



DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

# Mapping Digital Technologies

## Taxonomy and Inventory of Digital Game Changers

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**#DESIRA2020**

# Outline



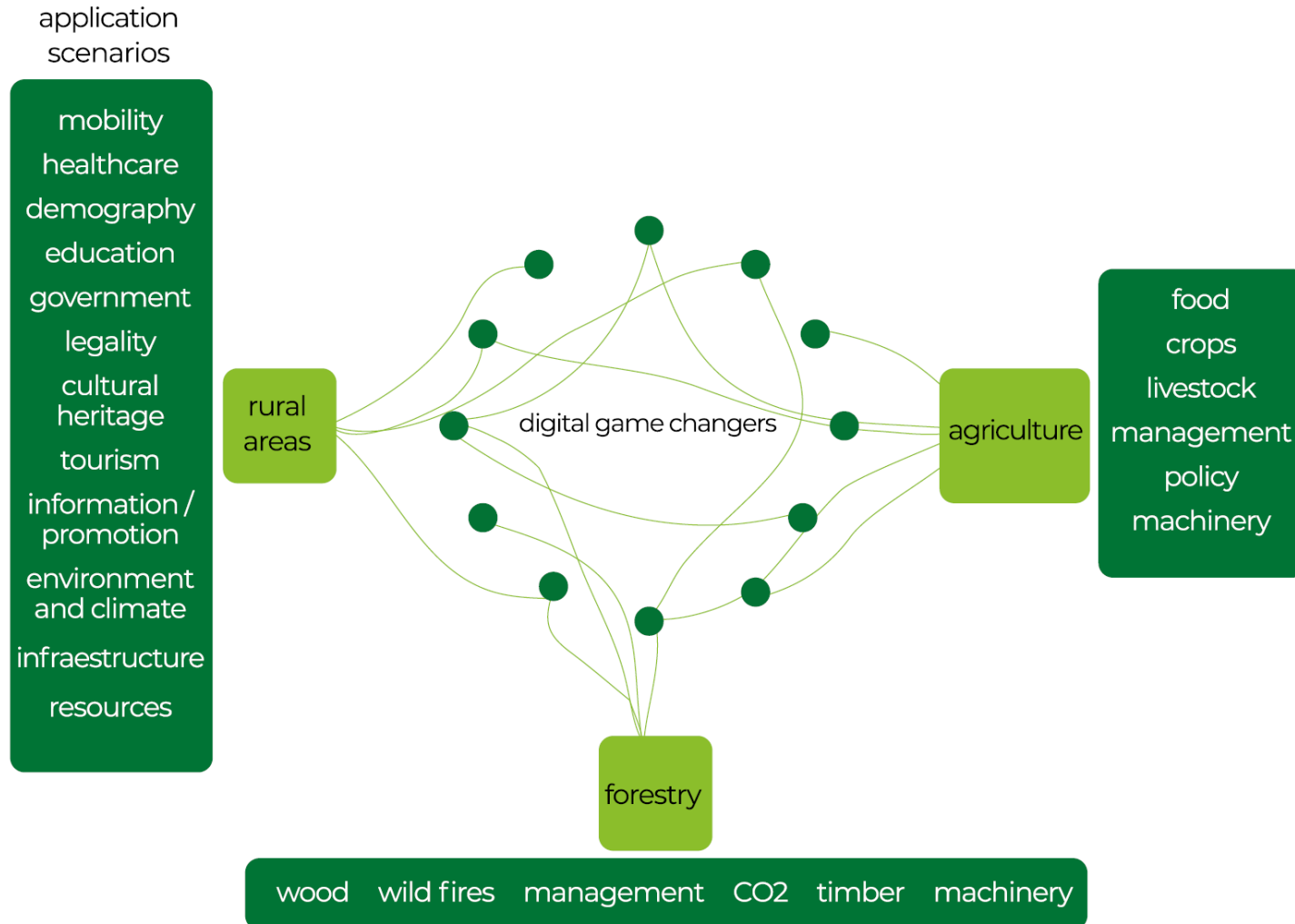
## A toolkit for DESIRA Living Labs

- inventory of digital tools
- application scenarios
- digital technologies
- socio-economic impacts

## Cyber-Physical Systems

- physical-digital-physical loop

# A Toolkit for DESIRA Living Labs



**OBJECTIVE** – supporting Living Labs in their work by providing:

- an **inventory** of digital tools collected by DESIRA, and of interest for **agriculture, forestry, and rural areas**
- **application scenarios** derived from the inventory of digital tools
- understanding of the **digital technologies** in use by tools
- qualitative evaluations of **socio-economic impacts** of the digital technologies

# Inventory of Digital Tools



Through an internal survey performed online, DESIRA has collected more than 600 digital tools of interest for agriculture, forestry, and rural areas (domains).

DESIRA looked for scientific projects, prototypes, tools already in the market, private and public services, and so on.

## SEARCHABLE INVENTORY

- \* in different domains
- \* understanding of the digital technologies used by digital tools
- \* qualitative assessment of socio-economic impacts

rural areas

*Y tú, ¿cómo pones*  
**ARAGÓN**  
**EN TU MESA?**



forestry



agriculture



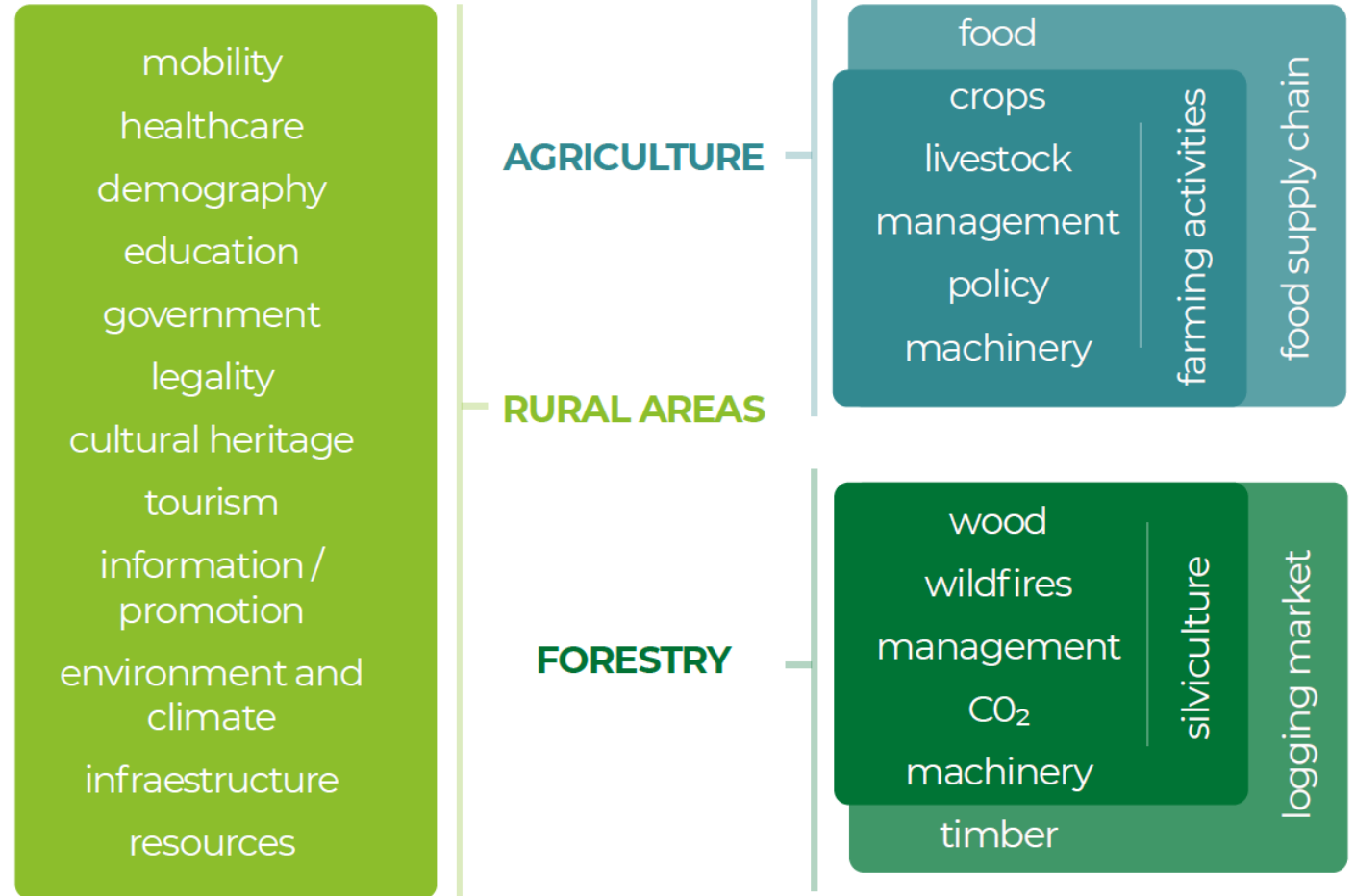
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# Application scenarios



From the inventory, DESIRA has derived a map of application scenarios.

**Application Scenario:** technical context in which a digital tool is used, the involved actors, and the interactions among the actors and with the digital tool.



# Digital technologies

## the potential to change the game



**Industry 4.0** technologies have been considered as main reference.

For digitalisation to occur, **basic conditions** - such as ICT infrastructures, connectivity, networks - and **enablers** - such as digital skills and investments - are needed\*.

If basic conditions are met and enablers are in place, digital technologies have the potential to change the game. Their joint use (*integration*) can amplify the effects.

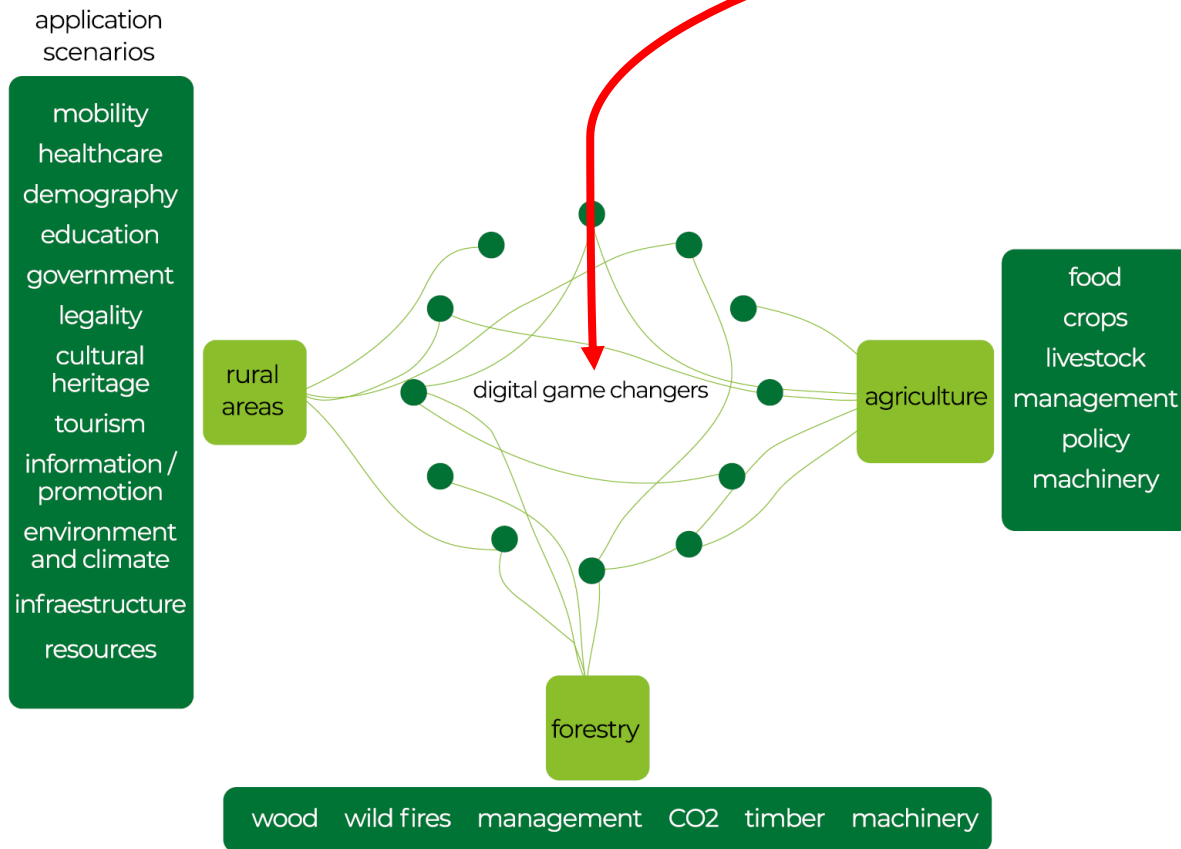
A key enabler of integration is the **CPS paradigm**.

\* N. M. Trendov, S. Varas and M. Zenf, "Digital Technologies in Agriculture and Rural Areas: Status Report," *Food and Agricultural Organization of the United Nations*, 2019.

Digital Technologies
social media and social networks
web sites and online platforms
cloud/edge services and applications
sensors, drone and/or satellite imagery (data sources)
blockchain (DLTs) and other certification / traceability applications and services
data analysis
augmented reality / virtual reality (XR)
3D/4D printing
artificial intelligence
autonomous systems and robotics
connectivity



# Digital technologies the potential to change the game



DIGITAL TECHNOLOGIES	DESCRIPTION AND EXAMPLES
social media and social networks	social tools for interaction / access to services
web sites and online platforms	web tools for interaction or to access/ offer services in a coordinated manner
cloud/edge services and applications	services available through mobile applications, web platforms, or other interfaces
sensors, drone and/or satellite imagery (data sources)	use of sensors in the field, drone (UAV) and satellite imagery to collect data
blockchain or other certification / traceability services	services (trust-dependent) to certify/trace products and processes
data analysis	techniques to extract information from data
augmented reality / virtual reality (XR)	extended reality techniques for training, education, or other purposes
3D/4D printing	production of 3D/4D objects through a printing-like process (programmable or not)
artificial intelligence	use of AI to analyse data / suggest actions
autonomous systems and robotics	robots / systems functioning autonomously
connectivity	landline and cellular connections

# Cyber-Physical Systems

DESIRA looks to CPSs as a conceptual model.

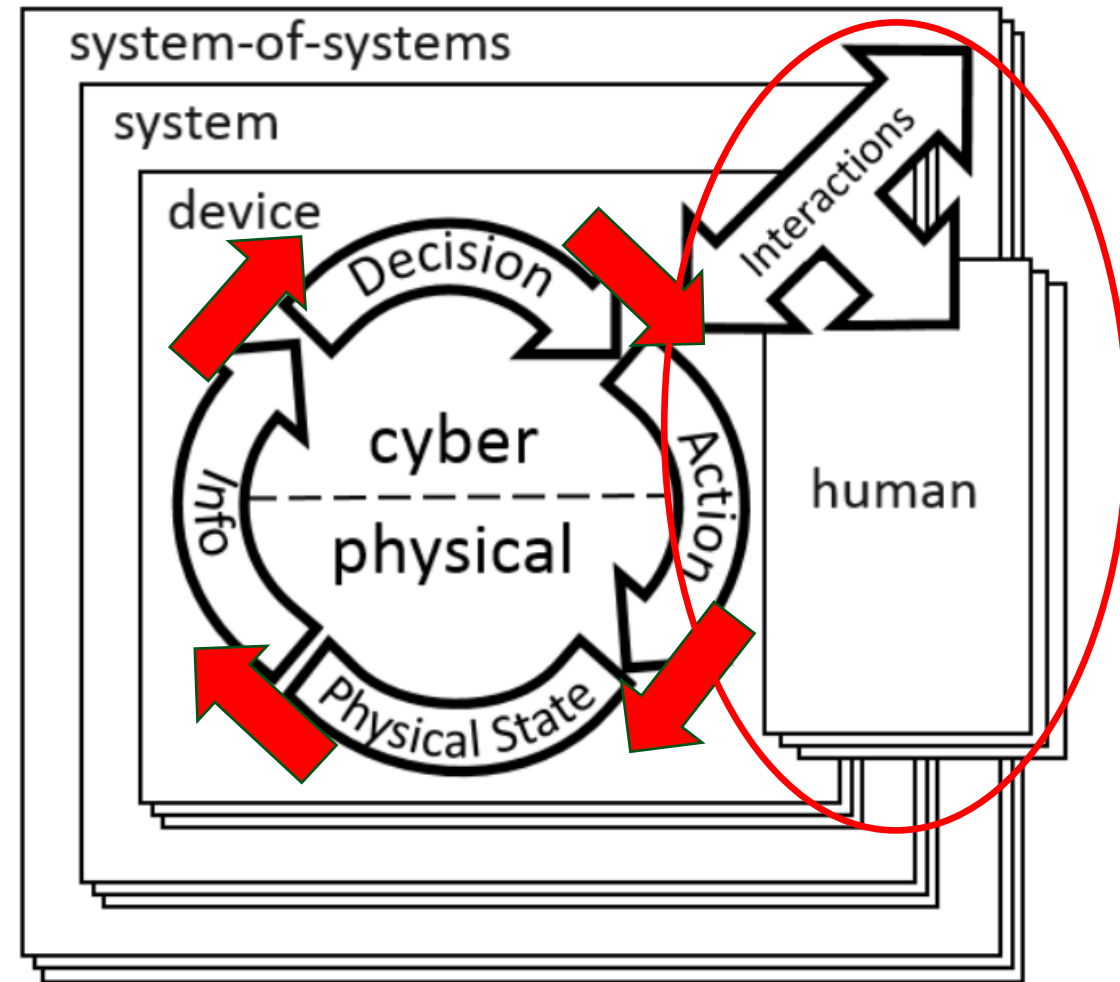
**DEVICE (sensing):** able to read a physical state and transform it into digital (raw) data

**DEVICE (computing):** fed with digital (raw) data, can extract useful information to support decisions and / or actions

**DEVICE (actuator):** once a decision has been taken and an action consequently defined, the latter can be applied to the system to change its state

**SYSTEM:** all devices together in a given context and working towards the same purpose form a system

**SYSTEM-OF-SYSTEMS:** multiple systems interacting among them



National Institute of Standards and Technology (NIST) framework for CPS



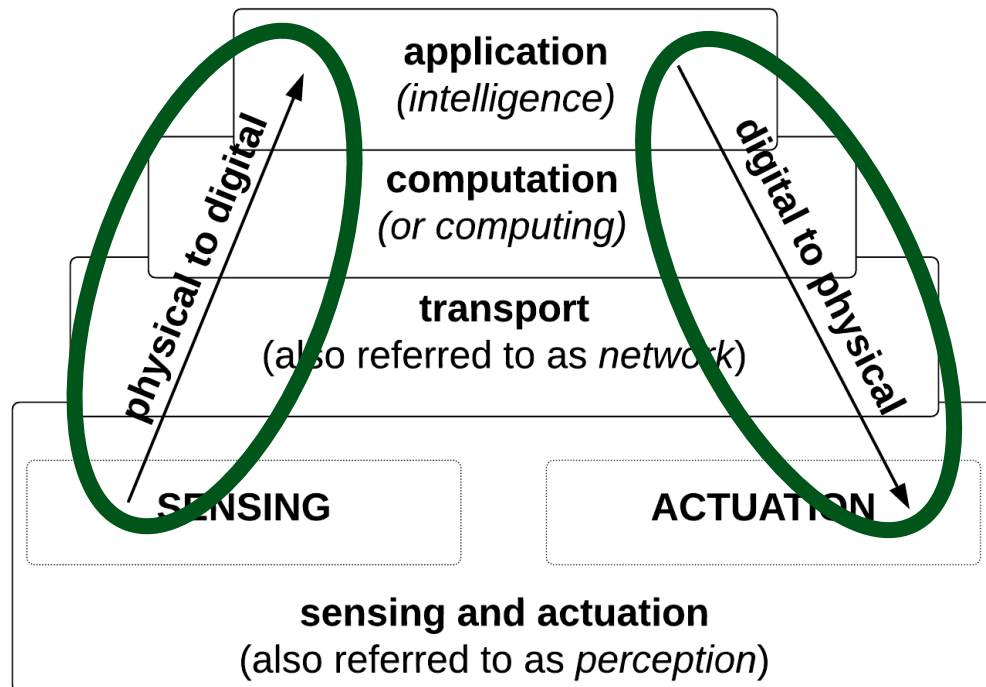
# PDP loop



The CPS model opens to the so-called **physical-digital-physical loop**.

physical-to-digital is the very basis of digitization.

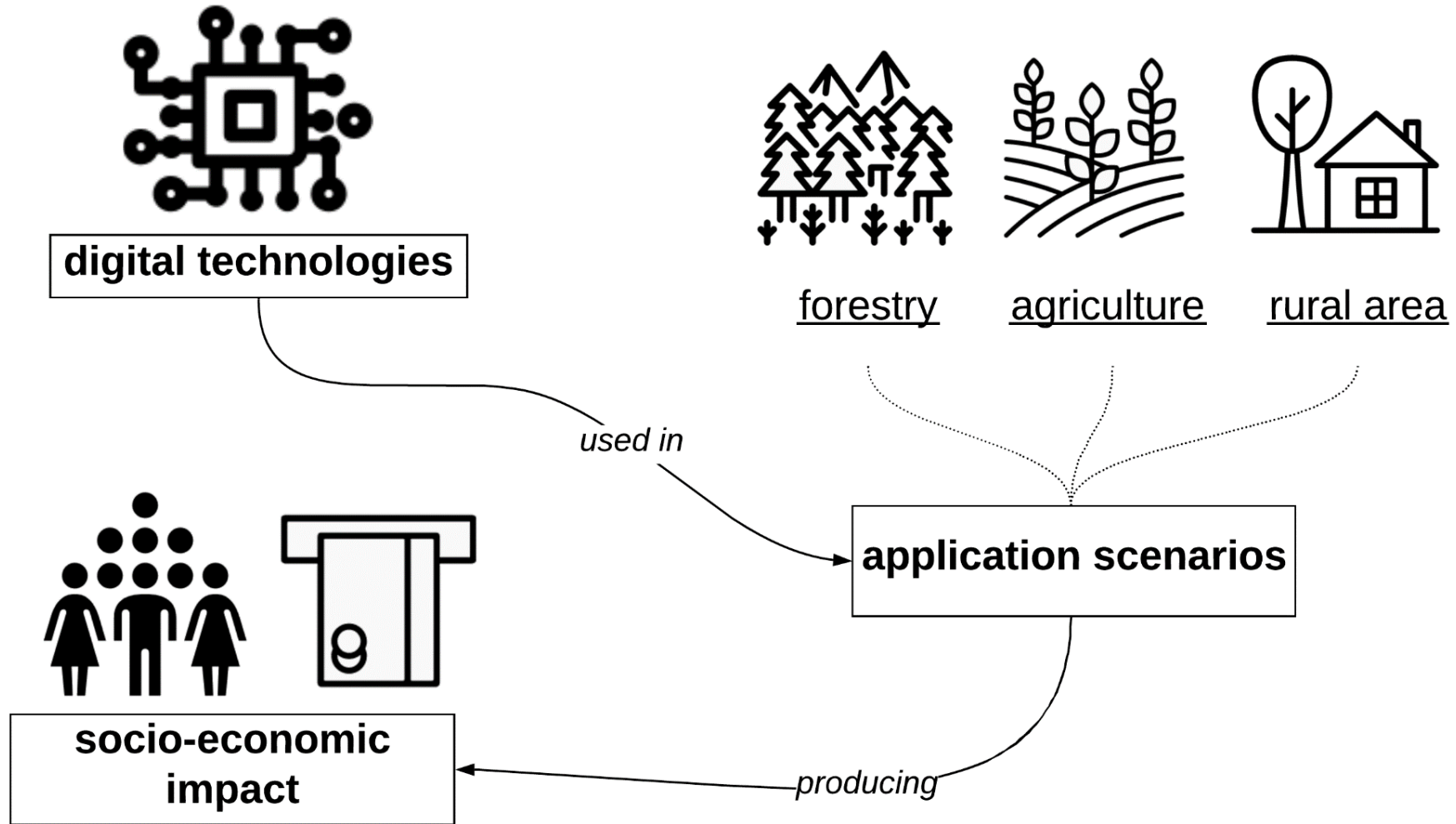
digital-to-physical means transforming collected data into valuable information to be used for: automating processes, feeding DSS, providing recommendations, ...



## EXAMPLE

Sensors in the field (**local sensing**) collect data about the **soil status**. A physical status (soil status) is transformed into **digital data** (moisture level, N concentration, ...); collected data are transmitted, stored, and analysed (**data analytics**) in a centralized **system (cloud)**. The information extracted from data is sent back to the farmer that can take **informed decisions**; for instance, irrigating or applying nitrogen.

# digital technologies, application scenarios, and socio-economic impact

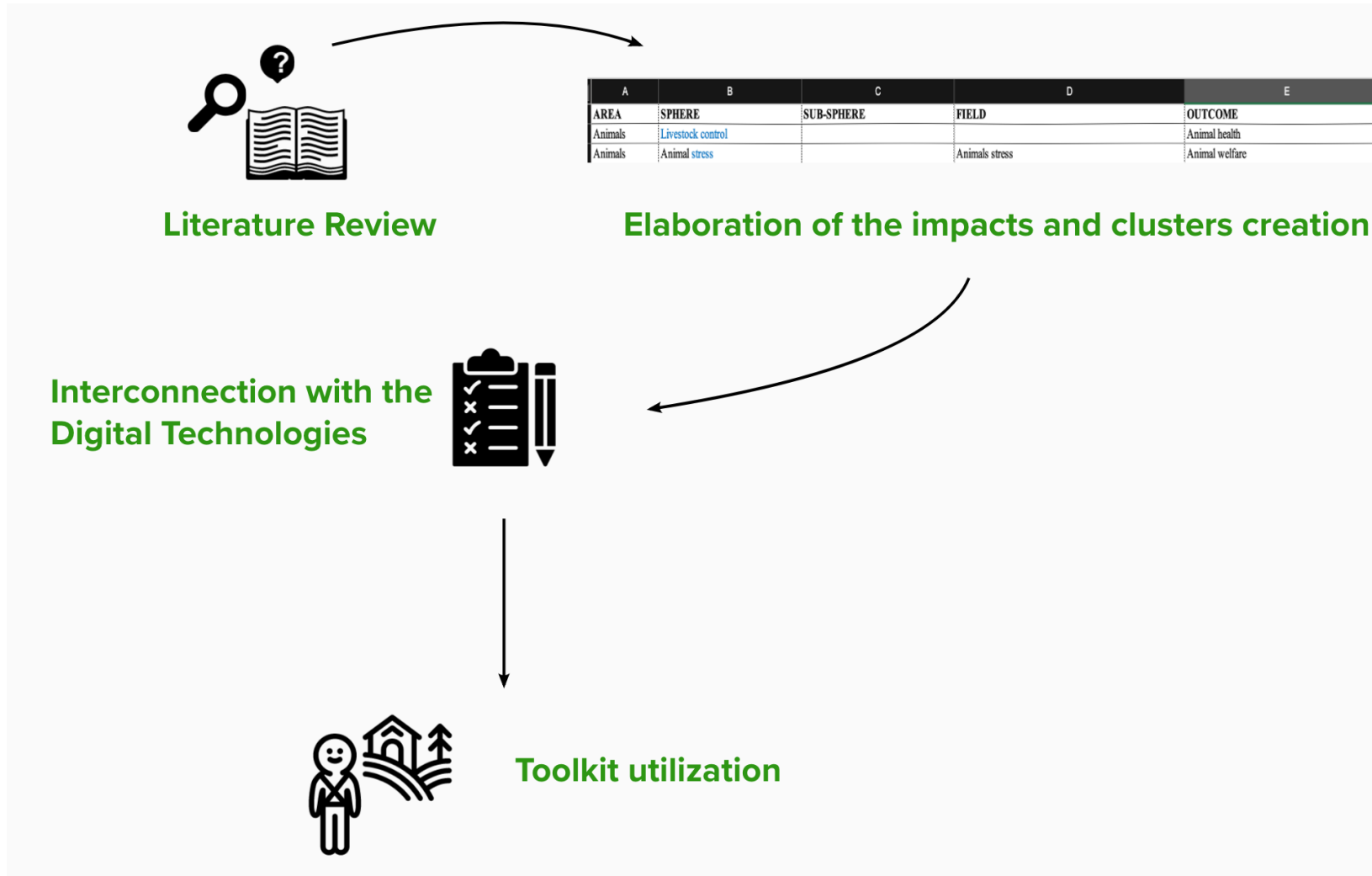


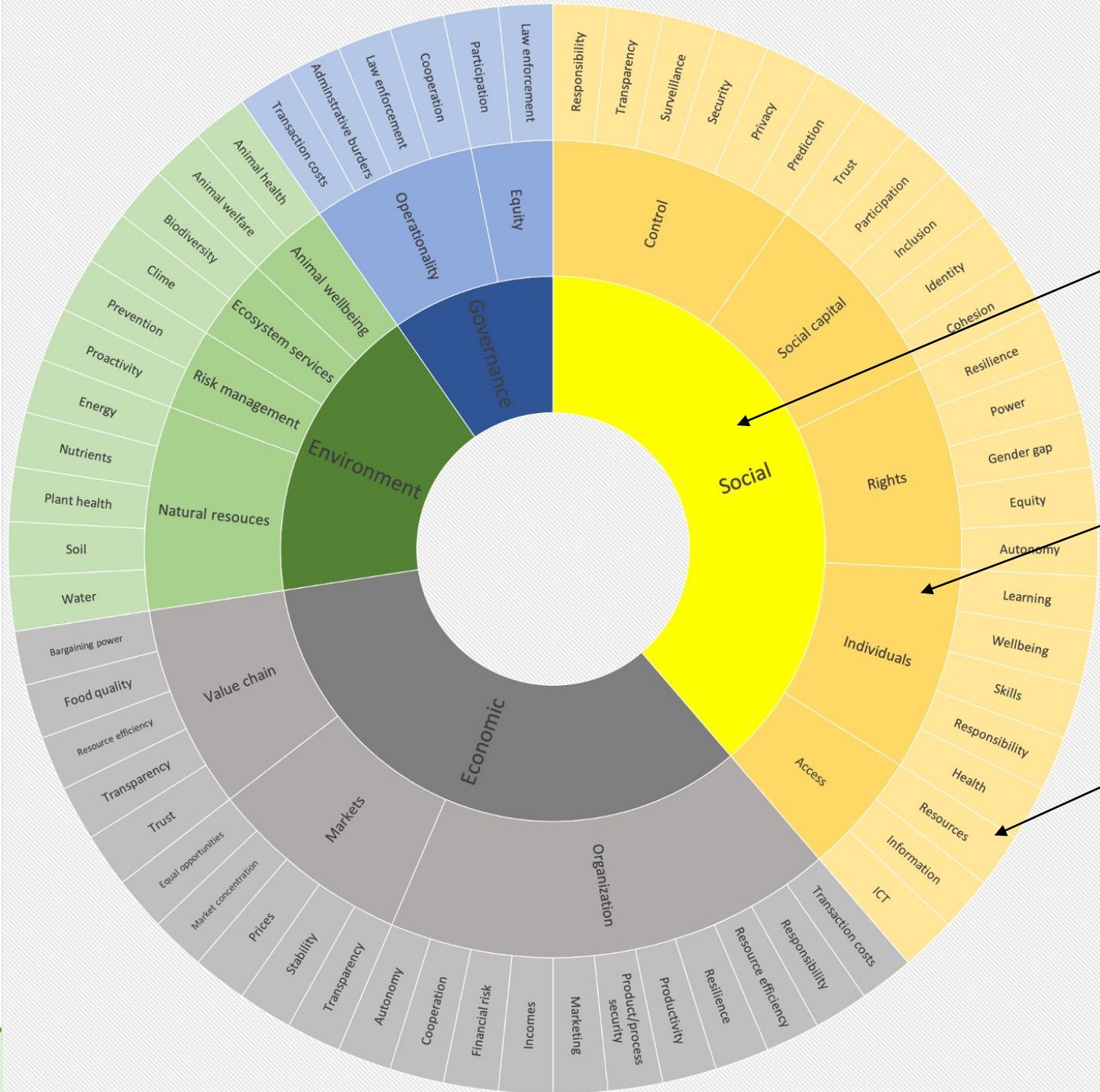
# Socio-economic impacts



To **contribute** at the creation of the **toolkit** while identifying **typologies of socio-economics impacts** in relation to the **selected digital technologies** identified as potential game changers.

# Methodology





## Domain:

it refers to the macro-dimensions involved in the digitalisation process as emerging from the literature review.

## Area of impact:

sub-dimensions or specific areas within each domain.

## Outcome:

for each area of impact, the main outcomes of digital technologies have been identified and selected.



# Mapping DTs and outcomes 1/2



DOMAIN	AREA OF IMPACT	OUTCOME IN	Social Media	Cloud	Local/remote sensing	Distributed ledger	Data analytics	Augmented reality	3D printing	Artificial intelligence	Autonomous systems	Connectivity	
Economic	Organization	Autonomy	x	x	x	x	x	x	x	x	x	x	
		Cooperation	x	x		x						x	x
		Financial risk	x		x	x	x				x	x	
		Incomes			x	x	x	x	x	x	x	x	x
		Marketing	x		x		x	x			x		x
		Product/process security	x		x		x				x	x	x
		Productivity		x	x		x	x			x	x	x
		Resilience	x	x	x		x			x		x	x
		Resource efficiency			x		x				x	x	x
		Responsibility	x			x	x						
	Transaction costs	x		x	x	x				x		x	
	Value chain	Bargaining power		x	x		x				x	x	x
		Food quality	x		x	x	x				x	x	x
		Resource efficiency					x				x		x
Transparency				x		x				x		x	



# Mapping DTs and outcomes 2/2



DOMAIN	AREA OF IMPACT	OUTCOME IN	Social Media	Cloud	Local/remote sensing	Distributed ledger	Data analytics	Augmented reality	3D printing	Artificial intelligence	Autonomous systems	Connectivity	
Economic	Organization	Autonomy	x	x	x	x	x	x	x	x	x	x	
		Cooperation	x	x		x						x	x
		Financial risk	x		x	x	x				x	x	
		Incomes			x	x	x	x	x	x	x	x	x
		Marketing	x		x		x	x			x		x
		Product/process security	x		x		x				x	x	x
		Productivity		x	x		x	x			x	x	x
		Resilience	x	x	x		x		x			x	x
		Resource efficiency			x		x				x	x	x
		Responsibility	x			x	x						
	Transaction costs	x		x	x	x					x		x
	Value chain	Bargaining power		x	x		x				x	x	x
		Food quality	x		x	x	x				x	x	x
		Resource efficiency					x				x		x
Transparency				x		x				x		x	

- **Question:** Which digital technologies can be useful to e.g. reducing financial risks?
- **Multiple impacts:** each digital technology affects several areas of impact
- **System:** combination / integration of DTs that produces effects relevant in specific areas

# an example 1/2

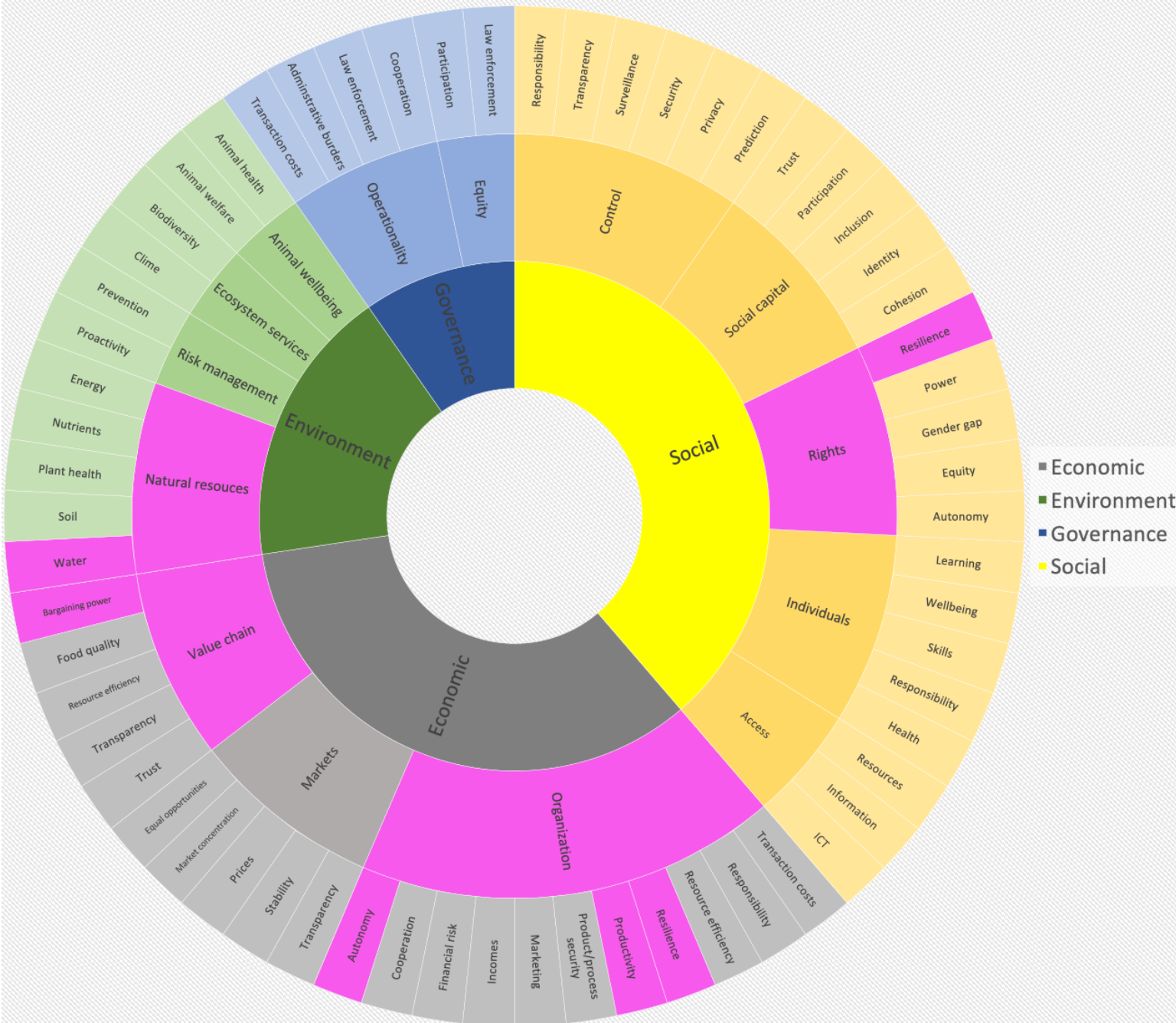


## EXAMPLE: *how to make irrigation efficient?*

Soil monitoring system: **local sensing** in the field collect humidity data, then delivered to a **cloud** system and analyzed (**data analytics**). The information is sent to the farmer for decision support.

Impacts: the main effects of the soil monitoring system are reported below.

DOMAIN	AREA OF IMPACT	OUTCOME	Digital technologies		
			Cloud	Local/remote sensing	Data analytics
Economic	Organization	Autonomy	X	X	X
		Productivity	X	X	X
		Resilience	X	X	X
	Value chain	Bargaing power	X	X	X
Environment	Natural resources	Water	X	X	X
Social	Rights	Resilience	X	X	X



## EXAMPLE:

*how to make irrigation efficient?*

### Soil monitoring system:

**sensors** in the field collect data about the humidity status transforming them in **digital data** transmitted to a **cloud system** and analyzed. The information is sent back to the farmer for decision support.

Impacts: the main effects of the soil monitoring system (consisting of three digital technologies) are reported below.

## an example 2/2



### EXAMPLE: *how to make irrigation efficient? – Soil monitoring system*

#### Outcomes

- > autonomy: *the decision to irrigate no longer depends on evaluations by experts*
- > bargaining power: *offer a more eco-sustainable product that is appreciated on the market*
- > resilience (social): *facilitates fairer access to water*

DOMAIN	AREA OF IMPACT	OUTCOME	Digital technologies		
			Cloud	Local/remote sensing	Data analytics
Economic	Organization	Autonomy	X	X	X
		Productivity	X	X	X
		Resilience	X	X	X
	Value chain	Bargaining power	X	X	X
Environment	Natural resources	Water	X	X	X
Social	Rights	Resilience	X	X	X

# Conclusions



## TOOLKIT FOR DESIRA LIVING LABS

- (under development) to support the work of DESIRA Living Labs
- search the **inventory** of digital tools and add/modify tools and related info
- **application scenarios** as exemplary contexts (*growing list*)
- **digital technologies** linked with the digital tools relying on them
- qualitative **socio-economic impacts**





## CYBER-PHYSICAL SYSTEMS (CPSs) as a reference framework

- physical-digital-physical (PDP) loop



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