scenario question

The finalized scenario question was chosen starting from the results of the report developed on past and present impacts on WP2. The question was changed and improved during several online meetings with the person responsible for the management of mountain areas which is the key contact for the DESIRA project and is working with the project team every time it is needed to confirm every assumption made by the researchers.

We can say that the scenario question was a co-production between the DESIRA researchers and the Reclamation Consortium “Toscana Nord”. Other participants in the Living Lab were not directly involved in defining the finalised scenario question, even if they contributed to the WP2 report through interviews and participation in the workshop providing key information to finalise the scenario question.

2.4. Relevant feedback on scenario questions from participants

The participants make some little comments on the scenario question as it was developed, as already said, together with the Reclamation Consortium “Toscana Nord” which allow to use the perspective of the local administrations.

The key critical issues identified are:

- The time frame: 2031 was considered too far away by the participants, they would like to work on a shorter timeframe. This is also related to the fact that people are not used to work with a long-term vision.
- The area of reference: in the definition of the scenario question, we considered the difference between mountain and valley and decided to focus on mountain areas. However, the participants underlined the need to be even more specific, depending on the characteristics of different zones.

One participant suggested **asking alternative questions, focusing on population density:** What can be done to avoid that in 10 years there is no one left?

In general, we observed little trust in research, some participants considered the event an exercise with limited practical utility. Direct policy intervention is considered more useful (**importance of policy rather than research**).

3. Relevant past events

3.1. List of relevant past events

The past events have been based on the use of digital technologies in the last 10 years in the work of ordinary land management on mountain areas in the Reclamation Consortium "Toscana Nord" derived from the analysis of the interviews done in WP2.

Four functions have been identified for digital technologies that allow clustering also the past events:

- Land monitoring (Involvement of farmers, Introduction of webcams and drones)
- Communication among actors (use of WhatsApp, use of digital photos)
- Data collection and management (WEBGIS, Digital forms to include data in the Reclamation Consortium Database)
- Interventions and maintenance work planning (Use of QGIS and Q field app, possibility to have the georeferenced position of the alert)

3.2. Description of past event activity

The past events were presented through the 4 functions identified in the WP2 report. For each function, a slide was produced to show the evolution in the use of technologies in time.

1. LAND MONITORING

The land and weather monitoring were traditionally done through weather stations, rain gauges. The first past event relevant for the Living Lab has been the involvement of farmers in the land monitoring process to focus on little water streams and possible obstacles that need to be removed to prevent floods and landslides downstream. The direct involvement of farmers started in 2014 **created a demand for some tools to facilitate the communication** between the farmers and the Reclamation Consortium "Toscana Nord".

Another relevant past event, in terms of the use of digital technologies, is the introduction of webcams and rain sensors to **increase the automation of land monitoring**, and more recently drones.

In addition, there is a platform, managed by the Regional Authority, recording the weather stations' results on rains with precise georeferentiation. This is another interesting source of information for the Reclamation Consortium "Toscana Nord" which could support the integration of knowledge requested to improve land monitoring that allows planning effective ordinary land management interventions.

Fig.3.2.1 - Timeline of past events related to the land monitoring.

2. COMMUNICATION

Concerning communication between the field and the office of Reclamation Consortium "Toscana Nord" in the last 10 years, there was a quick development of innovative tools for communication as more in general in the society.

A key past event was the **introduction of digital photos** that allow the person on the field to transfer in the office a photo of the obstacles on water streams observed to quickly evaluate the need for priority in intervention. This was used since 2012 as an important tool for communication starting the process of making alerts more effective.

The possibility to use e-mail to transfer photos and communication to the Reclamation Consortium "Toscana Nord" has also been used to give information on possible interventions to be made.

The development in 2014 of **the Web-Gis IDRAMAP** allowed for continuous communication between the public authority and the citizens on alert and intervention made. However, some of the farmers still used the classical phone to communicate with the public authorities and indicate the need for intervention in a specific place.

The real key event was the **large use of smartphones**, with the possibility to make digital photos and send them in real-time using WhatsApp. This was a real change in time of communication between farmers in the mountain areas and the Reclamation Consortium "Toscana Nord", even if there is always a limitation due to the broadband coverage in mountain areas: often farmers report that they make the photo and then they find a place where they have broadband access to send it to the Reclamation Consortium.

Finally, the next important last event was the possibility, after the COVID 19 pandemic, to involve farmers in the **use of video conferencing tools** to meet them and discuss specific issues. Since 2020 the use of video conferencing tools has become much more common by most citizens and this is useful in mountainous areas where people need many hours to move from one place to another.

Fig.3.2.2 - Timeline of past events related to communication.

3. DATA COLLECTION AND MANAGEMENT

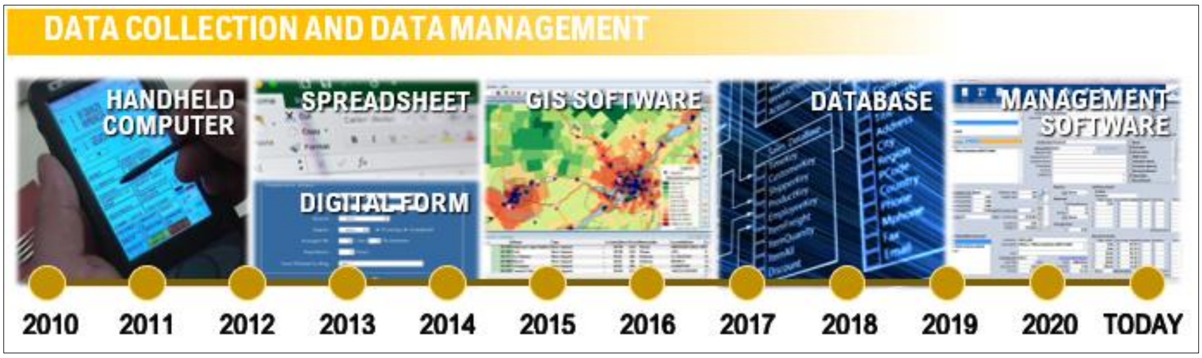
In the Data Collection and management, the key past events are related to the use of databases and the development of specific forms to move from excel files to databases collected within the Reclamation Consortium "Toscana Nord" system.

The development of the Web-Gis in 2014 was the first step to make the database visible to the public increasing transparency of the public administration activity.

The development of an alert system based on an online platform allows to organize all the alerts received and the associated maintenance works done.

The next steps that should be taken are related to the connection and integration of different databases used by Reclamation Consortium "Toscana Nord" in connection with other authorities such as the Regional Administration.

Fig.3.2.3 - Timeline of past events related to data collection and management.

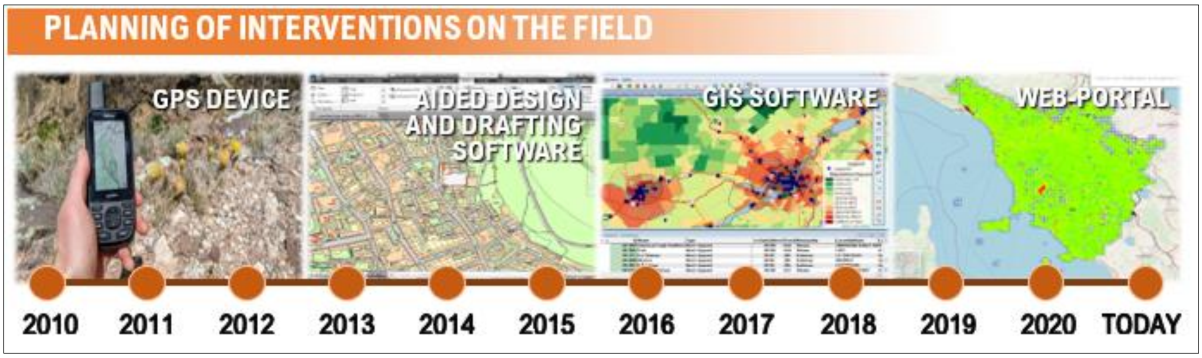


4. PLANNING OF INTERVENTIONS ON THE FIELD

In the work of engineers of the Reclamation Consortium "Toscana Nord", the use of GPS technologies was adopted already 10 years ago. The most important innovations were related to the use of software such as AUTOCAD and QGIS for the description of the intervention. In particular, the possibility to use in the field the QField app, associated with the QGIS software, allows them to save a lot of time and increase precision in the identification of intervention and maintenance works.

Finally, the work done with proper software also facilitate the connection with the Regional Administration platform.

Fig.3.2.4 - Timeline of past events related to the planning of interventions on the field.



3.3. Relevant feedback from participants

Participants in the workshop focused mainly on the past events related to communication, which are the ones that are more used by the actors internal and external to the Reclamation Consortium "Toscana Nord". They focused mostly on the possibility of using digital technologies to make such **communication more effective and rapid**, allowing to increase the number of interventions and reduce the time of verification for the need of intervention.

The DESIRA research team is planning a specific meeting with internal actors involved in the Living lab in order to further explore the impact of past events within the workload of the Reclamation Consortium "Toscana Nord".

4. Drivers Of Change (DOC)

4.1. List initial set of DOC

The list of initial DoCs [Tab.4.1.1] was developed in June 2021 by the DESIRA research team. The choice was to start with a long list, derived from individual identification of DOC by 4 researchers with different backgrounds involved in the Living Lab activity.

This is the list of the initial set of DoCs:

Fig.4.1.1 - List of Drivers of Change taken into account for scenario development.

SOCIAL	*(domain)*	*(category)*	
Hydrologic Risk-Related Behaviour	FORESTRY	SOCIAL	
Rural ageing	RURAL	SOCIETY Demographics	

Rural population density	RURAL	SOCIETY Demographics	✔
Education level of farmers	RURAL	SOCIETY Future of Education	✔
Farm succession/new entrants	RURAL	SOCIETY	
TECHNOLOGY	*(domain)*	*(category)*	
Connectivity and Broadband Infrastructure	RURAL	TECHNO	
Public/Private Investment in relevant science and technology	RURAL	TECHNOLOGY Digitalization	✔
Connectivity in the rural area	RURAL	TECHNOLOGY Digitalization	✔
Availability of open data	RURAL	TECHNOLOGY Digitalization	
Innovation	RURAL	TECHNOLOGY Digitalization	
Affordability of technology	RURAL	TECHNOLOGY Digitalization	
Drones	RURAL	TECHNOLOGY Digitalization	
Remote sensing	RURAL	TECHNOLOGY Digitalization	
Data hubs, platforms for data sharing	RURAL	TECHNOLOGY Digitalization	
ECONOMIC	*(domain)*	*(category)*	
Rural infrastructure	RURAL	ECONOMIC	
Costs of technology	RURAL	ECONOMIC	✔
ENVIRONMENT	*(domain)*	*(category)*	
Extreme weather events (inc. wildfires)	RURAL	ENVIRONMENT Climate Change	✔
Soil health	RURAL	ENVIRONMENT Climate Change	
Environmental awareness	RURAL	ENVIRONMENT Climate Change	✔
POLICY	*(domain)*	*(category)*	
Green recovery			✔
AKIS			✔
Digital policies			✔

4.2. List selected DOC

The list of DoCs that have been selected can be seen in the table in the previous paragraph [Tab.4.1.1]. it is sufficient to consider those marked by the following icon → ✔

4.3. Describe methodology to select DOC

The selection of relevant Drivers of Change (DoCs) started in June 2021, when after finalizing the WP2 report on past and present events related to the use of digital technologies in the Living Lab Toscana Nord, the research team started working on the future scenarios for the specific Living Lab. In particular, the team of 4 researchers working on the Living Lab, decided to work individually, using different perspectives and backgrounds to select relevant DoCs before meeting all together to discuss their choices.

The meeting involved all 4 researchers in the process of developing possible assumptions for each DoC to provide a first draft description of the two scenarios to be discussed during the Scenario Workshop. While developing the assumption, a final shorter set of DoCs was identified and included in the Matrix. In this way, the assumptions allow us to clearly define the differences and the similarities among the two scenarios.

In September 2021, the Matrix was sent to the key informants of the Reclamation Consortium for the Living Lab Toscana Nord and largely discussed with them in a specific meeting to validate the scenarios and the assumptions. Even if the list of DoCs was not explicitly presented to the participants, after the workshop, the assumptions were refined on the base of the discussion with all Living Lab participants.

4.4. Relevant feedback from participants

The main driver of change discussed with the participants was the rural population density, which is a relevant aspect to address local development policies. The participants said that rural population density should be broken down by zones (**spatial context [in relation to population]**). Because the reference territory differs too much from zone to zone. Moreover, the variations and impact of population change depending on where we are. There are areas that continue to develop despite being rural areas, but which have a tourist value (**rural tourist areas develop more, mountain areas less]**). One participant questioned the idea that rural population density will decrease in the next 10 years, because interest in some areas is growing (**possibility to avoid population reduction**).

The other driver of change directly discussed with participants was the connectivity in rural areas. Many participants complained about the limited connectivity in the area, underling the role of connectivity as a crucial game-changer.

Finally, from the workshop, it emerged that the role of institutions was the dominant driver in practice, as institutions can provide fundings and steer the future of the LL itself.

5. Matrix

5.1. Matrix description

The matrix has been developed starting from the drivers of change selected by the research team and validated by the LL participants in a specific meeting before the workshop. For each driver of change different options have been explored, developing specific assumptions in order to build the two main scenarios and the two secondary ones that were not discussed in the workshop but were presented to the participants. The complete matrix presented here has been refined after the workshop considering the contribution of the participants in further describing the scenarios. This allowed the researchers to improve the original matrix and in particular to identify the assumptions related to the two scenarios that were not discussed in detail.

SCENARIOS

	HUMAN INTENSIVE	TECHNOLOGY INTENSIVE	HUMAN & TECH COOPERATION	BUSINESS AS USUAL
S	***RURAL POPULATION DENSITY***			
	The **population density is stable**, and as not all watercourses can be constantly reached by the public administration, the farmers can support the monitoring of the ones close to their area and alert the public administration on the need for intervention.	The **population continues to decrease** and have a low population density. There is growing land abandonment. Ordinary land management does not involve citizens and it is done only on the major watercourse.	The **population density is stable** and the farmers are used to contributing to the monitoring of remote watercourses in mountain areas with the local Reclamation Consortium TN. There is a consolidated system of citizens participation in monitoring watercourses and maintenance works of ordinary land management.	The **population density is stable** and the farmers are contributing to ordinary land management through land monitoring. They are interacting with the public administration using different communication channels without a clear organization of information.
S	***EDUCATION LEVEL OF FARMERS***			
	Farmers have directly, or through someone in the family, a **high education level and they can learn digital skills** that allow them to use smartphones and digital platforms to contribute to reducing the hydrogeological risk in mountain areas. Farmers are autonomous in providing data relevant to the work of Reclamation Consortium TN.	People in the area have **low digital skills** and both farmers and public administrators do not have the capacity to use all the data collected by digital tools bought with public investments to increase the efficiency of ordinary land management.	Farmers have **increased digital skills** and they are constantly using an IT platform for interacting with the public administration and contributing to different service provisions.	Farmers have **low digital skills** and they prefer to use the phone or other classical communication tools to interact with the public administration

T	*PUBLIC/PRIVATE INVESTMENTS IN RELEVANT SCIENCE AND TECHNOLOGY*			
	Public/private investments can support **little investments** to use existing platforms or develop tailored ones to facilitate the interaction among citizens/farmers and public administration to apply an E-governing approach.	The **investments in technology are stable** and are addressed to improve the efficiency of ordinary land management.	**Public/private investments allow to develop efficient digital platforms**, well-integrated at different territorial levels and able to facilitate citizens contribution to ordinary land management. **Interoperability** among sensors, weather huts, antennas, digital maps and other tools with citizens information allows having constant monitoring of hydrogeological risk as a result of such investments.	**Public/private investments in digital technologies are used in other sectors** and ordinary land management is not considered a field in which is relevant to use digital tools.
T	*CONNECTIVITY IN RURAL AREAS*			
	Connectivity is still low, and sometimes there is a need for digital tools able to collect data offline and send them in a later stage when online. The **broadband coverage in rural areas is lower** than the one in urban areas and this will be taken into consideration when selecting the digital tool to use.	**Connectivity and Broadband Infrastructure will increase**, the rural area is covered by the signal and it is possible to use the Internet of Things approach in ordinary land management.	**Connectivity and Broadband Infrastructure is high**, the rural area is covered by the signal and it is possible to connect sensors and people and to the digital tools of the Reclamation Consortium “Toscana Nord”.	**Connectivity and Broadband infrastructure are low** and make complex the use of digital tools by farmers in remote areas.
E	*COSTS OF TECHNOLOGY*			
	High/middle costs of technologies do not allow to integrate sensors with	A **low cost of technology** allows existing investments to purchase all digital tools for an automated environmental	**Low/Middle cost of technologies** allow private/public actors to use all digital tools required to build an efficient system of	The **cost of technologies is too high** and cannot be afforded by Public Administration and private actors in remote

	human activities in land monitoring. However, the development of an efficient platform to coordinate the interaction between farmers/citizens and public administration allow the technical staff of the public administration to **integrate the two types of data manually.**		monitoring system in remote rural areas.	ordinary land management. The integration of information collected by sensors and by citizens is at the base of such a system.	areas. The budget of ordinary land management does not allow to consider the use of digital tools.
E	***ENVIRONMENTAL AWARENESS***				
	High environmental awareness of the population facilitates the involvement of citizens, in particular farmers, in ordinary land management.		The population have a **low environmental awareness** and is not interested in being directly involved in ordinary land management. There are not many economic activities in mountain areas that can offer environmental services.	The **environmental awareness of the population is increased** thanks to the private incentive to contribute to ordinary land management due to the possibility to get extra income for the maintenance works assigned by the public administrations in remote areas.	The population have a **high environmental awareness** and is willing to participate in environmental service provision. However, their collaboration is not structured and regular but it depends on specific direct relationships with the public administration.
E	***EXTREME WEATHER EVENTS***				
	Extreme events linked to climate change will increase. This assumption is common to all four scenarios.		**Extreme events linked to climate change will increase.** This assumption is common to all four scenarios.	**Extreme events linked to climate change will increase.** This assumption is common to all four scenarios.	**Extreme events linked to climate change will increase.** This assumption is common to all four scenarios.

P	***GREEN RECOVERY***			
	Digitalization and hydrogeological risks are	Putting together the priorities of this policy on	**Digitalization and hydrogeological risks are**	Green Recovery funds are **not combining**

	two key priorities of the Green Recovery at National Level. This policy can represent an opportunity to increase public investments in this specific field.	**reduction of hydrogeological risk and digitalization** allow using significant resources to buy digital tools for ordinary land management.	**two key priorities** of the Green Recovery at National Level. This policy can represent an opportunity to increase public investments in this specific field.	**digitalization and hydrogeological risk priorities** and are funding activities more focused on hydrogeological risk management than ordinary land management
P	*AKIS/DIGITALIZATION POLICIES*			
	The involvement of actors in developing an **innovative organizational model for ordinary land management** can facilitate the co-design of digital tools that can improve the efficiency of the process of interaction	National policies on digitalization support the **development of automated** ordinary land management systems.	The capacity of farmers/citizens to be involved in providing public services through the use of IT platforms will support their further involvement in developing **modelling approaches** to integrate quantitative and qualitative data.	Resources from digitalization policies will be **directed to other sectors** and specifically on ordinary land management

5.2. Define 4 pathways/scenarios selected

The 4 pathways/scenarios identified in the Living Lab Toscana Nord are strongly related to the involvement of local communities in ordinary land management of mountain areas.

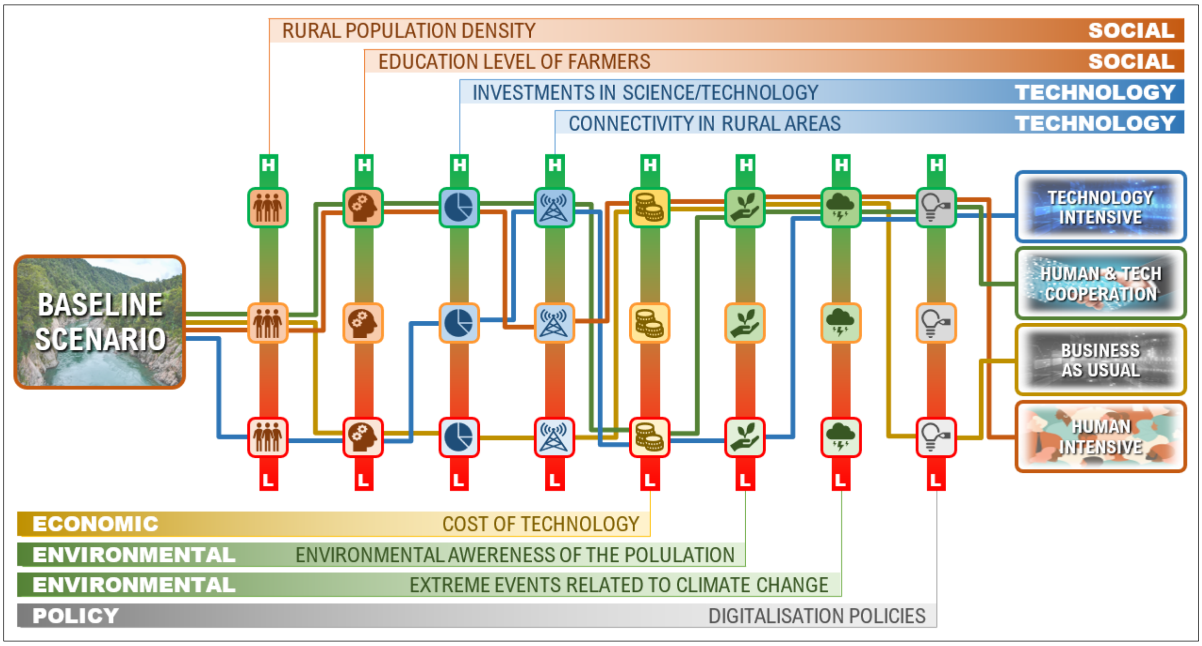
A. HUMAN INTENSIVE - In the first scenario, digital technologies are used to **facilitate the direct involvement of farmers/citizens in the land and watershed management**, allowing to increase the number of people able to send alerts to the Reclamation Consortium "Toscana Nord" who is responsible for the ordinary land management.

B. HUMAN AND TECHNOLOGY COOPERATION - In the second scenario, **digital technologies are used to integrate the direct involvement of farmers/citizens in the land and watershed management with a system based on the use of local and remote sensing technologies**. The integration of citizens' observations with sensors data is considered a good solution to increase the efficiency of the monitoring system.

C. TECHNOLOGY INTENSIVE - In the third scenario, digital technologies are used to develop **an automated land and watershed monitoring system** based on the integration of in situ environmental observation data derived from local sensors and webcams with a system of earth and environmental observations based on the use of satellite and other remote sensing tools.

D. BUSINESS AS USUAL - Finally, the fourth scenario considers the choice of **not having further investments in digital technology** to develop the local land and watershed monitoring system and to improve the efficiency of ordinary land management, using the resources for digital technologies in other sectors of the economy.

Fig.5.2.1 - Contribution of the different DoCs to the characterisation of the four scenarios.



The diagram [Fig.5.2.1] represents the contribution of the different Drivers of Change to the construction and definition of the four future scenarios. The starting point (BASELINE SCENARIO) is the one that refers to the current state (see Report WP2). Consistent with what has already been explained in the previous paragraphs, this will be influenced by a series of determinants that will lead it to evolve towards four hypothetical future scenarios. For each of the DoCs, three levels of magnitude

(**High**, **No change/stable**, **Low**) have been identified (approximately at this stage). As an example, let us consider the hypothetical scenario **TECHNOLOGY INTENSIVE**. Starting from the ***SOCIAL*** category, the assumptions linked to the DoC **Rural population density** are that the rural population will decrease drastically. For this reason, we can see that the magnitude is low [L]. Similarly for the DoC **Education level of farmers**, the magnitude is low [L]. Following the blue line, we can see that in the ***TECHNOLOGY*** category the DoC **Investment in science/technology** predicts that these will be stable, hence the magnitude is intermediate [NC], while the DoC **Connectivity in rural areas** predicts a high level of connectivity and hence the magnitude is high [H]. In the ***ECONOMIC*** category, the DoC **Cost of technology** predicts a low cost of technology, with a low magnitude [L]. In the ***ENVIRONMENTAL*** category, the DoC **Environmental awareness of the population** has a low magnitude [L], being (according to our assumptions) the population not very interested in this issue, while the DoC **Extreme events related to climate change** presents a high magnitude [H]. As can be seen in the matrix in the previous paragraph, this assumption is the only one that is common to all four hypothesised scenarios, and this representation offers the possibility to see it immediately (all four lines cross the high magnitude icon at the same time). Finally, for the *POLICY* category, (only for this representation) the three different DoCs have been grouped in a generic **digitalisation policy**, which in this hypothetical scenario is characterised by a high magnitude [H] because there are many possibilities offered by national and international policy. In the end, we have seen that following the lines (in one direction or the other) it is possible to have immediate information regarding the level of incidence of each DoC in the definition of the four hypothetical scenarios.

5.3. Identify the 2 pathways that will be defined in more detail

The two development pathways discussed during the workshop with the Living Lab participants are the following:

Scenario 1 (**HUMAN INTENSIVE**) focuses on the use of digital technologies to facilitate the participation of farmers/citizens in ordinary land management.

Scenario 2 (**TECHNOLOGY INTENSIVE**) focuses more on the exclusive use of digital technologies for ordinary land management and in particular for land and watercourse monitoring. In this case, the key technologies used are a combination of in-situ and remote sensing earth and environmental observations.

Fig.5.3.1 - The two hypothetical scenarios discussed in the workshop (from today to 2031).

5.4. Methodology used to identify pathways

The two pathways have been identified starting from the identification of Drivers of Changes and the development of alternative assumptions for each Driver of Change. In particular, the key driver of change that defines the difference between the two opposite scenarios is the one of Rural Population density as the main difference between the two Socio-Cyber-Physical systems defined by the two scenarios is related to the presence and involvement of local communities in land and watershed monitoring and management.

After defining the matrix with the assumptions for the two pathways the DESIRA research team had more than one meeting with the key contacts of the Living Lab Toscana Nord in order to validate and adapt the assumptions and the scenarios, before presenting and discussing them during the scenario workshop.

Finally, on the 28th of October 2021, the scenario workshop took place with a face-to-face meeting and, after a short presentation of past events, derived from the work done in WP2 about the past and present use of digital technologies in the context of the Living Lab, the participants have been divided into two groups with the aim of discussing more deeply the two scenarios and give more elements that allowed to define the scenario narratives.

5.5. Relevant feedback from participants

The participants of Scenario 1, gave particularly positive feedback on the possibilities offered by this scenario and had a positive attitude towards the technological change. The ones involved in Scenario 2, instead, manifested opposition towards the idea of a technology-intensive solution to the problem and raised several issues against this idea. This was useful to trigger potential negative impacts that may be caused by the introduction of technology without the involvement of the citizens in the loop.

6. Scenario Narratives

6.1. Name Scenarios

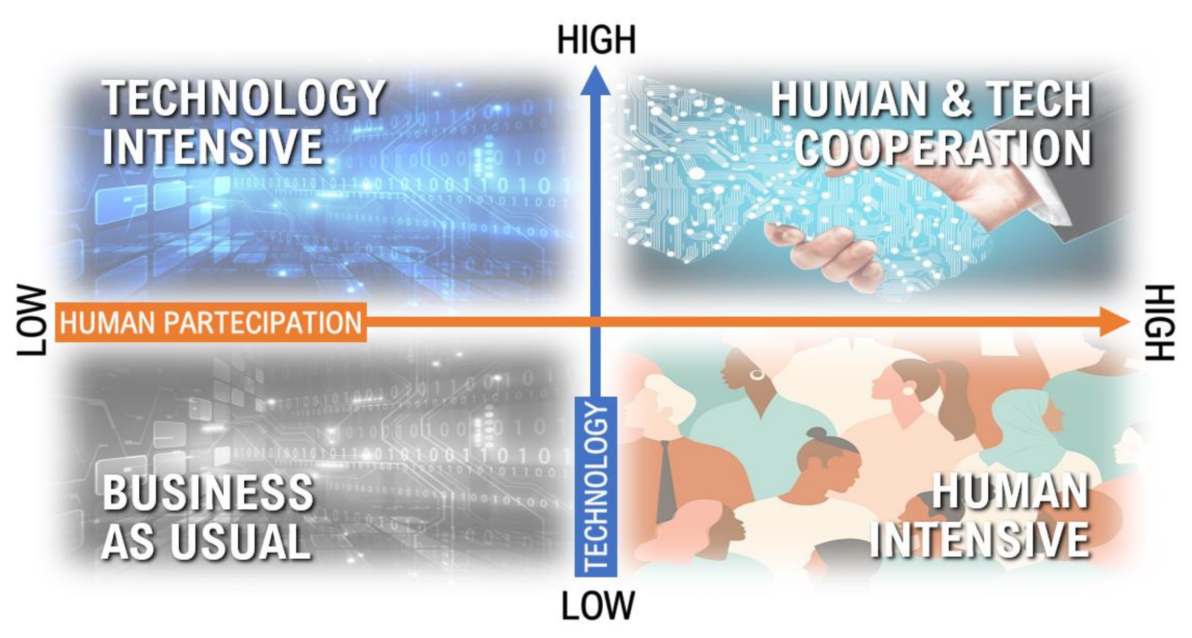
The names of the four hypothetical scenarios are designed to make it immediately understandable how the human and technological components are balanced (or unbalanced), or how they differ from the status quo. The following table [Tab.6.1.1] summarises the name of the scenario, a short description and an evaluation (worst, bad, good and best) resulting from the comparison work of the Living Lab Toscana Nord research team, also taking into consideration what emerged during the scenario workshop.

Tab.6.1.1 - List of hypothetical scenarios developed.

NAME	DESCRIPTION	JUDGEMENT
Human and technology cooperation	Integrating People and Technologies in ordinary land management.	Best (Utopic)
Human intensive	Focusing on people to improve the efficiency of ordinary land management.	Good
Technology intensive	Automated monitoring system for ordinary land management.	Bad
Business as usual	Digital technologies are not needed to improve the efficiency of ordinary land management.	Worst (Dystopic)

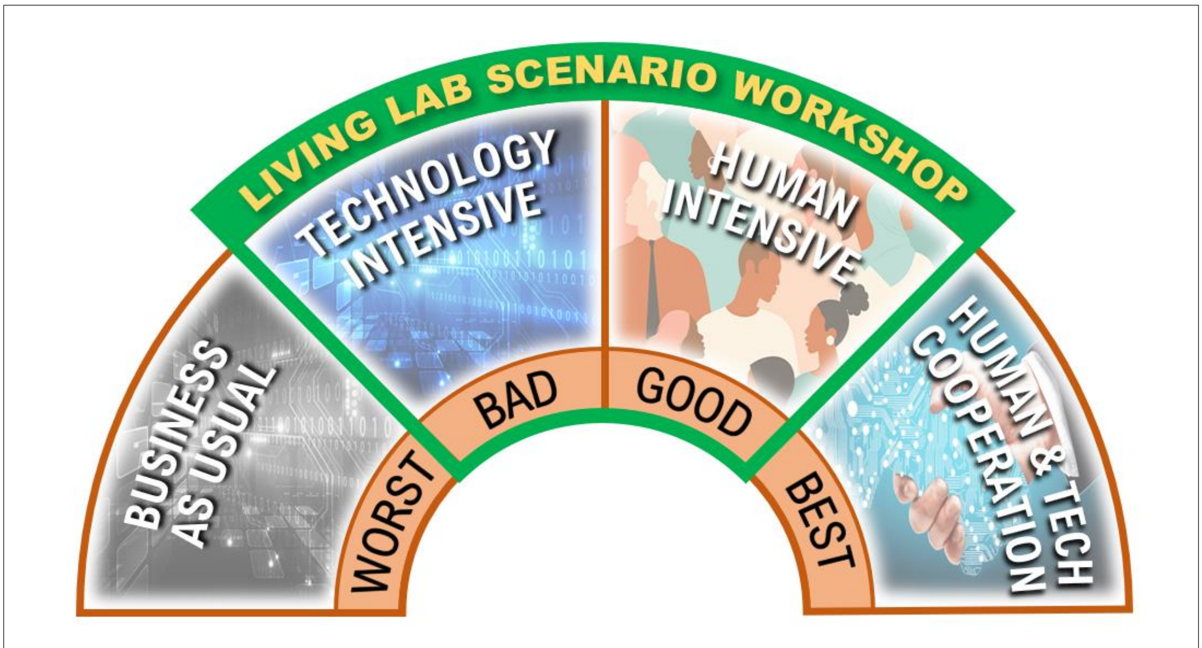
In the graph below [Fig.6.1.2] it is possible to see how the human component (**Human participation**) and the technological component (**Technology**) contribute at different levels in the characterisation of these scenarios. Starting with the scenario **HUMAN AND TECHNOLOGY COOPERATION** we can see that both components are very high. In contrast, the scenario **BUSINESS AS USUAL** has a minimum level of human and technology participation. The intermediate scenarios show a trade-off between these two components. We have the scenario **HUMAN INTENSIVE** (with a high level of human participation and low level of technology) and the scenario **TECHNOLOGY INTENSIVE** (with a high level of technology and low level of participation).

Fig.6.1.2 - Different levels of human and technological components in the four scenarios.



The figure below [Fig.6.1.3] highlights the judgement given on these four hypothetical scenarios. These opinions are the result of a process of comparison and evaluation by the team of researchers and the actors involved in the workshop. As such, they are influenced by considerable factors (mainly related to the job opportunities of the actors involved). The **HUMAN AND TECHNOLOGY COOPERATION** scenario is considered the **best**, while the **BUSINESS AS USUAL** scenario is the **worst**. The two intermediate scenarios (in terms of rating) are **HUMAN INTENSIVE** (rated as **good**), and **TECHNOLOGY INTENSIVE** (rated as **bad**).

Fig.6.1.3 - Judgement given to the four hypothetical scenarios.



6.2. Write the 2 or 3 detailed scenario narratives

HUMAN INTENSIVE

The increasing extreme climatic events ask for improved land and water monitoring system in remote and mountain areas and an improved ordinary land management strategy, to reduce the potential hydrogeological risk. In the human intensive scenario, there is **direct involvement of the local population**, mainly farmers and forestry managers in the monitoring of water streams in marginal mountain areas and the execution of maintenance work necessary for avoiding hydrogeological problems downstream. The main mechanism is based on an **alert system** in which farmers/forest managers send an alert to the Reclamation Consortium "Toscana Nord" (Public Administration) about **the need for intervention in a specific water stream** in their area. The Reclamation Consortium "Toscana Nord" verifies the need for the intervention and, if possible, assigns it to the farmer responsible for the area (who often is the same one who made the alert), with the corresponding **payment for the maintenance work**. This represents an important income integration for farmers in remote areas and it is also an interesting **incentive for participating in E-governance** initiatives and providing data on the status of the environment with a citizen science approach.

The integration of information collected by local sensors, weather stations, digital maps, and other digital tools with the information provided by citizens is done manually by the technical workers of the Reclamation Consortium "Toscana Nord" to improve the **reduction of the hydrogeological risk**.

The participation in maintenance works and ordinary land management processes represents an **incentive for farmers/forest managers to stay in marginal areas with their economic activity**, which also includes environmental services offered to the community. This is an interesting example of **income diversification for small enterprises** in remote rural and mountainous areas (Vanni et al. 2014).

The integration of income derived from the maintenance activities entrusted by the Reclamation Consortium "Toscana Nord" to the local farmers and forest managers for ordinary land management is relevant in keeping agricultural and forestry enterprises in the area. During the workshop, it was stated that each farmer would need at least two water streams on which to do the maintenance works to have a significant income integration that allows the farmers to maintain their economic activity profitable.

The **development of a digital platform to facilitate the communication** between farmers and public administration (Reclamation Consortium "Toscana Nord") could increase the type of environmental services the farmers can provide for the local community. Once a platform for farmers' involvement and farmers' network management will be developed, it could be used by different public administrations (e.g., local municipalities, regional parks managers etc.) to manage also other **environmental services in remote mountain areas** such as cutting the grass, management of trails etc. which could provide additional integrative income for small agricultural and forestry enterprises.

Land abandonment in remote mountainous areas creates problems downstream and increases the need for maintenance works. For this reason, the **management of abandoned lands should be public** and the public administrations should be able to decide if maintenance work is necessary. However, this is still not the case and often the unavailability of landowners to allow maintenance works in their land is an issue for the Reclamation Consortium "Toscana Nord". Not all landowners want to be involved in ordinary land management, however, if an IT platform can **facilitate the communication**

between the public and private actors this can further increase the awareness of landowners not present in the area.

It is important that **citizens, including farmers, are environmentally aware** and care about their territory and the potential negative effects of their behaviour. Therefore, they contribute not only for the subsidies received, but mostly because they **care about their territory and want to preserve it**. This is a key element that underlines that subsidies are not sufficient to promote the presence of people in remote rural areas, but if it is an individual choice to live in a remote rural area, the possibility to **be paid for a service provided to the community** can contribute to making it possible to live and have an economic activity on this type of territory.

Looking more specifically at drivers of change that can allow this scenario to happen or not happen, we should consider that the **rural population needs to be stable**, with some agricultural and forestry enterprises active in mountain areas. The **farmers have** (direct or indirect, through some other family members) **digital skills** that allow them to be autonomous in using digital technologies. Even if they will not directly use a drone for land monitoring, they can do **all the activities which can be done using an app on the smartphone**. The development of apps to improve the efficiency of the alert system and the identification of risk in different areas are considered relevant for this scenario.

In addition, there is **a need for public investments for the development of efficient digital platforms** that are specifically tailored for e-Government and interaction between public and private actors. **Connectivity and broadband infrastructure would grow in rural areas** more slowly than in urban areas. This means that it is not always possible to use digital maps on the field and the Regional Administration public portal and there will always be the need to print the maps before going in the field. Even if there is a growing use of fibre, there is a need to improve digital infrastructure to make the platforms working on the field **increase the possibilities for farmers to transfer information from the field to the decision-makers.**

Resources of new NRRP policies would support the creation of an innovation ecosystem based on the involvement of local actors. This type of resources could support the development of this scenario facilitating the **integration of innovation policies in agriculture and rural areas with the digitization policies and the one on Recovery and Resilience**. The only practical limitation in integrating different policies is related to the difficulty to identify the role of different public administrations and avoid overlapping among them.

TECHNOLOGY INTENSIVE

This Scenario focuses on the exclusive use of digital technologies for ordinary land management and in particular for land and watercourse monitoring. In this case, the key technologies used are a combination of in-situ and remote sensing earth and environmental observations. The hypothesis of high use of technology should balance a **high decrease in the population living in rural areas**; the eye of technology replaces the knowledge and experience of those who live, work and experience the land. For this to happen, we have assumed that **connectivity and broadband infrastructure is high** even in the most remote areas. Therefore, all the problems of communication and lack of signal are not there (neither in mountainous areas nor in more urbanised rural areas). In addition, the **level of public and private investment in technology is high**. The high availability of technology is also the result of the **low cost of technology** and is linked to the interoperability between instruments (sensors, weather cabins, antennas, digital maps), which makes it possible to obtain quality data at low prices, eliminating the need for human intervention (the complementary hypothesis to the reduction in population is an increasing abandonment of land, and this would induce a shortage of "human sentinels"). In terms of policies, the economic support for the development of an automated land monitoring system could derive from a combination of resources from the **Green Recovery** and the **Digital Action Plan Italia 2025**. All these advantages in terms of promoting the use of technology are contrasted by a low capacity in their use and the understanding of their outputs by farmers and citizens (**low level of digital skills**). This hypothesis serves to justify the need for fully autonomous technologies and to depart from the two scenarios where collaboration/integration between humans and technology is assumed. As far as environmental issues are concerned, the assumption (which is plausible to the extent that it has been taken into account for all four scenarios) is that **extreme weather events linked to climate change will increase**, and this assumption justifies the need for constant (and increasingly precise) monitoring of the relevant territory. This assumption justifies the need for constant (and increasingly precise) monitoring of the area in question. Unfortunately, this is compounded by a **lack of environmental awareness on the part of the population**, which has no time or interest in being involved in land management; a further reason why it is necessary to focus on technological autonomy since it can no longer count on the support of citizens and farmers.

The discussion of this scenario started with a review of the OPPORTUNITIES that a great availability of technology could offer. Everything starts from an increase in **connectivity**, which due to current problems is seen as an important goal that would offer many possibilities for the improvement of living and working conditions in rural areas. In a reality (the current one) characterised by mountain depopulation, it would be a valid incentive to **return/reside in the mountains**. The latter would be further enhanced by the possibility of using **distance education services**, which at the moment (with the covid-19 pandemic forcing the use of distance learning), are at the limit of acceptability in terms of quality. According to farmers actively engaged in maintenance activities, unfortunately, the advantages of exclusive use of technology would stop at macroscopic events (**"macro" landslide monitoring**). On the other hand, those who, in addition to forestry activities, are also engaged in hospitality activities (agritourism) tend to highlight the benefits that an increase in technology can bring to **tourism in marginal areas** (increased visibility and knowledge of the territory to foreigners).

Some ideas regarding the OBSTACLES that would prevent the feasibility of such a scenario were also shared. In addition to the problems of **bureaucracy** (which have never been solved and on which all participants were pessimistic about a possible positive evolution), there seems to be a widespread sense of scepticism and concern related to the **costs of the line** (concerning some events that happened between farmers and telephone providers, these costs would be borne by the user and too high if you are far from the exchanges) and above all to the **convenience of the connection** (providers are disincentivised to connect small villages or groups of houses). For these reasons, **political intervention** is called for to counteract private interests and increase the benefits for the community. Concerning monitoring activities, assuming the use of robots (to counteract the limitations of drones), some logistical obstacles related to moving to inaccessible areas are however highlighted (**difficulty of interventions**). **Knowledge of the territory** is also a fundamental aspect because the wealth of experience of farmers and citizens living in the area is irreplaceable.

The third step was to discuss the RISKS associated with the exclusive use of technology. The widespread idea is that some technologies have limits in their use and therefore in the possibility of being used autonomously and without human intervention. The **use of drones is not sufficient** to guarantee satisfactory monitoring in forest areas, precisely because of the limits of visibility in these areas. In addition, sensors and weather stations can be placed in flat areas with easy access, but in the target territory, these types of areas seem to be scarce. Finally, in contrast to the usefulness of monitoring macroscopic events, the fear (which seems to be a certainty) of the interviewees is that **microscopic events are not visible** and therefore it is useless to rely only on the technological factor.

Next, the WINNERS were identified (those who benefit most from this scenario). According to the participants, the main winners (for obvious reasons) are the **technology (and technical support) companies**. Even those with a **good level of education** and a **high level of financial resources** manage to adapt well, because both of these conditions allow you to learn about and take advantage of the opportunities offered by the policy, and for example to hire a consultant (accountant) to help you access support funds. In a reality in which technology is functional to the growth of economic and industrial productivity, **companies** (in this context we refer to the paper industry which is present in the area) are also considered winners because, in addition to their specific objectives, they have obtained the merit (officially recognised by TV and institutions) of having contributed to the repopulation of the mountains thanks to their ability to attract a specialised workforce (always useful despite the increasing automation of these productive realities).

Finally, there are the LOSERS (those who derive no benefit and who suffer the negative effects of the implementation of this scenario). In this context, they would be those with a **low level of education**, and in general the **mountain population** (with particular reference to **small farmers**). A large part of the discussion concerned e-commerce, leading to the conclusion that the losers include **small local shops**, which are now suffering from competition from these new online purchasing methods. Considering those who rely on e-commerce, what was observed was that even with an extremely large market potential it can be difficult to produce enough products to satisfy that potential market, and therefore even those who resort to this mode of sale can be defeated in a context where we have a lot of technology without the people.

6.3. Name and write the less detailed “best case” and “worst-case” scenarios

HUMAN AND TECHNOLOGY COOPERATION – *the “BEST-CASE” Scenario*

In this scenario, we have assumed that digital technologies are used to integrate the participation of actors in a land monitoring system based on the use of in situ environmental observation data (e.g. sensors, webcams, drones, etc.). As this is a scenario in which a close collaboration between the human component (in particular citizens and farmers) and the technological component is envisaged, it is important that these two are consistent and, above all, that they are very valid from a qualitative point of view. For this reason, the first assumptions (the social ones) are mainly based on the idea that the **level of the population living in rural areas does not change** and that farmers have a **high level of digital skills** to use smartphones and digital platforms. As previously mentioned, the latter component is just as important. This is why the technological assumptions we have made are that **connectivity and broadband infrastructure are very high** and that **public and private investment in technology is very high**. These are extremely favourable conditions for the growth of the level of digitisation (both qualitatively and quantitatively). From the economic point of view, the **cost of technology is very low**, and from the policy point of view, **there are many policies promoting digitisation** (AKIS [Agricultural Knowledge and Innovation Systems] approach activities, with a focus on horizontal development of innovation and direct involvement of end-users in the development of innovation are more appropriate in this kind of scenario since we have observed a certain scepticism from local communities in accepting technologies developed by others). In addition, **extreme weather events related to climate change will increase** (an assumption common to all four scenarios), and there is a **high environmental awareness on the part of the population**. These assumptions, together with the previous ones (objectively very favourable), make us understand that in such a scenario we can expect a positive response from the actors to the growing need to monitor the territory and to respond promptly to emergencies in mountain areas (we have a new SCPs characterised by social entities ready to interact in a useful way with new cyber entities that in 10 years could offer an even more powerful and precise monitoring service). For these reasons, and considering all these assumptions, we believe that this scenario is the best of the four.

BUSINESS AS USUAL – *the "WORST-CASE" scenario*

In this scenario, it is assumed that digital technologies other than those used now will not be used to enhance and improve the land monitoring process, as no further investments are made by public institutions in this field. So, the level of digitalisation remains the same (or increases very little). In general, the tendency is to cancel the supply of new generation technologies (certainly it is assumed that in 10 years the market will offer advanced tools, but there will not be the financial means to buy them, because resources will be scarce and destined to other uses). Therefore, those who will need technology will have to rely only on improvements offered at low cost (and therefore qualitatively unattractive and ineffective), while the contribution of technology to citizen involvement will be nil. The assumptions that make this scenario particularly extreme and characteristic are that **connectivity and broadband infrastructures are very low** and that **public and private investment in technology is also very low** (in fact, of the four scenarios, this is the one with the lowest level of technological AOCs). What makes the situation worse, from an economic point of view, is that the **cost of technology is very high**. On the other hand, from a policy point of view, **policies to promote digitalisation are non-existent (or at least very low)**. Therefore, on the first objective analysis, it appears that there is no drive to increase the level of digitisation. Citizens, farmers and professionals (including the technicians of the consortium) have no incentive to buy devices, and if they do, they fail to reap the benefits and exploit the potential in their everyday life and work. The **level of the population living in rural areas does not change**, but what aggravates the situation is the **low level of digital skills** that may characterise mainly residents and unskilled workers in these areas (on the contrary, we can take it for granted that skilled workers [especially those with IT education and technicians working with technology - in this case, the consortium staff] will continue to use technology, but with little innovation due to financial constraints). In general, in a context where **extreme weather events related to climate change will increase** (an assumption common to all 4 scenarios), **high environmental awareness on the part of the population** may not be a sufficient condition to offer protection from the disastrous effects that would result from poor quality monitoring. For these reasons, and taking all these assumptions into account, we consider this scenario to be the worst case.

6.4. Relevant Feedback from participants

The narratives have been developed after the workshop based on the discussion with the participants and the inputs from the interviews. We currently do not have feedback from the participants on this final version of the narratives.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.14 Spain (Andalucia)

SCENARIO WORKSHOPS

ANDALUCÍA – SPAIN

UCO

10.01.2022

MARÍA DEL MAR DELGADO-SERRANO, MARÍA ALONSO-ROLDÁN, GUILLERMO PALACIOS RODRÍGUEZ, RAFAEL Mª NAVARRO CERRILLO

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Introduction

This report presents the activities done in our local Living Lab (LL) to build future scenarios. Our LL explores the role of digitalisation in forest fires, more specifically, in forest fire firefight and restoration. Given the complexity of the social-cyber-physical (CSP) system and the consequences that forest fires have in it, a significant amount of effort, resources, and coordination from all the stakeholders is required to minimise their impact. Therefore, in this LL we have managed to involve representatives of the public administration, the private sector, the civil society organisations (CSO) and researchers in all the activities.

Whereas technologies have significantly evolved and contributed to manage and to control forest fires faster and better, there are still some issues in relation to protocols, data availability and interoperability. Also, coordination between the private sector, the public sector and the civic society could be improved. These issues are situated in a context of rural depopulation and ageing processes, highly impacted by the lack of profitability of forest and farming activities.

The scenario planning workshop was held in December 2021, once the high-risk period for forest fires in Andalusia finished (it was exceptionally extended until October 2021). We prioritised a face-to-face meeting to give participants a chance to interact, which does not frequently happen. Information was shared with the participants before the meeting so they could start reflecting on some aspects, starting by the focal question "*How can digitalisation contribute to reduce the damage caused by wildfires and to make more effective firefighting and degraded land restoration by 2030?*".

During the session, we combined interactive exercises with group discussion and presentations. First, we created a timeline with the milestones of digitalisation in forest fires management in the past decade, including the use of Remotely Piloted Aircraft System to monitor forest fires, smartphone devices and networks for immediate communication and geolocation, and hardware improvement for better and faster data processing. Then, the Drivers of Change (DOC) understood as critical uncertainties for the future were agreed, namely: the occupation and use of forest areas (Social); real time information flows and digital tools to prevent and control forest fires (Technological); Climate Change (Environmental); valorisation of forest resources and farming activities in forest areas (Economic); communication channels and protocols (Political). For each DOC, we proposed a set of assumptions, including a Business-as-Usual case, a more positive case, a more negative case, and, for some DOCs, an alternative one. Participants then defined individually different pathways that could lead to the creation of future scenarios. In group, we discussed two scenarios. The 'better not best scenario', called *In tech we trust*, is envisaged within a context of moderate climate change, with forests being slightly more vulnerable to forest fires. In this scenario, a combination of technological progress and increased awareness about the importance of forests, manage to revitalise the rural areas and to significantly reduce the impact of forest fires. The 'worse not worst' scenario - *Less shepherds, more developers*- envisions a lack of forest management and planning which deteriorates the forest areas, coupled with an uncontrolled land occupation and the disappearance of traditional farming activities linked to the forests. Within a context of severe changes in the climate, the forest fire risk increases significantly. For both scenarios, different policies and strategies were suggested.

1. Living lab summary

1.1 Name of LL

Forest Fires in Andalusia

1.2 Brief summary of LL

The LL is organised around the role of digitalisation in forest fire fighting and forest restoration. Forest fires are an increasingly recurrent phenomenon with an everchanging and more unpredictable behaviour. The consequences that these have require a significant amount of effort, resources, and coordination from all the stakeholders to minimise their impact, especially in a complex Socio-Cyber-Physical (SCP) system with numerous interactions. First, depopulation of rural areas and agriculture land abandonment have led to an increase of forest areas, many of which are not managed. Also, the limits between urban and forests areas have faded as new communities have settled within or in the vicinity of forest areas, putting more pressure in forests and increasing the risk to suffer fires. Rapid progress in R&D&I applied to forest fires require a more responsive public administration to establish data protocols and data interoperability mechanisms, as well as a better coordination with the communities and the private sector. Private forest owners, accounting for 75% of the Andalusian forests[9], are seeing their land profitability reduced and are affected by unfair competition of resources from public-owned forests. Finally, the sector is demanding professional profiles linked to technological changes that Academia is not yet able to provide.

In our LL, we have counted on the presence of members from the quadruple helix, namely, the public administration -including representatives from the regional government's forest fire service and the regulators-, the private sector contributing to forest fire prevention and management (data modelling and analysis, firefighting aircrafts, etc.), the forest property owners and the Academia.

1.3 LL participants

All the organisations engaged for the WP2 meeting held in December 2020 were also present in the scenario planning session, although some of the participants differed. Both the LL and the scenario workshop engaged stakeholders from the quadruple helix, namely:

- Public Administration: representatives from the regional government's forest fire service -INFOCA, the Agency for Environment and Water – AMAYA and the regional Ministry for Agriculture, Livestock, Fisheries and Sustainable Development.
- Businesses, industry: representatives from engineering, R&D companies and SMEs.
- CSOs: representatives from three forest property owners' associations.

[9] Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible, 2022. https://www.juntadeandalucia.es/medioambiente/portal/web/guest/montes-publicos

- Academia: researchers from the Forestry department, the Plant Physiology department, and the Agriculture Economics department.

1.4 Timing of Scenario Planning (WP3) workshops

The scenario planning workshop was organised in one-day session on 15th December 2021 in Seville, from 9h30 to 18h00. Participants attended in person although they were provided with relevant information (e.g. the selected Drivers of Change) in advance to start reflecting on ahead of the meeting.

2 Scenario question

2.1 Draft scenario question

The draft question proposed to the participants was the one agreed during the workshop in December 2020. The question states like this: *How can digitalisation contribute to reduce the damage caused by wildfires and to make more effective firefighting and degraded land restoration by 2030?*

2.2 Finalised Scenario question

The finalised scenario question remained the same as the draft one.

2.3 Methodology used to finalise scenario question

The draft scenario question was created and refined in the December 2020 workshop. It was shared with the participants via email before the scenario workshop as a reminder, since not all of them attended the first meeting. During the scenario workshop, the draft question was introduced again by the team (see Figure 8), giving few minutes to the participants to reflect on it and then opened the discussion. The workshop participants confirmed the suitability of this question without further modifications. One of the participants, the representative of an R&D company, provided an example confirming its pertinence: they had been asked by a public administration to analyse the impact of the water dumped by firefight aircrafts on the soil for fire extinction, to be able to prioritise land restoration actions, which requires an important amount of data processing and data modelling.

Figure 8. Team coordinator presenting DESIRA and the research question to scenario planning workshop participants.

2.4 Relevant feedback on scenario question from participants

The language used for the workshop was Spanish. Some participants shared their views in relation to the wording of the scenario question as some terms in Spanish might be understood differently by stakeholders.

3 Relevant past events

3.1 List of relevant past events

The items presented below is a non-exhaustive list of milestones in relation to digitalisation in forest fires management. They are mostly related to how the information is used and transferred, both of which are in constant development.

- Accurate geolocation systems
- Use of RPAS (Remotely Piloted Aircraft System) to monitor forest fires
- Miniaturisation of sensors which can be installed in different aircraft systems
- Hardware improvement for better and faster data processing

- Smartphone devices and networks that permit immediate communication and geolocation
- Digital communication systems
- Availability of real time meteorological monitoring, data, and predictive modelling
- Cloud-based storage of geographical big data enables the distribution of vast amount of standardised information in real time
- Light Detection and Ranging (LiDAR), an active remote sensing technology to monitor fire patterns
- Advanced information technology which can consume significant amount of data in real time

3.2 Description past event activity

Four participants (representatives of the public administration and R&D company) were asked before the workshop to prepare a short presentation of events and milestones happened in the past decade related to digitalisation in forest fires (see Figure 9 and Figure 10). The aim was to provide some baseline information from different types of stakeholders that could be enriched during the workshop. Templates were provided for the participants to use during their short presentations, but we kept a certain level of flexibility. One of the presenters classified the past events in different categories: geographical information systems, geomatic engineering systems, communications, geolocation, monitoring and control, and human capital. After each presentation, the organising team summarised the main points. The result was a collective and detailed list of events and descriptions, which served to demonstrate the evolution of digitalisation in the past decade, however these were not placed on a timeline.

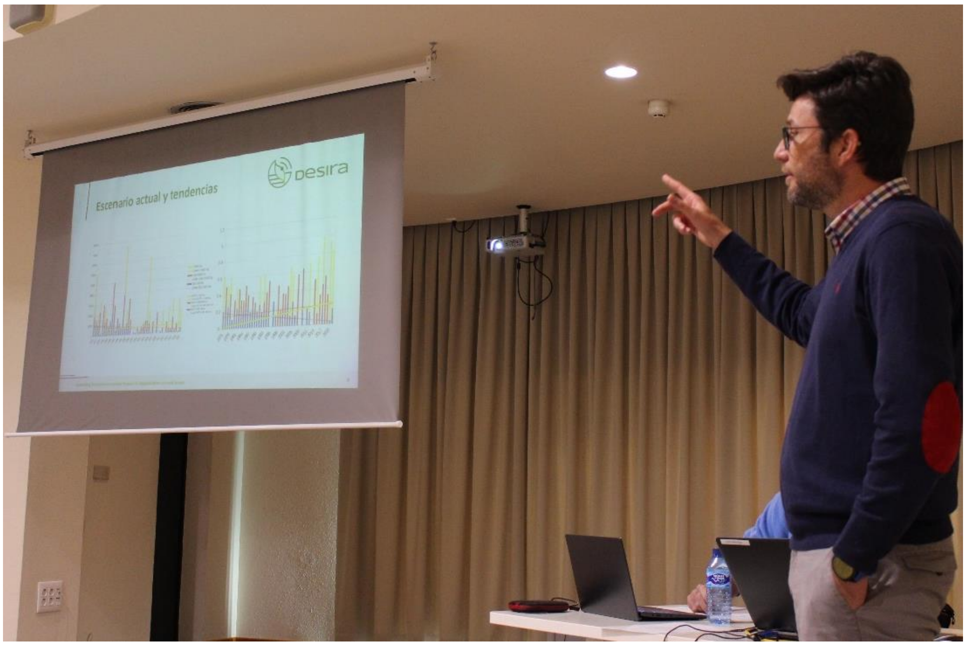

Figure 9. Representative of public administration introducing relevant past event

Figure 10. Snapshot of a presentation about past events in relation to digitalisation in forest fires management.

3.3 Relevant feedback from participants

There were some recurrent topics in relation to past events, namely:

- Ability of the forest fires sector to evolve and to incorporate new technological developments.
- Significant improvements in remote sensing, communications networks, and meteorological data.
- Use of drones and mobile phone devices to share real time data.
- External servers and communication networks have made information available simultaneously for those on site and in the headquarters.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

The initial set selected by the LL coordinators and the final set of DOCs used by the participants were the same (see Table 15).

Table 15 DOC Selected

STEEP	Drivers of Change, DOC
Social	Occupation and use of forest areas
Technological	Real time information flows and digital tools to prevent and control forest fires
Environmental	Climate Change
Economic	Valorisation of forest resources
	Farming activities in forest areas

Political	Communication channels and protocols

4.2 List selected DOC

The initial set selected by the LL coordinators and the final set of DOCs used by the participants were the same (see Table 15).

4.3 Describe methodology to select DOC

The coordination team extracted an initial list of 24 DOCs from the documentation and the previous work done with the LL participants (see Table 16). A team discussion was organised to assess how these DOCs were Critical Uncertainties in relation to the research question, based on personal knowledge and experience in the topic. The DOCs were refined to be concise, neutral concepts and not directional. After that, each member of the LL coordination team selected a total of six to ten DOCs from the different categories individually. With the final selection of DOCs, the team worked on the assumptions to build the morphological box, which resulted in minor adjustments to the DOCs (see Table 16).

The final DOCs selected were sent to the participants ahead of the meeting together with the research question and the LL report so they could start thinking about the suitability of such selection. During the workshop, participants were introduced to the DOCs and were given some time to share their views. No changes were suggested to the DOCs, however, different clarifications and interpretations aroused during the group discussion which will be presented later.

Table 16. DOCs selection process

		DOCs SELECTION PROCESS	FINAL DOCs SELECTED
Social	1	Awareness	Occupation and use of forest areas
	2	Citizen Science	
	3	Urban-forest interface	
	4	Farming activities in forest areas	
Technological	5	Online communication and cooperation	Real time information flows and digital tools to prevent and control forest fires
	6	Capability to process high amount of information in real time	
	7	Modelling based on Artificial Intelligence	
	8	Geolocation	
	9	Digital tools for local management	
	10	Remote sensing	
	11	National data bases	
	12	Real time information flows	
	13	Real time information flows and digital tools for local management	
Environmental	14	Climate Change	Climate Change
	15	Environmental and physiographic changes of forests	
	16	Resilient forests management	Farming activities in forest areas

Economic	17	Forest management	Valorisation of forest resources
	18	Forest management investments	
	19	Forest management payments	
	20	Economic diversification of rural areas	
	21	Investment in preventive measures	
Political	22	Interoperable online protocols	Communication channels and protocols
	23	Shared communication channels and protocols	
	24	Public investment in rural areas	

4.4 Relevant feedback from participants

There were two DOCs which triggered interesting discussions among the scenario workshop participants about the direction that such DOCs should follow.

The *Occupation and use of forest areas* refers to more people living in forest areas, more specifically, on the edges between urban and forests, and considers more people making use of the forests and their resources (e.g. mushroom picking, hiking, etc.). This was understood by some participants as a positive trend that should be encouraged, for example, by ensuring a high quality and stable internet connectivity to allow for remote working. "More people in the forests can foster the local economy and can revert the current depopulation trend of Andalusian rural areas. People presence boost territorial management and decrease risks", said a participant. Whereas for other participants, people without local knowledge moving into forest areas were expected to cause more harm than good, increasing the forest vulnerability to suffer forest fires. "New people who move into forest areas shall continue with their own way of life which means no traditional knowledge of forest use and management, to buy goods online, etc. and won't necessary contribute to improving their surrounding environments", said another participant.

The second DOC highlighted was the *Valorisation of forest resources*. This driver considers giving an economic value to resources that currently have none, such as carbon sequestration by the cork oak forests, or valorisation of different forest ecosystem services. This would support to finance the required preventive measures to prevent fire in forest ecosystems (clearance, maintenance of roading and firebreak infrastructures, etc.). There were different views as to how this valorisation should be structured: through incentives, 'green taxes' or other funding schemes (e.g. CAP). Regardless of the funding mechanism chosen, digitalisation could support in different ways: availability of data for the public administration, georeferenced payments, online funding applications, decrease in management costs due to more accurate modelling management, etc. Representatives of the forest property owners raised the concern about the current digital gap which is preventing numerous owners to apply for incentives. In 2018, a budget line was approved by the regional public administration to support owners in deploying their forest fire risk management plans. Three years later, only 5% of the total available budget was allocated - forest property owners are ageing and lack the digital skills required to apply, bureaucratic procedures are complex, the administration is very slow in taking decision. Another issue related to this driver was the valorisation of services from public forest (25% of the total forest land) versus the private ones. Property owners highlighted unfair competition from public administrated forest who sell their goods (for example, wood from clearance activities) at lower prices.

5 Matrix

5.1 Matrix description

The matrix displays a maximum of four assumptions for each DOC identified, providing ideas about what might happen in the next ten years in relation to forest fires management and digitalisation (see Table 17). The team wanted to offer a sensible starting point to participants during the scenario planning workshop and to facilitate their understanding of the tasks. The matrix was built in a co-creative manner by the research team, which comprises experts from different fields such as policy, forestry, agriculture, or environment.

The different assumptions were discussed, reformulated, and agreed considering that assumptions should be plausible, consistent, and useful. The second column of assumptions presents the 'Business as Usual' situation for the year 2031. To the left, more positive situations are introduced and to the right, the more negative ones. The fourth column of assumptions provide alternative ideas. Assumptions often include terms indicating degrees of change.

Table 17. Spanish Living Lab matrix for scenario planning

	Assumption (+)	BAU	Assumption (-)	Assumption (other)
Occupation and use of forest areas	General awareness on the importance of forests. Forest users and settlements in forests and forest edges increase in an organised way. Technologies facilitate forest fires control.	Users and settlements in forests and forest edges increase slightly with minimum control. Forests deteriorate due to lack of environmental awareness. Limited use of digital technologies.	Significant increase of users and settlements in forests and forest edges. Uncontrolled urbanisation is allowed without penalisation. The use of digital technologies is very low.	
Real time information flows and digital tools to prevent and control forest fires	Significant progress in technology and collaboration processes allow for real time information flows. Geolocation services help to save human lives. Citizen engagement and early detection technologies significantly improve the prevention of forest fires.	Real time information flows and digital technologies slightly improve prevention, detection, and control of forest fires.	Forest fire detection and control systems are not interoperable. Prevention technologies are very expensive. Limited 5G coverage, remote forest areas lack coverage to share real time data about forest fires.	
Climate Change		Decrease in rainfall and temperature increase are moderate, moderate extreme weather events occurrence. Forests vulnerability against fires increases.	Decrease in rainfall and temperature increase are severe, severe increase in extreme weather events occurrence. Forests vulnerability against fires increases significantly.	Disruptive technologies reduce the climatic trends of Climate Change suffered for the past 50 years, significantly decreasing GHGs concentration in the atmosphere.
Valorisation of forest resources	Valorisation of all the ecosystem services. Sustainable forest management fully implemented, preventive measures are funded and deployed. Risk of forest fires is significantly reduced. Technologies support valorisation and financing.	Forest resources are not fully valued. Management resources are limited, especially for forests with low productivity. Traditional resources (wood, Non-Timber Forest Products) provide limited added value. Other services (carbon sequestration, climate regulation) have not got market value.	Carbon compensation-sequestration mechanisms not fully implemented. Forests fire risk rises significantly due to the lack of management.	
Farming activities in forest areas	Farming activities in forest areas increase significantly, rural depopulation stops, and new extensive farms appear. Extensive livestock farming is highly valued, increasing its demand and profitability. Technologies allow forest and livestock monitoring and make farming easier	Integration of farming activities in forest management is limited. Few shepherds remain. The lack of grazing leads to increased fuel load, especially in protected areas.	Farming activities have nearly disappeared. Investment in preventive management is insufficient. High impact of forest fires. Technologies are expensive, scarce profits from farming dissuade their use.	Farming is fully digitalised, a 'neo-transhumance' model is implemented. The same cattle grazes in different forest areas. Technology helps to identify high fire risk areas in which grazing can reduce the fuel load.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols improve significantly, leading to more efficient cooperation to control forest fires.	Digital systems interoperability, unified databases and communication protocols improve slightly, but do not allow for a more efficient cooperation to control forest fires.	Digital systems interoperability, unified databases and communication protocols do not improve, there is not an efficient cooperation to control forest fires.	

	The public administration provides property owners with digital tools to facilitate their prevention actions.	Digital interaction channels between the public administration and the property owners are limited.	Property owners abandon their land due to lack of profitability.	

5.2 Define 4 pathways/scenarios selected

Instead of selecting four possible scenarios, we conducted an exercise with the participants to define as many pathways as possible. The five scenarios obtained are presented below, organised from more negative scenarios (in orange) to more positive ones (in green). The methodology we followed will be introduced in section 5.4.

Total disaster	
The worst climate change forecasts happen, technologies cannot contribute to reduce risks of forest fires and neither they are used to support sustainable rural development. Forests are left to their own devices.	
Occupation and use of forest areas	Significant increase of users and settlements in forests and forest edges. Uncontrolled urbanisation is allowed without penalisation. The use of digital technologies is very low.
Real time information flows and digital tools to prevent and control forest fires	Forest fire detection and control systems are not interoperable. Prevention technologies are very expensive. Limited 5G coverage, remote forest areas lack coverage to share real time data about forest fires.
Climate Change	Decrease in rainfall and temperature increase are severe; severe increase in extreme weather events occurrence. Forests vulnerability against fires increases significantly.
Valorisation of forest resources	Carbon compensation-sequestration mechanisms not fully implemented. Forests fire risk rises significantly due to the lack of management.
Farming activities in forest areas	Farming activities have nearly disappeared. Investment in preventive management is insufficient. High impact of forest fires. Technologies are expensive, scarce profits from farming dissuade their use.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols do not improve, there is not an efficient cooperation to control forest fires. Property owners abandon their land due to lack of profitability.

Less shepherds, more developers	
The lack of forest management and planning deteriorate the forest areas. More people use and live in forest areas, but the land occupation is out of control. Farming activities linked to the forests have almost disappeared, forest property owners leave, and forests are not managed anymore. Technology development is insufficient, as well as awareness of the forests and their resources. Within a context of severe changes in the climate, the forest fire risk increases significantly.	
Occupation and use of forest areas	Significant increase of users and settlements in forests and forest edges. Uncontrolled urbanisation is allowed without penalisation. The use of digital technologies is very low.

Real time information flows and digital tools to prevent and control forest fires	Forest fire detection and control systems are not interoperable. Prevention technologies are very expensive. Limited 5G coverage, remote forest areas lack coverage to share real time data about forest fires.
Climate Change	Decrease in rainfall and temperature increase are severe, severe increase in extreme weather events occurrence. Forests vulnerability against fires increases significantly.
Valorisation of forest resources	Forest resources are not fully valued. Management resources are limited, especially for forests with low productivity. Traditional resources (wood, Non-Timber Forest Products) provide limited added value. Other services (carbon sequestration, climate regulation) have not got market value.
Farming activities in forest areas	Farming activities have nearly disappeared. Investment in preventive management is insufficient. High impact of forest fires. Technologies are expensive, scarce profits from farming dissuade their use.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols do not improve, there is not an efficient cooperation to control forest fires. Property owners abandon their land due to lack of profitability.

The real deal / Resistance is 'fertile'	
Technology plays a key role (1) to raise awareness about forests and forest resources, (2) to reduce the effects of climate change, (3) to maintain the local population and (4) to manage forest fires.	
Occupation and use of forest areas	[Added by workshop participants] *The local population leave the rural areas, whereas forest users, visitors and vacation houses increase without control. The challenge is to identify how technologies could support the locals.*
Real time information flows and digital tools to prevent and control forest fires	Significant progress in technology and collaboration processes allow for real time information flows. Geolocation services help to save human lives. Citizen engagement and early detection technologies significantly improve the prevention of forest fires.
Climate Change	Decrease in rainfall and temperature increase are moderate, moderate extreme weather events occurrence. Forests vulnerability against fires increases.
Valorisation of forest resources	[Added by workshop participants] *Forest resources are valued to some extent. Vulnerable forest areas increase, but technology progress and management improve and contribute to increase valorisation progressively.*
Farming activities in forest areas	Integration of farming activities in forest management is limited. Few shepherds remain.

	The lack of grazing leads to increased fuel load, especially in protected areas.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols improve significantly, leading to more efficient cooperation to control forest fires. The public administration provides property owners with digital tools to facilitate their prevention actions.

In tech we trust	
Within a context of moderate climate change, where forests are slightly more vulnerable to forest fires, a combination of technological progress and increased awareness about the importance of forests managed to revitalise the rural areas and to reduce the impact of forest fires significantly.	
Occupation and use of forest areas	General awareness on the importance of forests. Forest users and settlements in forests and forest edges increase in an organised way. Technologies facilitate forest fires control.
Real time information flows and digital tools to prevent and control forest fires	Real time information flows and digital technologies slightly improve prevention, detection, and control of forest fires.
Climate Change	Decrease in rainfall and temperature increase are moderate, moderate extreme weather events occurrence. Forests vulnerability against fires increases.
Valorisation of forest resources	Valorisation of all the ecosystem services. Sustainable forest management fully implemented, preventive measures are funded and deployed. Risk of forest fires is significantly reduced. Technologies support valorisation and financing.
Farming activities in forest areas	Farming is fully digitalised, a 'neo-transhumance' model is implemented. The same cattle grazes in different forest areas. Technology helps to identify high fire risk areas in which grazing can reduce the fuel load.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols improve significantly, leading to more efficient cooperation to control forest fires. The public administration provides property owners with digital tools to facilitate their prevention actions.

Revitalised Spain "La España rellenada[10]"

[10] "La España rellenada" -repopulated Spain- as opposed to "La España vaciada" -emptied Spain-, a currently widely used term to define the severe rural depopulation faced by many

Revitalised rural areas thanks to a sudden change in the depopulation trend, farmers remain and increase their activity, reducing the vulnerability of forests to fire despite climate changes. Technology supports these processes.	
Occupation and use of forest areas	Users and settlements in forests and forest edges increase slightly with minimum control.
Real time information flows and digital tools to prevent and control forest fires	Significant progress in technology and collaboration processes allow for real time information flows. Geolocation services help to save human lives. Citizen engagement and early detection technologies significantly improve the prevention of forest fires.
Climate Change	Decrease in rainfall and temperature increase are moderate, moderate extreme weather events occurrence. Forests vulnerability against fires increases.
Valorisation of forest resources	Valorisation of all the ecosystem services. Sustainable forest management fully implemented, preventive measures are funded and deployed. Risk of forest fires is significantly reduced. Technologies support valorisation and financing.
Farming activities in forest areas	Farming activities in forest areas increase significantly, rural depopulation stops, and new extensive farms appear. Extensive livestock farming is highly valued, increasing its demand and profitability. Technologies allow forest and livestock monitoring and make farming easier.
Communication channels and protocols	Digital systems interoperability, unified databases and communication protocols improve significantly, leading to more efficient cooperation to control forest fires. The public administration provides property owners with digital tools to facilitate their prevention actions.

5.3 Identify the 2 pathways that will be defined in more detail

The two pathways which were defined in more detailed were intermediate scenarios, 'In tech we trust' and 'Less shepherds, more developers'.

5.4 Methodology used to identify pathways

Firstly, we introduced the pathway selection methodology to the scenario planning workshop participants. After that, we presented two different scenarios following compatible assumptions in the morphological box, one more positive and one more negative. Once the methodology was well

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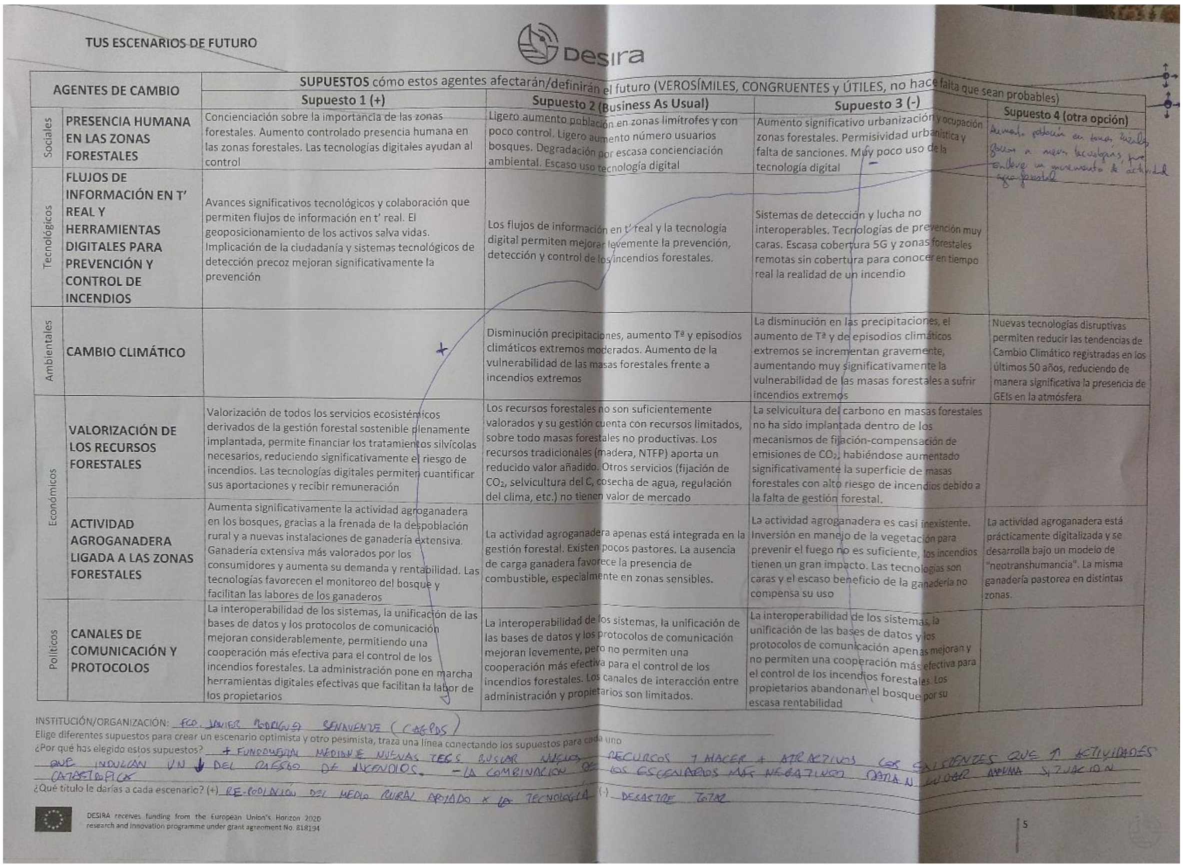
areas, which has derived from the original one coined by the Sergio del Molino in his book "Empty Spain", published in 2016.

understood by the participants, together, we reviewed the assumptions of the morphological box for clarifications, additions, and adjustments. After that, participants were given some time to think about different pathways individually. To do this exercise, they were provided with A3 copies of the morphological box (Figure 11 and Figure 12). The individual exercises were shared with the group. Some participants chose one single path (the one expected to happen, or the most plausible one), whereas others selected two including one positive scenario and one negative. Many pathways/scenarios were similar, so only the five different ones were included in section 5. We then chose two which were better but not best and worse but not worst to develop the narratives and policy recommendations.


TUS ESCENARIOS DE FUTURO

Desira

AGENTES DE CAMBIO		SUPUESTOS cómo estos agentes afectarán/definirán el futuro (VEROSÍMILES, CONGRUENTES y ÚTILES, no hace falta que sean probables)			
		Supuesto 1 (+)	Supuesto 2 (Business As Usual)	Supuesto 3 (-)	Supuesto 4 (otra opción)
Sociales	PRESENCIA HUMANA EN LAS ZONAS FORESTALES	Concienciación sobre la importancia de las zonas forestales. Aumento controlado presencia humana en las zonas forestales. Las tecnologías digitales ayudan al control	Ligero aumento población en zonas limítrofes y con poco control. Ligero aumento número usuarios bosques. Degradación por escasa concienciación ambiental. Escaso uso tecnología digital	Aumento significativo urbanización y ocupación zonas forestales. Permisividad urbanística y falta de sanciones. Muy poco uso de la tecnología digital	Aumento población en zonas rurales gracias a nuevas tecnologías, que conlleva un incremento de actividad agroforestal
Tecnológicos	FLUJOS DE INFORMACIÓN EN T' REAL Y HERRAMIENTAS DIGITALES PARA PREVENCIÓN Y CONTROL DE INCENDIOS	Avances significativos tecnológicos y colaboración que permiten flujos de información en t' real. El geoposicionamiento de los activos salva vidas. Implicación de la ciudadanía y sistemas tecnológicos de detección precoz mejoran significativamente la prevención	Los flujos de información en t' real y la tecnología digital permiten mejorar levemente la prevención, detección y control de los incendios forestales.	Sistemas de detección y lucha no interoperables. Tecnologías de prevención muy caras. Escasa cobertura 5G y zonas forestales remotas sin cobertura para conocer en tiempo real la realidad de un incendio	
Ambientales	CAMBIO CLIMÁTICO		Disminución precipitaciones, aumento Tª y episodios climáticos extremos moderados. Aumento de la vulnerabilidad de las masas forestales frente a incendios extremos	La disminución en las precipitaciones, el aumento de Tª y de episodios climáticos extremos se incrementan gravemente, aumentando muy significativamente la vulnerabilidad de las masas forestales a sufrir incendios extremos	Nuevas tecnologías disruptivas permiten reducir las tendencias de Cambio Climático registradas en los últimos 50 años, reduciendo de manera significativa la presencia de GEIs en la atmósfera
Económicos	VALORIZACIÓN DE LOS RECURSOS FORESTALES	Valorización de todos los servicios ecosistémicos derivados de la gestión forestal sostenible plenamente implantada, permite financiar los tratamientos silvícolas necesarios, reduciendo significativamente el riesgo de incendios. Las tecnologías digitales permiten cuantificar sus aportaciones y recibir remuneración	Los recursos forestales no son suficientemente valorados y su gestión cuenta con recursos limitados, sobre todo masas forestales no productivas. Los recursos tradicionales (madera, NTFP) aporta un reducido valor añadido. Otros servicios (fijación de CO_2, selvicultura del C, cosecha de agua, regulación del clima, etc.) no tienen valor de mercado	La selvicultura del carbono en masas forestales no ha sido implantada dentro de los mecanismos de fijación-compensación de emisiones de CO_2, habiéndose aumentado significativamente la superficie de masas forestales con alto riesgo de incendios debido a la falta de gestión forestal.	
Económicos	ACTIVIDAD AGROGANADERA LIGADA A LAS ZONAS FORESTALES	Aumenta significativamente la actividad agroganadera en los bosques, gracias a la frenada de la despoblación rural y a nuevas instalaciones de ganadería extensiva. Ganadería extensiva más valorados por los consumidores y aumenta su demanda y rentabilidad. Las tecnologías favorecen el monitoreo del bosque y facilitan las labores de los ganaderos	La actividad agroganadera apenas está integrada en la gestión forestal. Existen pocos pastores. La ausencia de carga ganadera favorece la presencia de combustible, especialmente en zonas sensibles.	La actividad agroganadera es casi inexistente. Inversión en manejo de la vegetación para prevenir el fuego no es suficiente, los incendios tienen un gran impacto. Las tecnologías son caras y el escaso beneficio de la ganadería no compensa su uso	La actividad agroganadera está prácticamente digitalizada y se desarrolla bajo un modelo de "neotranshumancia". La misma ganadería pastorea en distintas zonas.
Políticos	CANALES DE COMUNICACIÓN Y PROTOCOLOS	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación mejoran considerablemente, permitiendo una cooperación más efectiva para el control de los incendios forestales. La administración pone en marcha herramientas digitales efectivas que facilitan la labor de los propietarios	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación mejoran levemente, pero no permiten una cooperación más efectiva para el control de los incendios forestales. Los canales de interacción entre administración y propietarios son limitados.	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación apenas mejoran y no permiten una cooperación más efectiva para el control de los incendios forestales. Los propietarios abandonan el bosque por su escasa rentabilidad	

INSTITUCIÓN/ORGANIZACIÓN: FCO. JAVIER RODRIGUEZ SENAVENTE (CAGPDS)

Elige diferentes supuestos para crear un escenario optimista y otro pesimista, traza una línea conectando los supuestos para cada uno

¿Por qué has elegido estos supuestos? + FUNDAMENTAL MEDIANTE NUEVAS TECS BUSCAR NUEVOS RECURSOS Y HACER + ATRACTIVOS LOS EXISTENTES QUE ↑ ACTIVIDADES QUE INDUZCAN UN ↓ DEL RIESGO DE INCENDIOS. - LA COMBINACION DE LOS ESCENARIOS MÁS NEGATIVOS DARÁN LUGAR A UNA SITUACION CATASTROFICA

¿Qué título le darías a cada escenario? (+) RE-POBLACIÓN DEL MEDIO RURAL APOYADO X LA TECNOLOGÍA (-) DESASTRE TOTAL

DESIRA receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194

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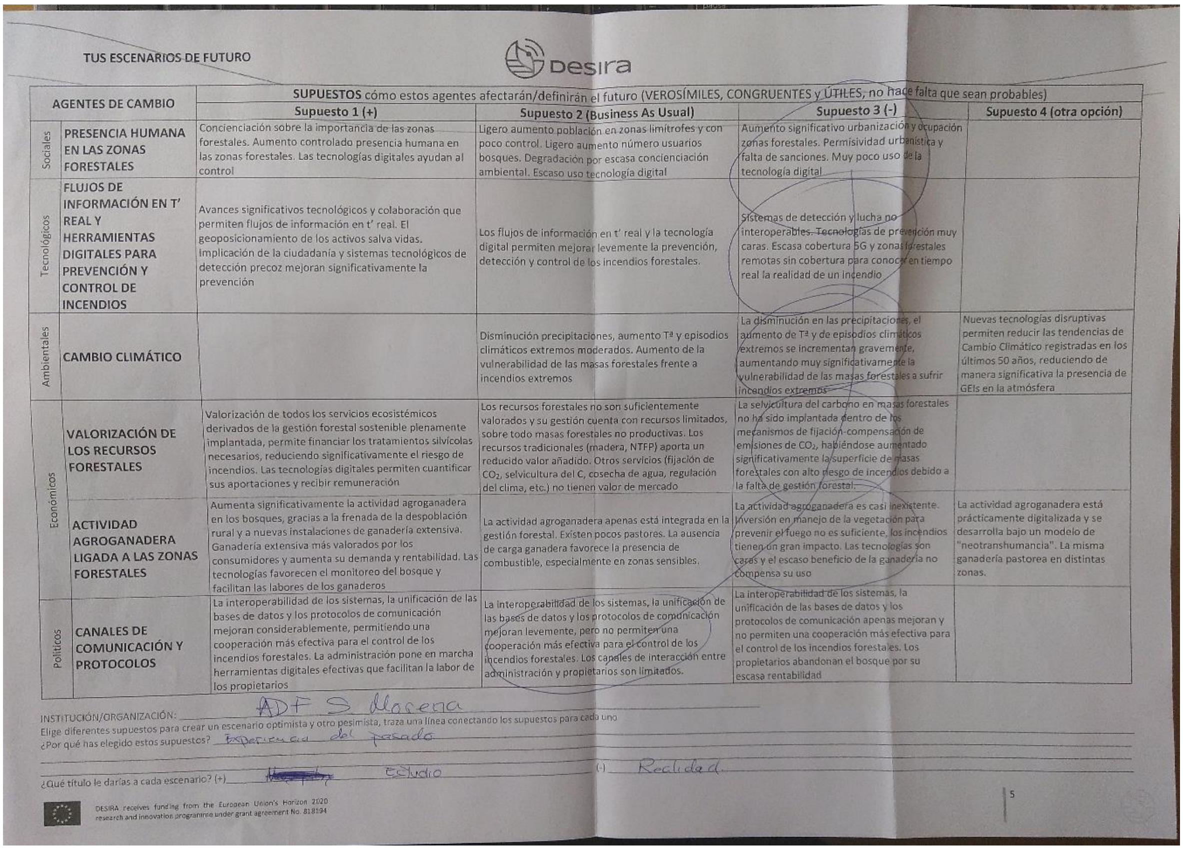
Figure 11. Pathway selection exercise by participant including two options



TUS ESCENARIOS DE FUTURO

AGENTES DE CAMBIO		SUPUESTOS cómo estos agentes afectarán/definirán el futuro (VEROSÍMILES, CONGRUENTES y ÚTILES, no hace falta que sean probables)			
		Supuesto 1 (+)	Supuesto 2 (Business As Usual)	Supuesto 3 (-)	Supuesto 4 (otra opción)
Sociales	PRESENCIA HUMANA EN LAS ZONAS FORESTALES	Concienciación sobre la importancia de las zonas forestales. Aumento controlado presencia humana en las zonas forestales. Las tecnologías digitales ayudan al control	Ligero aumento población en zonas limítrofes y con poco control. Ligero aumento número usuarios bosques. Degradación por escasa concienciación ambiental. Escaso uso tecnología digital	Aumento significativo urbanización y ocupación zonas forestales. Permisividad urbanística y falta de sanciones. Muy poco uso de la tecnología digital	
Tecnológicos	FLUJOS DE INFORMACIÓN EN T' REAL Y HERRAMIENTAS DIGITALES PARA PREVENCIÓN Y CONTROL DE INCENDIOS	Avances significativos tecnológicos y colaboración que permiten flujos de información en t' real. El geoposicionamiento de los activos salva vidas. Implicación de la ciudadanía y sistemas tecnológicos de detección precoz mejoran significativamente la prevención	Los flujos de información en t' real y la tecnología digital permiten mejorar levemente la prevención, detección y control de los incendios forestales.	Sistemas de detección y lucha no interoperables. Tecnologías de prevención muy caras. Escasa cobertura 5G y zonas forestales remotas sin cobertura para conocer en tiempo real la realidad de un incendio	
Ambientales	CAMBIO CLIMÁTICO		Disminución precipitaciones, aumento Tª y episodios climáticos extremos moderados. Aumento de la vulnerabilidad de las masas forestales frente a incendios extremos	La disminución en las precipitaciones, el aumento de Tª y de episodios climáticos extremos se incrementan gravemente, aumentando muy significativamente la vulnerabilidad de las masas forestales a sufrir incendios extremos	Nuevas tecnologías disruptivas permiten reducir las tendencias de Cambio Climático registradas en los últimos 50 años, reduciendo de manera significativa la presencia de GEIs en la atmósfera
Económicos	VALORIZACIÓN DE LOS RECURSOS FORESTALES	Valorización de todos los servicios ecosistémicos derivados de la gestión forestal sostenible plenamente implantada, permite financiar los tratamientos silvícolas necesarios, reduciendo significativamente el riesgo de incendios. Las tecnologías digitales permiten cuantificar sus aportaciones y recibir remuneración	Los recursos forestales no son suficientemente valorados y su gestión cuenta con recursos limitados, sobre todo masas forestales no productivas. Los recursos tradicionales (madera, NTFP) aporta un reducido valor añadido. Otros servicios (fijación de CO_2, selvicultura del C, cosecha de agua, regulación del clima, etc.) no tienen valor de mercado	La selvicultura del carbono en masas forestales no ha sido implantada dentro de los mecanismos de fijación-compensación de emisiones de CO_2, habiéndose aumentado significativamente la superficie de masas forestales con alto riesgo de incendios debido a la falta de gestión forestal.	
Económicos	ACTIVIDAD AGROGANADERA LIGADA A LAS ZONAS FORESTALES	Aumenta significativamente la actividad agroganadera en los bosques, gracias a la frenada de la despoblación rural y a nuevas instalaciones de ganadería extensiva. Ganadería extensiva más valorados por los consumidores y aumenta su demanda y rentabilidad. Las tecnologías favorecen el monitoreo del bosque y facilitan las labores de los ganaderos	La actividad agroganadera apenas está integrada en la gestión forestal. Existen pocos pastores. La ausencia de carga ganadera favorece la presencia de combustible, especialmente en zonas sensibles.	La actividad agroganadera es casi inexistente. Inversión en manejo de la vegetación para prevenir el fuego no es suficiente, los incendios tienen un gran impacto. Las tecnologías son caras y el escaso beneficio de la ganadería no compensa su uso	La actividad agroganadera está prácticamente digitalizada y se desarrolla bajo un modelo de "neotranshumancia". La misma ganadería pastorea en distintas zonas.
Políticos	CANALES DE COMUNICACIÓN Y PROTOCOLOS	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación mejoran considerablemente, permitiendo una cooperación más efectiva para el control de los incendios forestales. La administración pone en marcha herramientas digitales efectivas que facilitan la labor de los propietarios	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación mejoran levemente, pero no permiten una cooperación más efectiva para el control de los incendios forestales. Los canales de interacción entre administración y propietarios son limitados.	La interoperabilidad de los sistemas, la unificación de las bases de datos y los protocolos de comunicación apenas mejoran y no permiten una cooperación más efectiva para el control de los incendios forestales. Los propietarios abandonan el bosque por su escasa rentabilidad	

INSTITUCIÓN/ORGANIZACIÓN: ADF S Morena

Elige diferentes supuestos para crear un escenario optimista y otro pesimista, traza una línea conectando los supuestos para cada uno

¿Por qué has elegido estos supuestos? Experiencia del pasado

¿Qué título le darías a cada escenario? (+) Estudio (-) Realidad

DESIRA receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194

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Figure 12. Pathway selection exercise by participant including one option 'based on previous experience'

5.5 Relevant feedback from participants

No remarkable feedback in relation to the scenario methodology or the proposed scenarios themselves was given by participant, they added clarifications and new assumptions for the two DOCs that were more controversial.

In relation to the *Occupation and use of forest areas*, some participants suggested a fourth option which would represent intermediate or alternative situations to the ones included in the original morphological box, namely:

> *The local population leave the rural areas, whereas forest users, visitors and vacation houses increase without control. The challenge is to identify how technologies could support the locals.*
>
> *Digitalisation improvements in rural areas foster a population increase, leading to an increase of the farming activities in forests.*

An assumption was added to the DOC *Valorisation of forest resources* which was an intermediate option between Assumption 2 (BAU) and Assumption 3 (-) and stated as *Forest resources are valued to some extent. Vulnerable forest areas increase, but technology progress and management improve and contribute to increase valorisation progressively.*

These additions and other clarifications were useful to define with the group the key aspects for the narratives later (see Figure 13).

Figure 13. Group session during scenario planning workshop

6 Scenario Narratives

6.1 Name Scenarios

- “Menos pastores, más promotores” Less shepherds, more developers (Worse not worst)
- The real deal / Resistance is ‘fertile’ (BAU)
- In tech we trust (Better not best)

6.2 Write the 2 or 3 detailed scenario narratives

The two narratives are presented from the perspective of 2030. They tell a story referring to past events and the social, environmental, and economic changes that have led to the current situation.

6.2.1 Scenario 1

"Menos pastores, más promotores"
-Less shepherds, more developers-

The lack of forest management and planning deteriorate the forest areas. More people use and live in forest areas, but the land occupation is out of control. Farming activities linked to the forests have almost disappeared, forest property owners leave, and forests are not managed anymore. Technology development is insufficient, as well as awareness of the forests and their resources. Within a context of severe changes in the climate, the forest fire risk increases significantly.

This first scenario is defined by the more negative trends that the COVID-19 pandemic triggered. These were the unplanned occupation and use of forests and the limitations that the CSP system already had, namely high vulnerability and lack of joint strategies and coordination for forest fires management, especially on the prevention side.

In 2020 and 2021, the COVID-19 pandemic restrictions and lockdown measures prompted surge of interest of urban citizens in moving to quieter and bigger houses, which were mostly located in accessible rural areas and in the forest-urban interfaces. Similarly, more people started to visit and to use natural outdoor spaces to avoid the crowds. What began as a temporary phenomenon derived from an exceptional -pandemic- situation, progressively became a significant and uncontrolled increase of users and settlements in forests and forest edges in the past decade. Yet this circumstantial "ruralisation" did not lead to an increased forest awareness, as they were the means to an end. Consequently, the forests areas and their surroundings degraded because of misuse and littering, and forest resources -like the mushrooms or pine nuts- were extracted without control.

The spontaneous and rapid nature of these demographic movements made regulation difficult, therefore, unplanned occupation and forest resources abuse were rarely penalised. The situation worsened due to the slow response of the public administration, overloaded by other problems, such as sanitary emergencies.

This positive demographic trend did not however impact the local -native- population. Policies for sustainable rural development were not a priority for the public administration, reducing the chances to improve services (e.g. medical services, 5G connectivity). Less accessible and deprived rural areas continued to suffer depopulation and ageing processes. The holders of traditional knowledge and their activities (like cattle grazing in forests) decreased as well as the capacity to transfer the values associated to forests. As a result, there was an emotional 'detachment' of the population with the forests as well as with native communities. In a situation like this, traditional activities became less profitable, and forests and natural areas were neglected.

The physical dimension of the CSP system showed a critical situation in terms of risk to suffer highly impactful forest fires. The starting point was a vulnerable ecosystem composed of fragmented forest properties, homogenous landscapes (single species were planted in a monoculture during the 1950s and the 1960s), wrongly approaches to ecology that consider that cutting trees and clearance activities are deforestation activities, and rigid regulations that hindered changes in the use of forest areas. Policy changes to foster more resilient ecosystems, namely multifunctional and diverse, were not put into place in time. Together with the abandonment of traditional activities, the result was more fuel load on the ground, especially in protected areas.

Meanwhile, resistance to change of the public administration continued to cause coordination issues and deficient information flows. Replacement of civil servants, who represent about 90% of the regional administration workers, has been insufficient for the past decade, perpetuating the public administration static character. The Sierra Bermeja fire in 2021 exposed the need for a more coordinated strategy within the various public administration services, and with the private companies and the local communities. Despite the many technological developments available, the use of technologies to prevent and to control forest fires remained very low. Information to prevent forest fires (e.g. areas of high fire risk requiring intervention) is stored separately and it is hard to access, technologies for fire prevention were expensive. The forest fire detection and control systems were not interoperable, early warning systems could not mobilise the manpower available and neither did they lead to rapid extinction. The existing digital gap in remote rural areas -aggravated by ageing and population loss-, and the lack of investments in communication technologies, prevented the few locals remaining to engage in actions when fires occurred and to share real time information.

The CSP system is embedded in a context of extreme climate change. The worst forecasts projected a decade ago have become true, the decrease in rainfall and the temperature increase are severe, and so are the occurrence of extreme weather events. Forest fires incidence is slightly higher, but their impact is significantly augmented.

The winners in this scenario are clearly the people who benefit from forests without contributing to its maintenance, namely careless visitors, and newcomers. In return, the local population -including forest property owners and farmers- are the losers, for they have been gradually expelled from the forest areas and deprived of their legacy.

The challenges of this scenario are several. First, to use technological development to benefit and to maintain the local population as well as the farming activities that favours landscape resilience, for example, better modelling could lead to more accurate action planning which would lower the costs of managing forest ecosystems. A second challenge is the climate change evolution predictions and response-learning systems. The third challenge would be to valorise forest resources and to raise awareness about forests.

Back casting

- Planning of rural areas and forest edges settlements
- Rural development policies to support the use of technologies to
  - Facilitate farming in forests
  - Maintain the local population (access to services, etc.)
- Regulations to enable coordination of public administration and communities to manage forest fires prevention, control, and recovery
- Policy changes to foster diversity of uses in forest areas
- To raise awareness about the forests and to valorise their products/services

Figure 14 City crowds – Pixabay and Figure 15 City crowds - Photo by Sofía Marvizón on Unsplash

Figure 16 Littering in nature - Photo by John Cameron on Unsplash

Figure 17 Abandoned rural spaces - Photo by Erik Karits on Unsplash

Figure 18 Piloted aircraft - Photo by Steve Harvey on Unsplash

Figure 19 Firefighter - Photo by Fabian Jones on Unsplash

6.2.2 Scenario 2

In tech we trust

Within a context of moderate climate change, where forests are slightly more vulnerable to forest fires, a combination of technological progress and increased awareness about the importance of forests managed to revitalise the rural areas and to reduce the impact of forest fires significantly.

In this second scenario, increasing environmental awareness and the political strategies to protect and to give value to forests and their resources were key.

Global and European movements (e.g. Fridays for Future) initiated over a decade ago -mostly, by young people- changed the course of the relation that the adult generation has with nature and with natural resources in 2030. Supplemented by the implementation of strategies towards a "greener and fairer future" at all levels (e.g. EU Green Deal and Horizon Europe), we have consequently improved the way in which we conceive and use forests.

At regional level, the sustainable forest management strategy and the 2021 planning law should be highlighted. The first one was designed to revitalise the forest sector and to capitalise on the limited local knowledge that existed before it got disappeared. The strategy put measures in place that enabled the valorisation of all the ecosystem services, for example, by giving a market value to the carbon sequestrated by forests, their role in fire control and seeds dispersion, among others. These measures, in return, provided funding for forest owners to implement management measures (road maintenance, thinning, etc.) and forest fire preventive measures (clearing vegetation, etc.). Also, the strategy regulated and controlled the forest resources use including the visits to the forest and the goods extraction, like mushroom picking or beekeeping. Finally, the strategy included the possibility for a land use change from forest to agroforest or agriculture, and to combine renewable energy installations with farming, which increased the land productivity.

The Andalusian 2021 land planning law (Ley de Impulso y Sostenibilidad del Suelo de Andalucía -LISTA-) set up a new legal framework to regulate urban development in the region. The law especially impacted the rural areas as -at least- 300,000 rural homes were built illegally all over the Andalusian countryside before 2020. LISTA law regulated the situation of said homes, enabling the "illegal" rural homeowners to make investments and to push for services provision improvements, such as water supply or electricity services.

Revitalisation of forests and rural areas also affected the population that was living in them. With better services and higher valorisation of the forest resources (e.g. free-range meat became a highly-valued quality product), the profitability of forest land significantly improved and with it, the maintenance of the local population. Also, it promoted a controlled migration to forest, rural and adjacent areas. Custodians of local knowledge were able to share their values with newcomers and visitors, increasing the value and the maintenance of forests, which, in return, granted the local community to remain.

Public administration efforts were not limited to regulation, they made significant progress in other key aspects. First, shared communications protocols and databases were established to manage forests and forest fires, both within the public administration itself and with citizens and businesses. This was facilitated by the fact that Spain was already well prepared to assimilate and implement open data policies (in 2021, Spain was among the top European countries in the matter, according to the annual report of the European Public Data Portal[11]). It is worth mentioning that such collaboration transcended the limits of the Andalusian region. The government established agreements with the bordering regions since forest areas spreads beyond regional administrative boundaries. Secondly, progress was made to reduce the administrative burden related to forest management, including simplified and more accessible procedures as well as a more agile public administration in decision making.

Despite the digital gap that rural areas had a decade ago, the role of the cyber dimension of the CSP system was crucial. Technology development was put at the service of environmental protection and sustainable rural development. It supported farming, forest management and forest fire prevention and control in many levels. The use of technology in farming helped to solve the grazing shortage (key to reduce the fuel load in forests) and established a "neo-transhumance" model in which the same cattle grazes different forest areas. The selection of these areas was modelled to concentrate grazing in the most vulnerable to fire areas. Animals are monitored remotely, and the system is supported by portable electric net fences. In relation to forest management, the property owners were provided with accessible and easy-to-use digital tools to facilitate their prevention actions (e.g. to get thinning licenses). Also, sophisticated simulation software gave the property owners a more accurate guidance to plan and to exploit their resources (e.g. when and where to do pruning), reducing the management costs significantly. Yet the progress of technology in forest fires prevention and control was exceptional. Satellite internet constellations and remote processing and storage of geo big data allowed enormous quantities of information to flow in real time. This technological progress led to effective early warning fire detection and quicker forest fire control response. Changes in the Spanish legislation in 2022 introduced protocols for better coordination between piloted aircrafts and Remotely Piloted Aircrafts (RPAS). Together with the significant progress made in digital systems interoperability, this resulted in a more efficient cooperation to control forest fires.

This scenario presents more resilient forest ecosystems in which the impact of forest fires impact could, in theory, be reduced. However, climate change caused moderate decrease of rainfall and a slight increase of the temperatures as well as a moderate increase in the occurrence of extreme weather events. This is the main uncertainty because it is hard to predict the severity and occurrence of forest fires as well as the adaptability of the forest ecosystems to everchanging climatic conditions.

In general, this scenario portrays a situation in which everybody wins. The main challenges are the high dependence on technology and the reliance on people's will to change their behaviour towards nature. There are opportunities to start new businesses associated to farming in forests and to the exploitation of forest resources that could arise.

Back casting

- Sustainable forest management strategy to revitalise the forest sector and to capitalise on the local knowledge through:
    - valorisation of all the ecosystem services,
    - funding mechanisms for fire prevention measures and
    - land use change to agroforest.

[11] Bello. A "Datos abiertos y participación en el gobierno social" https://www.mincotur.gob.es/Publicaciones/Publicacionesperiodicas/EconomiaIndustrial/RevistaEconomiaIndustrial/405/BELLO%20GARC%C3%8DA.pdf

- Policies to enable shared communications protocols and databases
- Boosting the development of modelling capacities to identify the best intervention areas for prevention
- Cross-regions collaboration frameworks
- To reduce the administrative burden
- To promote accessible and easy-to-use technologies


Figure 20 Coordinated fire control systems - Photo by Fco. Senra

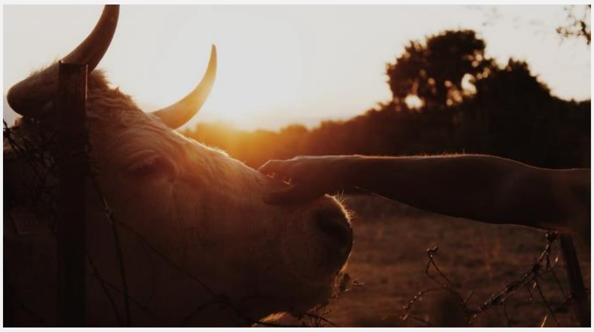
Figure 21 Nature connection - Photo by Rebe Pascual on Unsplash



Figure 22 and Figure 23 Valorisation of natural resources - Pixabay


Figure 24 Remote cattle grazing control - Pixabay


Figure 25 Revitalised rural areas - Pixabay

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

Total disaster

The worst climate change forecasts happen, technologies cannot contribute to reduce risks of forest fires and neither they are used to support sustainable rural development. Forests are left to their own devices.

This scenario presents the worst case possible: forests, rural areas, naturales resources and local communities are ignored and remain too weak to face the worst consequences of climate change.

The latest Common Agrarian Policy and other strategies, such as the Andalusian Climate Action Plan 2030 (PAAC 2030), did not revert a situation of highly fragmented and homogenous forest land. Forest property owners are forced to invest significant amounts of money in fire prevention and control measures every year, as subsidiary entity for forest fires. Technologies -like autonomous clearing saws- supporting these activities were still expensive and legislation did not favour a change of land use towards a more diversified and more profitable landscape. In return, public forests, which accounted for 25% of the total forest land, provided resources through unfair competition. The lack of profitability did not enable the new generations to take over these properties so the forest areas, were abandoned. The result is that the fuel load increased significantly, especially in private forest areas, growing the risk to suffer severe consequences from forest fires. Also, maintenance of the prevention and control measures, e.g. firebreaks, was not kept.

Similarly, rural communities who lived from farming and other traditional activities were left behind. The quality of basic services like medical care or education was significantly reduced, and no new investments were brought to the rural areas. In the post-COVID era, public administration and private investors prioritised the recovery of urban spaces, where most people lived.

In parallel, uncontrolled use and occupation of the forest areas increased after the COVID-19 pandemic. Newcomers lacked the traditional knowledge associated to forest management, which was worsened by a low environmental awareness, contributing to the neglection and deterioration of forests. Limits between urban and forest blurred and urban practices (illegal dumping, etc.) were deployed in more natural spaces.

Following the trend of the last decades, the surface affected by forest fires continuously increased. Limited connectivity, especially in remote areas, did not facilitate to share real time data during forest fire episodes. Moreover, interoperability of forest fire detection and control systems was not put in place. Qualified professionals to model and to process data were scarce and the public administration could not process and organise all the information generated during forest fires episodes, making anticipation and preparedness hardly possible.

The consequences of forest fires in 2030 are devastating, as the El País newspaper shows in the cover of 31st September 2031 "*Grazalema '7th Generation' forest fire is finally out after burning for 78 days and claiming the life of 17 people*".

EL PAÍS

www.elpais.com

EL PERIÓDICO GLOBAL

LUNES 15 DE SEPTIEMBRE DE 2031 | Año XLVI | Número 19.861 | EDICIÓN NACIONAL | Precio: 0,15 bitcoin

LA LIGA El Córdoba desaparece por las deudas del club

FÓRMULA 1 Verstappen gana un nuevo Mundial con 35 años

El incendio de "séptima generación" de Grazalema se controla 78 días después con un balance de fallecidos que asciende a 17

JESÚS SÉRVULO GONZÁLEZ
HUGO GUTIÉRREZ, Madrid

Un hombre examina los restos de su casa, reducida a escombros por el paso de un huracán en Mayfield, Kentucky (EE UU).

Pueblos arrasados y decenas de muertos tras una inaudita catástrofe en EE UU

Desaparec el ultimo reducto natural del planeta Tierra

IKER SEISDEDOS
Mayfield (Kentucky)

Otro titular increíblemente negativo del futuro pero más largo

GUILLERMO ABRIL, Bruselas

Otro titular increíblemente negativo del futuro

MARÍA MARTÍN
MIGUEL GONZÁLEZ, Madrid

Otro titular increíblemente negativo del futuro

MIKEL ORMAZABAL, San Sebastián

ANGELIQUE COETZEE
Presidenta de los médicos de Sudáfrica

"Ómicron no será tan grave como delta"

Revitalised Spain "La España rellenada"

Revitalised rural areas thanks to a sudden change in the depopulation trend, farmers remain and increase their activity, reducing the vulnerability of forests to fire despite climate changes. Technology supports these processes.

Severe forest fires of unprecedent consequences in years 2021 and 2022 pulled the trigger for an improved forest and forest fires management system. These changes were facilitated by the improvements in communication technologies, including 5G and satellite networks, which were deployed in rural areas with the aim to reach 100% coverage in the Andalusian territory.

Similarly, forest fires technologies for detection, control and monitoring continued to improve. First, the Andalusian Emergency Digital Radio was launched in 2023, a milestone in communication technologies that provided a third geolocation system for more accurate positioning which enabled to save lives. Secondly, RPAS were constantly enhanced so they could operate for longer periods, and they could carry more and better sensors, resulting in more complete and accurate information in real time. Thirdly, high-altitude platform station (HAPS) systems were fully implemented providing observations and improving communications. In 2031, the project phase U4 of the U-Space project was finalised, enabling a full cooperation of RPAS and piloted aircrafts. Finally, improvements in modelling and forest fire scenarios were developed supported by artificial intelligence and geo big data technologies.

Locally, the regional government's forest fire service -INFOCA- launched a web application in 2026, which could be accessed from any device, providing real-time information and forecasts. Also, the public administration made significant efforts to make all digital systems as interoperable as possible and to unify the databases and the communication protocols. All these, contributed to a more efficient cooperation to control forest fires. Along these lines, the public administration provided forest property owners with digital tools and staff to support forest fire prevention procedures and actions.

In the social aspect, the negative depopulation and ageing trends that rural areas suffered for over five decades, reverted. Technology played a key role in improving the profitability of forest properties and farms, as it made easier to manage free range livestock (e.g., through GPS systems) and forest fires preventive measures (e.g., remote strimmer). Socially, extensive livestock farming was highly valued, increasing its demand and profitability. Farming activities in forest areas therefore increased and new pastoral and extensive livestock farming appeared. To support this, the Andalusian Shepherds School was assigned more funding for the period 2021-2031.

The users and settlements in forests and forest edges increased slightly, with minimum control. The increase of residents resulted in new investments and demands for the rural areas, and the new generations had a feeling of ownership, leading to virtuous cycle for the rural population. With more people in rural areas, citizen engagement and early detection technologies significantly improved the prevention and control of forest fires, as stated in the cover of El País (15th September 2031) "*Grazalema '7th Generation' forest fire is controlled in less than 48 hours thanks to ForestAlert technology*".

EL PAÍS

EL PERIÓDICO GLOBAL

www.elpais.com

LUNES 15 DE SEPTIEMBRE DE 2031 | Año XLVI | Número 19.861 | EDICIÓN NACIONAL | Precio: 0,15 bitcoin

LA LIGA El Córdoba gana la liga tras un año grandioso

FÓRMULA 1 Verstappen se retira tras una caída fatal

El incendio de "séptima generación" de Grazalema se controla en menos de 48h gracias a la tecnología ForestAlert

JESÚS SÉRVULO GONZÁLEZ
HUGO GUTIÉRREZ, Madrid

Tras unos inicios titubeantes, la gestión de los fondos europeos empieza a coger ritmo en España. El Gobierno había previsto gastar este año 24.198 millones de euros de fondos europeos, pero un inicio repleto de dificultades estaba retrasando los proyectos y empañando su objetivo de convertirse en el alumno aventajado de la UE en la aplicación del fondo de recuperación. Las últimas semanas, sin embargo, todo se ha acelerado más del 73% del gasto total ya ha sido autorizado —unos 18.000 millones— y se ha comprometido un 64,5% del dinero —por encima de los 15.600 millones—. Fuentes de La Moncloa reconocen que existió un cuello de botella inicial, pero aseguran que han logrado superar el atasco. El Gobierno, además, ya ha transferido más de 11.000 millones a las comunidades, que aún acumulan retrasos en sus proyectos. Luis Garicano, vicepresidente del grupo liberal en el Parlamento Europeo, critica que ha sido culpa del Gobierno, por "la falta de capacidad para coordinarse con las autonomías". Elvira Rodríguez, del PP, señala que echa en falta proyectos transformadores.

Un hombre examina los restos de su casa, reducida a escombros por el paso de un huracán en Mayfield, Kentucky (EE UU).

Pueblos arrasados y decenas de muertos tras una inaudita catástrofe en EE UU

Recuperado el 75% de la masa forestal original del Amazonas

IKER SEISDEDOS
Mayfield (Kentucky)

Tras el tornado, llegó la calma. Pero en Mayfield todo era devastación. Una histórica serie de 30 tornados barrió la noche del viernes zonas rurales enteras en seis Estados del centro y el sur de EE UU y dejó decenas de muertos. Esta localidad de 10.000 habitantes en Kentucky es la zona cero del desastre. "Mi casa, mi negocio... Vi desaparecer toda mi vida en un instante", cuenta una mujer. "No sé si mis vecinos están vivos", lamenta otro hombre. Las casas han quedado reducidas a cascotes, no hay electricidad ni agua corriente. Y la fábrica de velas ha quedado arrasada: dentro había 110 trabajadores y los forenses trabajan a destajo.

Otro titular increíblemente positivo del futuro pero más largo

GUILLERMO ABRIL, Bruselas

La Comisión Europea propondrá esta semana la creación de reservas estratégicas de gas y un esquema voluntario de compra conjunta de este combustible. El objetivo es que los países puedan hacer frente a periodos críticos de desabastecimiento o de precios disparados. Para la compra conjunta se crearán grupos formados por varios países que compartan riesgos o necesidades y cada Estado podrá almacenar las provisiones en su territorio o en un país de su mismo grupo.

Otro titular increíblemente positivo del futuro

MARÍA MARTÍN
MIGUEL GONZÁLEZ, Madrid

El Gobierno ha creado una comisión con representantes de al menos seis ministerios para prepararse ante la futura apertura de las fronteras de Ceuta y Melilla. La hoja de ruta pospandemia deberá abordar cuestiones delicadas en la relación con el país vecino desde la posibilidad de instalar aduanas comerciales en los pasos fronterizos de las dos ciudades autónomas a la aplicación de Schengen.

Otro titular increíblemente positivo del futuro

MIKEL ORMAZABAL, San Sebastián

La sexta ola que se extiende por toda España en el País Vasco y Navarra campa a sus anchas. Los expertos no saben explicar a ciencia cierta por qué la incidencia allí incluso triplica la media nacional, aunque señalan como posibles causas el mal clima y el alto número de PCR.

ANGELIQUE COETZEE
Presidenta de los médicos de Sudáfrica

"Ómicron no será tan grave como delta"

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

15.15 Spain (Maestrazgo and Gúdar-Javalambre Digilab)

SCENARIO WORKSHOPS
ARAGÓN – SPAIN
SARGA

24.01.2022

JAVIER SANCHO, RUTH AGUAROD

DESIRA receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194.

SCENARIO WORKSHOPS REPORTING TEMPLATE

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Website	www.desira2020.eu
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Status	Draft
Authors	Javier Sancho, Ruth Aguarod
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

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Introduction

1. Living lab summary

1.2 Name of LL

Maestrazgo and Gúdar-Javalambre Digilab

1.3 Brief summary of LL

This LL is placed in Maestrazgo and Gúdar-Javalambre, in the southeast of Aragón (Spain). Both areas are known for having a great territorial dispersion among their villages with a low population density, representing less than 1 percent of the regional population in a territory that occupies 7.44 percent of Aragón's surface area. They have around 12.000 inhabitants distributed in 39 municipalities, spread over a territory of 3.556 km2.

The focal question this Living Lab worked with is: how can digitalisation contribute to enhance the global attractiveness of the territory of Maestrazgo and Gúdar-Javalambre while taking care of their natural resources and environment?

Tourist and environmental activities are the key activities developed, considering that being able to offer the local population and visitors a series of natural resources, as well as activities, makes it possible to reduce the quantitative gap in terms of cultural offerings that the rural environment suffers compared to the urban environment.

Some projects have been running over the last 10 years and they have been accelerated by the sanitary situation of COVID-19 (smart work, online market places and collaborative platforms). The final and desired impact of digitalisation would be to stop depopulation of rural areas, allowing young people to be able to stay and live in their villages by having a positive economic impact in the environment and also protect the natural resources, by focusing on a sustainable tourism.

1.4 LL participants

We had 7 stakeholders involved in the workshop. 3 of them had participated in the NEI workshop, the rest were new participants.

The profile of the participants was very interesting in terms of their experience, relevance with the LL context and expertise and they were all invited to participate due to their strategic views.

Table 1: List of participants (apart from SARGA, project partner) that participated on the scenario workshop:

	Institution	Gender
Participant 1	Director of the Maestrazgo Cultural Park	Male
Participant 2	Maestrazgo region technician	Female
Participant 3	Scientific Director of the Maestrazgo Geopark.	Male
Participant 4	General Director - Government of Aragón	Male
Participant 5	Managing director of the Dinopolis Foundation	Male
Participant 6	Culture and Tourism technician of the Andorra region	Female
Participant 7	Responsible for the landscape maps of Aragón	Male

1.5 Timing of Scenario Planning (WP3) workshops

The workshop was initially planned to take place in a face to face format, the last week of October 2021. Due to a medical situation, it was postponed and finally took place in a hybrid format, the 2nd December 2021 from 9:00 to 14:00 CET. We had 7 participants that were together in the same meeting room and 2 online participants (one of them being one of the writers of this report).

2 Scenario question

2.1 Draft scenario question

How do you think the territory of Maestrazgo and Gúdar-Javalambre will look like in 2031 with the implementation of the digitalisation measures and the 2030 agenda?

Figure 1: Image of the workshop:

2.2 Finalised Scenario question

How digitalisation and the 2030 agenda will change Maestrazgo and Gúdar-Javalambre by 2031?

2.3 Methodology used to finalise scenario question

Since the workshop was planned for October and was postponed, we had the time to discuss the scenario question with our expert stakeholders from the LL in advance. The first draft scenario question was longer and a rephrase and slight change was suggested to the better understanding of the question. These decisions have been taken jointly with our stakeholders for a better development of the scheduled activities.

2.4 Relevant feedback on scenario question from participants

No relevant comment was added during the workshop regarding the scenario question. We mentioned it at the beginning and opened a brief debate for any comment, but they seemed to have correctly understood the question and didn't felt the need to further change it.

As we have commented in the previous section, both the content and the format of the workshop were agreed upon together with the stakeholders involved.

3 Relevant past events

3.1 List of relevant past events

- 2009: WhatsApp is created.
- 2010: Avanza Plan: having the objective to extend telecommunications infrastructures in areas where they did not exist, such as promoting the installation of rural internet.
- 2010: Creation of Instagram.
- 2010: Although Smartphone devices were already created, this is the decade where they became more popular and used.
- Popularisation and new technologies applied in the use of drones.
- 2016: The Gúdar Javalambre region has been certified as a Starlight Reserve and Destination.
- 2018: Plan 300x100, which focuses exclusively on the deployment of broadband infrastructure for Spain.
- 2020: Remote work tools are implemented.

3.2 Description past event activity

Due to the nature of the event (hybrid) the past events were presented with a power point slide and then discussed with the stakeholders.

When searching for relevant events, it was difficult to find examples for every year that had impacted this particular region. Since the territory is known as a grey area in term of connection and infrastructure services, we find that some National Plans focused on those aspects must be visualised and commented.

3.3 Relevant feedback from participants

The scenario workshop led us to talk about stars (as can be seen later on in the pathways) and that is why stakeholders stated a reference to the Starlight Reserve was missing (and finally added). both the geopark and the region where it is located have made a firm commitment to astronomical tourism, the region of Gúdar -Javalambre where the geopark is located is the headquarters of the Javalambre Astrophysical Observatory and the Galactic Astronomical Center, one of the best locations in Europe is able to contemplate stars due to the clarity of its skies and the low light pollution. The astronomical centre has joined the Galactica project, a centre that aims to bring astronomy closer to all educational scales and position Spanish astrophysics at an international level.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

Table 2: DOC selected by LL coordinators.

STEEP	Drivers of Change, DOC
Social	Demographic (rural ageing, rural population density)
Technological	Connectivity in rural areas
Environmental	Climate Change
Economic	Rural infrastructure
Political	Local Administration implication

4.2 List selected DOC

Table 3: DOC finally selected.

STEEP	Drivers of Change, DOC
Social	Demographic (rural ageing, rural population density)
Technological	Digital APPs and services / Connectivity in rural areas
Environmental	Climate Change/ windmills and their impact to the environment
Economic	Rural infrastructure /Availability of labour force
Political	Local, Regional and National Administration implication

4.3 Describe methodology to select DOC

DOC were selected previous to the workshop and were shared with our key expert in the LL who made some suggestions.

We focused on those STEEP categories that were linked with our LL: rural ageing and rural density for the Social category, Connectivity, APPs and services for the Technological one, climate change, windmills and their impact to the environment for the Environmental category, rural infrastructure and labour force for the Economic one and finally Local, Regional and National Administration implication for the Political side.

4.4 Relevant feedback from participants

During the workshop we asked the stakeholders for any suggestion, addition or comment they wanted to include. Windmills were not at first chosen as a driver of change but it is an issue largely debated in recent months in the territory and was inevitably discussed during the workshop. Moreover, it became part of the scenarios as can be seen in the next sections.

5 Matrix

5.1 Matrix description

We developed four assumptions for each of the DOC and we decided to present them from negative (left) through Business as Usual (centre) to positive (right).

We chose the left column for the negative, because dystopia seemed to lead the assumptions discussion (not that this was planned but the participants naturally decided so) and then we worked from dystopia to utopia, from left to right. That is why we have chosen to represent the matrix in the same way.

Table 4: Matrix:

DOC	Assumption 1	Business As Usual	Assumption 2	Assumption 3
Demographic (rural ageing, rural population density)	Rural ageing is worst than ever with a rural population density at its lowest rates	Rural ageing and population density does not change significantly	Demographic situation remains the same	Reversion of rural ageing and rural population density with new younger inhabitants and the increase of babies being born
Digital APPs and services / Connectivity in rural areas	No further development of digital services and lack of connectivity and broadband in rural areas	Some new services are emerging	Digital APPs are emerging, and new services are being implemented thanks to a better connectivity and broadband access	Introduction of new services and connectivity and broadband is now a reality (and no longer a difference) between rural and urban areas
Climate Change/ windmills and their impact to the environment	Increase in extreme weather events (forest fires, snow) / windmills are having an impact on the environment	Climate and weather events remains as we know them / a few windmills are installed	In the territory there is a full awareness of climate change, although it is true that the installation of large wind farms is	Due to extreme weather events new economic activities emerge / the model of windmills do not affect the environment

			bringing a wide social response due to the significant effects on the landscape.	
Rural infrastructure /Availability of labour force	Decrease of jobs offerings and labour force available linked to a lack of basic infrastructure	Due to a deficient rural infrastructure, job offerings remains the same, as well as the availability of labour force (which still is not a worrying issue)	Due to an improvement on rural infrastructure, there is a slight increase in employment	More employment thanks to the possibility offered by remote working and also to the establishment of new companies and the increased availability of labour force
Local, Regional and National Administration implication	Loss of importance of local administration that seem to have forgotten the territory	Continuation of the so far achieved implication of different administrations	National implication is achieved and that translates into new strategies and funding for the provision of services	In recent years there is a greater concern on the part of the different administrations in unpopulated areas, new solutions are being sought to reverse the situation

5.2 Define 4 pathways/scenarios selected

Worse not worst scenario: highlighted in red.

Better not best scenario: highlighted in green.

Dystopia scenario: left column.

Utopia scenario: right column.

5.3 Identify the 2 pathways that will be defined in more detail

Worse not worst scenario

In this scenario, the potentially positive impacts of digitalisation have not improved the future of this LL in 2031. We assume that demographic does not change significantly, and rural ageing and population density is the same as in 2021. Even though some new digital services are emerging, they are not linked to the requested level of infrastructure. Employment is the same, with no new job offerings but at least, the availability of labour force (linked to the ageing of the population) is not a worrying issue. The region has not been able to catch the attraction of young people and local administration has not been able to gain importance. In fact, the territory feels as it has been forgotten. Windmills seem to be the economic chosen model, in spite of the reluctance of some of the stakeholders involved and, as feared, they are having an impact on the environment.

Due to the pandemic, there was hope that the teleworking measures would facilitate the incorporation of new inhabitants in the area, although this increase has been a testimony, in many cases due to the lack of a fixed legislation in teleworking

In many cases, digitisation eliminates jobs, although the approach from which it is aimed from the region, is to seek differentiated and quality rural tourism, in addition to a drive for quality agri-food products.

Better not best Scenario

In this scenario, the positive impacts of digitalisation have in fact improved the future of this LL in 2031. Even though the demographic situation remains the same and there is still an ageing situation, digital APPs and services are emerging and new services are being implemented thanks to a better connectivity and broadband access. The changes on the extreme weather conditions have led to new economic activities. Windmills have not affected the environment, as feared, and due to the improvement of rural infrastructure, basic services and broadband connectivity there is a slight increase in employment and people are able to work from home, which also help to increase the number of inhabitants that have decided to move from urban areas to rural ones. National implication is achieved and that translates into new strategies and funding for the provision of services.

Digitisation has improved access to some services that would have been impossible years ago, but the aging of the population continues inexorably and they continue to seek formulas that establish population in these areas. The pandemic has brought a considerable increase in visitors who opt for rural tourism. This business niche presents important growth opportunities, although concern is expressed about the effect of renewables on the landscape.

5.4 Methodology used to identify pathways

Once the morphological box was completed, we divided the face to face group into two groups. Separately, they were asked to develop the more plausible intermediate future scenarios (better not best and worse not worst) and to create the pathway selecting an assumption from each DOC.

We had prepared in advance a role play where we gave the participants different roles, in case their participation was less active than expected. This was not necessary to use because they naturally divide themselves into the scenario they felt more attracted to (either the positive or the negative one).

Once this task was finalised, they were asked to share and discuss their results and we gave the participants some time to reflect and comment on the different pathways and to move the assumptions from one column to another, if needed.

5.5 Relevant feedback from participants

No remarkable feedback was received at this point.

6 Scenario Narratives

6.1 Name Scenarios

Worse not Worst scenario: Windmill fields

Better not Best scenario: Europe's sky

6.2 Write the 2 or 3 detailed scenario narratives

Worse not Worst scenario: Windmill fields

June 2031. When opening the newspaper (which can be only found in digital format nowadays) a big headline is dedicated to windmills and how they have affected the environment of this particular territory. Instead of being known now for their beautiful landscapes and sky, they are now known for their windmill fields. Larger investments were made here and some results have been achieved as the slight increase in the number of jobs that came with the windmill's installation. However, citizens feel (one more time) political speeches failed to reach their promises.

There has been no significant increase in the number of services offered. The basic services for a comfortable living are still missing. With no new inhabitants, it is difficult to obtain the missing and requested services.

Even though some new digital services are emerging, they are not linked to the requested level of infrastructure. Basic services continue as back in 2021. The promised broadband never fully arrived. Basic services for citizens remains unchanged, meaning no improvement can be mentioned for the last ten years. Coverage is still an issue.

As a result, digital administration services weren't fully developed and therefore uptake was limited. Young people didn't have any problems but the older one lacked the skills and needed technology to use it.

Digital education, implemented at first during the COVID-19 lockdown periods, was never again tried in this part of the country and something similar happens with medical services, that didn't achieve a successful digital implementation.

Ageing of population is still an unsolved issue and population density is the same as in 2021 but at least, the availability of labour force (linked to the ageing of the population) is not still a worrying issue.

The region has not been able to catch the attraction of young people and local administration has not been able to gain importance. In fact, the territory feels as it has been forgotten.

The analysis made from the big city of this territory also failed. The local vision and the analysis from the perspective of the territory were lost.

Better not Best scenario: Europe's sky

As for the neighbour district of Matarraña, commonly known as the Spanish Tuscany, Maestrazgo and Gúdar-Javalambre had been known for the last years as Europe’s sky. Its sky is classified as one of the cleanest and darkest in the world due to its low light pollution, which makes it a privileged place for astronomical observation. The “Star Viewpoints Network” has increased and receives more visitors each year thanks to the great digital marketing campaign performed back in 2023 after the COVID-19 crisis and the Recovery Funds received for innovative projects that followed.

New innovation research has emerged thanks to the Javalambre Astrophysical Observatory and extreme weather conditions have helped the further expansion of ski resorts.

The region is known now for its tranquillity, with truly singular spots in the middle of nature. There’s no doubt it is among the Starlight Tourist Destinations for its clean sky and ideal conditions for observing the stars.

Hikers will be delighted to discover what the amazing natural landscape has to offer. They will be glad to know macro-projects of windmill fields didn’t succeed, as was feared back in 2021, and the natural park has been preserved. Even though some windmills were installed, they were installed in a sustainable way that hasn’t affected the environment.

Looking back to 2021, some improvement on services can be seen, thanks to digitalisation. This has been translated into more accessible services to citizens and more people coming to live there, thanks to the remote working possibilities that were first tried with the COVID-19 crisis that affected us all ten years ago.

Administration continued its digital path but thanks to training (especially on digital skills for the older ones) the citizens are able to use and get the most of it.

Online medicine has not so well advanced and there is a still reluctance to connect to a doctor online (some training is still needed there, especially for the older ones).

Digital education is a reality nowadays and used in a hybrid format (together with face to face courses) at all education levels. This has been a big improvement for university degrees, specially, since students do not have to cover such big distances to attend courses, if they don’t want to.

On the tourist and cultural side, the region has become an example on the potential use of digitalisation: the use of under-utilised resources was key to avoid depopulation. Thanks to a new APP implemented in 2025, abandoned houses were used as sustainable and renewed rural accommodation options, which rival the urban houses. Smart homes became a reality and tourism rates are excellent.

Also thanks to the Recovery Funds that arrived after COVID-19, broadband did finally arrive and coverage is no longer an issue. You can now talk and connect in any point of the region, although they remain slightly behind urban areas in terms of quality and speed.

Episodes of adverse weather (heavy snowfalls, avalanches, storms...) still happen but they are easily forecasted now and do not lead to the loss of communications for citizens living in the affected areas anymore. Power cuts caused by downed power lines are no longer a problem but just a memory of the past.

The region finally achieved to change the speech, be able to better sell itself and has managed to put its territories on the map.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

Worst case scenario: The nightmare of the future: empty of people and full of industrial waste.

As feared back in 2021, the region has become a large-scale wind power plant. The beautiful views are disrupted by windmill fields, being the development model finally chosen (among others) for this particular region. Thanks to new technologies, windmills are controlled remotely from Navarra, so they didn't contribute to the creation of jobs and the increase of population, as initially promised.

Basic services can be considered equal or worse than ten years ago. Services such as those offered by Administration did turn to a digital format, leaving the villages without face to face options. Old people are the only one that remained, and they did not adapt to the new technologies, so they are lonelier than ever.

Education also turned online, but it was an excuse to close schools and so children lack the needed contact with students of the same age.

Medicine followed the same path, with no doctors on the local health facilities, when needed citizens have either to connect online or travel the long distance they now have to a nearest hospital or health care facility.

The sustainable development goals were not fully achieved, and a differentiation can be seen between first and second class citizens (urban and rural, respectively).

One third of the villages have disappeared. Tired of the eternal promises of improved telecommunications and seeing that these improvements never came, the young population has been migrating to the big cities, leaving entire villages abandoned. Previously safe villages are affected by neglect, squatting and insecurity.

The small and local business didn't survive due to the pushing of big companies such as Amazon, they finally had to close, and the few remaining inhabitants have fewer services than ever. Petrol stations, banks, medical services are closed in many of the villages and the number of villages with decent access to services is decreasing, meaning that citizens have to cover a long distance when they need certain services.

The unemployment rate is the worst of the country and politics seems to have abandoned this part of the territory, which has become the peninsula industrial landfill. That is the only tourism received nowadays and that is the image sold in social media.

Best case scenario: The flagship on how to turn a depopulated territory into a whole new dimension on sustainable future.

COVID-19 was the beginning of a non-precedent change. Before the pandemic situation, citizens were tired of the eternal promise of telecommunications improvement that never came. But after the crisis, it really came, and everything is better than imagined: new jobs and occupations were created, and villages are populated as ever. Lots of young people came after the periods of lockdown in search of a different lifestyle and schools, streets and local enterprises are busiest than ever.

That has helped a reverse in the demographic situation with new younger inhabitants and the increase of babies being born.

Introduction of new services and connectivity and broadband is now a reality (and no longer a difference) between rural and urban areas. Remote services are offered for Administration, Education and Medical related issues. Metaverse has been implemented for simple things such as shopping, online classes and some medical consultation but they came with facilitation services to help those users who also need a face to face help.

As a result, more employment is available thanks to the possibility offered by remote working and also to the establishment of new companies and the increased availability of labour force.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.16 France (Inno'vin)

SCENARIO WORKSHOPS

INNO'VIN, FRANCE

28/01/2022

MARILYNE FILIPPI, OLIVIER FREY

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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Introduction

This report describes the scenario workshops in the Living Lab Inno'vin in France.

The Vegepolys Living Lab expressed interest for the topic because they also have a team dedicated to the wine industry. Therefore 3 people from Vegepolys participated to the workshops.

1. Living lab summary

1.1 Name of LL

Inno'vin

1.2 Brief summary of LL

Inno'vin is the wine cluster of New-Aquitaine Region in the South–West of France. It now brings together nearly 180 industry players. Inno'vin, a unique structure in France, brings together players in the wine ecosystem. The cluster supports companies in their innovation projects (more than 100 projects successfully supported since 2010). Inno'vin contributes to meeting the challenges of the sector through innovation by helping to germinate solutions. Inno'vin promotes the competitiveness of companies in the wine industry, contributes to its economic development and to maintaining its leadership position.

1.3 LL participants

The first workshop has been coordinated by France Clusters. The participants were all involved in the wine industry. Some of them were academic researchers, others were working for clusters that had a wine branch, some were working on the digitalization of the wine industry. They all came from different regions of France.

After the first workshop the participants were asked if they were willing to participate to the second one. Even though most of them expressed their interest, no suitable date came up and we had to do the second workshop with only a few of the participants. We also had one to one interviews in order to complete the task.

1.4 Timing of Scenario Planning (WP3) workshops

The workshops for the WP3 scenario planning were held on January 5th and 20th 2022. Due to the rise of the Omicron variant and the restrictions imposed by the French government, the workshops took place online.

2 Scenario question

2.1 Draft scenario question

What will French viticulture look like in 2031 in connection with the evolution of digital?

2.2 Finalised Scenario question

What will French viticulture look like in 2031 in connection with the evolution of digital?

2.3 Methodology used to finalise scenario question

The scenario question has been elaborated in accordance with the WP2 conclusions.

During the WP3 workshop the scenario question was provided to the participants through a Powerpoint presentation. We did not actively seek to change the question during the workshop. The participants agreed that the scope of the question served well the purpose of the workshop.

2.4 Relevant feedback on scenario question from participants

In both the preparatory stage and during the scenario development workshop the stakeholders of the Living Lab and participants of the workshop approved the scenario question.

3 Relevant past events

3.1 List of relevant past events

- The French wine industry has embraced digital very quickly (CAP declarations' dematerialisation, weather stations, GPS)
- For several years, the dissemination of digital technologies on vineyards has been slowing down due to the specific nature of the sector
- An ageing and declining population of vineyards managers resulting from a drop in the number of installations a decline in the age at which farmers enter the profession and numerous retirements
- Viticulture is the agricultural orientation with the lowest installation rate (3.0% in 2017) for the highest average age at installation (39.7 years old)
- The surface area of vineyards cultivated according to the principles of organic farming represented 17% of French vineyards in 2020, whether they are certified or in conversion. The organic vineyard reached 137,442 hectares in 2020.
- The upstream of the value chain is characterised by the pressure of legislation and societal expectations that lead to a professionalization of winegrowers.

- Wines still dominate the French alcoholic beverages market with 31.1% of market share in value. But beer consumption is growing strongly and becoming its main competitor.
- Wine e-commerce represented around 10% of total wine sales in 2019 but got a boost thanks to the pandemic.

3.2 Description past event activity

The selection of past event activity was done according to the work that was done for the WP2. The list was selected in order to provide some key points about the development of viticulture and the use of digital by the wine industry at the upstream and at the downstream of the value chain.

3.3 Relevant feedback from participants

No specific feedback.

4 Drivers Of Change (DOC)

4.1 List initial set of DOC

DOMAIN	DOC			
Social	Demographics of the viticultural population	Societal pressure on the use of plant protection products	Societal expectations towards organic viticulture	
Technological	Robotics	Traceability	Connectivity in the rural areas	Data sharing
Economic	Consumer demand	E-commerce	International competitiveness	Labour force
Environmental	Extreme weather events	Pressure on water resources		
Political	Legislation on the use of plant protection products	The public health policy towards alcohol	Legislation on robots	

4.2 List selected DOC

DOMAIN	DOC			
Social	Demographics of the viticultural population	Demand for a more environmentally friendly viticulture	Acceptability of local residents on the contribution of new technologies in the vineyards	Training of the workforce
Technological	Data sharing / Interoperability	Access to technological developments		
Economic	Globalization Vs Local			
Environmental	Extreme weather events	Carbon neutrality in viticulture		
Political	Role of public authorities in the adoption of new technologies applied to vineyards	Legislation on the management of the wine industry		

4.3 Describe methodology to select DOC

The initial list of drivers of change (DOC) were selected by the researchers leading the workshop. These drivers were based on the list of DOC provided by the WP3 team and supplemented with additional DOC based on the information gathered in the WP2 research and workshop.

Participants were given the chance to change the list of DOC during the WP3 workshop. They have been told at the beginning of the workshop that if they identified other relevant DOCs, these could be added to the scenarios during the process.

For each domain of STEEP a set of drivers was chosen.

4.4 Relevant feedback from participants

Several drivers were slightly adjusted by the participants during the workshop. This allowed us to combine several of the drivers, as well as to provide nuance or additional aspects to the existing drivers.

The participants also added new drivers that seemed important to them.

For the driver “International competitiveness”, participants preferred a driver they named “Globalization Vs Local” that reflected more the exposure of the wine industry to threats from some countries (like for example the Trump tax European agricultural goods).

For the drivers “Societal pressure on the use of plant protection products” and “Societal expectations towards organic viticulture” they preferred to combine them into a new driver called “Demand for a more environmentally friendly viticulture”.

For the driver “Data sharing” they asked to add the problem interoperability and the driver was renamed “Data sharing / Interoperability”.

The new drivers they added were :

- Acceptability of local residents on the contribution of new technologies in the vineyards
- Training of the workforce
- Access to technological developments
- Carbon neutrality in viticulture
- Role of public authorities in the adoption of new technologies applied to vineyards
- Legislation on the management of the wine industry

5 Matrix

5.1 Matrix description

The matrix provides the DOC that we identified in the previous chapter with 3-4 assumptions for each driver for the next ten years. Given the time constraint we had for the second workshop, we provided template assumptions for some of the DOC, both to better explain to the participants what was expected from them and in order to be able to keep within the time assigned for this task. We reviewed all the DOC with the participants. They completed several of the assumptions we provided. For the DOC with no template assumptions, the participants provided all of the assumptions themselves.

STEEP DOC	Assumption 1 Best	Assumption 2	BAU Assumption 3	Assumption 4	Assumption 5 Worst
Demographics of the viticultural population (S)	In the absence of a sufficient number of buyers, the size of wine-growing holdings continued to increase. At the same time, the wine-growing holdings that have been taken over have led to a rejuvenation of the managers. The wine-growing holdings are more professional and technological.		Increased segmentation of the wine-growing holdings between those who have adopted new technologies and those who have not. There is a two-speed viticulture that has been established.	The increasing age of retirement has meant that older generations have stayed in business longer. Due to lack of investment, wine-growing holdings have not adopted digital technologies.	Generational renewal has not taken place. The new generations are resistant to digital technology. The concentration of wine-growing holdings is slowing down because the surface area of vineyards is decreasing. The cost of technology remains high, which slows down the development of digital technology.
Demand for a more environmental	All the wine-growing holdingshave environmental		The consideration of the environment	The extreme focus of consumers/citizens on	The consideration of the environment

ly friendly viticulture (S)	ly friendly certifications and are able to promote them to consumers.		by the wine industry is progressing. However, it is still difficult to promote these approaches to consumers. There are multiple environmental labels that coexist.	environmental issues has led to a strong rejection of digital technologies (precision viticulture, ecommerce...).	by the wine industry is stagnating due to the lack of success in promoting the approaches to consumers.
Acceptability of local residents on the contribution of new technologies in the vineyards (S)	The wine industry has been working to raise awareness and increase transparency about its practices. Local residents have come to accept the use of certain technologies by winegrowers and to perceive the benefits.		The wine industry has done a lot of work to raise awareness, but local residents are still not very familiar with agricultural practices. However, some technologies are more accepted than others because they are less intrusive.		The wine industry has turned in on itself following repeated attacks by NGOs. Residents, who are increasingly numerous in the countryside, have taken legal action against farmers who can no longer operate their own automated materials.
Training of the workforce (S)	Agricultural education (initial and continuing) has evolved and integrates complete training modules on digital and precision agriculture. Learning tools		Only the basics about digital technology are taught in agricultural institutions. The learning tools have evolved slightly and the courses only attract		Digital technology is still not sufficiently taught in agricultural institutions and in continuing education programs. Learning tools have not

	have evolved and learners are demanding these new skills. Graduates have hybrid skills in agriculture and digital. "Connected technicians" are increasingly common profiles on farms.		certain qualified profiles. Graduates are still highly specialized in agriculture but still have a solid foundation in digital.		evolved much and training courses do not attract professionals. Due to a lack of skills, farmers must surround themselves with digital professionals. Access to technological innovations is limited due to a lack of skills.
Data sharing / Interoperability (T)	Data sharing is the norm. The data market is transparent and operational. Some of the data is freely available as open data. All the Decision Support Tools and softwares are interoperable.	Winegrowers have organized themselves and created data cooperatives with the aim of valorizing and preserving the sovereignty of the data collected on their farms.	Large companies dominate the data market, farmers have relatively little influence on this market. Data aggregators are in the hands of these large companies.		Data is not shared and the infrastructure for data sharing is poorly developed. Many standards coexist and prevent interoperability. Effective data sharing is difficult.
Access to technological developments (T)	The digital offering has become simpler, inexpensive, user-friendly and reliable. The majority of winegrowers have access to most digital technologies.		The digital offer is very diversified. There are many different solutions providers and it is complicated for a winegrower to choose the right solution or to fully use		Digital technology has become more complex and expensive. The big digital players have abandoned viticulture, which they have not deemed profitable. The offer in digital technologies

			the chosen solutions.		has become poorer.
Globalization Vs Local (Econ.)	International markets remain open and agricultural goods can circulate freely without prohibitive customs duties. International demand for French wines remains strong. The demand for local wines remains relatively limited.		World markets remain open but some countries are turning inward and imposing high customs duties on products imported from Europe (and therefore from France), and in particular wine. International demand for French wines is stagnating.	World markets have closed and agricultural goods, in priority wine, are heavily taxed by some countries. To get around this de-globalization, some large wine companies are buying up vineyards abroad and creating global brands.	The world markets have closed and agricultural goods, and in priority wine, are heavily taxed by some countries. Countries that used to import wine (China, Russia...) have developed their own wine production. The international demand for French wines is decreasing. The demand for local wines reinforces the de-globalization and only the most famous French wines are exported.
Extreme weather events (Env.)	Weather conditions are becoming more and more predictable. There are new technological solutions that allow wine growers to adapt.		Weather conditions remain difficult to predict. There are new technological solutions that allow to adapt but they remain expensive and not very usable by the wine growers (regulatory constraints...) .		Weather conditions remain unpredictable. Extreme events are multiplying without the time to set up protections. Technologies are still struggling to anticipate extreme weather events. More and more

					winegrowers are quitting to do something else.
Carbon neutrality in viticulture (Env.)	The wine industry has quickly achieved carbon neutrality. Winegrowers display low-carbon labels on their bottles. Some winegrowers value their surpluses on a functioning carbon market.		The wine industry has reduced its GHG emissions. There is a multiplicity of low-carbon labels at the international level. The consumers get lost in this, which does not allow for a sufficiently high value added for the winegrowers.		Despite some attempts, the wine industry remains a large emitter of GHGs. No international standard for a low-carbon label has emerged. Consumers reject initiatives that they consider as greenwashing.
Role of public authorities in the adoption of new technologies applied to vineyards (P)	Legislation has rapidly followed the development of digital technologies. Public authorities, through incentives including financial ones, encourage the adoption of digital technologies. Digital viticulture has become a national cause.		Legislation is struggling to keep up with the development of digital technologies. The public authorities are sprinkling aid for the digital transformation of companies without any real effect.		Legislation hinders the development of digital technologies (data sharing, precautionary principle...). The weight of the Covid debt prevents any public financing towards companies.
Legislation on the management of the wine industry (P)	Broader acceptance of the AOC's*, which allows many innovations.		The AOC's evolve very slowly, which slows down the acceptance		Strengthening of the AOC's, which reinforces the link to the territory and

	The international definition of wine has become more flexible. Industrial viticulture has imposed itself as the leading model and has become generalized on the basis of the model of the food industry.		and diffusion of innovations. The international definition of wine is subject to constant change and debate. Coexistence between an industrial viticulture that demands innovations and a terroir viticulture that tends to ignore them.		the environment and prohibits many innovations. The international definition of wine is becoming stricter. The terroir viticulture is now the only one that remains.

*According to INAO (www.inao.gouv.fr), the Appellation d'Origine Contrôlée (AOC) refers to products meeting the criteria of the PDO and protects the denomination on the French territory. It constitutes a step towards the PDO, now Europe-wide sign.

5.2 Define 4 pathways/scenarios selected

We have defined 4 different scenarios.

Scenario 1 is the utopia scenario. It corresponds to the very left column of the morphological box.

Scenario 2 is the “better not best” scenario.

Scenario 3 is the “worse not worst” scenario

Scenario 4 is the dystopia scenario. It corresponds to the very right column of the morphological box.

Scenario 1: technological and carbon neutral French wines (Most positive)	
Demographics of the viticultural population (S) **Assumption 1**	In the absence of a sufficient number of buyers, the size of wine-growing holdings continued to increase. At the same time, the wine-growing holdings that have been taken over have led to a rejuvenation of the managers. The wine-growing holdings are more professional and technological.
Demand for a more environmentally friendly viticulture (S) **Assumption 1**	All the wine-growing holdings have environmentally friendly certifications and are able to promote them to consumers.
Acceptability of local residents on the contribution of new technologies in the vineyards (S) **Assumption 1**	The wine industry has been working to raise awareness and increase transparency about its practices. Local residents have come to accept the use of certain technologies by winegrowers and to perceive the benefits.
Training of the workforce (S) **Assumption 1**	Agricultural education (initial and continuing) has evolved and integrates complete training modules on digital and precision agriculture. Learning tools have evolved and learners are demanding these new skills. Graduates have hybrid skills in agriculture and digital. "Connected technicians" are increasingly common profiles on farms.
Data sharing / Interoperability (T) **Assumption 1**	Data sharing is the norm. The data market is transparent and operational. Some of the data is freely available as open data. All the Decision Support Tools and softwares are interoperable.
Access to technological developments (T) **Assumption 1**	The digital offering has become simpler, inexpensive, user-friendly and reliable. The majority of winegrowers have access to most digital technologies.

Globalization Vs Local (Econ.) **Assumption 1**	International markets remain open and agricultural goods can circulate freely without prohibitive customs duties. International demand for French wines remains strong. The demand for local wines remains relatively limited.
Extreme weather events (Env.) **Assumption 1**	Weather conditions are becoming more and more predictable. There are new technological solutions that allow wine growers to adapt.
Carbon neutrality in viticulture (Env.) **Assumption 1**	The wine industry has quickly achieved carbon neutrality. Winegrowers display low-carbon labels on their bottles. Some winegrowers value their surpluses on a functioning carbon market.
Role of public authorities in the adoption of new technologies applied to vineyards (P) **Assumption 1**	Legislation has rapidly followed the development of digital technologies. Public authorities, through incentives including financial ones, encourage the adoption of digital technologies. Digital viticulture has become a national cause.
Legislation on the management of the wine industry (P) **Assumption 1**	Broader acceptance of the AOC's, which allows many innovations. The international definition of wine has become more flexible. Industrial viticulture has imposed itself as the leading model and has become generalized on the basis of the model of the food industry.

Scenario 2 : environmentally friendly French wines (better not best)	
Demographics of the viticultural population (S) **Assumption 1**	In the absence of a sufficient number of buyers, the size of wine-growing holdings continued to increase. At the same time, the wine-growing holdings that have been taken over have led to a rejuvenation of the managers. The wine-growing holdings are more professional and technological.
Demand for a more environmentally friendly viticulture (S) **Assumption 3**	The consideration of the environment by the wine industry is progressing. However, it is still difficult to promote these approaches to consumers. There are multiple environmental labels that coexist.
Acceptability of local residents on the contribution of new technologies in the vineyards (S) **Assumption 1**	The wine industry has been working to raise awareness and increase transparency about its practices. Local residents have come to accept the use of certain technologies by winegrowers and to perceive the benefits.
Training of the workforce (S)	Agricultural education (initial and continuing) has evolved and integrates complete training modules on digital and precision agriculture. Learning tools have evolved and

Assumption 1	learners are demanding these new skills. Graduates have hybrid skills in agriculture and digital. "Connected technicians" are increasingly common profiles on farms.
Data sharing / Interoperability (T) Assumption 2	Winegrowers have organized themselves and created data cooperatives with the aim of valorizing and preserving the sovereignty of the data collected on their farms.
Access to technological developments (T) Assumption 3	The digital offer is very diversified. There are many different solutions providers and it is complicated for a winegrower to choose the right solution or to fully use the chosen solutions.
Globalization Vs Local (Econ.) Assumption 3	World markets remain open but some countries are turning inward and imposing high customs duties on products imported from Europe (and therefore from France), and in particular wine. International demand for French wines is stagnating.
Extreme weather events (Env.) Assumption 1	Weather conditions are becoming more and more predictable. There are new technological solutions that allow wine growers to adapt.
Carbon neutrality in viticulture (Env.) Assumption 1	The wine industry has quickly achieved carbon neutrality. Winegrowers display low-carbon labels on their bottles. Some winegrowers value their surpluses on a functioning carbon market.
Role of public authorities in the adoption of new technologies applied to vineyards (P) Assumption 3	Legislation is struggling to keep up with the development of digital technologies. The public authorities are sprinkling aid for the digital transformation of companies without any real effect.
Legislation on the management of the wine industry (P) Assumption 1	Broader acceptance of the AOC's*, which allows many innovations. The international definition of wine has become more flexible. Industrial viticulture has imposed itself as the leading model and has become generalized on the basis of the model of the food industry.

Scenario 3: the digital divide (Worse not worst)	
Demographics of the viticultural population (S) Assumption 3	Increased segmentation of the wine-growing holdings between those who have adopted new technologies and those who have not. There is a two-speed viticulture that has been established.

Demand for a more environmentally friendly viticulture (S) **Assumption 5**	The consideration of the environment by the wine industry is stagnating due to the lack of success in promoting the approaches to consumers.
Acceptability of local residents on the contribution of new technologies in the vineyards (S) **Assumption 3**	The wine industry has done a lot of work to raise awareness, but local residents are still not very familiar with agricultural practices. However, some technologies are more accepted than others because they are less intrusive.
Training of the workforce (S) **Assumption 3**	Only the basics about digital technology are taught in agricultural institutions. The learning tools have evolved slightly and the courses only attract certain qualified profiles. Graduates are still highly specialized in agriculture but still have a solid foundation in digital.
Data sharing / Interoperability (T) **Assumption 3**	Large companies dominate the data market, farmers have relatively little influence on this market. Data aggregators are in the hands of these large companies.
Access to technological developments (T) **Assumption 3**	The digital offer is very diversified. There are many different solutions providers and it is complicated for a winegrower to choose the right solution or to fully use the chosen solutions.
Globalization Vs Local (Econ.) **Assumption 5**	The world markets have closed and agricultural goods, and in priority wine, are heavily taxed by some countries. Countries that used to import wine (China, Russia...) have developed their own wine production. The international demand for French wines is decreasing. The demand for local wines reinforces the de-globalization and only the most famous French wines are exported.
Extreme weather events (Env.) **Assumption 5**	Weather conditions remain unpredictable. Extreme events are multiplying without the time to set up protections. Technologies are still struggling to anticipate extreme weather events. More and more winegrowers are quitting to do something else.
Carbon neutrality in viticulture (Env.) **Assumption 3**	The wine industry has reduced its GHG emissions. There is a multiplicity of low-carbon labels at the international level. The consumers get lost in this, which does not allow for a sufficiently high value added for the winegrowers.
Role of public authorities in the adoption of new technologies applied to vineyards (P) **Assumption 5**	Legislation hinders the development of digital technologies (data sharing, precautionary principle...). The weight of the Covid debt prevents any public financing towards companies.

Legislation on the management of the wine industry (P) Assumption 3	The AOC's evolve very slowly, which slows down the acceptance and diffusion of innovations. The international definition of wine is subject to constant change and debate. Coexistence between an industrial viticulture that demands innovations and a terroir viticulture that tends to ignore them.

Scenario 4: the end of an era (Most negative)	
Demographics of the viticultural population (S) Assumption 5	Generational renewal has not taken place. The new generations are resistant to digital technology. The concentration of wine-growing holdings is slowing down because the surface area of vineyards is decreasing. The cost of technology remains high, which slows down the development of digital technology.
Demand for a more environmentally friendly viticulture (S) Assumption 5	The consideration of the environment by the wine industry is stagnating due to the lack of success in promoting the approaches to consumers.
Acceptability of local residents on the contribution of new technologies in the vineyards (S) Assumption 5	The wine industry has turned in on itself following repeated attacks by NGOs. Residents, who are increasingly numerous in the countryside, have taken legal action against farmers who can no longer operate their own automated materials.
Training of the workforce (S) Assumption 5	Digital technology is still not sufficiently taught in agricultural institutions and in continuing education programs. Learning tools have not evolved much and training courses do not attract professionals. Due to a lack of skills, farmers must surround themselves with digital professionals. Access to technological innovations is limited due to a lack of skills.
Data sharing / Interoperability (T) Assumption 5	Data is not shared and the infrastructure for data sharing is poorly developed. Many standards coexist and prevent interoperability. Effective data sharing is difficult.
Access to technological developments (T) Assumption 5	Digital technology has become more complex and expensive. The big digital players have abandoned viticulture, which they have not deemed profitable. The offer in digital technologies has become poorer.
Globalization Vs Local (Econ.) Assumption 5	The world markets have closed and agricultural goods, and in priority wine, are heavily taxed by some countries. Countries that used to import wine (China, Russia...) have developed their own wine production. The international

	demand for French wines is decreasing. The demand for local wines reinforces the de-globalization and only the most famous French wines are exported.
Extreme weather events (Env.) **Assumption 5**	Weather conditions remain unpredictable. Extreme events are multiplying without the time to set up protections. Technologies are still struggling to anticipate extreme weather events. More and more winegrowers are quitting to do something else.
Carbon neutrality in viticulture (Env.) **Assumption 5**	Despite some attempts, the wine industry remains a large emitter of GHGs. No international standard for a low-carbon label has emerged. Consumers reject initiatives that they consider as greenwashing.
Role of public authorities in the adoption of new technologies applied to vineyards (P) **Assumption 5**	Legislation hinders the development of digital technologies (data sharing, precautionary principle...). The weight of the Covid debt prevents any public financing towards companies.
Legislation on the management of the wine industry (P) **Assumption 5**	Strengthening of the AOC's, which reinforces the link to the territory and the environment and prohibits many innovations. The international definition of wine is becoming stricter. The terroir viticulture is now the only one that remains.

5.3 Identify the 2 pathways that will be defined in more detail

The 2 pathways that were used for the second workshop were the second and third scenarios. These correspond to the "better not best" and "worse not worst" scenarios.

5.4 Methodology used to identify pathways

Given the difficulty to find a suitable date for a third workshop to discuss the scenarios and given the time constraint, the WP3 team worked together to find two possible pathways, one with a rather positive future and one with a rather negative future. The 2 pathways were then sent to several participants of the workshop via email. Those participants were then asked to give their opinion about those paths during a short one on one interview.

5.5 Relevant feedback from participants

6 Scenario Narratives

6.1 Name Scenarios

Scenario 1 : technological and carbon neutral French wines

Scenario 2 : environmentally friendly French wines

Scenario 3 : the digital divide

Scenario 4 : the end of an era

6.2 Write the 2 or 3 detailed scenario narratives

6.2.1 environmentally friendly French wines

Paris, October 1st, 2031,

French viticulture is on a new path. During the past decade, a high percentage of winegrowers turned 67 years old and had to retire. As their children didn't want to become winegrowers and pursue the family tradition, most of the retirees decided to sell their wine-growing holding. But, as the price of a hectare of vineyard was still high in many wine producing regions, the number of candidates who could afford such an investment was quite low. Consequently, some were sold to foreign investors or were bought by other winegrowers who were already big enough and looking to expand. This has led to a concentration of the production and consequently the mean size of the wine-growing holdings is more important in 2031 than it was at the beginning of the 2020's. On the positive side, this concentration led to bigger economies of scale and has been a catalyst for the use of digital technologies in many wine producing regions.

Following this wave of retirements, most of the vineyard managers are now younger than a decade ago (the mean age is around 30 years old). This new generation of vineyard managers is also more tech savvy than the previous one. Not only were they born with digital but they also benefited from the rising importance of digital literacy in the middle of the 2020's. The French society understood that digital needed to be taught in schools and universities in order not to lag behind some countries like China that were embracing digital technologies very quickly. Hence, in the middle of the 2020's, the government decided that digital literacy was a national priority and all the universities and schools had to propose a complete course on digital to their students. In the agricultural institutions, students had access to a complete training on digital, data and precision agriculture. They not only learned about agronomy but also about how to use data and algorithms in an efficient way to improve agricultural practices and anticipate diseases, water stress and extreme weather events. Thanks to their hybrid skills, they quickly managed to impose the use of digital technologies in the vineyards. The majority of winegrowers have access to most digital technologies. But even though the price of sensors has dropped, the offering in terms of software and decision support tools is still very diversified and their costs remain expensive. For those who can afford it, it is possible to combine weather stations, soil probes, moisture probes, robots and micro sensors that can monitor the vineyard 24/7. For those who cannot afford to invest in a totally technological viticulture, it is possible to choose simpler digital technologies but using those efficiently implies that the vineyard managers spend more time looking for the right solution and implementing it. But overall, viticulture has made progress using digital technologies. At the beginning of the 2020's precision viticulture was at the "descriptive analytics" stage and was only able to describe what had happened, by using techniques such as yield maps. During the previous decade precision viticulture managed to move forward to "diagnostic analytics", which allowed to look at why something happened. Then it took a leap forward and introduced "predictive analytics", which consisted in forecasting what will happen. Now it has reached the "prescriptive analytics" stage and the vineyards managers of the most prestigious wineries are now able to manage and control what happens in the vineyards. Even though extreme weather events have multiplied in the last years they are more and more predictable thanks to all the digital technologies available on the market. Vineyard managers can now predict extreme weather events like heat or frost a few days in advance and protect the vineyard in consequence.

Winegrowers have also organized themselves and created data cooperatives in the middle of the 2020's. Those data cooperatives oversee collecting and valorising data for all their members. The data cooperatives also ensure the sovereignty of the data.

On the legislative side however, the legislation is still struggling to keep up with the development of digital technologies. Technology seems to be advancing at a rate that the law simply cannot keep up with. The law is at least five years behind developing a technology. The public authorities are sprinkling financial support for the digital transformation of companies without any real effect. This has slowed the adoption of some technologies that could have allowed French viticulture to move forward as a whole.

On the demand side, most of the world markets remain open to the rest of the world. However, after some disagreements and in response to previous economic sanctions from the EU, some countries have decided to impose high customs duties on products imported from Europe, and in particular wine. Following what Russia did a few years ago, some countries have also decided a total embargo on European products. This had an impact on the global demand for French wines. However, France still remains in the top 3 of the wine producing countries.

E-commerce sales of wines now account for around 25% of the total wine sales. Every winery has its own e-commerce site, and the consumer can access easily to all the needed information about the wine they are purchasing.

While the number of extreme weather events has continued to rise steadily since the 2020's, people have become more eco-friendly than ever before. Wine consumers are now looking for wines that are climate-neutral. The shift of wine consumers towards environmentally friendly products has been putting pressure on the wine industry for some years. In reaction, most of the wine players have taken a long-term commitment to sustainability and reducing their impact on the planet. In order to do so they have bet on innovation and digital technologies. After reviewing all parts of the winemaking process that caused carbon to be released the wine industry players started to tackle them one by one. Following the route taken by the most prestigious wineries at the beginning of the 2020's, most of the wineries have now become climate-neutral. Wineries manage to offset their environmental impact by switching to renewable energy sources like wind, reducing or eliminating chemical sprays or using smarter packaging like lighter-weight bottles. Moreover, there is now a fully functional global marketplace on which wineries can sell their extra carbon credits. It is now financially rewarding to produce wine in a climate-positive way. The use of digital technologies like blockchains and NFT's has also improved the transparency of the wine industry. It is now easy for consumers to get information about the way grapes are grown and wine is produced by just scanning a code that is encrypted in the wine label with their smartphone. This transparency with the consumers and the citizens is the reason why local residents accept the use of certain technologies in the vineyards. As the cost of robots has decreased in the last decade, more and more wine growers are using automated robots in their vineyards. Weeding robots can now work automatically at night and have allowed winegrowers to stop using herbicides.

During the last decade, digitalization has improved the way wine is produced in France. At the upstream of the wine chain, it has helped winegrowers adapt to climate change, by allowing them to predict extreme weather events in advance, to manage and control what happens in the vineyards 24/7, to replace herbicides with automated weeding robots and to anticipate diseases more quickly. Wines are also more environmentally friendly than a decade ago and most wineries have managed to become carbon neutral. At the downstream of the wine chain, digitalization has been a catalyst for a better relationship with consumers, it has brought more transparency about the practices and improved the way wine is sold online.

6.2.2 the digital divide

Paris, October 1st, 2031,

At the very beginning of the 2020's, a high percentage of French winegrowers turned 60 years old and started to think about their retirement and the future of their wine-growing holding. But, for most of them, their children didn't want to take over and it was difficult to sell to a younger newcomer mainly because of a lack of interest for this profession but also because the price of a wine-growing holding was too prohibitive. Given the difficulties faced by some players in the wine industry and the decreasing consumption of wine in France, several banks refused to finance such a project for many newcomers. Moreover, in the mid 2020's, the government decided to push the legal age of retirement to 69 years old. Consequently, many of winegrowers who struggled to sell their wine-growing holding decided to continue working. For those who managed to sell their holding, rich foreign investors or important holdings were the only buyers who could afford such an investment. This has led to a two-speed viticulture with, on one side, rich and prestigious wine-growing holdings that could afford to invest in new technologies and develop an industrial production of wine. On the other side, there are winegrowers who were getting old and could not keep up with the speed of development of digital technologies.

Another problem faced by many companies based in France is the relatively poor knowledge of digital in the country. While some countries, like for example China or Estonia, fully embraced the digital revolution in the 2010's, France still hasn't managed to improve the digital literacy of the overall French population. Even though many experts early agreed that digital literacy should have been a national priority, the successive governments haven't succeeded in giving digital literacy the importance it should have had. Therefore, while we are at the beginning of the 2030's French universities and schools still only propose basic courses on digital to their students. In agricultural institutions for example, students are still mostly taught about agronomy. And even though France has been renowned for decades for the expertise in agronomy of its agricultural institutions like INRAE, the country is now behind many European countries in terms of expertise on data management and precision agriculture. Moreover, the French legislation is a hindrance for the development of digital technologies. Technology has been advancing at a rate that the law simply cannot keep up with and the precautionary principle has been one of the greatest obstacles to the development of certain technologies in France. Eleven years after the outbreak of the Covid-19 pandemic, the weight of the Covid debt is still very important in France and the State cannot afford to get into more subsidization of companies who want to develop digital technologies.

In the 2010's, the motto in agriculture was "farmers' data are a gold mine". Twenty years later, the data market is dominated by large companies who collect data from tractors or milking robots. Farmers have a relatively little influence on that market. Their data are often used without their consent and there is no transparency regarding the use of data by third parties. Unfortunately, their lack of digital literacy prevented them from taking the future of data seriously when it was still time to do so.

On the demand side, most of the world markets have now strengthened their borders with the rest of the world. Most countries impose heavy duty taxes on some agricultural goods that come from Europe, especially wine. Moreover, countries that used to import a great number of French wines in the past, like for example Russia and China, are now developing their own wine production. With this deeper focus on national production by some countries, the rise of the demand for local wines and the increasing competition from other wine producing countries, the demand for French wines has decreased in the last decade.

Since the beginning of 2020's, people have finally agreed that climate change is a reality. Therefore, there was a shift of wine consumers towards environmentally friendly products. This has been putting pressure on the wine industry for some years. In reaction, most of the wine players have tried to lower their GHG emissions. Unfortunately, with their poor use of digital, most of them didn't manage to promote their actions and consumers got lost because too many low-carbon labels coexist on the market. Only the most prestigious wineries managed to be transparent about their practices and have managed to benefit from the carbon-neutral strategy they have adopted a few years ago.

While the extreme climate events have multiplied, weather conditions remain unpredictable. The digital technologies are still struggling to anticipate extreme weather events like heatwaves, heavy rains, hailstorms, late frost episodes… More and more vineyards have been affected and many winegrowers have decided to quit because their vineyards deeply suffered several times during the last decade.

There is now a clear digital divide in French viticulture. On the one hand, there is the "digitalized viticulture", with the prestigious wineries who managed to invest and make a good use of digital technologies both at the upstream and at the downstream of the wine chain. They have the capacity to collect a lot of data on all the vineyards they own and to pay large fees to the large companies who dominate the data market to analyse those data. They can also rely on the image of their prestigious wines that are exported all over the world and communicate adequately on all the different social media platforms. With the rise of e-commerce, they now have improved their relationship with their most important customers. On the other hand, there is the "low tech viticulture", that concerns the vast majority of winegrowers who did not manage to make a good use of digital technologies and turned to some kind of "terroir viticulture" instead. They have rejected most of the digital technologies. Even though there is demand for wines that are produced without any use of digital technologies, those winegrowers are often impacted by extreme weather events and their yield has decreased in the last years. They now produce fewer bottle of wines than a decade ago. They mostly sell their wines locally and haven't managed to increase the price of their wines.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

6.3.1 technological and carbon neutral French wines

Paris, October 1st, 2031,

French viticulture is now fully technological, and the French wine industry has reached carbon neutrality.

During the past decade, a high percentage of winegrowers retired. While the number of candidates to take over their wine-growing holdings was inferior to the number of holdings that were on the market, many of them sold to foreign investors or were bought by other winegrowers who were already big enough and looking to expand. This has led to a concentration but at the same time there was a rejuvenation of the managers.

Most of the vineyard managers are now younger but also tech savvy and are very comfortable with data management and precision viticulture. This generation of vineyard managers was born with digital and smartphones, but they also benefited from the rising importance of digital literacy in the middle of the 2020's. In the middle of the 2020's, the French government decided that digital literacy was a national priority and all the universities and schools had to propose a complete course on digital to their students. Therefore, the students who graduated from agricultural institutions have hybrid skills. The new wave of vineyard managers quickly changed the French wine industry, both at the upstream and at the downstream of the chain.

A lot has been done in the last decade about data sharing and data sovereignty. Data sharing is now the norm, and the data market is transparent and fully operational. Winegrowers are trusting the companies who use their data. Moreover, all the decision support tools, and software are fully interoperable. The digital offering has become simpler, user-friendly, and reliable. Most winegrowers have access to most digital technologies and can use them at their full potential. The time of precision agriculture is done, we are now entering the era of ultra-precision agriculture.

The legislation has also rapidly followed the development of digital technologies. For example, the use of automated robot is allowed without human supervision. It is very common to see weeding robots work at night in the vineyards. The wine industry has done a lot in the last years to raise awareness and increase transparency about its practices. The principle "a secret life is a happy life" is now over in the wine industry and the agricultural sector in general. Everybody understood that transparency is also a way to retain consumers. By being transparent about the use of digital technologies and robots, winegrowers are now in peace with the local citizens, who accept that a weeding automated robots works at night because they understood that it was a way to stop using chemical products.

Even though extreme weather events have multiplied in the last years they are more and more predictable thanks to all the digital technologies available on the market. Vineyard managers can now predict extreme weather events like heat or frost a few days in advance and protect the vineyard in consequence.

On the demand side, international markets remain open and agricultural goods can circulate freely without prohibitive custom duties. The demand for French wines remains strong and e-commerce sales of wines now account for around 25% of the total wine sales. Every winery has its own e-commerce site, and the consumer can access easily to all the needed information about the wine they are purchasing. Following the route taken by the most prestigious wineries at the beginning of the 2020's, all the wineries have now become climate-neutral. They use renewable energy sources like wind, they managed to eradicate the use of chemicals, they invented lighter-weight bottles. Moreover, there is now a fully functional global marketplace on which wineries can sell their extra carbon credits. It is financially rewarding to produce wine in a climate-positive way.

During the last decade, digitalization has totally transformed the way wine is produced in France. At the upstream of the wine chain, it has helped winegrowers adapt to climate change, by allowing them to predict extreme weather events in advance, to manage and control what happens in the vineyards 24/7, to replace herbicides with automated weeding robots. French wines are now all carbon neutral. At the downstream of the wine chain, digitalization has been a catalyst for a better relationship with consumers, it has brought more transparency about the practices and improved the way wine is sold online.

6.3.2 the end of an era

Paris, October 1st, 2031,

During the past decade, a high percentage of winegrowers had to retire. Most of them decided to sell their wine-growing holding but the younger generation could not afford to buy. Some of the holdings were sold to foreign investors, others were bought by other ageing winegrowers, and some didn't find a buyer and had to convert to other crops. The surface dedicated to grape is decreasing year after year in France.

During the first half of the 2020's, the wine industry tried to get more environmentally friendly and invested in new technologies to reduce its GHG emissions. Unfortunately, wineries did not manage to promote all those efforts to the consumers. The fact that no international standard for a low carbon label emerged during the past decade made it more difficult to show progress and consumers mainly reject most of the initiatives that they see as greenwashing.

Moreover, the world markets have gradually closed during the last decade and agricultural goods, and especially wine, are heavily taxed by some countries. In addition, some countries that used to be major importers of French wines have also developed their own wine production. This has led to a decreasing demand for French wines at the global level. Only the most famous French wines are exported.

The use of digital technologies in the wine industry is low for many reasons. Firstly, they have become more complex and expensive. Secondly, the education system has not evolved enough in the last decade and students are not trained on the use of digital technologies. Therefore, there is a global lack of skills that limits the access to digital technologies. To bypass this lack of skills, some rich winegrowers tried to work with digital professionals. But, as the infrastructure for data sharing is poorly developed and the winegrowers are reluctant to share their data, they didn't manage to make an effective use of digital technologies. Even though they had the money to buy weeding robots, the ones who tried faced the rejection of those technologies by the local residents who didn't hesitate to go to justice to prevent them to use such technology. Finally, extreme weather events have multiplied in the last decade, but digital technologies are still struggling to anticipate them early enough. After several years of bad grape harvests more and more winegrowers are quitting to do something else.

The low digitalization has had a very negative impact on the French wine industry. Being unable to make good use of digital technologies, many winegrowers didn't manage to keep the quality that has made French wines renowned all over the world for decades. Compare to countries who bet on digitalization, France is now a small producer of wine.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.17 France (Agronov)

SCENARIO WORKSHOPS

AGRONOV, FRANCE

02/02/2022

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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Introduction

This report describes the scenario workshops in the Living Lab Agronov in France.

1. Living lab summary

1.1 Name of LL

Agronov

1.2 Brief summary of LL

Agronov is an agricultural cluster (LL) localized in the Bourgogne Franche-Comté Region in the East of France, dedicated to agro-ecological transition. Agronov is an innovation network serving agro-ecology. Composed of 61 members, 80% of whom are companies (incl. start-ups), its mission is to pool skills within an ecosystem also associating consular actors, professional agricultural organizations, but also research institutes and training organizations. These missions aim to understand the needs of actors in the field, in order to promote innovation through experimentation and transfer mechanisms within the various sectors of agriculture in the Bourgogne Franche-Comté region. Bourgogne Franche-Comté (BFC) is an agricultural region characterized by great culture diversification (animal versus vegetal) and two main parts (plains versus mountains), high quality with many labeling products and an important urban area (Dijon).

1.3 LL participants

The first workshop has been coordinated by Agronov. The participants were all involved in the agribusiness sector and/or digital technologies. They all came from the Bourgogne Franche-Comté Region.

After the first workshop the participants were asked if they were willing to participate to the second one. Even though most of them expressed their interest, no suitable date came up and we had to do the second workshop with only a few of the participants. We also had several one to one interviews in order to complete the task.

1.4 Timing of Scenario Planning (WP3) workshops

The workshops for the WP3 scenario planning were held on January 21 st and individual interviews were held during the week of January 31st 2022. Due to the rise of the Omicron variant and the restrictions imposed by the French government, the workshops and individual interviews took place online.

2. Scenario question

2.1 Draft scenario question

"What would be the contributions of digital technology to accompany the reduction of synthetic inputs by 2031?"

2.2 Finalised Scenario question

"What will be the contributions of digital technology to accompany the reduction of inputs in agriculture by 2031?"

2.3 Methodology used to finalise scenario question

The scenario question has been elaborated in accordance with the WP2 conclusions.

During the WP3 workshop the scenario question was provided to the participants through a Powerpoint presentation. We ask them their opinion during the workshop.

2.4 Relevant feedback on scenario question from participants

The participants agreed that the scope of the question served well the purpose of the workshop but they wanted two changes.

Firstly, they thought that the use of the verb “would” was too narrow. As they are convinced that digital technology will play a role in the future, they preferred to go with the verb “will”.

Secondly, they thought that focusing only on “synthetic inputs” was too restrictive because organic agriculture will also have to reduce its use of inputs like copper for example. So they decided that it was better to use the generic term “inputs”.

Finally, they decided to add the term “agriculture” to be more specific.

3. Relevant past events

3.1 List of relevant past events

- Until today, data is mostly collected through dedicated networks and processed by technical institutes as part of scientific work or for experiments in chambers of agriculture.
- The landscape and the organization of agro-supply actors are shifting at the same time as the needs of the agricultural world are diversifying: this requires responsiveness and flexibility.

- The separation between sales of agricultural inputs and consulting/farm advisory services is effective since 2021.
- The two consecutive Ecophyto plans had mitigated results
- The Farm to fork strategy has an objective to decrease the use of chemical pesticides by 50% by 2030 and at least 20 % for the use of fertilizers.

3.2 Description past event activity

The selection of past event activity was done according to the work that was done for the WP2. The list was selected in order to provide some key points about the development of viticulture and the use of digital by the wine industry at the upstream and at the downstream of the value chain.

3.3 Relevant feedback from participants

No specific feedback.

4. Drivers Of Change (DOC)

4.1 List initial set of DOC

DOMAIN	DOC			
Social	Demographics of the agricultural population	Societal pressure on the use of plant protection products	Societal expectations for an agriculture that is more respectful of the environment and animal welfare	Acceptability of local residents on the contribution of new technologies (drones, night work of robots...)
Technological	Robotics	Connectivity in the rural areas	Traceability	Data sharing/Interoperability
Economic	International competitiveness	Workforce		
Environmental	Extreme weather events	Water scarcity	Soil erosion	
Political	Legislation on the use of plant protection products	Legislation on new technologies applied to agriculture (drone, robots...)		

4.2 List selected DOC

DOMAIN	DOC			
Social	Societal expectations for a more environmentally friendly agriculture	Training	Evolution of agricultural advisory services	
Technological	Data sharing / Interoperability/Sovereignty	Robotics		
Economic	Economic valuation of agroecological labels	Competitiveness and economic relevance of the proposed solutions		
Environmental	Extreme weather events	Pressure on natural resources (water, soil, biodiversity)		
Political	Right to experiment on a certain number of practices	Payments for Environmental Services (PES)		

4.3 Describe methodology to select DOC

The initial list of drivers of change (DOC) were selected by the researchers leading the workshop. These drivers were based on the list of DOC provided by the WP3 team and supplemented with additional DOC based on the information gathered in the WP2 research and workshop.

Participants were given the chance to change the list of DOC during the WP3 workshop. They have been told at the beginning of the workshop that if they identified other relevant DOCs, these could be added to the scenarios during the process.

For each domain of STEEP a set of drivers was chosen.

4.4 Relevant feedback from participants

Several drivers were slightly adjusted by the participants during the workshop. This allowed us to combine several of the drivers, as well as to provide nuance or additional aspects to the existing drivers.

The participants decided to exclude some of the drivers from the list :

- Demographics of the agricultural population
- Acceptability of local residents on the contribution of new technologies
- International competitiveness

- Workforce
- Legislation on plant protection products
- Legislation on new technologies applied to agriculture

The participants also added new drivers that seemed important to them.

For the drivers “societal pressure on the use of plant protection products” and “societal expectation for an agriculture that is more respectful of the environment and animal welfare they preferred to combine them into a new driver called “social expectations for a more environmentally friendly agriculture”

For the drivers “water scarcity” and “soil erosion” they preferred to combine them into a new driver called “pressure on natural resources”.

For the driver “Data sharing” they asked to add the problem of sovereignty and the driver was renamed “Data sharing / Interoperability/Sovereignty”.

The new drivers they added were :

- Right to experiment on a certain number of practices
- Payments for Environmental Services
- Evolution of agricultural advisory services
- Economic valuation of agroecological labels
- Competitiveness and economic relevance of the proposed solutions

5. Matrix

5.1 Matrix description

The matrix provides the DOC that we identified in the previous chapter with 3-4 assumptions for each driver for the next ten years. Given the time constraint we had for the second workshop, we provided template assumptions for some of the DOC, both to better explain to the participants what was expected from them and in order to be able to keep within the time assigned for this task. We reviewed all the DOC with the participants. They completed several of the assumptions we provided. For the DOC with no template assumptions, the participants provided all of the assumptions themselves.

STEEP DOC	Assumption 1 Best	Assumption 2	BAU Assumption 3	Assumption 4	Assumption 5 Worst
Societal expectations for a more environmentally friendly agriculture (S)	All farms have environmental and societal certifications and are able to promote them to consumers. The approaches are complete and systemic, with a global vision of the challenges facing agriculture, and the digital tools make it possible to make decisions based on the various	The consumer understands and accepts that some plant protection products are necessary for agricultural production and health safety. Some effective products can still be used by farmers and farmers are responding to societal expectations with respectful practices.	The consideration of the environment by the agricultural sector is progressing. However, it remains difficult to convert all French farms because of technical and economic obstacles. It is still complicated to promote the certifications to consumers.	The consideration of the environment by the agricultural sector is stagnating due to the lack of success in promoting the approaches to consumers.	The extreme focus of consumers/citizens on environmental issues has led to their rejection of digital technologies (precision agriculture, ecommerce...).

	dimensions of sustainable development, and not just on the reduction of inputs.				
Training (S)	All farmers and farm advisors are trained, whether it be on farming practices, proper use of inputs, and digital technologies. There are many online training courses to gain knowledge. These training courses remove the technical and technological obstacles to the agro-ecological transition.		All farmers and farm advisors are trained but have only basic knowledge of farming practices, proper use of inputs and digital technologies. The trainings provide a medium level of knowledge for the agroecological transition.	The training courses do not integrate the agro-ecological aspects in their courses and the agricultural profession finds itself helpless to face the hazards of production.	The training of farmers and advisors is not at the level needed to enable them to take into account the environment and society's expectations. Moreover, there a reticence towards automation/robotization of agriculture and a lack of knowledge of agricultural practices by the general public.
Evolution of agricultural advisory services (S)	The farm advisors have a perfect command of digital tools and technologies. They are able to accompany farmers in the field and		Farm advisors have partially mastered digital tools and technologies. Although many digital solutions exist, there		Digital solutions are rejected by the entire profession and therefore by the agricultural advisory services, which are unable to develop them. The means are not gathered to allow farmers to benefit from an individualized

	farmers are able to pay for individualized advice. They use their knowledge to the benefit of the agricultural profession, which embraces this change and values them. The model is coherent.		are barriers to their use by both advisors and farmers. The "new generation" technical advice is only addressed to a part of the farmers. There are still great disparities in the support given to farmers, who lack advice in the field, and in the practices used to reduce inputs.		advisory service on the field to face the change and the reduction of phytosanitary solutions. The profession of advisor is disappearing and farmers are trained on the basis of unrecognized knowledge and practice without outside help.
Data sharing / Interoperability/Sovereignty (T)	Data sharing is the norm. The data market is transparent and operational. Some of the data is freely available in open data. All the Decision Support Tools and softwares are interoperable. Farmers retain ownership	Farmers have become aware of the importance of sharing and having their data analyzed to get advice. They have organized themselves and created data cooperatives with the aim of valorizing and	Large companies (large agricultural equipment manufacturers, large agricultural cooperatives) dominate the data market, farmers have relatively little influence on this market. Data		Data is not shared and the infrastructure for data sharing is poorly developed. Many standards coexist and prevent interoperability. Effective data sharing is difficult. Farmers are dispossessed of their data and do not benefit from it.

	of their data and benefit from it.	maintaining the sovereignty of the data collected on their farms. The interoperability of the Decision Support Tools and softwares is not standardized and requires a technical or financial investment.	aggregators are in the hands of these large companies.		
Robotics (T)	Autonomous robots have been democratized thanks to a decrease in their cost, a better social acceptance and the evolution of the law. They provide technological means to reduce inputs and are adapted to all types of production and protection products. They free up human time for complex operations.		The cost of autonomous robots has dropped, but not enough for them to be democratized in farms. Algorithms to allow robots to reduce inputs are very complicated to set up and to adapt to each context. Only large farms use them. The law has become more flexible but the social acceptance of robots		The cost of robots is still too high. The development of robots is focused on the issue of labor but not on the reduction of inputs. The law is still too restrictive on the autonomy of robots. The social acceptance of robots is contested. In many countries competing with France, the use of autonomous robots has become the norm. French agriculture is losing momentum because it has not been able to accept the change.

			remains complicated.		
Economic valuation of agroecological labels (Econ.)	The agro-ecological label finds its place among the recognitions and brands of quality. It makes sense for the consumer, who is ready to pay more for a premium and environmentally friendly product. Digital technology provides clear and precise communication on the impact of the product, its origin and the differences from other labels, so that the consumer can make an informed choice.		There are a few agroecological labels that coexist. However, because of their limited legibility and the high cost differential, agroecological labelled products remain a niche.		The agroecology label brings confusion in the messages to the consumer. Due to a lack of clarity and interest, consumers are not willing to pay a premium for agroecology labeled products.
Competitiveness and economic relevance of the proposed solutions (Econ.)	The digital solutions offered meet the needs of farmers and manufacturers. France has become	The digital solutions available on the market are effective but remain fragmented. Disparities	The digital solutions available on the market remain fragmented and costly. The added value of the		The proposed digital solutions are too costly or do not bring enough value to the market. They are not efficient and do not allow the French food industry to be

	a world leader in AgTech. They are proposed at an acceptable cost for the farmers and bring real alternatives for the reduction of inputs.	between the different sectors and production systems remain significant	solutions is not objectified. The disparities between the different sectors and production systems remain significant.		competitive. They even make the processes more cumbersome and increase the workload of the farmer for an extreme traceability without added value for him.
Extreme weather events (Env.)	Extreme weather conditions are becoming more and more predictable. There are new technological and agricultural solutions that are preventive or curative and that allow farmers to reduce their impacts.		Extreme weather conditions remain difficult to predict. There are new technological solutions that allow to adapt but they remain expensive and not very usable by farmers (regulatory constraints. ..).	The numerous climatic hazards make appear on the market new polluting solutions or with still unknown effects of fight and protection .	Extreme weather conditions remain unpredictable. Technologies are still struggling to anticipate these events. The solutions are not relevant. Agricultural productions are more and more impacted.
Pressure on natural resources (water, soil, biodiversity) (Env.)	Digital technologies help reduce the pressure on natural resources and improve their regeneration. They are used by all the players		Digital technologies help to reduce the pressure on natural resources. However, they are being adopted to varying degrees depending		Digital technologies are not helping to reduce the pressure on natural resources. Agricultural yields are declining, soils have become depleted and biodiversity is at risk.

	in the agri-food sector.		on the sector and the actors. Nevertheless, agricultural yields are decreasing.		
Right to experiment on a certain number of practices (P)	Farmers, in connection with agricultural actors, are allowed to experiment and increase their skills in a local and situational way on the levers to reduce inputs. Farmers can report their observations and experiments on digital sharing platforms. The academic research takes these results into account and develops solutions that can be used in the field.		Farmers do not have regulatory approval to conduct their experiments. But the experimental approach taken by farmers is beginning to be taken into account by The academic research. Tools are being developed to identify the benefits. Digital sharing platforms are limited.		Regulations related to experimentation are becoming stricter and the evolution of practices is limited. The platforms do not encourage peer-to-peer feedback. The observations and experiments made in the field by farmers are not taken into account.
Payments for Environmental Services (PES) (P)	Aid for services rendered to the environment has been increased and allows	Aid for services rendered to the environment is no longer necessary	The aid for services rendered is insufficient and only partially allows the sectors to	The aids being conditioned to the service rendered discourage the	The aid for services rendered does not allow the sectors to invest in digital solutions to better take into account the environment.

	industries to invest in digital solutions to better take into account the environment. The services provided by farmers are easily quantifiable and inalienable thanks to digital tools. The terms of the aid condition largely support the transition on farms	because the efficiency of new digital tools has made it possible to dispense with it.	invest in digital solutions to better take the environment into account. The services provided by farmers are still difficult to quantify. The condition of the aid further widens the gap between farmers already engaged in the agro-ecological transition and those who have fallen behind in the evolution of their practices.	farmers and increase the difficulties of installation of new farmers.	The services provided by farmers are not quantifiable. The condition of the aid makes new farms disappear which are not profitable without aid.

5.2 Define 4 pathways/scenarios selected

We have defined 4 different scenarios.

Scenario 1 is the utopia scenario. It corresponds to the very left column of the morphological box.

Scenario 2 is the "better not best" scenario.

Scenario 3 is the "worse not worst" scenario

Scenario 4 is the dystopia scenario. It corresponds to the very right column of the morphological box.

Scenario 1: zero chemical inputs	
Societal expectations for a more environmentally friendly agriculture (S) Assumption 1	All farms have environmental and societal certifications and are able to promote them to consumers. The approaches are complete and systemic, with a global vision of the challenges facing agriculture, and the digital tools make it possible to make decisions based on the various dimensions of sustainable development, and not just on the reduction of inputs.
Training (S) Assumption 1	All farmers and farm advisors are trained, whether it be on farming practices, proper use of inputs, and digital technologies. There are many online training courses to gain knowledge. These training courses remove the technical and technological obstacles to the agro-ecological transition.
Evolution of agricultural advisory services (S) Assumption 1	The farm advisors have a perfect command of digital tools and technologies. They are able to accompany farmers in the field and farmers are able to pay for individualized advice. They use their knowledge to the benefit of the agricultural profession, which embraces this change and values them. The model is coherent.
Data sharing / Interoperability/Sovereignty (T) Assumption 1	Data sharing is the norm. The data market is transparent and operational. Some of the data is freely available in open data. All the Decision Support Tools and softwares are interoperable. Farmers retain ownership of their data and benefit from it.
Robotics (T) Assumption 1	Autonomous robots have been democratized thanks to a decrease in their cost, a better social acceptance and the evolution of the law. They provide technological means to reduce inputs and are adapted to all types of production

	and protection products. They free up human time for complex operations.
Economic valuation of agroecological labels (Econ.) Assumption 1	The agro-ecological label finds its place among the recognitions and brands of quality. It makes sense for the consumer, who is ready to pay more for a premium and environmentally friendly product. Digital technology provides clear and precise communication on the impact of the product, its origin and the differences from other labels, so that the consumer can make an informed choice.
Competitiveness and economic relevance of the proposed solutions (Econ.) Assumption 1	The digital solutions offered meet the needs of farmers and manufacturers. France has become a world leader in AgTech. They are proposed at an acceptable cost for the farmers and bring real alternatives for the reduction of inputs.
Extreme weather events (Env.) Assumption 1	Extreme weather conditions are becoming more and more predictable. There are new technological and agricultural solutions that are preventive or curative and that allow farmers to reduce their impacts.
Pressure on natural resources (water, soil, biodiversity) (Env.) Assumption 1	Digital technologies help reduce the pressure on natural resources and improve their regeneration. They are used by all the players in the agri-food sector.
Right to experiment on a certain number of practices (P) Assumption 1	Farmers, in connection with agricultural actors, are allowed to experiment and increase their skills in a local and situational way on the levers to reduce inputs. Farmers can report their observations and experiments on digital sharing platforms. The academic research takes these results into account and develops solutions that can be used in the field.
Payments for Environmental Services (PES) (P) Assumption 1	Aid for services rendered to the environment has been increased and allows industries to invest in digital solutions to better take into account the environment. The services provided by farmers are easily quantifiable and inalienable thanks to digital tools. The terms of the aid condition largely support the transition on farms

Scenario 2 : on the right path	
Societal expectations for a more environmentally friendly agriculture (S)	The consideration of the environment by the agricultural sector is progressing. However, it remains difficult to

Assumption 3	convert all French farms because of technical and economic obstacles. It is still complicated to promote the certifications to consumers.
Training (S) Assumption 1	All farmers and farm advisors are trained, whether it be on farming practices, proper use of inputs, and digital technologies. There are many online training courses to gain knowledge. These training courses remove the technical and technological obstacles to the agro-ecological transition.
Evolution of agricultural advisory services (S) Assumption 1	The farm advisors have a perfect command of digital tools and technologies. They are able to accompany farmers in the field and farmers are able to pay for individualized advice. They use their knowledge to the benefit of the agricultural profession, which embraces this change and values them. The model is coherent.
Data sharing / Interoperability/Sovereignty (T) Assumption 2	Farmers have become aware of the importance of sharing and having their data analyzed to get advice. They have organized themselves and created data cooperatives with the aim of valorizing and maintaining the sovereignty of the data collected on their farms. The interoperability of the Decision Support Tools and softwares is not standardized and requires a technical or financial investment.
Robotics (T) Assumption 3	The cost of autonomous robots has dropped, but not enough for them to be democratized in farms. Algorithms to allow robots to reduce inputs are very complicated to set up and to adapt to each context. Only large farms use them. The law has become more flexible but the social acceptance of robots remains complicated.
Economic valuation of agroecological labels (Econ.) Assumption 1	The agro-ecological label finds its place among the recognitions and brands of quality. It makes sense for the consumer, who is ready to pay more for a premium and environmentally friendly product. Digital technology provides clear and precise communication on the impact of the product, its origin and the differences from other labels, so that the consumer can make an informed choice.
Competitiveness and economic relevance of the proposed solutions (Econ.) Assumption 1	The digital solutions offered meet the needs of farmers and manufacturers. France has become a world leader in AgTech. They are proposed at an acceptable cost for the farmers and bring real alternatives for the reduction of inputs.

Extreme weather events (Env.) **Assumption 3**	Extreme weather conditions remain difficult to predict. There are new technological solutions that allow to adapt but they remain expensive and not very usable by farmers (regulatory constraints...).
Pressure on natural resources (water, soil, biodiversity) (Env.) **Assumption 3**	Digital technologies help to reduce the pressure on natural resources. However, they are being adopted to varying degrees depending on the sector and the actors. Nevertheless, agricultural yields are decreasing.
Right to experiment on a certain number of practices (P) **Assumption 1**	Farmers, in connection with agricultural actors, are allowed to experiment and increase their skills in a local and situational way on the levers to reduce inputs. Farmers can report their observations and experiments on digital sharing platforms. The academic research takes these results into account and develops solutions that can be used in the field.
Payments for Environmental Services (PES) (P) **Assumption 1**	Aid for services rendered to the environment has been increased and allows industries to invest in digital solutions to better take into account the environment. The terms of the aid condition largely support the transition on farms

Scenario 3: target missed	
Societal expectations for a more environmentally friendly agriculture (S) **Assumption 4**	The consideration of the environment by the agricultural sector is stagnating due to the lack of success in promoting the approaches to consumers.
Training (S) **Assumption 5**	The training of farmers and advisors is not at the level needed to enable them to take into account the environment and society's expectations. Moreover, there a reticence towards automation/robotization of agriculture and a lack of knowledge of agricultural practices by the general public.
Evolution of agricultural advisory services (S) **Assumption 3**	Farm advisors have partially mastered digital tools and technologies. Although many digital solutions exist, there are barriers to their use by both advisors and farmers. The "new generation" technical advice is only addressed to a part of the farmers. There are still great disparities in the support given to farmers, who lack advice in the field, and in the practices used to reduce inputs.

Data sharing / Interoperability/Sovereignty (T) **Assumption 3**	Large companies (large agricultural equipment manufacturers, large agricultural cooperatives) dominate the data market, farmers have relatively little influence on this market. Data aggregators are in the hands of these large companies.
Robotics (T) **Assumption 5**	The cost of robots is still too high. The development of robots is focused on the issue of labor but not on the reduction of inputs. The law is still too restrictive on the autonomy of robots. The social acceptance of robots is contested. In many countries competing with France, the use of autonomous robots has become the norm. French agriculture is losing momentum because it has not been able to accept the change.
Economic valuation of agroecological labels (Econ.) **Assumption 3**	There are a few agroecological labels that coexist. However, because of their limited legibility and the high cost differential, agroecological labelled products remain a niche.
Competitiveness and economic relevance of the proposed solutions (Econ.) **Assumption 3**	The digital solutions available on the market remain fragmented and costly. The added value of the solutions is not objectified. The disparities between the different sectors and production systems remain significant.
Extreme weather events (Env.) **Assumption 5**	Extreme weather conditions remain unpredictable. Technologies are still struggling to anticipate these events. The solutions are not relevant. Agricultural productions are more and more impacted.
Pressure on natural resources (water, soil, biodiversity) (Env.) **Assumption 5**	Digital technologies are not helping to reduce the pressure on natural resources. Agricultural yields are declining, soils have become depleted and biodiversity is at risk.
Right to experiment on a certain number of practices (P) **Assumption 3**	Farmers do not have regulatory approval to conduct their experiments. But the experimental approach taken by farmers is beginning to be taken into account by the academic research. Tools are being developed to identify the benefits. Digital sharing platforms are limited.
Payments for Environmental Services (PES) (P) **Assumption 3**	The aid for services rendered is insufficient and only partially allows the sectors to invest in digital solutions to better take the environment into account. The services provided by farmers are still difficult to quantify.

	The condition of the aid further widens the gap between farmers already engaged in the agro-ecological transition and those who have fallen behind in the evolution of their practices.

Scenario 4: zero digital inputs	
Societal expectations for a more environmentally friendly agriculture (S) **Assumption 5**	The extreme focus of consumers/citizens on environmental issues has led to their rejection of digital technologies (precision agriculture, ecommerce...).
Training (S) **Assumption 5**	The training of farmers and advisors is not at the level needed to enable them to take into account the environment and society's expectations. Moreover, there a reticence towards automation/robotization of agriculture and a lack of knowledge of agricultural practices by the general public.
Evolution of agricultural advisory services (S) **Assumption 5**	Digital solutions are rejected by the entire profession and therefore by the agricultural advisory services, which are unable to develop them. The means are not gathered to allow farmers to benefit from an individualized advisory service on the field to face the change and the reduction of phytosanitary solutions. The profession of advisor is disappearing and farmers are trained on the basis of unrecognized knowledge and practice without outside help.
Data sharing / Interoperability/Sovereignty (T) **Assumption 5**	Data is not shared and the infrastructure for data sharing is poorly developed. Many standards coexist and prevent interoperability. Effective data sharing is difficult. Farmers are dispossessed of their data and do not benefit from it.
Robotics (T) **Assumption 5**	The cost of robots is still too high. The development of robots is focused on the issue of labour but not on the reduction of inputs. The law is still too restrictive on the autonomy of robots. The social acceptance of robots is contested. In many countries competing with France, the use of autonomous robots has become the norm. French agriculture is losing momentum because it has not been able to accept the change.
Economic valuation of agroecological labels (Econ.) **Assumption 5**	The agroecology label brings confusion in the messages to the consumer. Due to a lack of clarity and interest, consumers are not willing to pay a premium for agroecology labelled products.

Competitiveness and economic relevance of the proposed solutions (Econ.) **Assumption 5**	The proposed digital solutions are too costly or do not bring enough value to the market. They are not efficient and do not allow the French food industry to be competitive. They even make the processes more cumbersome and increase the workload of the farmer for an extreme traceability without added value for him.
Extreme weather events (Env.) **Assumption 5**	Extreme weather conditions remain unpredictable. Technologies are still struggling to anticipate these events. The solutions are not relevant. Agricultural productions are more and more impacted.
Pressure on natural resources (water, soil, biodiversity) (Env.) **Assumption 5**	Digital technologies are not helping to reduce the pressure on natural resources. Agricultural yields are declining, soils have become depleted and biodiversity is at risk.
Right to experiment on a certain number of practices (P) **Assumption 5**	Regulations related to experimentation are becoming stricter and the evolution of practices is limited. The platforms do not encourage peer-to-peer feedback. The observations and experiments made in the field by farmers are not taken into account.
Payments for Environmental Services (PES) (P) **Assumption 5**	The aid for services rendered does not allow the sectors to invest in digital solutions to better take into account the environment. The services provided by farmers are not quantifiable. The condition of the aid makes new farms disappear which are not profitable without aid.

5.3 Identify the 2 pathways that will be defined in more detail

The 2 pathways that were used for the second workshop were the second and third scenarios. These correspond to the “better not best” and “worse not worst” scenarios.

5.4 Methodology used to identify pathways

Given the difficulty to find a suitable date for a third workshop to discuss the scenarios and given the time constraint, the WP3 team worked together to find two possible pathways, one with a rather positive future and one with a rather negative future. The 2 pathways were then presented to several participants of the first workshop via email. Those participants were then asked to give their opinion about those paths during several one on one interviews.

5.5 Relevant feedback from participants

6. Scenario Narratives

6.1 Name Scenarios

Scenario 1 : zero chemical inputs

Scenario 2 : on the right path

Scenario 3 : target missed

Scenario 4 : zero digital inputs

6.2 Write the 2 or 3 detailed scenario narratives

6.2.1 on the right path

Paris, October 1st, 2031,

Social expectations regarding healthy food and the preservation of natural resources and biodiversity have become increasingly clear at the European level during the past decade. There was a growing awareness in society around the sustainability of food production, and particularly the sustainable use of pesticides. The European Commission addressed these societal concerns under the European Green Deal, and in particular under its “Farm to Fork” and Biodiversity strategies. The "Farm to fork" strategy that was adopted in 2025 had two ambitious goals regarding inputs in agriculture: a 50 % reduction in the overall use and risk of chemical pesticides and in the use of more hazardous pesticides by 2030 and at least 20 % reduced use of fertilizers by 2030. To achieve these two goals, profound and disruptive changes in the entire agri-food sector were necessary.

6 years later, France hasn’t yet reached the objectives set by the Farm to fork strategy but is on the right path to reach them in 2 or 3 years. It has already managed to reduce the use of pesticides by at least 40%. But there are still some bumps in the road.

The impulse actually started in the 2010’s with the Ecophyto plan. The idea to lower the use of chemical pesticides was there but the solutions to do so were not ready yet. The two consecutive Ecophyto plans had mitigated results. At the beginning of the 2020’s, the publication of the Farm to fork strategy, with its ambitious objective on the reduction of the use of chemical pesticides, created a shockwave in the French agricultural sector. In order to reduce the use of pesticides, a paradigm shift was needed. This shift consisted in moving from curative crop protection to means other than chemical pesticides implemented to prevent the appearance or development of pests within the crops. All these had to be based on agroecological principles. To do so, many experts insisted on the importance of training farmers and farm advisors not only on agronomy but also on the proper use of inputs and on digital technologies. Therefore, in agricultural institutions students were given access to a complete training on digital, data and precision agriculture. They not only learned about agronomy but also about how to use data and algorithms in an efficient way to improve agricultural practices, lower the use of inputs, anticipate diseases, water stress and extreme weather events. For the older generation of farmers, online courses have been developed and there are now many online courses available to improve their practices and help them reduce the use of inputs. The development of those courses has removed the technical and technological obstacles to the agro-ecological transition. Nowadays, the consideration of the environment by the agricultural sector has progressed compared to a decade ago. However, it remains difficult to convert all French farms because French agriculture is very heterogenous in terms of production and land use. Therefore, there are still some technical and economic obstacles in some areas.

In 2021, the law imposed the separation of sales and advisory activities for all uses (agricultural or not) of plant protection products. The initial objective was to offer two different types of advice to farmers: on the one hand, a strategic, multi-year, individualized advice; on the other hand, a specific advice, meeting a specific need. The daily activity of farm advisors has evolved, it is now more focused on advice than on the sale of inputs. Thanks to the training they were given during the last five years they now have a perfect command of digital tools and technologies. They can accompany farmers in their efforts to improve their agro-ecological performance. Farmers are able to pay for such an individualized advice.

Moreover, the digital solutions that have been developed by startups and digital players meet the needs of farmers and manufacturers. They are proposed at an acceptable cost for the farmers and bring real alternatives for the reduction of inputs. Unfortunately, the full interoperability of the Decision Support Tools and softwares is not yet standardized, there is still room for improvement on that matter. France is now a world leader in AgTech and several French AgTech startups have become unicorns during the last decade. At the beginning of the 2020's precision agriculture was at the "descriptive analytics" stage and was only able to describe what had happened, by using techniques such as yield maps. During the previous decade precision agriculture managed to move forward to "diagnostic analytics", which allowed to look at why something happened. Then it took a leap forward and introduced "predictive analytics", which consisted in forecasting what will happen. Now it has reached the "prescriptive analytics" stage and the farmers are now able to manage and control what happens in their field.

Following the development of AgTech startups, farmers have changed the way they look at data. After several years of dithering, they have become aware of the importance of sharing and having their farm data analyzed to get advice in return. They have organized themselves and have decided that their data should be co-operativised. Thus, they created data cooperatives that are independent from their agricultural cooperatives. Those data cooperatives give farmers the ability to control their data and share it with those they want. They are helping farmers control and manage their data and do so primarily through the provision of a safe and secure data repository. The farmer members of the data cooperatives own their data and are sovereign about their own data.

Automation has also improved during the last decade. The law has become more flexible on the use of automated robots in agriculture and it is now allowed to have a robot work without human supervision. Even though the social acceptance of robots remains complicated in some areas, it is now common to encounter a farmer who uses an AI-driven weeder to reduce the need for herbicides. But, if the cost of autonomous robots has dropped compared to the beginning of the 2020's, there are still some smaller farms who cannot afford such an investment. Nevertheless, autonomous robots have replaced humans for some repetitive and non complex tasks. But, for many years the development of automation has been based mainly on replacing humans for some tasks, not on reducing or suppressing inputs in agriculture. Therefore, the algorithms built to use robots to reduce inputs are very still complicated to set up and to adapt to each context. More research on data and machine learning is needed to improve pest detection, monitoring practices, and crop health.

In order to promote agroecology, a common label has been created at the European level. This label has found its place among the recognitions and brands of quality. It makes sense for the consumer who wants to buy products that are pesticides free. In return the consumer is ready to pay more for environmentally friendly products. With the help of digital technologies like blockchain, the consumer has access to clear and precise information on the impact of the product, its origin and the differences from other labels.

If digital technologies have helped reduce the use of agricultural inputs, they still fail to predict extreme weather conditions adequately. Of course, with there are brand new technological solutions that are developed and allow farmers to better adapt to weather conditions. But due to the important research and development costs, they remain expensive and not very usable by farmers. What digital technologies have also managed to improve is the pressure on natural resources. There are now many sensors in the soil or on the plants that collect huge amounts of data and precision irrigation and soil management have allowed to use natural resources more efficiently. However, those technologies are being adopted to varying degrees depending on the sector and the actors.

What has also been a game changer for the reduction of the use of agricultural inputs is the fact that farmers have been allowed to experiment and increase their skills in a local and situational way on the levers to reduce inputs. Some farms have started transitioning toward a strong reduction in pesticides at the beginning of the 2020’s. But the academic research was still focused on a top-down approach at that time. Nowadays, it is easier for those experimenting farmers to disseminate their innovative practices. They can report their observations and experiments on digital sharing platforms and exchange with other farmers, farm advisors and scientists. Open innovation is everywhere and the boundaries between scientists and practitioners have blurred. With this paradigm shift and a bottom-up approach, the academic research takes these results into account and develops solutions that can be used in the field.

Moreover, aid for services rendered to the environment has been increased and allows industries to invest in digital solutions to better consider the environment. The terms of the aid condition largely support the transition on farms.

6.2.2 target missed

Paris, October 1st, 2031,

Social expectations regarding healthy food and the preservation of natural resources and biodiversity have become increasingly clear at the European level during the past decade. There was a growing awareness in society around the sustainability of food production, and particularly the sustainable use of pesticides. The European Commission addressed these societal concerns under the European Green Deal, and in particular under its “Farm to Fork” and Biodiversity strategies. The "Farm to fork" strategy that was adopted in 2025 had two ambitious goals regarding inputs in agriculture: a 50 % reduction in the overall use and risk of chemical pesticides and in the use of more hazardous pesticides by 2030 and at least 20 % reduced use of fertilizers by 2030. To achieve these two goals, profound and disruptive changes in the entire agri-food sector were necessary.

In the 2010's, the two consecutive Ecophyto plans had an objective of reducing the use of chemical pesticides but the ended with mitigated results. At the beginning of the 2020's, the publication of the Farm to fork strategy, with its ambitious objective on the reduction of the use of chemical pesticides, was very criticized by the French agricultural sector. Nobody believed such an objective was reachable. But the French agricultural sector didn't manage to explain the citizens/consumers why some inputs were needed to protect and grow crops, both because there was a lack of communication on one side and a lack of knowledge of agricultural practices on the other side. The society continued to push for the suppression of chemical inputs and the sector didn't have any other choice than to try to do so.

6 years later, France is still far from the objectives set by the Farm to fork strategy and there is still a large margin of progress.

Even though many experts early agreed that digital literacy should have been a national priority, the successive governments haven't succeeded in giving digital literacy the importance it should have had. Therefore, while we are at the beginning of the 2030's French universities and schools still only propose basic courses on digital to their students. In agricultural institutions for example, students are still mostly taught about agronomy. This lack of digital literacy is now a burden for French agriculture. Farmers and farm advisors were not given adequate training on the proper use of inputs and on digital technologies, either during their studies in agricultural institutions or through continuing education programs. Therefore, most farmers and farm advisors have not been able to consider the impact of their farming practices on the environment during the last decade. Although there are digital solutions which can help farmers decrease their use of agricultural inputs, those are still costly, and their added value is not objectified. On top of that, the fact that farm advisors only partially master digital tools and technologies prevent most of them from giving proper advice on the use of those solutions. The "new generation" technical advice is only addressed to a part of the farmers. There are still great disparities in the support given to farmers, who lack advice in the field, and in the practices used to reduce inputs. The payments for environment services (PSE) are also insufficient and only partially allow the sectors to invest in digital solutions to better take the environment into account. The services provided by farmers are still difficult to quantify. Moreover, the condition of the PSE further widens the gap between farmers that are already engaged in the agro-ecological transition and those who have fallen behind in the evolution of their practices.

In the 2010's, everybody was talking about big data and there was a widespread assumption that farmers' data are the oil of the 21st century for agriculture. Unfortunately, their lack of digital literacy prevented them from taking the future of data seriously when it was still time to do so. Twenty years later, the data market is dominated by large companies, either large agricultural equipment manufacturers or large agricultural cooperatives. Farmers have a relatively little influence on that market. Their data are often used without their consent and there is no transparency regarding the use of data by third parties.

Another impediment to the development of agroecological practices in France is the lack of success in promoting the approaches to consumers. A few agroecological labels have been created but because of their limited legibility and the high cost differential, agroecological labelled products remain a niche.

In the 2010's robotization in agriculture was seen as promising, not only for replacing farm workers for some repetitive tasks but also for helping farmers reduce their consumption of herbicides. But, as of today, it still hasn't shown any potential. Firstly, their cost is still too high and only a few big farms can afford to buy a weeding robot. Secondly, for the last decade the development of robots has mainly focused on the issue of labor, not on the reduction of inputs. Therefore, robots do not provide a proper answer to reduce inputs. There is still a lot of work to do to improve the algorithms and the efficacy of automated weeding robots and automated spraying drones because French agriculture is very heterogenous. Moreover, the law is still too restrictive on the autonomy of robots. Farmers still cannot use a robot without human supervision. There is also a strong reticence of the French society towards the automation/robotization of agriculture. Contrary to the situation in France, in many of our competing countries, the use of autonomous robots has become the norm. French agriculture is losing momentum because it has not been able to accept the change.

While the extreme climate events have multiplied, weather conditions remain unpredictable. The digital technologies are still struggling to anticipate extreme weather events like heatwaves, heavy rains, hailstorms, late frost episodes… More and more productions have been affected and many farmers have decided to quit because they lost an important part of their production several times during the last decade. Moreover, digital technologies are not helping either to reduce the pressure on natural resources. Agricultural yields are declining, soils have become depleted, and biodiversity is at risk.

Another obstacle to the development of agroecology has been the fact that farmers do not have regulatory approval to conduct their experiments. They rely on references and standards that are sometimes not adapted to their situation. Therefore, experience sharing platforms are limited. But some experimental approaches taken by farmers are beginning to be considered by the academic research. But it will take time to the academic world to shift its paradigm and evolve from a rather top-down approach to a bottom up one.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

6.3.1 zero chemical inputs

Paris, October 1st, 2031,

The "Farm to fork" strategy that was finally adopted in 2025 had two ambitious goals regarding inputs in agriculture: a 50 % reduction in the overall use and risk of chemical pesticides and in the use of more hazardous pesticides by 2030 and at least 20 % reduced use of fertilizers by 2030.

6 years later, France has met the objectives set by the Farm to fork strategy.

After the presidential election of 2022, and in response to the Farm to fork strategy, the new government decided that reaching a zero-chemical inputs agriculture by 2040 was now a national priority.

Therefore, in agricultural institutions students were given access to a complete training on digital, data and precision agriculture. For the older generation of farmers, online courses have been developed and there are now many online courses available to improve their practices and help them reduce the use of inputs. The development of those courses has removed the technical and technological obstacles to the agro-ecological transition. Farm advisors have a perfect command of digital tools and technologies. Their approaches are complete and systemic, with a global vision of the challenges facing agriculture, and the digital tools make it possible to make decisions based on the various dimensions of sustainable development, and not just on the reduction of inputs.

All farms now have environmental and societal certifications. Moreover, farmers are able to promote them to consumers because the agro-ecological label has found its place among the recognitions and brands of quality. Digital technology provides clear and precise communication on the impact of the product, its origin and the differences from other labels, so that the consumer can make an informed choice and is ready to pay more for a premium and environmentally friendly product.

Data sharing is the norm. The data market is transparent and operational. Some of the data is freely available in open data. All the Decision Support Tools and softwares are interoperable. Farmers retain ownership of their data and benefit from it. Autonomous robots have been democratized thanks to a decrease in their cost, a better social acceptance and the evolution of the law. They provide technological means to reduce inputs and are adapted to all types of production and protection products. They free up human time for complex operations. The digital solutions offered meet the needs of farmers and manufacturers. France has become a world leader in AgTech. They are proposed at an acceptable cost for the farmers and bring real alternatives for the reduction of inputs.

Extreme weather conditions are becoming more and more predictable. There are new technological and agricultural solutions that are preventive or curative and that allow farmers to reduce their impacts. Digital technologies help reduce the pressure on natural resources and improve their regeneration. They are used by all the players in the agri-food sector.

Nowadays, it is easier for those experimenting farmers to disseminate their innovative practices. They can report their observations and experiments on digital sharing platforms and exchange with other farmers, farm advisors and scientists. Open innovation is everywhere and the boundaries between scientists and practitioners have blurred. With this paradigm shift and a bottom-up approach, the academic research takes these results into account and develops solutions that can be used in the field.

Aid for services rendered to the environment has been increased and allows industries to invest in digital solutions to better consider the environment. The services provided by farmers are easily quantifiable and inalienable thanks to digital tools. The terms of the aid condition largely support the transition on farms

The proper use of digital technologies introduced a new era for precision agriculture. Combined with the progress in terms of plant improvement and genetics, it has allowed French agriculture to drastically decrease the amount of input levels.

6.3.2 zero digital inputs

Paris, October 1st, 2031,

The "Farm to fork" strategy that was finally adopted in 2025 had two ambitious goals regarding inputs in agriculture: a 50 % reduction in the overall use and risk of chemical pesticides and in the use of more hazardous pesticides by 2030 and at least 20 % reduced use of fertilizers by 2030.

6 years later, France has totally failed to meet the objectives set by the Farm to fork strategy and the poor use of digital by the French agricultural sector is to blame.

French universities and schools still only propose basic courses on digital to their students. Therefore, farmers and farm advisors were not given adequate training on the proper use of inputs and on digital technologies. Moreover, the extreme focus of consumers/citizens on environmental issues has led to their rejection of digital technologies. This has affected the development of precision agriculture and automation/robotization of agriculture. On top of that, digital solutions are rejected by the entire agricultural sector. As they could not develop individualized advisory services, the profession of farm advisor is disappearing. Farmers are now more and more self-trained, but their training relies on unrecognized knowledge and practice.

Some farmers tried to experiment things to reduce the use of inputs. Unfortunately, regulations related to experimentation are becoming stricter and the evolution of practices is limited. Besides, the digital platforms do not encourage peer-to-peer feedback. The observations and experiments made in the field by farmers are not considered by the academic research, which is still too much focused on a top-down approach.

The lack of digital literacy in agricultural has led to a poor consideration of data. Data is not shared and the infrastructure for data sharing is poorly developed. Moreover, many standards coexist and prevent interoperability. As they didn't really embrace digital and more specifically data management, farmers are now dispossessed of their data and do not benefit at all from potential analysis that could have been done.

The development of automation and robotics also suffered from the general lack of digital literacy. The cost of robots is still too high for most of the farms. Furthermore, the development of robots is has mainly focused on the issue of labor during the last decade, not at all on the reduction of inputs. In addition, the law is still too restrictive on the autonomy of robots and the social acceptance of robots is still contested. Because it has not been able to accept change, French agriculture is losing momentum and many competing countries are now in the forefront of precision agriculture and robotics.

On the demand side, the agroecology label brings confusion in the messages to the consumer. Due to a lack of clarity and interest, consumers are not willing to pay a premium for agroecology labelled products.

Finally, extreme weather events have multiplied in the last decade, but digital technologies are still struggling to anticipate them early enough. The solutions are not relevant. Agricultural productions are more and more impacted. Digital technologies also fail to reduce the pressure on natural resources. Agricultural yields are declining, soils have become depleted, and biodiversity is at risk.

Digital had zero input to help reduce the use of agricultural inputs. The competitiveness of French agriculture is decreasing, more and more farmers are quitting, and the food security of the country is at risk.

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

13.18 Scotland

SCENARIO WORKSHOP REPORT: SCOTLAND

DOMINIC DUCKETT, CHRISTINA NOBLE, CLAIRE HARDY, LEANNE TOWNSEND

30.11.2021

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Authors	Dominic Duckett, Christina Noble, Claire Hardy, Leanne Townsend
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

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1. Living lab summary

1.1 Name of LL: Crofting in Coigach (Scotland)

1.2 Brief summary of LL

In Scotland, small-scale ‘crofts’ are the prevalent form of agricultural land holding in the Highlands and Islands region, often concentrated in remote, upland locations which typically have severely constraining biophysical limits on commodity production adversely affecting commercial viability. More than just agricultural holdings, crofts are typically pluri-active and play an important role in rural economic development, maintaining the population in remote rural areas, providing a secure base for the development of small businesses, and maintaining and supporting a range of unique wildlife habitats.

The Coigach Living Lab investigates how digitalisation could impact crofts in the Digital Decade. We explore the past, current, and plausible future impacts of digitalisation, consider challenges and opportunities around digital developments including potential winners and losers, and make recommendations based on a participatory process held at the local community centre.

Within the Living Lab, we pose the following focal question:

What are the most appropriate pathways to equitable and beneficial digitalisation for crofting communities in 2030?

1.3 LL participants

Describe the range of multi-actors involved in the LL and scenario workshops [100 words]

The Scottish Living Lab involves a diverse range of actors including crofters from the local community, along with individuals representing support agencies. The participants present in the scenario workshop included men and women from the local crofting community, along with representatives from Scottish Enterprise and Scottish Government. There was also one second home owner participant. Although efforts were made to include younger crofters, this proved difficult due to work commitments and the fact that they are few. Therefore, the workshop was composed of older (in some cases retirement age) participants which is indicative of the ageing population.

1.4 Timing of Scenario Planning (WP3) workshops

A single workshop was held on the 7th of October 2021 and incorporated both in person and virtual participation. Timing of the workshop was difficult due to numerous factors that had to be considered including: Covid restrictions; availability of people due to pluriactive commitments; and facility availability. After numerous emails discussing the various meeting possibilities it was decided to have a single day meeting, in their community hall and the exact day and time was selected to achieve the maximum number of participants.

2. Scenario question

2.1 Draft scenario question

What will crofting communities be like in 2031 given future digitalisation?

2.2 Finalised Scenario question

What will crofting communities be like in 2031 given future digitalisation?

(No revision of the question was made).

2.3 Methodology used to finalise scenario question

Please describe how the finalised question was chosen (e.g., virtual, f2f workshop co-production etc) [150 words approx.]

We discussed the draft scenario question with the LL participants in plenary during the scenario workshop, but no revisions were made to the scenario question.

2.4 Relevant feedback on scenario question from participants

Please provide any feedback you feel is interesting and relevant provided by the workshop participants

3. Relevant past events

3.1 List of relevant past events

Give bullet point list of past events used [approx. 10 points]

- 2010 Haiti Earthquake
- 2010 UK General Election
- 2010 Launch of Kindle3
- 2011 Death of bin laden
- 2011 AirBnB arrives in UK
- 2011 Launch of ZOOM
- 2011 Fukushima disaster
- 2012 Black Lives matter forms
- 2012 Tinder founded
- London 2012 Olympics
- 2013 Human genome breakthrough
- 2013 Mandela dies
- 2013 Horsemeat Lasagne scandal
- 2014 3D Printing becomes mainstream
- 2014 Scotland rejects independence in referendum

- 2014 Alexa launched
- 2014 Facebook takes over Whatsapp
- 2015 Paris Climate Agreement
- 2015 North Coast 500 is inaugurated
- 2015 China stock market soars
- 2015 Apple I-watch launched
- 2016 Blockchain technology arrives
- 2016 Self Driving cars arrive
- PokemonGo
- Donald trump elected
- 2017 TikTok founded
- 2017 Digital banking app hits the Highlands
- 2017 #MeToo Movement founded
- 2017 Tesla's Electric Car breaks through
- 2018 Apple Corp worth 100 billion dollars
- 2018 Oxford Analytical scandal
- 2018 What3Words app a hit in the Highlands
- 2019 UK declares Climate Emergency
- 2019 On-line shopping goes mainstream
- 2019 Corona Virus discovered
- 2020 laptops more popular than desktops
- 2020 Brexit
- 2020 NHS test and trace
- 2020 Corona virus vaccines emerge

3.2 Description past event activity

Images of events from the previous decade were arranged on a living wall for participants to identify and reflect upon. The exercise was designed to emphasise the magnitude of change that a single decade can produce. Events were incorporated that showcased the volatility of society, technology (particularly digital technology), politics, environment, and the economy. The aim was to encourage equally radical strategic foresight about the coming decade. Significant reflection and discussion was seen during this activity and group dynamics were established.

3.3 Relevant feedback from participants

Past events engaged the participants as expected in a wide-ranging discussion about society, technology, economics, the environment and politics as intended. Participants reflected on the timeline by adding post-its as they chatted to one another.

It was noted that the start, 2010, coincided with the launch of the Coigach Community Development Company. The founding of ZOOM and march of AirBnB in the UK in 2011 provoked various comments. ZOOM was viewed as reshaping the work meeting without necessarily being an improvement. AirBnB was reflected on as exacerbating a tension between holiday accommodation and homes felt keenly in this part of the world. The Fukushima tidal wave was said to have pushed climate change up the agenda. A food scandal in 2013 prompted comments about the mass production of food and the need for sustainable practices. 2014 saw a fractious independence referendum in Scotland and naturally the recollection reopened political wounds. For technology the corporate acquisition of WhatsApp by Facebook provoked discussion about identity fraud and threats harboured within social media. Data security was a significant theme throughout the workshop. The North Coast 500 tourist route was launched in 2015 and continues to be a local concern due to mixed effects of changed touristic dynamics. The extent to which this development is a digital phenomenon given its links with digital accommodation platforms and satellite navigation availability was discussed. By 2017 participants were reflecting on an online banking app that had come to the Highlands. The following year What3Words, a location finding app, was proving popular. Participants also discussed data ownership in relation to the Cambridge Analytica scandal. Images for 2019 led to conversations about Covid and the new normal, and the Climate Emergency. The end of the reflection, 2020, was clearly most salient, with test and trace apps and vaccines dominating the technological scene and Brexit being the political headline.

The exercise appeared to successfully foreground the strategic foresight tasks and the participants seemed to both enjoy it and grasp its purpose without difficulty.

4. Drivers Of Change (DOC)

4.1 List initial set of DOC

See below – initial DOC were selected, then revised and expanded by others in the Hutton team.

4.2 List selected DOC

Give final DOC that were selected

S1 = Inclusive communities

S2 = Physical and online communities

T1 = Connectivity in rural areas

T2 = Digital platforms e.g. e-commerce, training, healthcare

Ec = Supporting diversification and pluriactivity in the local community

En = Natural assets, green recovery, heritage and stewardship

P = Rural support mechanisms

4.3 Describe methodology to select DOC

Drivers of change were selected within the LL team at Hutton. This was done online, given that most Hutton colleagues are still working from home due to Covid-19. Initial DOC were sketched out by one team member, then MIRO was used as a means of gathering additional ideas on DOC for the Scottish LL. These were iteratively finalised for the workshop.

4.4 Relevant feedback from participants

Some email feedback was received, and it was generally positive. The hybrid live/virtual attendance attracted one negative response. Further feedback is likely at future engagements within the project.

5. Matrix

5.1 Matrix description

Our matrix is organised around seven rows representing STEEP drivers of Change (DOC) relevant to the Living lab in Coigach.

There are two drivers for the Social' category (S) and two for the Technological/Digital category (T). There are five columns to capture the assumptions made for each of the DOC. Column one represents assumptions that are at the 'better not best' end of the spectrum with column two 'business as usual (BAU) and column three the 'worse not worst' assumptions. The fourth column captures three assumptions that might operate in a cross-cutting way, i.e., might equally apply in combination with the assumptions from columns one, two and three.

Drivers were formulated by the research team reflecting upon earlier engagement with the LL. Some opportunity was afforded at the beginning of the workshop to reviewing the drivers, but no participants did not express an inclination to change any of them. This could have been done in a more participatory way with greater co-construction, but ultimately time constraints exacerbated by the pandemic necessitated a strong guiding hand from the researchers.

STEEP DOC	Assumption 1	Assumption 2 – BAU	Assumption 3	Assumption 4
(S) Inclusive communities	The future brings a more level 'digital' playing field > inclusivity > enabling	Inequalities remain. Few new digital opportunities disadvantaged stakeholders inc. women, older residents, disabled & marginalised ethnic groups	Gap is widening due to post Covid austerity, GIG economy and lack of effective action around equality e.g., no levelling-up.	
(S2) Physical & Online communities	Blended solution with increased inclusivity	Virtual interaction gradually reduces face to face interactions benefitting some and excluding or dis-benefitting others	Virtual networking leads to a sharp decline in face-to-face interactions abruptly increasing the digital divide	
(T) Connectivity in the rural area	Connectivity is HIGH, favourably comparable with UK urban areas with 7G and 8G services available.	Connectivity is MODERATE, service provision lagging behind urban areas. 6G is the typical local service.	Connectivity is POOR 4G and 5G services limit both opportunities for rural businesses and availability of services in this area.	Connectivity gets better for some and doesn't improve for others – provision is unequal
(T2) Digital platforms e.g., ecommerce, training, health care	Digital platforms are more widely available and rural participation is high creating new opportunities.	Provision of Digital platforms targeted at rural users and local services is limited. Digital divide remains.	Provision of Digital platforms targeted at rural users and local services is poor increasing the digital divide.	
(E) Supporting diversification/ pluractivity in the local community	Ecommerce is providing a lucrative market for croft-based enterprises.	Ecommerce provides a modest market for croft-based enterprises supplementing other incomes.	Ecommerce is a weak driver for croft-based enterprises.	Ecommerce platforms are dominated by larger players.
(E) Natural assets, Green Recovery, Heritage & Stewardship	Under a strong Green Recovery, crofting communities benefit.	Under a modest Green Recovery, crofting continues to make moderate progress	Without effective Green Recovery crofting communities decline.	Green Recovery promotes woodland expansion over traditional crofting
(P) Rural support mechanisms	Strong public support is available for rural areas crofting inc. crofting payments that safeguard livelihoods	Static public support for rural areas does little to safeguard livelihoods	Reduced public support for rural areas leads to declining livelihoods	

5.2 Define pathways/scenarios selected

Three pathways were defined and were organised in columns in the above figure. The pathways represent: (Blue) a 'better (than business as usual) not best' future in 2031 through which more optimistic views were explored; (Green) a 'business as usual' (BAU) scenario which was not explored explicitly due to the relatively small group size; and (Pink) a 'worse (than business as usual) not worst' scenario that was explored through a more pessimistic perspective.

5.3 Identify the 2 pathways that will be defined in more detail

The Blue, 'better (than business as usual) not best' future in 2031 was selected for through participatory exploration in a breakout group in line with the agreed methodological guidelines. The Green 'business as usual' (BAU) scenario was not explored in depth due to the relatively small group size, again in line with the agreed guidelines. The Pink 'worse (than business as usual) not worst' scenario formed the second of the two scenarios identified for exploration through a breakout group. Both pathways that were explored in the breakout groups were presented in plenary for feedback.

5.4 Methodology used to identify pathways

Pathways were identified by clustering the assumptions for 'better not best' and 'worse not worst' scenarios. In our matrix this is already reflected in the organisation of the columns shown above, however earlier iterations of the matrix had different and unsorted assumptions that were refined and sorted in an iterative process with the research team. Researchers who had attended the earlier LL were particularly keen to align assumptions with discussion previously facilitated with stakeholders.

What is presented is a final version of the matrix already adjusted to make the pathways clear to workshop participants.

5.5 Relevant feedback from participants

No relevant methodological feedback received.

6. Scenario Narratives

6.1 Name Scenarios

Better Not Best: Gross Domestic Happiness

Worse not Worst: Digital Clearances

6.2 Better Not Best: Gross Domestic Happiness

The group decided on this name to capture a future vision in which technology corporations and large businesses eschew profits as the biggest marker of success in a radical realignment of values. Improving mental health and wellbeing were key factors in the development of this scenario as well as funds going back into local communities, rising employee satisfaction levels, an increase in flexible working arrangements, duty of care from employers and leading on moral and ethical obligations. This in turn increases the degree of resilience in the community to respond to future and/or external crises such as lorry shortages (Brexit/Covid), fuel price increase (Brexit/Covid), health crisis (Covid) etc.

The “better not best” future scenario breakout group was composed of three male participants (one participating online), three female participants and facilitated by three female Hutton researchers, leading to nine in total.

The group began by recapping the scenario “better not best” in each STEEP category for 2031 to ascertain the group’s first impressions towards a more detailed plausible future narrative. One group member suggested that the scenario presented a strong ‘demand-led’ narrative, one in which the local community were given more authority and ownership over new initiatives and projects. Other group members reacted positively towards this view, with suggestions that a market-research type review could take place to establish what is currently available within the community, what will be available in the future, what gaps exist and what can be done by the community to help achieve and establish future goals.

With most services moving online or offering both an online as well as in-person option, a clear opportunity exists for the community and other remote rural crofting communities. Growing e-commerce opportunities are jump-starting local initiatives bringing together local suppliers that currently contend with large distances, islands and other physical geographical features. A recent initiative "the Green Bowl" is inspirational to the possibilities that exist for local crofters and community members to take advantage of widely available digital platforms and high digital connectivity levels comparable to urban areas. The Green Bowl, (see https://openfoodnetwork.org.uk/the-green-bowl/shop#/about) started by two female crofting neighbours in summer 2020 is part of the Open Food Network, UK, resembles an online version of a farmers' market. Produce (including meat, vegetables, home-bakes and preserves) are available for purchase and can be delivered to the doorstep if within a certain radius, or available for collection at a designated place. Workshop participants remarked that this initiative connected local producers, providing safe and traceable food produce to the benefit of the local community. It also was remarked upon as a means to minimise the current national lorry driver crisis that was affecting food supplies in supermarkets.

National and global crises, including the then current diminishing supply of drivers for heavy-goods vehicles (HGVs), attributed to a culmination of both Brexit and Covid-19 related shortages, was noted amongst participants as having the potential to impact remote rural areas such as Coigach deeply. By relying more on locally grown produce and services (shorter supply chains), some workshop participants saw new initiatives like the 'Green Bowl' as a means to increase the resilience of the community. Not only providing an alternative or supplement to supermarket bought produce, in ten years' time, it is hoped this initiative will have spear-headed locally led food and service provision, created a unique brand identity and fostered increased cooperation amongst the crofters and residents in the local area.

Following the desire for increased cooperation, the workshop participants identified the opportunity to attract 'new entrant crofters', not only in terms of increasing the current population of the area, but a type of crofter that valued working with and for the community at the forefront, as well as utilizing the 'Common Grazings' to benefit the local biodiversity of the region. A focus upon viewing crofting as a way of life that emphasises a positive mental wellbeing was welcomed by the workshop participants. The issue of absentee crofters coupled with the current waiting list for a croft with housing nearby, presented an immediate way in which digital technology could create a more streamlined system for the necessary regulatory and community bodies. Housing was seen to be necessary to attract the in-migration of a younger demographic as well as the return of previous residents who had left to pursue higher education or employment outside the region. There was a suggestion to create a community fund, with the goal to develop social housing and other services to ensure the future viability of the community such as land purchases and ways in which to utilise spaces to increase entrepreneurship amongst new and existing residents. A younger demographic was identified as key to the survival of typical crofting communities which currently attract many second-home owners and retirees. Affordable housing, more flexible working arrangements and broadband comparable to urban areas were all identified as ways to future-proof the community.

In this scenario, technology was also identified as a means to increase democracy by encouraging participation from more community residents. Local council or planning committees for example can host hybrid meetings which allow the opportunity for residents unable to attend in-person the chance to still participate by joining remotely online and air their views and opinions. By increasing the means of public engagement, it is hoped this will transpire into a stronger sense of community and belonging to the local area by a wider and diverse range of participants. Another positive consequence of the move towards working online and connecting digitally with other residents and communities is the increase in citizen science. The monitoring of local fauna and flora for example can feed into wider national research projects whilst at the same time creating local solutions. Encouraging community participation can also help focus on climate change actions, presenting an opportunity to empower local residents to work cooperatively in order to tackle the global issue.

6.3 Worse Not Worst: Digital Clearances

'Digital Clearances' as a name, plays on the tragedy of the Highland Clearances, a seismic event in the social history of Scotland. Predominantly between 1750 and 1860 a forced eviction of small-scale farming communities concentrated upon the Highlands and western islands of Scotland took place. Small tenant farmers were violently dispossessed of their land and homes by wealthy estate owners. Amidst catastrophic destitution many impoverished Scots emigrated while others resettled the least favourable agricultural land available. This, the most controversial of subjects in modern Scottish history, lives on in the folk memory of crofting areas and was drawn upon here by a crofting community to frame a vision of a bleak future in which, once again, a powerful elite could act to disenfranchise small holders.

The manner of the Digital Clearances was envisaged around already emerging trends whereby so-called Green Lairds are buying up vast tracts of land in remote areas to plant with trees in order to offset carbon emissions elsewhere. Those with deep pockets, for example Brew Dog who have purchased 9000 acres (3,642ha) across Scotland, can acquire land with potential for carbon sequestration but in doing so, drive up land prices in what has been likened to a gold rush. Participants feared that an increasingly digitised bioeconomy might offer little in the way of community benefits with land effectively set aside from small scale pluractivity, outside the control of local actors and becoming a global commodity, transferred from one corporation's net zero portfolio to another's at the discretion of an algorithm. A landscape-scale disempowerment of local communities was feared whereby dispossessed locals, priced out of real estate assets, depend on faceless corporations or the super rich to shape their destinies.

The North Coat 500 is a tourist route comprising around 500 miles of coastal roads in the far North of Scotland. While increasing certain aspects of tourism, local communities, including Coigach, see the development as a double edged sword and in this more negative scenario NC500 disbenefits are accentuated. The digital element of the NC500, albeit indirect, derives from the digital connectivity of motorists that has opened this amenity to mass tourism. The 'back roads' and 'meandering country tracks' described on internet sites and social media platforms promoting the tour and that are, in many ways, ill-suited to sharp increases in traffic, are made all the more accessible by the geolocational intelligence of modern cars and camper vans. Not only is the route facilitated by satellite technology reducing the level of navigational skill required to explore this remote region, but a whole back office of waypoints and internet sites informs the tourist about points of interest, places to stay, petrol stations, charging points, opening times of attractions, weather information and a myriad of other information. This is reinforced by a host of travel and outdoors-themed social media accounts on Instagram, Twitter and Facebook which popularises these points of interest on the NC500 route.

What would have been a specialist holiday for the more intrepid motorist just a few years ago has become mass tourism through digitalisation of transport, networks and information. Launched in 2015, 29000 more people visited the area in its first year. This 'success' has brought its own problems with increased journey times for locals, dirty camping, increased road traffic accidents and strains upon local infrastructure. Digitalisation is the engine of the back office that supports exploitation of remote areas, here encapsulated in the NC500. Winners may be distant actors renting camper vans in urban centres or taking commissions on accommodation through cloud-based booking apps, while losers are locals whose routines and amenities are disrupted.

Wider tensions can be generalized around connectivity. Something of the allure of remote regions both to the inhabitants and the visitors is bound-up with a lack of connectivity and a scarcity of infrastructure. Balancing these tensions is challenging and simply improving connectedness and accessibility can alienate communities who value tranquillity, even solitude. The local provision of schooling declined in Digital Clearances. Without effective reversal of demographic trends an exacerbation of the downward trajectory was feared as school numbers fell below sustainable levels presenting yet further barriers to young families wishing to move to the area. While the local school here was thought to have a reasonable chance of surviving due to its wider catchment, the general regional decline was expected to continue. The effect on digitalisation was projected as negative with the ageing community failing to stay digitally up to date. Innovation was associated with a vibrant and diverse community and effectively excluding the young was thought to be a route to stagnation.

Digital privacy and security was both a current and future concern at the workshop and in this scenario inadequate protections have led to increased intrusions, identity theft and disempowerment. People's current experience inspired dark visions where privacy has been eroded.

6.4 Name and write the less detailed 'best case' and 'worst case' scenarios

6.4.1 Worst Case

The worst-case scenario depicts ***a bleak landscape*** where there are no schools, no skills and no local shops. Coigach, in common with neighbouring districts is little more than an extension of a highland theme park with a Disney-fication of once a proud culture. Mega-crofts have swallowed-up small holdings and crofting is no longer a way of life. Without vibrant communities there is no diversity and hence, no place for the LGBT community. Climate change adds to the general inhospitality of the region with more frequent extreme weather events adding to the jeopardy of the few hardy souls that remain.

In many respects, the worst was not so different from the worse, i.e., Digital Clearances for this community, a long history of exploitation and disempowerment has provided them with ample material to lapse into a dystopic melancholy.

6.4.2 Best Case

We ended the workshop on the most positive note by facilitating discussion of ***the ideal scenario***. Herein, the vision of a fully developed North West Highlands Geopark has been realised and tourism, sensitive to local community needs, has flourished. These developments are indirectly enabled by digitalisation as visitors navigate their participation in an increasingly digitalised world. There are grants for woodland expansion accessible to local people not to exploitative corporations and land grabbers. There is agreement with Scottish Government and the appropriate agencies to extend crofting and make more crofts available. Again, these provisions are digitally enabled with accessible schemes and procedures facilitated by digital platforms that are user-friendly and equitable.

There is funding for affordable housing in part responding to increased demand with a growing population whose digital skills enable economic activity to flourish and prosperity to flow into the area. Physical connectivity is improved with a regular ferry from Ullapool.

The crowning glory of this revitalised region is newly founded University of Ullapool, an institution serving local needs through the development of relevant skills. It allows local youngsters to pursue higher and further education without emigrating and it pulls incomers including internationals to the area stimulating greater diversity, innovation and vibrancy in a sustainable population.

13.19 Belgium

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

SCENARIO WORKSHOPS

FLANDERS – BELGIUM

ILVO

25/11/2021

DANIEL VAN DER VELDEN; LIES DEBRUYNE

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Authors	Daniel van der Velden; Lies Debruyne
Work Package Leader	James Hutton Institute
Project Coordinator	UNIPI

Introduction

1. Living lab summary – Flemish Living Lab

1.1 Brief summary of LL

The living lab in Flanders involves a range of actors in the Flemish livestock industry. The central question of this living lab deals with the possibility of monitoring environmental performance on individual livestock farms, in this case ammonia emissions. While technologies to measure ammonia emissions on livestock farms are currently in development, there is little knowledge about the potential impact of these technologies on the livestock farming industry. As a result, there is also doubt about how these technologies should be used once they are developed and whether it is desirable to use these technologies as a monitoring tool on farms. The scenario workshops were used to provide some tentative answers to these questions.

1.2 LL participants

Most of the actors involved in the scenario workshops had also participated in the WP2 workshop (Needs, Expectations and Impacts) at the start of 2021. These stakeholders were asked to participate again through email. A further open invitation was spread through social media channels and selected stakeholders in order to broaden the range of actors engaged in the research.

Participating actors came from farmers unions, innovation brokers, agricultural advisors, research farms, researchers and the regional government. This range of actors represents the different agricultural actors active in this topic of ammonia emissions and digitalisation. Three participants of the first workshop were unable to join the second workshop. One additional participant joined for the second workshop.

1.3 Timing of Scenario Planning (WP3) workshops

The workshops for the WP3 scenario planning were held on the 21st and the 28th of October. The workshops were in-person. This allowed us to keep the workshops interactive and allowed the participants more interaction between them. The workshops took about four hours each, from 9am to 1pm.

2. Scenario question

2.1 Draft scenario question

The draft scenario question proposed to the participants was: "what will be the impact of digitalisation and monitoring on ammonia emissions in 2031"

2.2 Finalised Scenario question

The participants did not change the scenario question in our living lab. This means that the finalised scenario question is: "what will be the impact of digitalisation and monitoring on ammonia emissions in 2031"

2.3 Methodology used to finalise scenario question

During the workshop the scenario question was provided during a presentation. We did not actively seek to change the question during the workshop.

2.4 Relevant feedback on scenario question from participants

There was some discussion over the potential to broaden the question to all emissions in livestock farming. However, because the living lab had so far been focused on ammonia emissions, it was decided to have this remain the same.

3. Relevant past events

3.1 List of relevant past events

Below we provide nine of the past events that were used to explore the development of digitalisation and the issue of ammonia emissions in Flanders. These events were provided on the timeline that we used to open the first WP3 workshop. Participants provided additional events during the last 20-30 years on the timeline and discussed these events. A picture of the timeline is provided in figure 1.

- Cow neck tag with RFID (first one in 1980s)
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the key directive for ammonia emission regulation)
- First internet connection in Belgium (1993)
- First GPS technology in agriculture (1993)
- Farmer protests (Early-mid 2010's)
- Temporary ammonia regulation (2014)
- Survey showing high usage of precision (digital) agriculture (2018)
- Government plans to digitally transform Flanders (2021)
- Court case blocking the expansion of a farm, large implications for the regulation on ammonia emissions (2021)

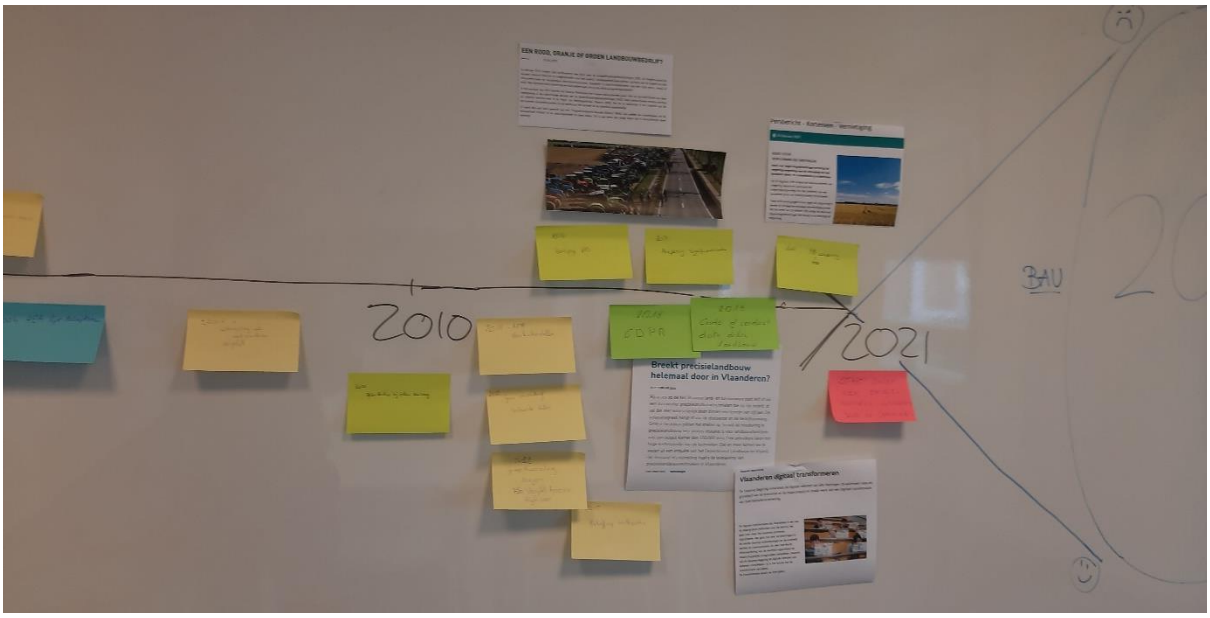

Figure 26: An overview of the updated timeline (workshop 1)

3.2 Description past event activity

The list of past events was selected to provide some key points in the development of both digital technology in Flanders and in agriculture, as well as for the issue of ammonia emissions and regulation. These past events were not meant to be exhaustive or even to cover the most key events, but rather were selected to engage participants and to make them discuss and think about what key events transpired over the last 20-30 years.

Participants mainly added key events on ammonia emissions and government regulation on farming. These further contributed to the existing list of events and provided some further information about the history of these regulations. Key events for digitalisation were focused on the past 3-4 years with the code of conduct for data usage, the GDPR and the start of further research on measuring ammonia emissions at the barn level of farms.

3.3 Relevant feedback from participants

Interesting to note was that participants mainly added events that were focused on government regulation. These events were focused on changes in regulation and especially focused on agri-environmental regulation. We also asked participants as to what they thought was the key event in the last 20 years that had driven changes. Several participants described agri-environmental regulation as well as the recent court case (February 2021) that blocked the expansion of farms close to natural areas. Generally there was less attention for the developments in digital agriculture and around digitalisation, although two participants added the research on monitoring ammonia emissions, the GDPR and the code of conduct for data sharing in agriculture.

4. Drivers Of Change (DOC)

Below we provide the initial list of drivers of change (4.1) and the final list of drivers of change (4.2).

4.1 List initial set of DOC

Initial list of DOC
Societal pressure on agriculture
Digital skills of farmers
Data sharing and access to data
Development of digitalisation in agriculture
Economic developments in agriculture
Ammonia emissions
Climate and weather in Flanders
Government policies for livestock farming

4.2 List selected DOC

Initial list of DOC
Societal pressure on agriculture
Digital skills of farmers and the dependence on external support
Data sharing, access to data and quality of data
Development of digitalisation in agriculture
Economic developments in agriculture and the role of retail
Emissions in livestock farming
Environmental objectives, climate and weather
Government policies for livestock farming
Scientific research
Courts & Rule of law

4.3 Describe methodology to select DOC

The initial list of drivers of change (DOC) were selected by the researchers leading the workshop. These drivers were based on the list of DOC provided by the WP3 team and supplemented with additional DOC based on the information gathered in the WP2 research and workshop. The selected DOC were selected with the research interests, the results from the research so far, and the scenario question in mind.

Participants were given the chance to change the list of DOC during the WP3 workshop. This was done during the face-to-face workshop in order to be able to explain the DOC concept and to allow participants time to discuss these DOC together. It was stressed that the initial list was a draft version and that participants were free to change DOC, remove existing ones and add new ones. Additionally, it was explained to the participants that we are looking for DOC that are 'critical uncertainties' and what this meant for adding DOC to the list.

4.4 Relevant feedback from participants

Several drivers were slightly adjusted by the participants during the workshop. This allowed us to combine several of the drivers, as well as to provide nuance or additional aspects to the existing drivers. We will shortly describe every addition and change to the original DOCs and describe how this was relevant.

On the driver 'Digital skills of farmers', participants added the aspect of 'dependence on external support' (new driver: Digital skills of farmers and the dependence on external support). Participants were worried about the need for farmers to hire external advisors and engage other actors in order to use and understand digital technology. While some saw the dependence of farmers on external advice in digitalisation as an objectively bad thing, others were more nuanced and pointed to the specifics of this farmer-advisor relation. The addition to the DOC was made to reflect this and to be able to discuss this in the assumptions for this driver. Throughout the workshop there was some discussion about the role of external advisors and how this should be seen.

The third driver 'Data sharing & access to data' was adjusted to also focus on data quality (new driver: data sharing, access to data & data quality). Participants were worried about this aspect of data and whether all data used was accurate and correct. The combined driver reflects different aspects of data and concerns both the access and sharing of data as well as the quality of this data.

For the fifth driver 'Economic developments in agriculture and the role of retail' there was the addition of retail as an actor. This was done to reflect the major role of retail in price-setting and their role in the agri-food supply chain. Retail was generally not seen in a positive light and they were described as having too strong a role in setting the price that farmers get for their products. This also reflected back on consumers, who were described as somewhat ignorant of the realities of farming and unwilling to pay a higher price for sustainable production.

The sixth driver 'Emissions in livestock farming' was changed from the original focus on ammonia emissions. This was done to be able to speak more broadly about the different (gaseous) emissions in livestock farming, also involving greenhouse gasses, odour and other compounds. Current policies often focus on specific emissions that do not take into account broader interactions between emissions or between strategies that reduce emissions. This can for example be seen in the reduction of ammonia in livestock farming which might increase greenhouse gas emissions or worsen other emissions.

The seventh driver 'Environmental objectives, climate and weather', saw the addition of environmental objectives to broaden this driver to more aspects concerning the environment and the quality of natural areas. There was some attention to the impact of climate change on environmental objectives and as to how climate change would change natural areas in Flanders (something that carries a lot of uncertainty). Equally, current environmental objectives set the standard for the maximum rates of ammonia deposition and consequently set an upper limit to livestock farming around these natural areas. As our participants were mainly stakeholders in the livestock industry they described potential solutions this by broadening environmental objectives to no longer solely focus on ammonia emissions.

Two additional drivers were selected, 'scientific research' and 'Courts & rule of law' as participants saw these two drivers as playing a major role over the last few decades and expected this to continue.

Scientific research was quickly added as a driver, without a lot of discussion about as to why this driver needed to be included. In the section on the assumptions for each driver we will explore this driver further.

Courts & Rule of law was chosen as a driver to reflect the importance of the courts ammonia emissions and livestock farming. As we described in the section on past events (3.3), there has recently been a court case that blocked the expansion of livestock farms close to natural areas unless they could prove that there was no impact of ammonia emissions on these natural areas. This has meant that new regulation is needed to address the emissions of ammonia (and nitrogen in a broader sense) on natural areas. As this is has a large impact on livestock farms, participants decided to add the courts and rule of law as one of the new drivers.

5. Matrix

5.1 Matrix description

The matrix provides the DOC that we identified in the previous chapter with 3-4 assumptions for each driver for the next ten years. Most of these assumptions were identified by the participants in the workshop. For the first four DOC we provided template assumptions, both to better explain to the participants what was expected from them and in order to be able to keep within the time assigned for this task. Participants added to, and changed these assumptions. For the last six DOC the participants provided all of the assumptions themselves.

The scenario outlines were made by selecting one or more assumption per driver of change for each scenario. Several small additions and combinations to the assumptions were made while discussing the scenario outlines. These changes are reflected in section 5.2. In general the assumptions run from left to right from most positive, through business as usual, to more negative. However, this also depends on several other factors, where other actors might interpret these assumptions in a different light (e.g. the negative assumption as something positive.)

What drives change?	Assumption A	Assumption B	Assumption C	Assumption D
Societal pressure on agriculture	The knowledge and understanding of agriculture among all societal actors will improve. Implicitly this will lead to a reduced societal pressure for agriculture	Large societal pressure on agriculture to change. Alternative forms of agriculture are embraced.	Pressure on agriculture from certain NGO's and societal organisations. The majority of society does not change in consumption patterns.	The price of food is determinant. Consumers do not want to pay too much for food. Intensive livestock farming is appreciated for its efficiency.
Digital skills of farmers and the dependence on external support	Every livestock farmer is fully digital with a high level of digital skills. Agriculture is data-driven and farmers know how to interpret this data.	Some farmers have digitally transformed their farm. Most farmers are digitalizing but are still lacking in digital skills. It turns out to be difficult to interpret the data on the farm.	Some farmers have digitally transformed their farm. Most farmers are digitalizing but are still lacking in digital skills. It turns out to be difficult to interpret the data on the farm and there is a large dependence on external advisors for digital agriculture	Digitalisation stalls compared to 2021. The digital infrastructure in rural areas is ageing.
Data sharing, access to data and quality of data	Everyone shares their data. Data sharing is the norm and is supported by data-hubs. Data is not traded but is completely open.	Data sharing is the norm and the farmer profits from this (not necessarily monetarily). Data is traded but the farmer is in control of data. Neutral data-hubs that govern the access and	Large companies dominate the data-market, farmers have relatively little say in this. Data-hubs are in the hands of these larger companies.	Data is not shared and infrastructure for data-sharing is little-developed. Effective data sharing is difficult.

		sharing of data play a key role.		
Development of digitalisation in agriculture	Everything can be measured, per farm and in detail. Machine learning and decision support tools help the livestock farmer in optimising their operation.	More and more can be measured and quantified, but it is difficult to tie this to concrete farm management decisions. A lot of support is necessary to allow farmers to use this data.	Investments in digital technology and sensor technology stall. No new technological developments happen in livestock farming.	-
Economic developments in agriculture and the role of retail	Retail changes its mind and will pay farmers a fair price based on the costs made to produce this food.	Government intervention in retail. The price of foodstuff will be partially determined by an independent agency for honest trade practices.	The world market determines the price of food and farmers undergo fluctuating prices. (intensive) livestock farming is no longer profitable in Flanders. The local market shrinks and other countries can produce meat at a lower price.	
Emissions in livestock farming	Technology allows for an integral and broad reduction in emissions from livestock farming. This technology is affordable for the livestock farmer.	Ammonia emissions are no longer the only parameter for livestock farming but there is a broader focus on resource cycles and the efficiency of resource use in farming.	Ammonia emissions are not sufficiently reduced. Technology that is currently used or in development does not suffice for reductions in emissions. Shrinking the livestock population is the only solution to	

			reduce ammonia emissions.	
Environmental objectives, climate and weather	All natural areas reach their environmental goals.	There is a re-evaluation of the environmental regulation and the environmental objectives to bring them in line with current realities.	Environmental objectives are not reached. There will be stricter demands on agriculture to reduce environmental impacts.	
Government policies for livestock farming	Regulation is developed that couples ecological benefits to a liveable agricultural policy. The polarisation between nature and agriculture is reduced.	The government develops a robust framework that allows for the development of the livestock sector with space for innovations.	Agricultural policy remains dependent on other actors and is (too) variable with a lack of long-term vision.	The government keeps current environmental targets and shrinks the livestock farming sector.
Scientific research	Scientific research leads to a full quantification of emissions in agriculture. This allows for complete insight into emissions.	Scientific research makes large steps in the development of technology and innovations that reduce and track emissions.	Scientific research has a determining role in policy. At the same time there remain uncertainties about aspects of emissions..	Scientific research contradicts itself which increases uncertainty.
Justice/Rule of law	The courts take a broader societal view on current policies and judge accordingly.	The courts rule in a way that can be seen as pro-agriculture or pro-livestock farming.	The European policy-level is of increasing importance. Court cases in Germany and the Netherlands determine the situation in Flanders.	The courts judge against current policies and the courts are increasingly used to challenge policy.

5.2 Define 4 pathways/scenarios selected

Scenario 1: A farmers choice (Most positive)	
Societal pressure on agriculture	The knowledge and understanding of agriculture among all societal actors will improve. Implicitly this will lead to a reduced societal pressure for agriculture
Digital skills of farmers and the dependence on external support	Every livestock farmer is fully digital with a high level of digital skills. Agriculture is data-driven and farmers know how to interpret this data.
Data sharing, access to data and quality of data	Data sharing is the norm and the farmer profits from this (not necessarily monetarily). Data is traded but the farmer is in control of data. Neutral data-hubs that govern the access and sharing of data play a key role.
Development of digitalisation in agriculture	Everything can be measured, per farm and in detail. Machine learning and decision support tools help the livestock farmer in optimising their operation.
Economic developments in agriculture and the role of retail	Retail changes its mind and will pay farmers a fair price based on the costs made to produce this food.
Emissions in livestock farming	Technology allows for an integral and broad reduction in emissions from livestock farming. This technology is affordable for the livestock farmer.
Environmental objectives, climate and weather	All natural areas reach their environmental goals.
Government policies for livestock farming	Regulation is developed that couples ecological benefits to a liveable agricultural policy. The polarisation between nature and agriculture is reduced.
Scientific research	Scientific research leads to a full quantification of emissions in agriculture. This allows for complete insight into emissions. & Scientific research makes large steps in the development of technology and innovations that reduce and track emissions.
Justice/Rule of law	The courts rule in a way that can be seen as pro-agriculture or pro-livestock farming. & The courts take a broader societal view on current policies and judge accordingly.

Scenario 2: Benefits of a crisis (better not best)	
Societal pressure on agriculture	The knowledge and understanding of agriculture among all societal actors will improve. Implicitly this will lead to a reduced societal pressure for agriculture
Digital skills of farmers and the dependence on external support	Some farmers have digitally transformed their farm. Most farmers are digitalizing but are still lacking in digital skills. It turns out to be difficult to interpret the data on the farm.
Data sharing, access to data and quality of data	Data sharing is the norm and the farmer profits from this (not necessarily monetarily). Data is traded but the farmer is in control of data. Neutral data-hubs that govern the access and sharing of data play a key role.
Development of digitalisation in agriculture	More and more can be measured and quantified, but it is difficult to tie this to concrete farm management decisions. A lot of support is necessary to allow farmers to use this data.
Economic developments in agriculture and the role of retail	Government intervention in retail. The price of foodstuff will be partially determined by an independent agency for honest trade practices.
Emissions in livestock farming	Ammonia emissions are no longer the only parameter for livestock farming but there is a broader focus on resource cycles and the efficiency of resource use in farming.
Environmental objectives, climate and weather	There is a re-evaluation of the environmental regulation and the environmental objectives to bring them in line with current realities.
Government policies for livestock farming	The government develops a robust framework that allows for the development of the livestock sector with space for innovations.
Scientific research	Scientific research makes large steps in the development of technology and innovations that reduce and track emissions.
Justice/Rule of law	The courts take a broader societal view on current policies and judge accordingly.

Scenario 3: Uncertain future (Worse not worst)	
Societal pressure on agriculture	Pressure on agriculture from certain NGO's and societal organisations. The majority of society does not change in consumption patterns.
Digital skills of farmers and the dependence on external support	Some farmers have digitally transformed their farm. Most farmers are digitalizing but are still lacking in digital skills. It turns out to be difficult to interpret the data on the farm and there is a large dependence on external advisors for digital agriculture
Data sharing, access to data and quality of data	Large companies dominate the data-market, farmers have relatively little say in this. Data-hubs are in the hands of these larger companies.
Development of digitalisation in agriculture	More and more can be measured and quantified, but it is difficult to tie this to concrete farm management decisions. A lot of support is necessary to allow farmers to use this data.
Economic developments in agriculture and the role of retail	The world market determines the price of food and farmers undergo fluctuating prices. (intensive) livestock farming is no longer profitable in Flanders. The local market shrinks and other countries can produce meat at a lower price.
Emissions in livestock farming	Ammonia emissions are not sufficiently reduced. Technology that is currently used or in development does not suffice for reductions in emissions. Shrinking the livestock population is the only solution to reduce ammonia emissions.
Environmental objectives, climate and weather	Environmental objectives are not reached. There will be stricter demands on agriculture to reduce environmental impacts.
Government policies for livestock farming	Agricultural policy remains dependent on other actors and is (too) variable with a lack of long-term vision.
Scientific research	Scientific research contradicts itself which increases uncertainty.
Justice/Rule of law	The European policy-level is of increasing importance. Court cases in Germany and the Netherlands determine the situation in Flanders.

Scenario 4: Stagnation till the end (Most negative)	
Societal pressure on agriculture	The price of food is determinant. Consumers do not want to pay too much for food. Intensive livestock farming is appreciated for its efficiency.
Digital skills of farmers and the dependence on external support	Digitalisation stalls compared to 2021. The digital infrastructure in rural areas is ageing.
Data sharing, access to data and quality of data	Data is not shared and infrastructure for data-sharing is little-developed. Effective data sharing is difficult.
Development of digitalisation in agriculture	Investments in digital technology and sensor technology stall. No new technological developments happen in livestock farming.
Economic developments in agriculture and the role of retail	The world market determines the price of food and farmers undergo fluctuating prices. (intensive) livestock farming is no longer profitable in Flanders. The local market shrinks and other countries can produce meat at a lower price.
Emissions in livestock farming	Ammonia emissions are not sufficiently reduced. Technology that is currently used or in development does not suffice for reductions in emissions. Shrinking the livestock population is the only solution to reduce ammonia emissions.
Environmental objectives, climate and weather	Environmental objectives are not reached. There will be stricter demands on agriculture to reduce environmental impacts.
Government policies for livestock farming	The government keeps current environmental targets and shrinks the livestock farming sector.
Scientific research	Scientific research leads to a full quantification of emissions in agriculture. This allows for complete insight into emissions. (*The following section was added to this assumption by participants*) However, it turns out that shrinking the livestock herd is the only option for reducing ammonia emissions. Scientific research has a determining role in policy.
Justice/Rule of law	The courts judge against current policies and the courts are increasingly used to challenge policy.

5.3 Identify the 2 pathways that will be defined in more detail

The 2 pathways that were used for the second workshop were the second and third scenario, ‘benefits of a crisis’ and ‘uncertain future’. These were respectively the slightly positive (or better not best) and slightly negative (worse not worst) scenario. The third scenario (uncertain future, slightly negative) was seen as the ‘business as usual’ scenario by participants.

5.4 Methodology used to identify pathways

Participants were split into two groups after the matrix (chapter 5.1) was made. These two groups were asked to develop rough scenario outlines using the drivers of change and corresponding assumptions. One group was given the task to develop more extreme scenarios (utopic and dystopic) while the other group was given the task to develop more nuanced scenarios (better not best and worse not worst).

The two groups were instructed on the focus of these scenarios (spanning the range of plausible futures) and that these outlines were going to be used to further develop the scenarios in the second workshop. Participants were also instructed to attempt to form a consistent scenario, where assumptions formed a somewhat sensible and logical combination.

For each driver of change, the groups were asked to indicate which assumptions formed part of their scenarios. The two groups discussed among themselves which assumptions to add to the scenario outline and were left free to develop the outlines on their own. A facilitator was present for each group to help answer any questions the participants had, and to help guide the process of forming a scenario outline.

5.5 Relevant feedback from participants

Several assumptions were combined or had additions made to develop the scenario outlines during the workshops. This was mainly the case in the most negative scenario, where scientific research became part of a discussion that centred on how desirable it was to actually quantify certain environmental parameters. This also formed part of the discussion in the second scenario workshop.

In general, participants had no difficulty with developing the outlines from the lists of assumptions. This part of the workshop was done in the first workshop and took about 15 minutes total. Participants largely agreed on which assumptions they saw as more or less negative and formed scenarios that were mostly in agreement (between the different assumptions).

6. Scenario Narratives

6.1 Name Scenarios

The four names of the scenarios are, in order of most positive to most negative:

1. A farmers' choice
2. Benefits of a crisis
3. Uncertain futures
4. Stagnation till the end

6.2 Write the 2 or 3 detailed scenario narratives

In the scenario workshops we developed two scenario's: one better not best, and one worse not worst. The names of these scenarios are 'benefits of a crisis' and 'uncertain futures' which we believe capture the contents of these scenarios quite well. We outline the scenarios and describe how participants saw the development of these scenarios under the chosen assumptions.

1. Benefits of a Crisis

The first more detailed scenario starts from a crisis, brought about by existing drivers of change that come to a head in the near future (between now and 5 years). This means that even in the positive scenario there is a crisis, but participants saw this crisis as the catalyst that would enable positive change in the livestock industry.

The crisis that stakeholders envisioned was brought about by a combination of different factors. These factors were low prices connected to the dominance of retail actors in the agri-food supply chain, connected to an export-oriented business model in the livestock industry and government regulation that increases the costs for farmers. Combined these drivers cause a financial crash in the livestock industry with farms going bankrupt. Stakeholders pointed towards the pork industry in Flanders, which was already going through a crisis that resembled some of these elements, as an example of this.

A crisis like this, which would lead to a reduction in livestock farms and a reduction in food production would also potentially lead to empty supermarket shelves and Belgian citizens not being able to purchase animal products. A crisis like this was seen as a necessity in order to bring about the positive changes that were envisioned in this scenario, where this 'need for a crisis' was developed during the back-casting exercise.

For digitalisation in agriculture, things also first take a turn for the worse, where farmer data is not owned by the farmer and is used (and potentially abused) by governments and large agri-food companies.

Both of these crises function as triggers for other societal actors to bring about change in the agricultural sector. The key actor in all of this is the government (mainly at the regional and national level). The key element in these changes was the development of a long-term strategy for agriculture, which will provide greater stability, both to the sector and to the environment. Part of this long-term strategy is a more holistic view on the environmental impact of farms, where a broad view is taken to assess the environmental impact of farms, instead of focusing on single parameters.

Concurrent with these new agri-environmental policies and the long-term vision is an increase in funding for the sciences, which allow for an improved understanding of environmental impacts and how to reduce these impacts. The sciences also benefit from the use of increasingly data-driven agriculture, which drives a feedback loop where data from farms is used by researchers and companies in order to develop solutions that improve in-sights for farmers and help solve points of concern in agriculture.

This data-driven approach to farming is also helped by the stricter enforcement of data privacy and data ownership in agriculture, where previous crises around data has made the government implement new regulation that ensures that farm data is owned by the farmer. Because of the newly developed trust between farmers and other actors, data sharing is no longer an issue, enabling the rapid development of both knowledge and technologies that help reduce the environmental impact of farms.

Further government regulation orients itself to the role of retail and the fact that retail has become too powerful in setting prices for the agri-food supply chain. A regulatory agency is developed, or strengthened, in order to ensure fair prices throughout the food supply chain. This also allows farmers financial breathing room to develop their farm and make a switch to more sustainable farming practices. This further allows farmers to invest in (digital) technologies and provides opportunities for the digitalisation of the agri-food supply chain, causing knock-on effects throughout the agri-food supply chain and leading to improved digital technologies for farmers.

Making the switch to more sustainable food products, and coinciding price increases that allow for sustainable food production, will be difficult for consumers. Stakeholders identify this as a risk in these developments, as consumers are difficult to sway. Retail and governments will have to work in tandem if consumers are going to be convinced of paying a fair price for sustainable and local products. Equally there will be a need to better inform consumers on farming and on how agriculture works. This might include having some farmers as role models that show both consumers and farmers how sustainable farming is, and can be.

In this scenario there are some obvious winners, such as most farmers, governments, nature and society as a whole. The government has a key role to play in this scenario and in the transition to a more sustainable food system. Stakeholders agree on the need for a strong government in order to make this change, where consistent regulation and a long-term vision allow this revolution in the food system. Increasing use of data and data-driven agriculture is one of the key enablers in this as well.

There might be some risk to non-digital farmers in this data-driven agriculture, and attention needs to be given to this in order to ensure that all farmers are able to benefit from digital agriculture. This might be part of government policies that enable farmers to improve digital skills. Equally, this might be helped by some more digitally advanced farmers who are able to support the broader farming community in using digital agriculture. At the same time stakeholders expressed their desire that farmers were free to choose their own style of farming, where digital agriculture can be an option.

A clear loser in this scenario is the retail sector, although this was described by some stakeholders as 'retail winning less'. Through government regulation they lose some of their power over the agri-food supply chain and lose (some of) their role in setting the prices for agricultural products.

2. Uncertain Futures

In our more negative scenario there are several aspects that will influence one another to create a scenario that stakeholders described as highly realistic, but negative for most actors involved in livestock farming. As opposed to the more positive scenario, in this scenario the government does not develop a long-term vision but rather develops policies in succession that show little direction and are to an extent inconsistent with one another. Similar to some other agri-environmental policies, this might lead to a succession of policies that aim to curb ammonia emissions but that generally do not succeed in actually reducing ammonia emissions.

This is also not helped by the fact that science is unable to provide clear answers about ammonia emissions. It remains difficult to track these emissions and there is uncertainty about the amount of emissions individual farms produce. Equally, there remains uncertainty about the potential for new technologies in reducing emissions in farming. This also has a knock-on effect for the potential of sensors that can monitor ammonia, as the lack of knowledge on how to interpret the data coming from these sensors means that farmers are unable to incorporate this data in their farming practice.

Stakeholders do see potential for improved policy if the government is able to incorporate this existing uncertainty in agri-environmental policies. However, in this scenario it is far more likely that policy-makers, politicians and scientists are unable to make this switch.

While digitalisation does reduce uncertainty in some aspects, it is not enough to impact this scenario significantly. Because data is not owned by the farmer in this scenario and large corporations and governments can access this data, there is little trust among farmers in digital technologies in general. This widespread distrust causes a stagnation in the adoption of digital technologies and leads to slower development of new digital technologies.

Power in the agri-food supply chain also remains in the hands of a few large agri-food companies. The inequality between producers and other actors causes a scale differentiation where a few large farms survive. These large farms will most likely be much larger than current intensive livestock operations in Belgium. This allows these farms to produce at competitive prices for the world market, ensuring that they remain export-driven operations. Farmers that are unable to catch on to these developments in time, will either have to get out of farming, potentially remaining with a hobby-sized farm, or will be stuck with debt and an unprofitable farm.

Consumers do not significantly change their consumption patterns over the next ten years in this scenario. Animal products, and especially cheap animal products, remain appreciated by the vast majority of consumers. This, together with the power differences in the agri-food chain, also ensures that intensive large-scale farms are the only way to ensure food production. This is not necessarily a positive aspect for the Flemish farmer however, as retail will most likely import increasing amounts of products to ensure low prices.

This also causes further societal polarisation, where the environment remains under pressure while a large group of consumers desires cheap food. Polarisation between nature and farming is the effect of this, which does not benefit either group of actors. Alternative food systems remain marginal in this scenario and only small groups of consumers purchase their foodstuff through these alternative markets.

Digitalisation in agriculture does not necessarily correlate with the scale of farms. A small group of farmers (both mid-sized and large farms) are using an advanced level of digital technologies on their farm. These farms are also able to further automate their operation, lowering labour costs on their farm. There is however little reasons for these farmers to install environmental monitoring technology if it does not also allow them to raise the productivity of their farm. This means that the technologies of ammonia monitoring are used on a few research farms and by some interested farmers, limiting the uptake of this technology.

A potential role of environmental monitoring technologies and ammonia sensors, which was extensively discussed by the stakeholders, was dependent on if the government forces the uptake of ammonia emission monitoring by making these sensors compulsory for the farmer. While this scenario is undesirable and stakeholders were generally against this, they also saw it as a scenario that could very well materialise. In this scenario, farmers would have to have a sensor in their barns, which would most likely lead to resistance among farmers. Equally, scientists and ag-tech companies might not be ready for the implementation of these technologies, leading to farmers lacking the possibility to use these sensors for anything. This was described as the worst scenario possible by one stakeholder, which is why we solely mention this possibility but do not use it as an overarching theme for this scenario.

The winners and losers in this scenario are nearly opposite to the more positive scenario. In this scenario, large agri-food companies, retail and foreign livestock producers would win, both because of power in the agri-food chain remaining in the hands of these players and livestock production reducing in Flanders, which would be picked up by producers in other countries.

The losers in this scenario are the farmers, nature, governments, science and the agricultural economy. Farmers and the agricultural economy lose because of the mentioned scale differentiation in livestock farming, coupled to the lack of real solutions for emissions. Nature would lose because it turns out to be near-impossible to reduce livestock emissions except for by shrinking the livestock population. Governments would lose because of a lack of trust by farmers and broader society, after more and more regulation fails to improve environmental conditions.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

3. A Farmers' Choice

The most positive scenario, 'A farmers' choice' is called this because the essential element that makes this the ideal scenario, is increasing operational freedom for farmers. Rather than larger socio-economic circumstances and political institutions that determine the way that farms operate, in this scenario the farmer can choose how to structure their farm and whether to take a digital or non-digital approach, an intensive or less-intensive approach, and so on.

In terms of digitalisation, many new developments will happen in this scenario. Over the next ten years it will be possible to fully quantify all parameters on the farm. Newly developed sensor technologies allow farmers to track their livestock and other aspects of the farm (such as ammonia emissions) and they can use this data to optimise their farming operation. Machine learning and decision support systems help the farmers in interpreting this data and in their daily farming practice. This rapid development of digital agriculture is helped by increased investments, which is indirectly supported by improved financial circumstances for farmers.

The development of sensors that enable farmers to track ammonia emissions, coupled with new scientific insights in how to reduce ammonia emissions on farms, will enable the Flemish livestock industry to significantly reduce the total amount of ammonia emissions produced on farms. An open attitude to sharing data among farmers and other actors in the livestock industry, also helps gain insights on the data collected from a large numbers of farms. This open attitude is helped by the fact that other actors acknowledge the farmer as the owner of data, following the existing code of conduct on data sharing.

These improved scientific insights, coupled with increased investments in new technology, also lead to the development of new technologies that can reduce emissions while improving other aspects of livestock farming (including animal welfare). These technologies that address issues in a holistic way pave the way in addressing long-standing issues in the livestock industry (from animal welfare to broader emissions).

These developments coincide with the development of a new long-term vision for agriculture that is developed by the government in collaboration with other societal actors. The developments we described before ensure that this long-term vision succeeds in finding broad acceptance in society. This also reduces the tension between nature and agriculture, where the reduced impact on natural areas helps lessen this tension. Because of the long-term vision for agriculture and the fact that nature and farming can coexist, polarisation decreases for this topic.

This all would however not be possible without the increased prices that farmers get for their products. This increased price is caused by retail actors realising that an increased price is necessary in order to reach sustainable food production. Food retail, in this ideal scenario, starts these changes without having to be forced by government agencies. This increased price for farmers enables the investments in new technology that we described before.

4. Stagnation till the End

The most dystopic scenario is in many ways the opposite of the more positive scenarios. One of the main drivers in this scenario is the consumer and the importance of food prices. In this scenario the price of food remains the main element that determines consumer choice. The world market sets this price and Flemish farmers as well as other actors have little impact on these prices. Prices fluctuate on the world market, causing additional stress while they are generally too low to make a profit for most farmers. This is also caused by environmental regulation and a relatively high labour cost in Flanders, which drives up costs while not gaining a higher price for their products. Because of environmental regulation and relatively high labour costs, it is not possible to produce at this price.

The digitalisation of agriculture and rural areas stagnates in this scenario and rural areas are left behind in the development of digital infrastructure. The roll-out of 5G, and fiber internet remain limited to cities and dense suburban areas. This causes issues for the development of digital agriculture, where technologies cannot be adopted on farms because of limited internet speeds in rural areas. Equally, the low profitability of livestock farming does not make for an attractive market for companies developing these technologies or for investors looking to fund these developments.

In the meantime, scientific research progresses and is able to quantify all aspects of ammonia emissions on livestock farms. This allows for researchers to understand the level of ammonia emitted by different farms and how this impacts natural areas close to the farm. However, these developments also show that is near-impossible to adequately reduce ammonia emissions without also reducing the livestock herd on farms. Agri-environmental policy-makers use these insights in their policies, which will be focused on reductions in the livestock herd.

Natural areas are still threatened both by ammonia deposition from livestock farms, possibly mainly because of existing accumulated deposits of ammonia combined with a changing climate that makes it near-impossible to reach the environmental goals set for these areas. As the goals that policy has set for these natural areas are not reached, new policy is necessary in order to reduce the emissions of ammonia from livestock farms. These policies, as we described before, are mainly focused on shrinking the livestock herd and closing farms close to natural areas. As goals will remain difficult to reach, new and stricter regulation is developed every few years, leading to increased uncertainty for farms and other actors in the livestock industry.

Combined, these developments will most likely lead to a significant reduction of livestock farms and a broad reduction in the livestock herd. These reductions are the main cause for a lack of investment in livestock farming, which causes a vicious circle where there are no technologies available to increase the sustainability of livestock farming and a lack of sustainability ensures that governments develop increasingly strict policy to reduce the impact of livestock farming on the environment.

13.20 Ireland

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

SCENARIO WORKSHOPS
CULTIVATE (IRELAND)

18.11.2021

MEL WHITE, AARON BAILEY

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SCENARIO WORKSHOPS REPORTING TEMPLATE

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Table of contents

Introduction

1. Living lab summary

1.1 Name of LL

Cultivate

1.2 Brief summary of LL

The Living Lab is based around a community enterprise centre located in Cloughjordan Ecovillage, a 10 year old development which has brought an influx of around 100 professionals and their families to a sparsely populated area of rural Ireland. The Ecovillage, which is run as an educational charity, consists of 67 acres of land with three broad uses – residential, woodland and farmland, with approximately a third of the land afforded to each. The community's landscape design is based on the principles of environmental and ecological diversity, productive landscape and permaculture. Houses are built to energy efficient standards, and a district heating system provides shared use of renewable energy.

WeCreate Enterprise Centre is run by Cultivate, a worker's cooperative that's focused on citizen-led innovation and social enterprise with the aim of supporting the local community, furthering ecological sustainability, and fostering regional resilience. It contains a digital fabrication studio (FabLab) equipped with laser cutters, CNC routers, and 3D printers; a digital media studio used for webinars and podcasts; two large Enterprise bays, one of which is designated as a local food hub and hosts a digital farmer's market, a large event space, smaller meeting rooms, and several co-working desks.

Key activities include education and training, digital manufacture, promoting and developing local food systems, hosting events, creating and sustaining international networks and communities of practice, the incubation and development of innovative projects, and the provision of co-working facilities and meeting spaces for the local community.

1.3 LL participants

Living Lab stakeholders are all those involved in the Enterprise Centre in any capacity. These include cooperative members, co-workers, remote partners, local businesses, community groups and local individuals.

The workshop participants were mainly members of the cooperative who run the Enterprise Centre which is the focus of the Living Lab. They included people who are actively involved in different areas of work within the Enterprise Centre, including the FabLab, the digital studios, the food hub and digital farmers market, and administration and management of the building.

1.4 Timing of Scenario Planning (WP3) workshops

The workshops took place on the 22nd and 29th October 2021. Both were three hours in length, and were held face to face. Templates were prepared on a Miro board, which was projected onto a large screen in the room to ensure participants were clear on which part of the Miro board was under discussion. All participants had editing access to the Miro board, and worked directly on it on their own laptops, while discussing their contributions with those present in the room.

2. Scenario question

2.1 Draft scenario question

How might a rural community enterprise centre support regional resilience in 2031, while adapting to developments in digitalisation and the transition to a low carbon society?

2.2 Finalised Scenario question

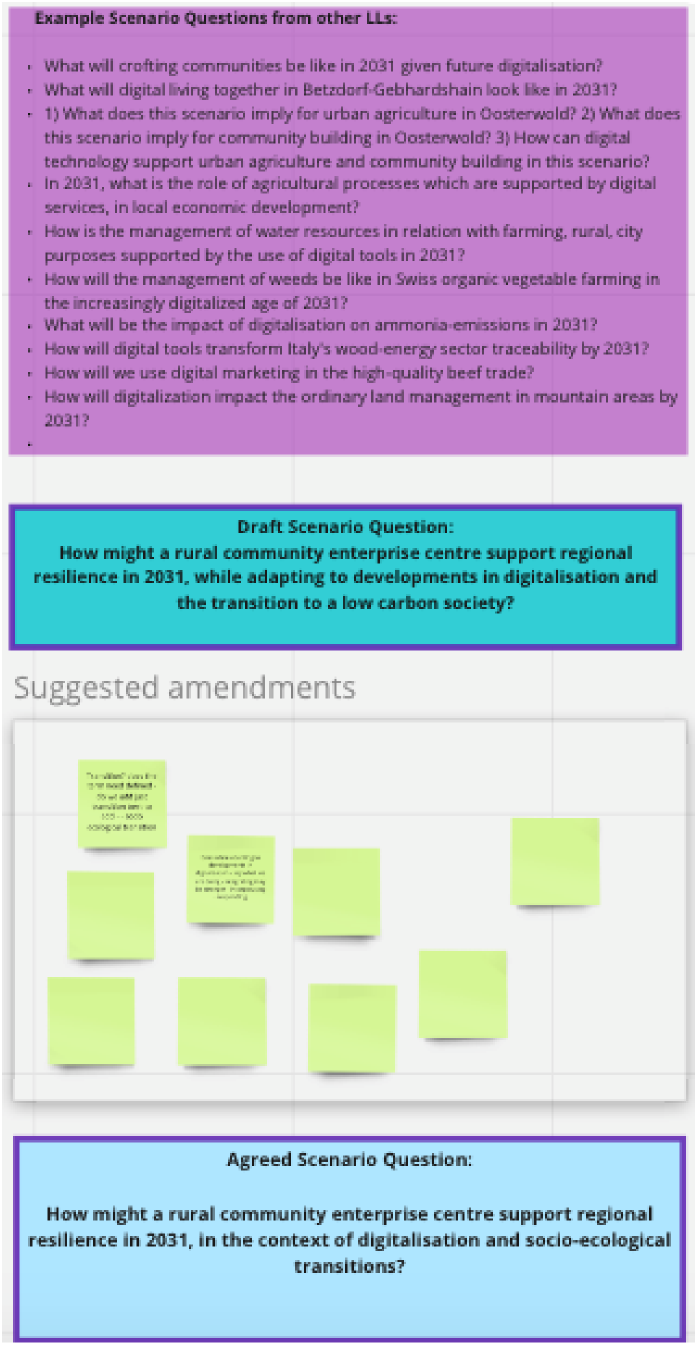
How might a rural community enterprise centre support regional resilience in 2031, in the context of digitalisation and socio-ecological transitions?

2.3 Methodology used to finalise scenario question

The finalised scenario question was selected by participants during the first scenario workshop. Participants were first given an overview of the plan for the workshop, to give them an understanding of how the scenario question would be used. They were then presented with the focal question from

WP2, and it was explained that the scenario question ought to be related in some way to the focal question. The time frame was also explained - that we are focusing 10 years into the future. Participants were then shown sample scenario questions from other Living Labs. Finally, they were presented with the draft scenario question. At this point they were given sticky notes, and invited to spend a few moments jotting down thoughts related to the question and suggested amendments. This was followed by a group discussion, which led to rewording of a section of the scenario question.

This followed a similar process undertaken by the coordinators in advance of the workshop. While the initial steps were the same, in the final stages of the preparation process the coordinators produced several different drafts, and spent some time refining them before they settled on the one they presented at the workshop.



2.4 Relevant feedback on scenario question from participants

The use of the word 'adapting' was queried by participants. It was felt that the word doesn't fully explain the mission of the Living Lab, which is more proactive: the Living Lab and its participants consider themselves early adopters - not merely adapting to changes, but anticipating them, and creating models for other organisations and communities to follow. The team considered replacing 'adapting' with a stronger verb (suggestions included integrating, incorporating, and responding to) before agreeing on the finalised wording.

Participants also concurred that the transition mentioned in the scenario question will be broader than a transition to low-carbon (although this will be a significant part of it). The phrase 'just transition' was also suggested. The group then agreed that the term 'socio-ecological transition' was both broad enough and narrow enough to cover the ideas intended.

The word 'developments' in relation to digitalisation was also queried, and the point was made that it should not be assumed that all changes to digitalisation would necessarily be advances, and that there is a possibility that energy crises could result in less, rather than more, access to technology in the future.

3. Relevant past events

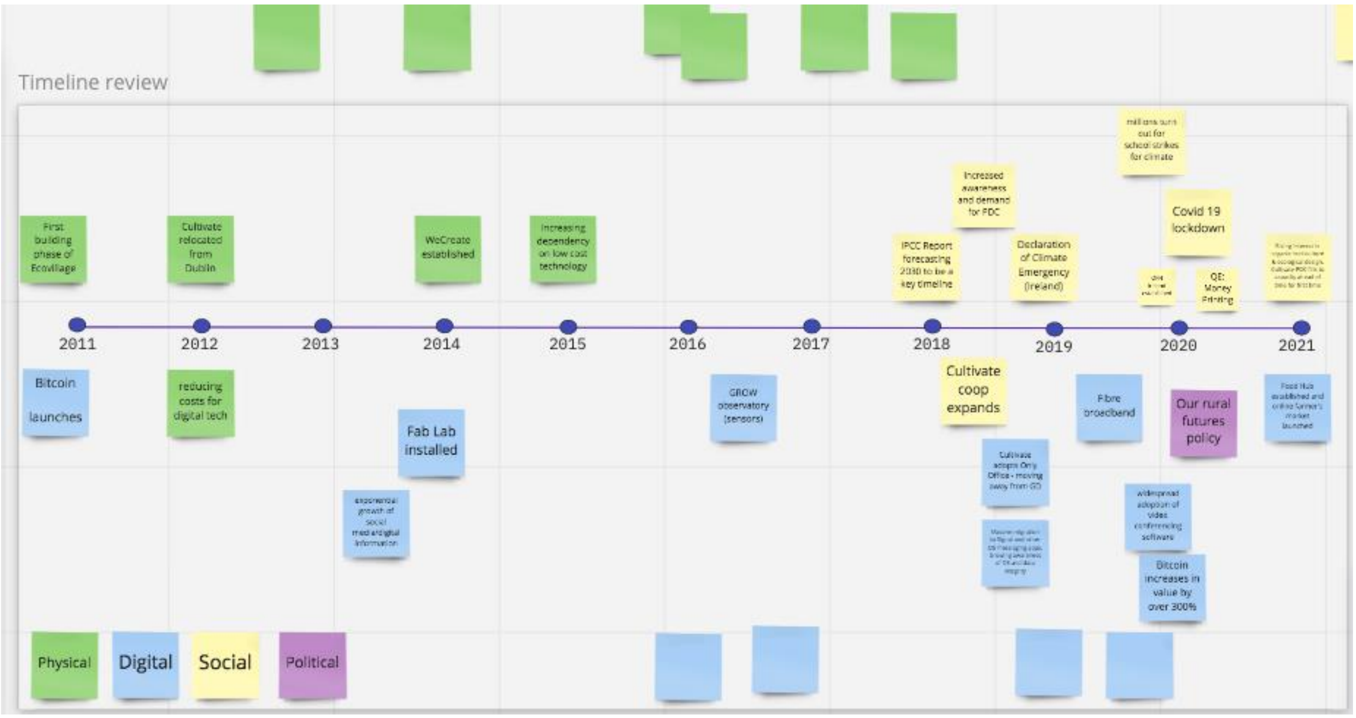
3.1 List of relevant past events

- 2011 - first building phase of Cloughjordan Ecovillage
- 2012 - Cultivate (the cooperative at the heart of the Living Lab) relocated from Dublin to Cloughjordan Ecovillage
- 2013 approx - Reducing costs of hardware components make digital tech more accessible
- 2014 - WeCreate Enterprise Centre established and FabLab installed
- Exponential growth of social media and digital information
- 2018 - IPCC Report forecasting 2030 to be a key timeline
- Fibre broadband installed in WeCreate Enterprise Centre
- Millions engaged in School Strikes for Climate movement
- Covid 19 and lockdowns
- Widespread adoption of video conferencing software
- Open Food Network Ireland established, and WeCreate's Open Food Hub and digital farmer's market launched
- Rising interest in organic horticulture & ecological design. Cultivate's annual Permaculture Design Course fills to capacity ahead of time for the first time

3.2 Description past event activity

It was explained that the purpose of this exercise was to give a felt sense of how much change to expect in the next ten years, and that this would be useful preparation for later parts of the workshop when the group would be projecting ten years into the future.

The Living Lab coordinators had pre-prepared a timeline on Miro, and populated it with a few of their own suggestions of relevant past events. During the workshop, each participant worked on their own laptop. They were given a few minutes to add sticky notes to the timeline on the Miro board with suggestions for other relevant events. This was followed by a group discussion, in which participants were given the opportunity to explain why they considered certain events important, and to explain in more detail any notes which were unclear to other participants.



3.3 Relevant feedback from participants

It was noted that while certain events could be dated precisely, there were others which were cumulative, and it was difficult to decide exactly where on the timeline they ought to be placed.

It was interesting to observe that ten years is precisely how long ago the Ecovillage building project began, so all the work of the Living Lab in this location has taken place in that timeframe (although the cooperative, Cultivate, had already been operational in Dublin for over 10 years previously).

One participant suggested the reducing cost of hardware components as a critical turning point. The significance of this was not obvious to other participants at first, but in the discussion that ensued the huge knock-on effects were noted, and it was agreed that a lot of later advancements would not have been possible were it not for this.

4. Drivers Of Change (DOC)

4.1 List initial set of DOC

- Social: New Ecovillage development phase - influx of new residents of varying ages
- Social: Networks / communities of practice driving the work programmes
- Tech: Development and adoption of digital accreditation badges
- Tech: Future of 3D printing
- Environmental: supply and access to energy
- Environmental: environmental awareness
- Economic: local economies / uptake of local supply chains
- Economic: shift to circular economy
- Political: national and international climate commitments
- Political: distribution of subsidies (local/global)

4.2 List selected DOC

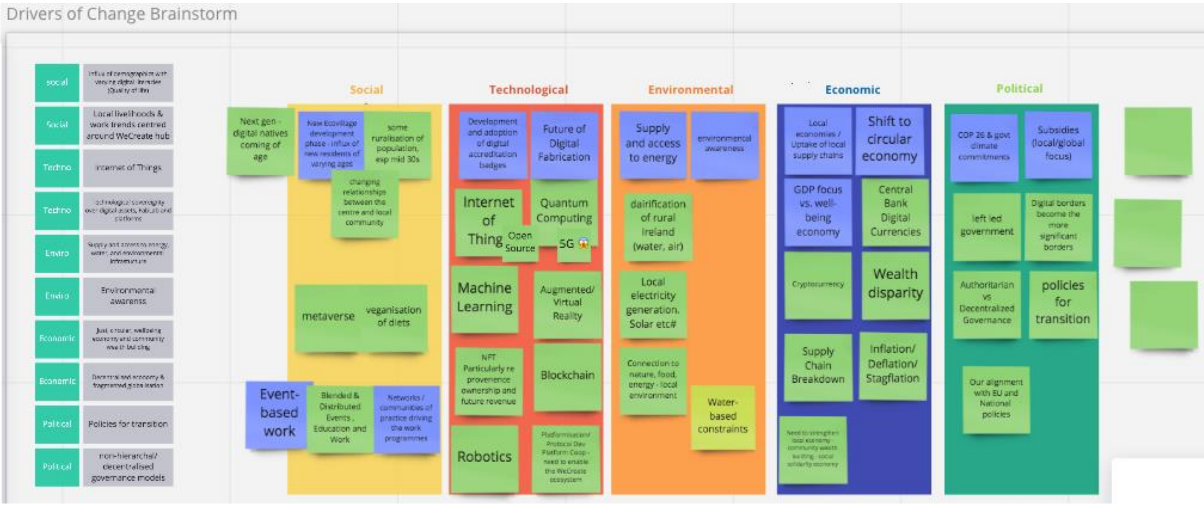
- Social: Influx of new residents
- Social: Local livelihoods & work trends centred around WeCreate
- Tech: internet of things and platform cooperatives
- Tech: Future of digital fabrication
- Environmental: supply and access to energy and transport
- Environmental: environmental awareness
- Economic: supply chains
- Economic: funding
- Political: policies for transition
- Political: non-hierarchical/decentralised governance models

4.3 Describe methodology to select DOC

In the workshop planning stage, the coordinators first listed predetermined events (for example, that the effects of climate change will become increasingly apparent). They then brainstormed an expansive list of both external and internal drivers of change, to ensure they were covering a broad enough range of factors. These were then categorised according to STEEP. A further step involved reflecting on which of these could be considered critical uncertainties (this step happened concurrently with an initial brainstorm of four scenarios for each DOC to be outlined in the matrix, to help clarify how useful each option would be to explore). Having narrowed down the drivers of change in this way, the coordinators then zoomed out to get an overview of their selection, to ascertain whether there were any important gaps.

For the workshop, five frames were created on Miro, and each one labelled according to one of the letters of the STEEP acronym. The suggested drivers of change were posted at the top of each of these frames. Using their laptops, participants were then invited to post sticky notes in each of the frames with other suggestions. This section of the workshop generated lots of ideas, and each frame contained multiple notes by the end of the exercise. The coordinators then spent a few moments grouping some of these together, combining those which overlapped in meaning. By the end of this stage there were approximately ten suggestions in each of the five frames.

Another template had been created on Miro with only two spaces for each letter of STEEP, and through group discussion the participants then refined the selection until they had agreed on the 10 drivers of change. Workshop participants decided that for each category of STEEP they would aim to select one internal and one external driver of change. This was slightly adjusted in some cases: internal DOCs were interpreted as those which had impacts primarily at a local level, regardless of whether the source of the DOC was internal to the Living Lab.



4.4 Relevant feedback from participants

For some of the DOCs it was unclear where to position them according to STEEP. Several suggested DOCs could be considered either economic or political (funding and subsidies for example, are controlled by policy decisions).

It was generally agreed that a lot of the factors contributing to the Living Lab work could be considered environmental. However, as most of that work is office/Enterprise Centre based and not directly affected by the physical environment (weather, soil erosion, biodiversity loss, etc) it was difficult to decide on environmental factors that were relevant.

For the technological category narrowing down to two options seemed almost arbitrary. The Living Lab aims to be at the cutting edge of digital innovation in relevant fields, and for every DOC the participants considered it was evident that several equally valid DOCs would have to be discarded. The final decision to select 'Internet of Things' was made under time pressure, as the three hours allocated for the workshop did not allow for much further deliberation. Some participants expressed a preference for a DOC which directly referenced platform cooperatives, as these are fundamental to the Living Lab's way of working. There was not enough time available to tease out whether this could be expressed in a way that allowed for critical uncertainties, but it was agreed to somehow combine the two themes under one DOC. In the end the participants were relatively happy with the selection, but it was clear that more time for this and later parts of the workshops would have been preferable.

5. Matrix

5.1 Matrix description

Two DOC were selected for each category of STEEP and each was expanded upon to describe its likely outcome underneath each case/assumption. 'Business as usual +/-' indicates that assumptions could be seen as either slightly more or less favourable than the current BAU paradigm. Pathway 1 is denoted with the purple tile background, while Pathway 2 is yellow. Pathway 3 (the best plausible pathway) is shown in green tiles, and Pathway 4 (the worst plausible case) is shown with red tiles. Where pathways overlap in the DOC cases, the tile and text colours alternate. Eg. Pathway 1 and Pathway 3 both begin with the same assumption therefore the tile is purple and the text is green, and Pathway 2 and Pathway 4 overlap in the 3rd DOC, therefore the tile is yellow and the text is red.

Drivers of Change	Best plausible case	Business as usual +/-	Business as usual +/-	Worst plausible case
Influx of new residents (Social)	Influx of young dynamic people into the Ecovillage who create livelihoods in the community.	Ageing, wealthy, demographic - more consumers for local livelihoods, less competition for jobs	Social housing brings a lower income demographic into the community.	Planning permission hurdles cannot be overcome. No new building phase. Depopulation in the wider region
Local livelihoods & work trends centred around WeCreate (Social)	WeCreate prototyping new livelihood approaches which are adopted by other communities	More local involvement in the Enterprise Centre - collaborating on projects, and making use of assets	WeCreate activities mainly attractive to people outside the locality. Limited local awareness	Commuting increases. Work centres around urban areas, extracting wealth from the region. Conflict between the Centre and the community
Internet of Things and platform cooperatives (Technological)	Internet of things develops alongside citizens' sovereignty over digital assets and platforms, WeCreate drives democratic digitalisation to enchant lives.	Advancement of Open Source community-led digitalisation enabled by the internet of things. Collaborative projects and community-owned platforms like OFN thrive.	The internet of things results in even more sedentary, screen-based lifestyles, consumer culture, fads for the latest gadget and growth of Amazon-type corporations and chain services	Internet of things controlled by corporations and governments, limited societal freedoms and little awareness or potential for alternatives ('The Matrix' with intergenerational debt)
Future of digital fabrication (Technological)	Digital fabrication allows for sustainable local production of goods and becomes a keystone of local supply chains	Digital fabrication becomes fashionable - regular demand for use of WeCreate's FabLab by local schools and businesses	Other fab labs/ makerspaces develop locally, WeCreate's tech becomes outdated	Fab Labs remain niche and never really take off (the MySpace of manufacturing - superseded by what comes next)

Supply and access to energy and transport (Environmental)	Energy demand stabilises with production of low-cost renewable energy, reduction of emissions. Abundant affordable public transport provides easy connectivity with all parts of the country	Slow but steady growth of renewable energy sector including community-owned resources. Improved semi-regular public transport connects Cloughjordan to urban centres. Legislation and incentives for car sharing. Rising energy costs	Energy crises hit Global North hard, resulting in fuel poverty and less digital access and opportunities; prohibitive cost of fuel and limited public transport options greatly reduces travel to/from the area	Consumption continues to increase rapidly, driving up emissions and depleting resources, leading to conflict.
Environmental awareness (Environmental)	Societal values and environmental awareness reach tipping points to achieve successful socio-ecological transition. Biodiversity begins to recover and species loss halted.	Environmental awareness and high public interest in the Ecovillage. More eco-communities develop. Huge uptake for sustainable education (eg PDCs)	Public opinion influenced by greenwashing - fake transition and limited genuine environmental awareness	Too little changes implemented too late to reach climate targets and adaptation.
Supply Chains (Economic)	Strong local supply chains and community wealth building. Price of imports reflects the true cost of production. Mainstreaming of circular economy (reuse, repair etc). Increased food security and equitable access to resources	Breakdown of global supply chains causing a slowly growing awareness of local alternatives. Frequent shortages of essential items (eg paper)	Supply chains largely monopolised by a few corporations. Increased trade agreements and subsidies to global supply chains despite shocks and environmental impacts.	Sudden breakdown of global supply chains causes panic. Poverty and wealth disparity increase

Funding (Economic)	Alternative currencies and/or changes to the financial system enable viable alternatives to external funding	Increased European and national funding and support that is aligned with our work provides financial stability within the Centre	External funding is minimal or greatly reduced, reliance on income that can be generated directly from individuals locally or within our networks; struggle for finance	Closure of WeCreate Centre
Policies for transition (Political)	Huge political ambition to meet sustainability targets and additional supports and funding for the economic transition. Adoption of eg the Doughnut model	Some transition policies align with the LL's mission and channel resources to its stakeholders.	Policies favour conventional system and business as usual approaches with a green tint. Our LL remains an outlier pioneering alternatives, without viability.	Policies fail to make the transition needed, leading to national debt and social unrest as politics fail society.
Non-hierarchical/ decentralised governance models (Political)	Decision-making models adapt to empower subsidiary area and citizens. CEV and Cultivate are highlighted to model and teach these.	Slightly more societal cooperative ownership and governance.	Gov parties change/act radically more conservative/ authoritarian. Our cooperative ways are fringe.	state control of encryption and criminalisation of privacy and engagement

5.2 Define 4 pathways/scenarios selected

The four pathways include a best case scenario, worst case scenario, and two more plausible pathways. Both of these plausible pathways contain both positive and negative aspects, and as such cannot really be defined as 'better not best' and 'worse not worst' pathways.

The first of these plausible pathways could be considered better than the other from the Living Lab's subjective standpoint. World events include an energy crisis and supply chain breakdown, creating an outlook which is far from positive on a global scale. However, under this scenario, the Living Lab was reasonably well prepared for these events, its work plan is still relevant, and projects currently being established have proved successful and are flourishing in 2031. A young and vibrant demographic embraces the changes in the world with creative, innovative energy, and the Enterprise Centre becomes an active, thriving community hub. The energy and supply chain crises bring many knock-on effects, but these are seen as challenges to adapt to rather than overwhelming problems, and some move us closer to climate targets and a more equitable society.

For the second pathway, workshop participants chose as the starting point an ageing demographic in the locality, which sees the Living Lab less prepared to deal with changes in the world, and left behind by some of the latest technological advances. While the Living Lab was once an early adopter of many developments in digitalisation, participants are forced to watch these technologies develop in new and different directions, and find their own business model is no longer relevant. In this scenario, Living Lab participants are struggling to find solutions to problems close to home, such as the removal of funding and a shortage of young, dynamic energy.

In the best case scenario, society has adapted its outlook and policies and we are on track towards a just transition, with the goal of meeting the needs of all within planetary boundaries. The local economy is flourishing, and the Living Lab benefits greatly from funding that supports its members in providing education relating to the Ecovillage's model of sustainable living.

The worst case scenario presents a world in which not enough has been done nationally and internationally to reach climate targets, and at a local level the Living Lab is struggling to remain viable. Society appears further embroiled in delusionary consumerism and digital obsession than ever. Digitalisation has resulted in further ecological breakdown, rather than in creating a better world.

5.3 Identify the 2 pathways that will be defined in more detail

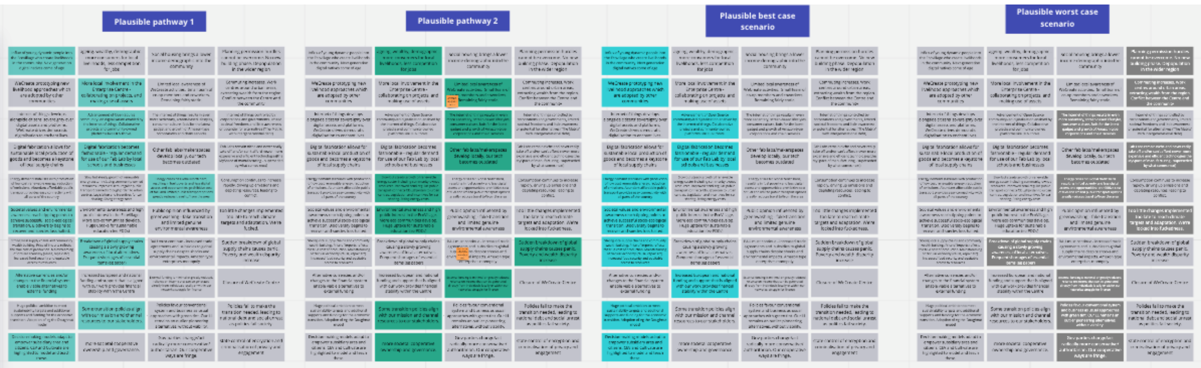
The pathways labelled plausible pathway 1 and plausible pathway 2 will be described in more details

5.4 Methodology used to identify pathways

The matrix was copied and pasted four times into Miro, and each one given a different title (plausible pathway 1, plausible pathway 2, plausible best case scenario, and plausible worst case scenario). The coordinators emphasised that it was important for each pathway to be internally consistent. Participants were instructed to change the background colour of the chosen steps of the pathway.

The participants began working through the pathways as a group. However, some disagreement soon arose as to whether it was preferable to work through one pathway at a time, or whether to fill in the top row of all four matrices before proceeding to the second row (and so to work on one DOC at a time across all four possible scenarios). As different participants expressed a preference for different working styles during this discussion, the outcome was that the group divided into small groups, and each group worked on a different scenario.

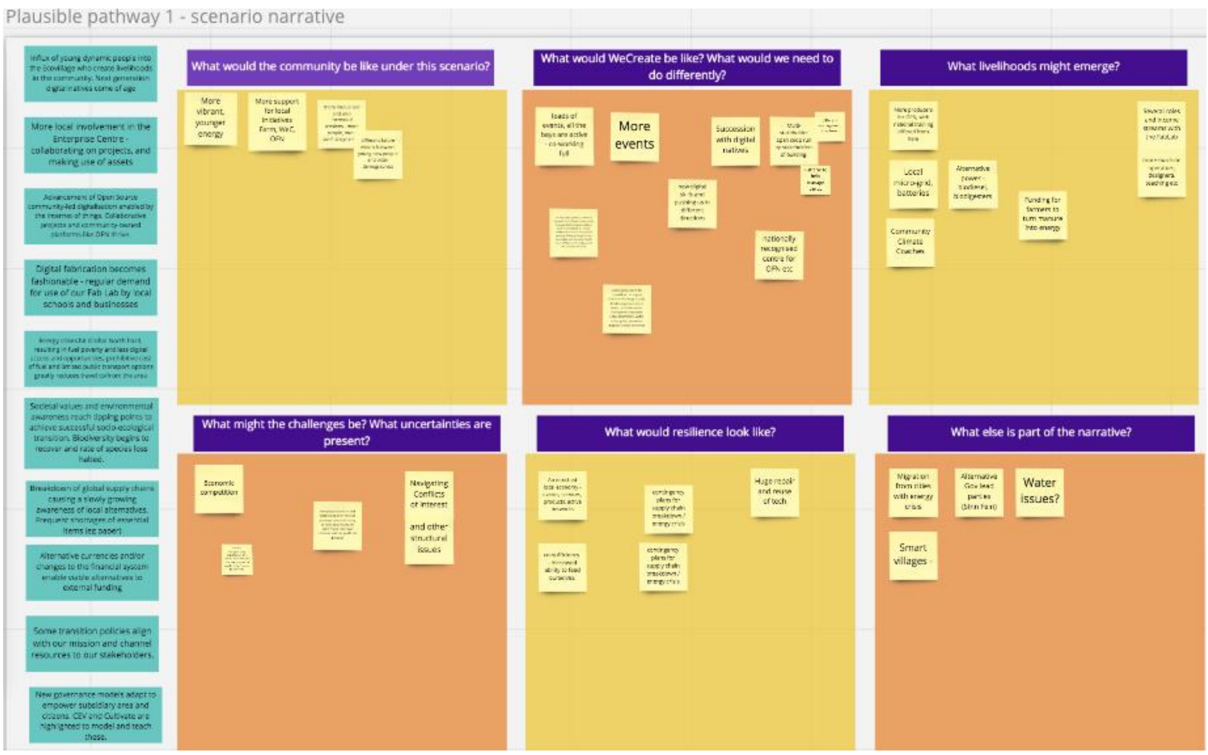
Once all four pathways had been highlighted in this way, the group as a whole reviewed the four chosen pathways. Those who had selected the pathways were invited to justify why they believed the different aspects of their chosen pathway belonged to the same narrative.



5.5 Relevant feedback from participants

The participants were relatively happy with the first plausible pathway, but the consensus was that the second pathway was less cohesive. More work was later done to further develop plausible pathway two, particularly in terms of imagining the technological developments in greater depth.

6. Scenario Narratives



6.1 Name Scenarios

Plausible pathway 1: High energy (from humans), low energy (from fuel)

Plausible pathway 2: Older and wiser – less active and viable

Plausible Best case: The Future is Bright – but not Burning

Plausible Worst case: Down but not Out…Yet.

6.2 Write the 2 or 3 detailed scenario narratives

High energy (from humans), low energy (from fuel)

This scenario is largely heralded by an energy crisis, which hits the Global North hard and results in fuel poverty for many disadvantaged groups. The need to drastically reduce emissions in line with global climate targets has led to high carbon taxes, and the prohibitive cost of fuel and limited public transport options greatly reduces travel to and from the area. This is coupled with a breakdown of global supply chains, and frequent shortages of essential items. After the initial shocks when everyday items (from food staples to basic materials such as paper) suddenly became unavailable for periods of time, people have begun to recognise the need for local alternatives. There is a growing trend towards regional resilience and sustainability.

A new development phase took place in the Ecovillage in the 2020s, and in this scenario this has brought an influx of youthful, dynamic energy. The generation who took to the streets in support of School Strikes for Climate Action are now in their twenties and thirties, and they are determined not to have their future stolen from them. Although most of these young activists have moved away from protest, they are still fully aware of the extent of the climate crisis and many were drawn to the Ecovillage in search of solutions to the state of the world.

As travel is no longer cheap or straightforward, those who have relocated to Cloughjordan are unlikely to be commuting or otherwise travelling elsewhere, so outside of occasional family visits the population of the area is fairly constant.

The Enterprise Centre becomes a bustling, busy place, with every space utilised, various projects underway, and frequent events with high levels of attendance. As it is no longer common to travel frivolously, most events include the possibility to attend virtually. Co-working spaces are used to capacity by people working remotely, and several soundproofed pods have been built to facilitate conference calls.

Shopping is now conducted almost entirely virtually, and there are very few walk-in outlets - physical shops have been replaced by warehouses that distribute goods for home delivery, and virtual reality enables customers to recreate the experience of walking into a shop and handling products without having to leave their home (this is especially popular for clothes shopping, as people are able to virtually try on clothes and easily see how good they look from the back).

Specialised search engines showcase what is available in the locality. There is a lot of support for local initiatives, many of which are supported by digital platforms such as the Open Food Network, a platform cooperative through which the Enterprise Centre hosts a digital farmers market directly connecting local producers and consumers - this is now thriving. This has created a number of new livelihoods, and many small businesses have sprung up: growing, harvesting, preparing, preserving and selling local produce. The platform now includes a virtual element, so customers are able to visit the producers online to see exactly where their food comes from, and to judge for themselves whether products meet their ethical standards (the public is now much more concerned about sustainability and food origins and holding businesses accountable).

Digital fabrication has become mainstream, and the FabLab now provides a number of income streams. There are more machine operators, designers, and teachers, and visits from local schools are a frequent occurrence. There is also increased cohesion between the different activities of the Enterprise Centre, and the community make more use of the facilities - the FabLab is used to produce and repair things for the Ecovillage, to create artworks for local festivals held on Ecovillage land, and to make products and packaging for sale through the Open Food Hub. Frequent 'repair cafe' events take place, during which technicians dedicate their time to fixing any broken items that individuals bring in.

Long standing co-op members, who had been pioneers in their fields, now find their skills surpassed by a new generation of digital natives who have recently come of age, and are often surprised to find themselves pushed in unexpected directions. A new co-operative governance model is in place which was spearheaded by these older members, who are now bemused to find their ideas and experience are no longer respected, and their voices carry little weight in decision making. They grapple with the dilemma of how to step back and not try to keep control, allowing the younger generation to make their own mistakes without guiding the direction.

There are also tensions in the village, as some of the older population have different future visions, and are not all happy with the changes they see implemented, and the speed with which change is happening. Several older residents take refuge in the consensus decision-making processes that have been long established in the Ecovillage, which require two months of consultations before decisions can be made. This causes frustration in some of the newcomers, who wish to see project ideas implemented more quickly.

There are strong concerns relating to long-term access to goods and services that can not be sourced locally, and a drive to put contingency plans in place for breakdown in supply chains and energy supply. Materials often prove to be unavailable, which has caused an upsurge in creativity at times as people are forced to deviate from their original plans to manage with whatever is to hand, and there is much more of an acceptance that people have to do without certain things at times. Despite the popularity of the FabLab, there is frequent disruption to electricity supply, and manufacture has often been delayed because of the temporary inoperability of machinery. Events, meetings and conferences occasionally have to be cancelled due to sudden power outages. The digital farmer's market, too, has been affected by power outages, and the coordinators have had to devise back-up means of communication to inform suppliers of what items have sold, as it is no longer one hundred percent reliable that electronic communications will be received immediately. As these types of electronic hiccups are now commonplace across all sectors of society, people are much less likely to complain these days when things don't work as expected, and digital technologies remain popular, despite their less than perfect track record of reliability.

Biodiesel generators have been purchased in an attempt to mitigate the issues, but as these have seen a rapid increase in popularity, demand for fuel often outstrips supply. There is widespread regret in the Ecovillage that there was not a more concerted effort to repair or replace the large installation of faulty solar panels before components became difficult to source. Open source designs are available for 3D printed replacement parts for the solar panels, but experiments with these have not yet proved successful, although there is still hope that they will be up and running soon. Wider micro grids are proving effective in some areas, and certain pocket neighbourhoods within the Ecovillage have a steady supply of locally generated electricity. However these are taking time to install and have yet to cover the Ecovillage in its entirety, much less the wider region. Overall, though, the Ecovillage is faring better than many other localities which were less well prepared to deal with energy crises, and energy disruption is minimal here compared to other areas.

Older and Wiser – Less Active and Viable

Supply chains have suffered from recent shocks due to the knock-on effects of Climate Change in the Global South, with severe weather events, soil depreciation, and political turmoil in affected countries contributing to a sudden drop in global production. There is huge pressure from businesses and the public to fix the supply chain crisis and make imported goods readily available once more, so governmental policy focus turns towards global issues and away from local projects. As a result, funding and subsidies are channelled away from the Living Lab. As a number of the Living Lab's traditional work areas involving remote work and European partnerships are no longer viable without external funding, the cooperative is forced to abandon many of its projects and focus on ways to generate income directly from individuals in the immediate community or within its networks.

In the Ecovillage, the recent building phase mainly produced expensive, privately owned houses, and the influx of new residents was largely confined to an older, wealthy demographic. The pre-existing occupants of the Ecovillage have aged ten years since the time of writing, and many are now retired or approaching retirement age. Many of the children raised in the Ecovillage have grown up and left the community.

This older demographic brings with it a certain increased energy, with an upsurge of voluntary work from people who have more time post-retirement, although there's also a significant number of elderly residents who now require care and are unable to contribute their time. A small but dedicated younger cohort have moved into the Ecovillage or the surrounding area, mainly following involvement in volunteering projects or permaculture courses. However they make up a small fraction of the population, and there is a widespread awareness that without an up-and-coming younger generation the long term sustainability of the Ecovillage project is under threat. There is a general sense of regret that more wasn't done to focus on affordable accommodation in the recent housing development, as many of the current issues facing local residents are perceived to stem from a lack of opportunities for younger demographics to move into the Ecovillage.

The housing issues notwithstanding, an opportunity is present for those of employable age in that the ageing demographic provides more consumers for local businesses, at the same time as less competition for local jobs. The challenge is to harness this opportunity and find ways to meet the needs of all while adapting to the new circumstances.

Shopping for essentials has been largely automated for some time. Fridges, freezers and food storage units are routinely fitted with sensors which update a database with details of stock levels. Major food outlets use this data to generate automatic shopping lists based on individuals' consumption habits - ordering more of items that are used up quickly, for example, and adding new product suggestions based on predictions made by algorithms. Many people are happy with the convenient option of skim-reading these pre-prepared lists and merely adding or subtracting the occasional item from their regular order. Under this system, the majority of people have been sourcing most of their food through centralised corporations.

Local food initiatives rely on digital platforms which connect them directly with consumers, like the Open Food Network, a community owned platform cooperative which the Living Lab used to set up an online farmer's market. In Cloughjordan the OFN has been reimagined to incorporate a 'meals-on-wheels' service aimed primarily at elderly residents, providing ready cooked healthy food made from local ingredients which are ordered through the online platform. However this has only brought in a limited income for the co-operative, whose members have tended to have a more administrative and promotional role in local food systems, and have not been directly involved in food production.

The need to meet global climate targets and adapt to low carbon models is now well established both politically and publicly. There has been a slow but steady growth of the renewable energy sector over the years, and incentives to move towards a circular economy: built in obsolescence is no longer common, and people are encouraged to reuse and repair rather than replace broken items.

Digital fabrication has leapt into the mainstream, and many products can now be repaired locally (it is more common to use this technology for replacing components, rather than creating products from scratch). Most households now contain a small 3D printer, although their use is limited to replacing small items which don't contain moving parts or sensors - the knob for an oven door, for example, could be scanned to get access to the plans, and a replacement could be made and fitted at home. For the repair of more complex items, a well-known chain has bought the schematics of all products supplied by most of the major companies: once you identify the make, model and problem with a broken cooker, for example, they can make a replacement part in one of their local fabrication spaces.

Small, independent Fab Labs still exist, and it's possible to find Open Source alternatives for many designs. However, the WeCreate FabLab has failed to realise its potential, largely due to the development of other maker/repair spaces locally, and competition for a limited customer base in a low populated area. Meanwhile, WeCreate's tech has become outdated and financial constraints have prevented the cooperative from upgrading the machinery - moreover with the removal of funding, any new investment has become unlikely. This is the cause of a lot of frustration and a sense of missed opportunity, particularly amongst those who had been early proponents of digital fabrication. There is regret that the Living Lab failed to communicate the potential of digital fabrication to the community in the early days: had the assets been appreciated and well utilised, they may have provided enough income to justify upgrading the tech in a timely manner.

In general, there is limited local awareness of WeCreate activities, and little understanding of the activities that the Enterprise Centre has been involved in, or the difficulties faced by the lack of funding. Despite this lack of local involvement, there has been consistently growing interest in the Centre's activities from further afield. Cloughjordan Ecovillage is widely recognised as an early proponent of sustainable and regenerative ideas, whose experience and expertise is well respected, and the Permaculture Design Courses have continued to attract more and more participants. Cultivate are considering running these back to back throughout the year in an attempt to manage the current financial shortfall, as a focus on more educational initiatives is increasingly seen as the most likely avenue to financial viability for the Centre.

Unfortunately, the lack of suitable accommodation and a dedicated education centre limits the centre's capacity to hold more of these courses face to face. The failure to provide these kinds of spaces during the building development is a sore topic for many, particularly as improved semi-regular public transport connects Cloughjordan to all the main urban centres, making the Ecovillage easier than ever to reach. However, the digital media studio is well equipped to allow virtual participation in courses, and while many people feel there is no replacement for actually visiting the Ecovillage, advancements in virtual reality technology now allow people who are not physically present to participate even in the hands-on, practical activities that are part of the course.

6.3 Name and write the less detailed 'best case' and 'worst case' scenarios

The Future is Bright – but not Burning

On the back of scientific consensus, and following multiple international summits on climate change, governments worldwide have acknowledged the severity of the crisis and formed binding agreements in an attempt to mitigate the worst impacts. In Ireland there is a national drive towards building sustainable communities, and public information campaigns around climate action reminiscent of those in Covid-19 times have long been the norm.

Since the early 2020s, funding and subsidies have been increasingly channelled towards sustainable projects, and the Living Lab has benefited greatly from these. A large grant enabled the recent building development to include a large dedicated education centre equipped with catering facilities, and enough accommodation and seminar rooms for several courses to be held simultaneously. Many of these courses are subsidised, allowing the Ecovillage to run many trainings for free, or at low cost to participants. The viability of educational offerings is enhanced by the affordable, upgraded public transport infrastructure that was installed over 7 years ago (and greatly aided the reduction of emissions). As a result, the Ecovillage receives a constant stream of visitors, and many people throughout the country have taken part in some sort of training programme offered in Cloughjordan. A reasonable percentage of these courses are run in collaboration with the Enterprise Centre, and the Living Lab's cooperative, citizen-led approach has become an inspiration to many. The Ecovillage has since become hugely influential in re-designing the socio-economic landscape of the country.

Popular courses in social/group dynamics, decision making, and collaborative governance have had a wide public influence, and political parties are beginning to opt for decision-making structures that rely more on citizen input and subsidiary empowerment. One of the Centre's earlier courses, which has been taught for well over ten years, is focused on community resilience, food sovereignty and local food systems, and showcases the community supported agriculture model adopted by Cloughjordan Community Farm, under which members pay a monthly fee for their vegetables, and farmers receive a guaranteed wage, as well as the digital farmers market hosted by the the Open Food Network, which allows local producers to connect directly with local consumers. The course also contained a module on Community Wealth Building, a model under which key public institutions such as hospitals and universities source their food and other resources locally, thus invigorating local economies. This module ignited the imagination of certain students who went on to become influential public figures, which led to these and similar schemes being championed and later established nationally, at a time when all countries had begun subsidising lower-carbon local food initiatives. With the end of cheap, subsidised imports, the real cost of production became evident, and there was a rapid increase in jobs to replace previously outsourced positions.

Digital fabrication now allows for sustainable local production of goods and has become a keystone of local supply chains. Further supports for local production enable the FabLab to take on bigger projects. Partnerships with national universities have brought both younger residents and bigger outputs, including interior CNC kit-outs and small dwellings for students and visitors.

As society finally starts to collaborate toward a fairly unified vision of an equitable world, just social values and environmental awareness reach the necessary tipping points for a just socio-ecological transition to be in sight. Mainstream economists now promote alternative economic models such as Doughnut Economics, which replaces the goal of GDP growth with the more visionary goal of meeting the needs of all within planetary boundaries. Cities are being developed in balance to the ecosystems they're a part of, with a focus on safeguarding the natural world along with the built environment, and the Living Lab has recently begun work with local councils to implement Permaculture Design in more urban settings. The circular economy is now an overarching theme in Cultivate's work programme and advancements in VR and AR have enriched how circular cities and towns can be visualised and reimagined. Cultivate are pioneers in these new ways of thinking, outlining how systems can nest within each other to be parts of an integrated whole, and waste products can be reabsorbed into the system and become resources for other areas of the local economy.

Down but not Out…Yet.

Within the EcoVillage, planning permission hurdles cannot be overcome, and no new building phase takes place. This is mirrored by depopulation in the wider region: work is increasingly centered around urban areas. For a while commuting increases, but as energy prices rise, and little public money is channelled into rural public transport, the cost of travelling for work becomes prohibitive. Fuel poverty becomes a major national issue, with hefty carbon taxes and little subsidies for those outside of cities. Eventually the energy crisis overtakes the housing crisis, and it becomes more affordable to live in Dublin than to commute from a rural area. For remaining Cloughjordan residents it becomes difficult to leave the area, and difficult to attract visitors.

Meanwhile technological advances continue elsewhere, but Cultivate are no longer pioneers or early adopters. Fab Labs remain niche and never really take off (the MySpace of manufacturing - superseded by what comes next). WeCreate can't afford the newer, more expensive and efficient technologies, and get left behind in the race towards the future. The development of the internet of things results in even more sedentary, screen-based lifestyles. Consumer culture reaches ever greater heights, with continuous fads for the latest gadget and the growth of Amazon-type corporations. Platform cooperatives and open source alternatives fail to gain a foothold in the mainstream imagination. Tech giants like Google and Apple continue to integrate smart-hardware with their services, making the internet of things and virtual spaces almost inaccessible without subscribing to their products, and thus, corporately owned data systems. Individual companies have a monopoly on products, so it becomes impossible to, for example, buy a cooker which is a different brand from your fridge, as it will be incompatible with the system.

In light of these developments, the Living Lab remains an outlier, still making some attempt to improve the situation both locally and globally, but without viability. External funding is minimal or greatly reduced, and stakeholders face constant financial struggles. Cultivate's event and educational work largely grinds to a halt, and the cooperative largely relies on consulting work to keep the Centre afloat. The scope of consultancy is enhanced by digital developments, such as immersive 3D rendering of projects, which also offers vast new potentials for virtual gatherings and conferences. However, this work is less satisfying overall and further entrenches cooperative members in sedentary lifestyles as much of it can be done remotely.

Policies favour the conventional system and business as usual approaches with a green tint, and too little changes are implemented too late to reach climate targets and adaptation. All of the above issues are overshadowed by the impending sense of disaster as climate breakdown continues to accelerate. There's a deep sense of grief in the Ecovillage as well as anguish for future generations, and within the Living Lab, resignation that the mission to achieve a resilient society has failed. Many local efforts now focus on preparation measures for coming hardships like stockpiling food and needed resources. Digitalisation at this point seems to be both a distraction and a proponent of the rate of environmental degradation - with continued mining and burning of resources for energy, data centres and consumerism.