



DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

NATIONAL POLICY ANALYSIS

THE NETHERLANDS



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Executive Summary

The process of digitalisation is happening at a rapid pace. It is therefore of great importance that governments and societies get a better understanding of developments of digital technologies and their socio-economic impacts. This is especially important to close the digital divide, as it can be noticed that rural areas lag behind in the digital transformation (Salemink & Strijker, 2018). Thus, where necessary and possible, governments should be able to steer developments accordingly. In this policy analysis, the different Dutch (rural) policies are presented that aim to boost the digitalisation in the generic sense and in rural areas more specifically.

It is striking that in the Netherlands there is a large variety of national and regional digitalisation policies. Especially in the past couple of years, more and more generic policies have emerged which are directed towards the digitalisation and the reduction of the digital divide. Also, broadband coverage is addressed by several policies and the use of digital services is increasing. Soon, the new national CAP will be published, which will encourage farmers to apply more practices that help to increase biodiversity and reduce the emission of greenhouse gases. Also, other digital policies for the agricultural sector, such as the national digital policy by the Ministry of Agriculture, Nature, and Food Quality, will boost the digital transformation in agriculture even more.

It will be challenging for the Netherlands to remain in the competitive position in terms of digital innovations (EC, 2021e). However, much effort is directed towards initiatives and programmes that boost digital innovations. Also, since more and more attention is regarded to safe access to sensible data, data management by the government is becoming increasingly important. Moreover, the improvement of the agriculture and food system is mentioned to be needed to support the digital transformation, by for example encourage better coordination between existing cooperation or by encouraging accessible intermediate systems.

1. Introduction

The process of *digitalisation* is happening at a rapid pace. It is therefore of great importance that governments and societies get a better understanding of developments of digital technologies and their socio-economic impacts. This is especially important to close the digital divide, as it can be noticed that rural areas lag behind in the digital transformation (Salemink & Strijker, 2018). Thus, where necessary and possible, governments should be able to steer developments accordingly. Therefore, attention has been directed towards prioritising digitalisation by the European Union (EU) and its member states, especially in rural areas (see for example the declaration on agriculture and rural areas [EU, 2019b]). This report analyses the impacts of digitalisation policies and strategies on agriculture and rural areas in the Netherlands. It presents an overview of the current policies regarding digitalisation in rural areas and may serve as a starting point for discussions on (future) policies for rural areas.

This policy analysis focuses on three different aspects. Firstly, it addresses the national and international context of digitalisation and thereby also the influence of the European policies on Dutch policies. Secondly, the state of affairs of Dutch national policies is described. This analysis is mainly shaped by two types of policies, namely generic policies boosting digitalisation and the digital transformation that also affect agriculture and rural areas on the one hand, and dedicated agricultural and rural policies that foster digitalisation, on the other¹. Lastly, this report focuses on the digital ecosystem, for example digital innovation hubs and digital public services, and how it is governed in the Netherlands.

This report starts with chapter 2 that provides an overview of the Dutch context for digitalisation. In this chapter, the demographic situation of the Netherlands, the Digital Economy, and Society Index (DESI) score, as well as the digital divide in the Netherlands are presented. As a country with an overall high population size and high population growth, the cities of the Netherlands are growing, whereas the rural municipalities are shrinking. Moreover, there is almost complete rural coverage. However, to ensure internet access for the remaining households will be difficult mainly because the households are difficult to access. The digital divide is especially noticeable between the ages. Older people make use of digital technologies less often than younger people.

In chapter 3, the (rural) policy framework of the Netherlands is discussed. It was shown that overall, the different national strategies are closely related to the European strategies. This can be noticed because it is often mentioned that the Dutch agendas and strategies are developed in accordance with European policies. In the Dutch digitalisation strategy, rural digitalisation is not directly addressed. However, the digitalisation of the agricultural sector is a frequently occurring topic as could also be seen in other policy documents. In general, the Dutch Digital Strategy is characterised by its overarching nature. The digitalisation strategies and agendas of different policy areas by the Dutch government are summarised in the Dutch Digital Strategy. Therefore, this strategy functions more as

¹ Within the DESIRA project it is about policies for the digitalisation of agriculture, *forestry*, and rural areas. We did not include policies for digitalisation of forestry, because these were not found to be relevant in the Dutch context.

an overview of the broad policy scenario in the Netherlands. It is striking that most of the other digitalisation policies do not directly address the digital transformation in rural areas in the generic sense, but only farmers as a specific target group. The opportunities to use digital technologies in agriculture are mentioned in most of the digital strategies and agendas. Moreover, some mention that the connectivity of all inhabitants of the Netherlands is an important starting point for a digitally connected society.

In section 3.2.3, the initiatives to reduce the digital divide are presented, which either aim to increase digital inclusion through the improvement of the digital infrastructure, aim to inform about the digital environment and teach people how to deal with digital tools, study the opportunities and risks of digitisation and experiment with digital governance, or connect people online. Specific initiatives that help boost digital literacy and digital inclusion in rural areas could not be found. There are, however, lots of initiatives that address the broadband coverage of rural areas in the Netherlands. The connectivity to the internet is needed to become digital literate and is therefore the basis for digital literacy.

More specifically in section 3.3., policies regarding the broadband infrastructure, digital public services, Strategies for Smart Specialisation (RIS3), and digital innovation hubs are presented. Policies that incentivise digital innovation are manifested in initiatives from the government and other innovation organisations, like the top sectors. In the Netherlands, the top sectors and their alliances play an important role in digital innovations. In 2018, the Dutch government formulated a new approach for the top sectors and innovation policy. They call for a stronger connection of actors through public-private partnerships to seize the opportunities for addressing societal challenges. Key technologies have a critical function in the upbringing of innovations. The key technologies of ICT and AI are often mentioned in the strategies.

In section 3.4, the national strategic plan is presented. The plan which will include the national version of the Common Agricultural Policy (CAP) has not been published yet. However, the government already published an outline of the national CAP. It has been pointed out that farmers who are willing to invest in climate-friendly measures are more strongly supported by the future national CAP. Next, there will be regulations which will have effects that go beyond one specific plot or farm, and therefore aim to improve the local environment. On the way towards the next CAP grant period (2021-2027), the seven future-proof agriculture pilot projects of the Netherlands exist to gain experiences with performance-based compensation.

In section 3.5, the data management strategy of the Dutch government shows policies that support the secure use of data and open data. Responsible use of data by the government contributes to increasing transparency and improving services. Open data is an important and frequently occurring topic. Moreover, cybersecurity seems to play an ever-important role, since a higher degree of digitalisation also implies the need for safer use of digital technologies. Moreover, the topic of responsible use of data is also becoming more relevant. Several initiatives help to open the discussion for responsibility in the web and to teach people about responsible use of digital technologies.

Finally in Chapter 4, the challenges and opportunities of rural digitalisation are analysed based on the findings from the preceding chapters, which are depicted in Table 6 and 7, while Chapter 5 concludes with the main findings of this policy analysis.

2. Current Context for rural digitalisation

This chapter provides background information on the current state of digitalisation in the Netherlands. The demographic situation of rural areas in the Netherlands is depicted first. Hereafter, the technological circumstances, as broadband coverage and an overview of Information and Communication Technology (ICT) services and their economic impact in the Netherlands, are presented. This chapter also considers some social factors that influence digital accessibility, by describing differences in internet skills and use.

The Netherlands has the second-highest *population density* of all EU member states, after Malta (Berkhout et al., 2019). Per square kilometre of land area there are almost 520 inhabitants in the Netherlands (World Bank, 2020). According to Eurostat, which provides a division of the EU territory for statistical purposes, a big share of the area of the Netherlands is labelled as urban (23 regions) or intermediate (16 regions), whereas only one region is labelled as rural (Eurostat, 2021; Eurostat, 2018). Even though there is a high overall population density, the different municipalities in the Netherlands vary in population density. Of the 17 million inhabitants of the Netherlands, almost three million inhabitants live in municipalities with less than 1000 addresses per square kilometre (Centraal Bureau voor de Statistiek [CBS], 2021).

The demographic situation in the Netherlands is constantly changing. Between the years 2015 and 2020 the *population size growth* of municipalities was measured (Compendium voor de Leefomgeving [CLO], 2020). Overall, it has been found, that the population size growth was especially high in the West of the Netherlands. In the West of the Netherlands, the four biggest cities of the Netherlands can be found. The West was densely populated even before 2015 and because there is lots of employment in the West, even more people are attracted to live nearby (CBS, 2018). On the contrary, the population is shrinking in several rural and economically less privileged areas. Especially young people leave these areas to find work or go to schools and universities elsewhere. The municipalities in which the number of inhabitants declines are mainly located at the borders of the Netherlands (CLO, 2020). The areas with the strongest population decline are expected to see a 16% drop in population by 2040 (Rijksoverheid, 2018). The cities of the Netherlands are thus growing, whereas the rural municipalities are shrinking.

The *Digital Economy and Society Index (DESI)* is a composite index elaborated by the European Commission that summarises relevant indicators on the European digital performance and tracks the evolution of digital competitiveness (European Commission [EC], 2019). It serves as an indication of the social impact of ICT on the economy. The DESI comprises scores of the five policy areas of connectivity, human capital, use of the internet, integration of digital technology, and digital public services (EC, 2020a). In comparison to other EU countries, the Netherlands ranks 4th in the DESI of 2020 (see Figure 1). The DESI score (ranges from 0 to 100) of the Netherlands increased from 60.8 in 2018 to 67.7 in 2020, whereas the EU average in 2020 is around 50.

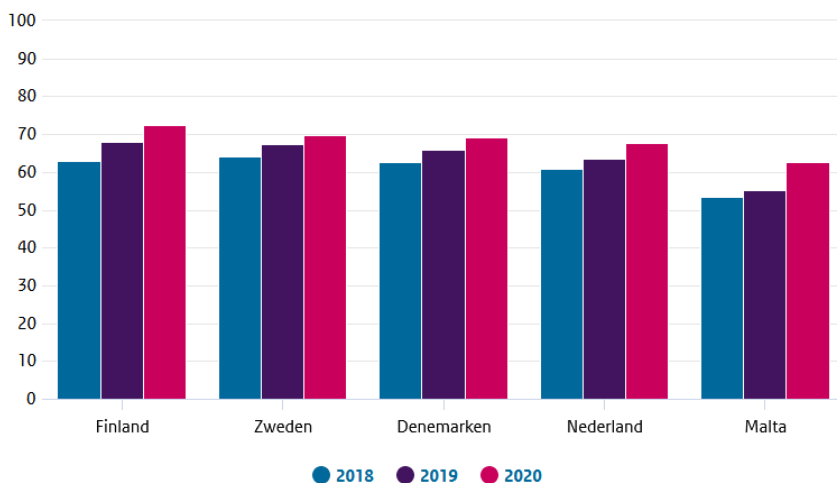


Figure 1: Digital Economy and Society Index (DESI), 2018-2020: top 5 (Ministry of Economic Affairs and Climate Policy [EZK], 2020a).

In general, the Netherlands scores high for all five principal policy areas of the DESI (see Figure 2). The principles depend on each other and therefore similar scores of the principles indicate a stable situation of the DESI in the Netherlands (De Clercq, et al. 2021).

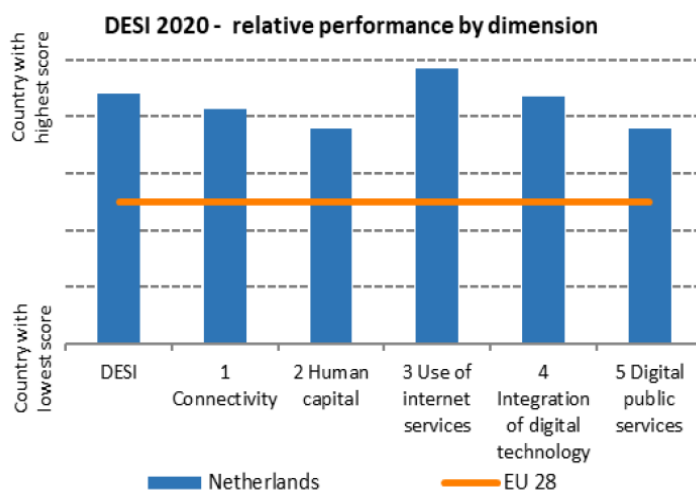


Figure 2: Digital Economy and Society Index (DESI) the Netherlands (EC, 2020a).

Connection to the internet is a necessary condition for the digital transformation. *Connectivity* of the EU member states is measured considering the broadband coverage, as well as fixed and mobile broadband take-up (EC, 2020a). Thus, connectivity does not comprise the technological preconditions for internet connection alone, other factors of internet access (e.g., price or digital literacy) also play a role. Between 2019 and 2020, the connectivity score of the Netherlands increased faster than the years before. While on EU level the DESI for connectivity increased from 45 to 50, in the Netherlands, it increased from 51 to 60. This high score makes the Netherlands rank 6th in terms of connectivity (EC, 2020a). However, to compare the *rural areas* of the EU, the fixed broadband coverage serves as an indicator for connectivity, because only fixed broadband coverage-related indicators are available for all European regions (European Network for Rural Development [ENRD], 2021). Therefore, and because broadband coverage is a necessary condition for the development of the other indicators targeted by the DESI, the *Rural Digitisation Index* (RDI) concentrates on broadband coverage alone (de

Clercq et al., 2021). In Figure 3, the broadband coverage of at least 100Mbit/s in the Netherlands is depicted. Overall, the Netherlands is almost completely covered with Next Generation Access (at least 30Mbit/s). The fixed Very High-Capacity Network (at least 100 Mbit/s) coverage in the Netherlands is 89%, whereas the EU average is only 44% and therefore the Netherlands can be seen as a frontrunner in broadband coverage (EZK, 2020b).

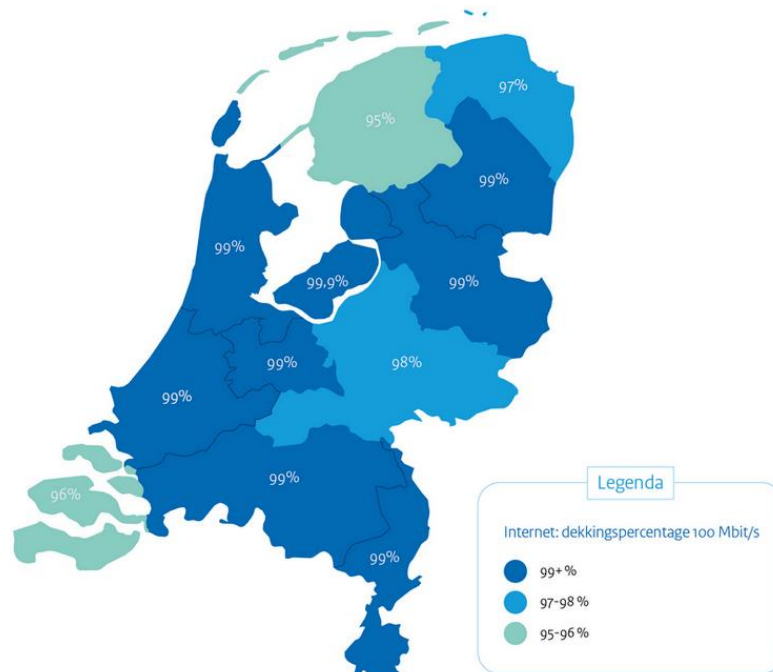


Figure 3: Broadband coverage 2020 in the Netherlands (EZK, 2020b).

Moreover, mobile broadband coverage is expanding. 5G is approaching complete coverage, whereby in some areas there are even two or three providers of internet access available (Rijksoverheid, 2020a). The Netherlands provides an infrastructure with several fixed telecom networks (copper, cable, and fibre) by KPN, T-Mobile, and VodafoneZiggo. However, the broadband price index (56 points out of 100) of the Netherlands remains under the EU average (EC, 2020a). This means that the prices of broadband access in the Netherlands are comparatively high. According to the Consumers' Association, this is because there is too little competition in the Netherlands, where VodafoneZiggo and KPN hold the lion's share of the market (Consumentenbond, 2021). The EU aims to support the accessibility to high-speed electronic communication networks by reducing its costs (See Broadband Cost Reduction Directive [2014/61/EU]). According to the EU digital progress by EC (2017), there seems to be further scope for exploring the opportunities by reducing the cost of broadband access of the Netherlands. Even though the costs of broadband access are higher than in other EU countries, the use of internet services is well above the EU average. 95% of the population uses the internet regularly, whereas the EU average lies 10% lower (EC, 2020a). Other social factors that determine the connectivity to online communication networks will be discussed later in this chapter.

The application and impact of *information and communication technology* (ICT) is an indicator of the competitiveness of states in the global economy. The Network readiness index (NRI) presented in Dutta & Lanvin (2020) maps the network-based readiness landscape based on their ICT performances across 60 variables which are divided into the four pillars of technology, people, governance, and impact. The Netherlands ranks 3rd with an NRI of 81.37 and loses its 2nd rank to Denmark compared to the previous year, whereas Sweden has the highest NRI in the EU comparison. The Netherlands is best showing in the pillars of technology and governance. The Netherlands even ranks 2nd in one of the variables concentrating on the creation of digital content. In trust (3rd) and inclusion (5th), the country also scores high. Concerning the people pillar of the NRI, it is said that the Netherlands could increase the score by facilitating greater use of ICT among individuals (20th).

Having an internet connection is not sufficient for people to be able to use the internet. Human capital in the context of the DESI refers to internet user skills and advanced skills. *User skills* in dealing with digital technology are monitored to indicate how the digital transformation of the Dutch population is proceeding. In the DESI report of 2020, the Netherlands scores 4th in human capital scores of the DESI. The scores of basic and advanced digital skills are above the EU average. Like no other country in the EU, 80% of all Dutch inhabitants have at least basic digital skills, whereas the EU average lies around 58%. However, since more and more ICT experts are needed in the digital transformation, the labour shortage also increases. 6% of the positions of ICT experts are not occupied. Next to the user skills, other social factors can hinder access to digital technology. The lack of need or interest and high costs of internet access and equipment are also mentioned reasons (EC, 2020b).

The Netherlands does not experience major broadband inclusion gaps, because there is good overall connectivity (EC, 2017). Rural coverage in the Netherlands lies around 97%, whereas the EU average is only 18% (EC, 2015). The Dutch government set the goal to provide an internet connection to all households in the Netherlands by 2023. It is however expected that the goal to reach 100% 100Mbit/s speed coverage will not be reached completely. It is expected that 0.5% of all households, which is the equivalent of 50,000 households, remain without internet access. The internet access provision for the remaining households will be difficult. This is especially the case for the 20,000 households in rural areas (EZK, 2019). The effort of citizens' initiatives and market players will play a crucial role in the provision of internet access for all. It could be seen that in the past years these actors boosted the development of internet access in remote areas (Rijksoverheid, 2021a). Even though on an international comparison the difference of connectivity between rural and urban areas may be low, an increase in connectivity of all rural areas is necessary to include remote areas and to bridge urban with rural areas.

In the Netherlands, there are also differences regarding digital connectivity and accessibility between different groups of people. These differences are known under the term *digital divide*. In general, men have statistically higher basic digital skills (EC, 2020c). However, in the group of 16- to 24-year-old inhabitants, women were found to be more skilled (see Figure 4). Nevertheless, the number of women working as ICT specialists is only 1.9% (1.4% in the EU). It is not found if men or women living in rural areas are more or less digitally skilled in the Netherlands.

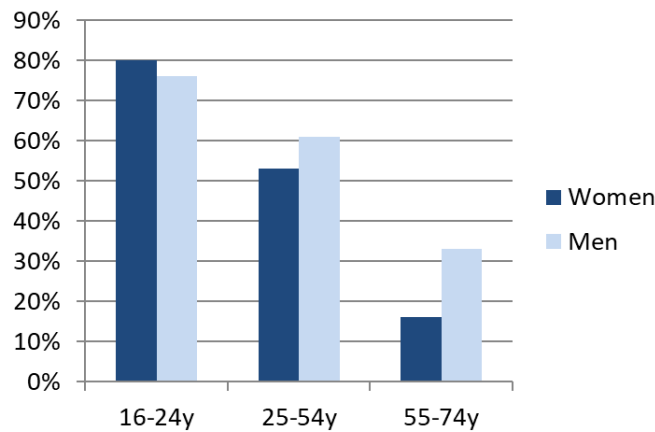


Figure 4: Above basic digital skills by age and gender of Dutch inhabitants (EC, 2020c).

The group of people of 75 years and older use the internet less frequently than people younger of age. There are different reasons for older people to refrain from internet use. Because the internet coverage is pretty good in the Netherlands the relatively low internet use by older people can be attributed to the lack of skills, interest, need, or trust (EC2020b). While in 2014 more than 50% of inhabitants older than 75 had no internet connection, in 2020 however, only 23% of the elderly were not using online communication (Digitale Overheid, 2020a).

In the International Computer and Information Literacy Study (ICILS) of 2018, the share of pupils (grade 8 students) in the Netherlands that do not have knowledge of computers as tools and are unlikely to be able to create digital information products was found to be 8 %, which is comparably lower than the EU average of 10% (EC, 2019a). However, in a study by the government, it was found that 17 thousand inhabitants with children between 5 and 13 years have no internet at home (Digitale Overheid, 2020a). Not only in the Netherlands, but in all member states, parental occupational status, parents' educational attainment, and the number of books at home are positively associated with the pupils' achievements, also in terms of digital literacy. Also, pupils from families with a migrant background and pupils speaking another language at home than the test language score lower in digital skills (International Association for the Evaluation of Educational Achievements [IEA], 2018).

Additionally, the general farming population is aging. In 2000, over 16% of the farmers were younger than 40, in 2018, there were 4,381 farmers under 40 years of age and 26,352 of a total of 53,857 farmers, which is 8% (Berkhout et al., 2019). The population in rural areas is slightly older than in urban areas (Ibid.), therefore it can be assumed that human capital in rural areas is also lower. The latter is of importance since policies often address the increase of digital skills of older people and therefore indirectly address rural areas.

3. Policy framework for (rural) digitalisation

This chapter aims to identify how generic policies boost digitalisation, how they influence rural areas, and also how rural and agricultural policies foster the digital transformation. Since in the Netherlands, agriculture and horticulture are the biggest users of space (about 55% of the spatial room in the Netherlands is agriculture), the Dutch policies and strategies often address digitalisation in agriculture. Even though most of the information on digitalisation in the Netherlands is either indirectly about the

impact on rural areas or specifically on agriculture, this report aims to analyse the impact of different policies on all areas outside the urban cluster. In this chapter, first, the European digital policies and how these shape the Dutch policy scenario are described. Second, national policies, like the Dutch Digital Strategy 2021 followed by other policies and strategies, are presented. Third, the contributions from the structural and investment funds and the cohesion policy to the digital transformation are outlined. And last, it will be presented how digitalisation is addressed in the CAP national strategic plan.

3.1. European Digital Policies

This section aims to explore how the different European policies and strategies aiming to boost digital transformation, such as the Digital Single Market, the European Digital Strategy, the Digital Agenda for Europe, the Digital Europe Programme, the Connecting Europe Facility 2, the EU Green Deal or the EU Next Generation and Recovery Funds are shaping the national policy scenario. Some of the European policies and their influence on rural digitalisation are shortly introduced, followed by a general description on how these policies have an influence on the policy scenario in the Netherlands.

The aim to boost the digital transformation can be found in several European agendas and policies. The report 'A Path to the Digital Decade: common governance and coordinated investment for the EU's digital transformation by 2030' for example, focusses on this aim. The report contains a proposed governance framework to reach digital targets in the areas of digital skills, digital infrastructures, digitalisation of businesses, and public services in the entire European Union (EC, 2021d). This policy thus aims to reduce the digital divide in Europe.

In other European policies digitalisation is addressed specifically in regard to agriculture and rural areas. In the Green Deal the inclusion of rural areas in the circular and bio-economy is a point of attention. The European funds for rural development (EAFRD) can help to realise the possibilities of a green economy (EC, 2019d). The 'twin transition', in which sustainable, green development goes hand in hand with the digital transformation, to support the environment and at the same time create new jobs and environment-friendly digital innovations, is also mentioned in the report. Furthermore, it said that digitalisation can support the transformation towards more transparent food systems. Also, in the From Farm to Fork Strategy transparency in the food supply chain is a reoccurring topic (EC, 2020d). Digital technology can be used to give the consumer more information about how the food is produced, where it comes from, and connect consumers and producers directly to each other. Moreover, sustainable fish and seafood production is thematised. It is said that digital technologies may be used to control imported fish to prevent illegal products from entering the EU market. Comparatively to the From Farm to Fork Strategy, the Farmers of the Futures report emphasises digitalisation in agriculture. Processes of precision farming and automatisisation of practices are going to change the farming activities, wherein the availability and transparency of data will play a crucial role for farmers (Krzysztofowicz et al, 2020). In the long-term vision for the EU's rural areas, the need for digital tools to create stronger rural areas and to encourage social innovation is emphasised (EC, 2021c). Overall, digitalisation in rural development is thus often mentioned in European policies.

The different national strategies are closely related to the European strategies. This can be noticed because it is often mentioned that the Dutch agendas and strategies are developed in accordance with European policies (see e.g., Dutch Digital Strategy 2021). In the outline of the digital strategy for the agricultural sector, it is mentioned that the strategy is consistent with steps being taken in Europe, for example in the Farm to Fork strategy, the Green Deal, and the climate agreements (Ministerie van Landbouw, Natuur en Voedselkwaliteit [LNV], 2021a). Therefore, the Dutch digital strategy for agriculture is based on other European and national policies that already have addressed the digital transformation.

Several initiatives and programmes (some of which are presented in section 3.2.4) in the Netherlands are financed (partly) by the European Union. Amongst others, the Common Agricultural Policy (CAP) in the Netherlands is implemented via the 'Platteland ontwikkelingsprogramma (POP3)' (rural development programme). The funding for this programme comes partly from the European Agricultural Funds for rural development (EAFRD), which was around EUR 800 million for the funding period 2014-2020 (POP3, 2021). In the Netherlands, like in many other EU member states, EIP-AGRI projects help to facilitate innovative ideas in agriculture. Key technologies, such as robots, drones, or sensors, are often integrated into the innovative projects of the operational groups (see ec.europa.eu/eip/agriculture/en/find-connect/projects for an overview of the EIP-AGRI-projects in the Netherlands).²

Other initiatives, like the SmartAgriFood Accelerator, SmartAgriHubs, and NETWORK (ERA-NET) ICT-AGRI partnerships, are also financed by the EU and are implemented on the national level. It can be noticed that in general there are lots of different initiatives, which are financed by the EU, that concentrate on digitalisation in agriculture and rural areas in the Netherlands.

3.2. National Policies boosting Digitalisation

In this chapter, the generic national policy on digitalisation in the Netherlands and its indirect influence on agriculture and rural areas is described in section 3.2.1. The digital strategies influencing rural areas are presented in 3.2.2. In this, rural and agricultural policies, for example the outline of the digital strategy for the agricultural sector are highlighted. Furthermore, other policies are presented that are more specifically directed towards digital literacy and how to tackle the digital divide (3.2.3) or towards incentivising digital innovation (3.2.4).

3.2.1. Dutch Digitalisation Strategy 2021

The latest national digital agenda is the *Dutch Digital Strategy 2021* (Rijksoverheid, 2021a). It was published by the Ministry of Economic Affairs and Climate Policy in close cooperation with the Ministry of the Interior and Kingdom Relations and the Ministry of Justice and Security. In the agenda it is mentioned that the government's vision of digitalisation is closely aligned with that of the European

² europaomdehoek.nl/fondsen - overview on how the European funds are used in the Netherlands.

Commission, since the programme of the European Commission is similar to that of the Netherlands. Both focus on the twin transition of sustainability and digitalisation. The strategy brings together all central government policies on digitalisation of the Netherlands. It contains an overview of the achievements of past digitalisation strategies and includes a foresight study on key trends and developments, which will be described in this section. Furthermore, the budget for digitalisation research and development is outlined in the digital strategy. The national generic instruments, which is the financial support available for digital technology and innovation for entrepreneurs in the Netherlands, are estimated at around EUR 1.8 billion per year. The lion's share of the generic instruments comes from tax incentives by the WBSO (R&D tax credit scheme).

The key results of the previous strategies are categorised into the six priority areas of artificial intelligence, data use and sharing, inclusion, connectivity, resilience, and government. Some of the key results concentrate on the value of digital technologies for agriculture. In the strategy, it is pointed out that digitalisation is crucial for sustainable agriculture and fisheries, and to strengthen biodiversity and nature. Some examples of initiatives, that are based on this belief, are presented that aim to boost digitalisation in agriculture; In Lelystad, the innovation and demonstration programme of the farm of the future was officially opened in mid-2020 (<https://farmofthefuture.nl/>), which functions as a test facility for circular agriculture. Besides, the public-private partnership precision agriculture 4.0 is presented, which aims to empower farmers by giving them direction and control over data generated by their business activities.

The foresight study 'Outlook Digitalisation 2030' includes the most important trends and developments regarding the digital transformation that may be expected in the future. The spotlight was put on possible future developments to enable the reflection on digitalisation policies and their impacts. Based on 11 trends, e.g., digital currencies or optimisation of humans, the study aims to provide an overview of the main opportunities of digitalisation, but also to bring to light uncertainties and questions around the implementation of digital technology. Especially the trend of autonomisation seems applicable for rural areas. Autonomisation in agriculture can change the way farmers work because Artificial Intelligence (AI) can be used to take over some of the farming activities. In the strategy, it is however also noted that there is uncertainty regarding what the future of automated technology will look like. It is said that it is uncertain which tasks the machinery of the future will take over and who is responsible for the actions of smart technology.

It is also mentioned that it is important to equip everyone with the right skills and competences to take full advantage of the opportunities that digitalisation brings for tackling societal challenges. Moreover, the key areas such as lifelong learning, AI, and digitalisation of businesses are clearly based on a transparent and accountable approach to benefit the buy-in of all actors. In general, the Dutch Digital Strategy is characterised by its overarching nature. The digitalisation strategies and agendas of different policy areas by the Dutch government are summarised in the Dutch Digital Strategy. Therefore, this strategy functions more as an overview of the broad policy scenario in the Netherlands. Similar to the national digital strategies, there are also regional digital strategies, as for example the strategy of Gelderland 'Strategische verkenning digitaliserend Gelderland' (Dialogic, 2018). In the regional strategies, similar topics are addressed as in the national digital strategy.

3.2.2. Other Policies and Strategies influencing (rural) Digitalisation

First, this section presents an overview of other policies and strategies that are not specific for rural areas, but that aim to boost digitalisation and as such might influence agriculture and rural areas in the Netherlands. Five different policy documents were found that were recently published and address the digital transformation in the Netherlands. In Table 1, the main objective and the intended impact of these policies on rural areas are listed. Thereafter, other policies that thematise the digital transformation from a rural or agricultural perspective are presented (see the overview in Table 2).

The Dutch government launched the 'DIGIbeter 2020 - Agenda Digitale Overheid' (Digital Government Agenda; Digitale Overheid, 2020c). Initially, this broad agenda was published in March 2020. It was updated in the same year and contains additional policy recommendations regarding the COVID-19 pandemic. It is pointed out, that the corona pandemic has shown us that precisely now it is important that everyone can continue to participate in digital communication. Next to the aim to enable everyone to take part in online communication, the agenda also aims to increase the autonomy of individuals and entrepreneurs by the facilitation of information sharing that is accessible and clear to all. The agenda includes so called life events, that intent to help inhabitants in certain life situations. The topic of digital inclusion is discussed in detail in this agenda, however digitalisation in rural areas is not directly discussed. Although one of the life events mentioned is 'irrigation in times of drought'. Another life event presented in the 'Perceelwijzer' (perceelwijzer.nl), by means of which farmers can receive information about the water level and up-to-date regulations on irrigation.

The 'Actieplan Digitale Connectiviteit' (Connectivity Action Plan) outlines the effort of the government to stay well-equipped in high-quality digital connectivity (Ministerie van Economische Zaken en Klimaat, 2018b). The increase of internet connections in rural areas of the Netherlands is directly addressed by the report. It has been pointed out that there are investment barriers that exist in rural areas (see KPMG, 2018). Economically profitable investments in rural areas are difficult because the threshold to invest in fibre optic connection is too high, due to the lack of expected return.

In the 'NL DIGITAAL Data Agenda Overheid' (data agenda by the government) five aims are listed to promote responsible and safe use of data. These aims are i) Solving societal problems with data-driven activities, ii) Taking into account legislation and public values, iii) Improving the quality of government data and using it more efficiently, iv) Gathering and sharing knowledge about data-driven activities, and v) Investing in people, organisation and change of culture. Rural areas are not addressed in the agenda.

The Netherlands presents itself as the leader in the development of AI for people and society in the EU and abroad. Its 'Strategisch Actieplan voor Artificiële Intelligentie (SAPAI)' (Strategic Action Plan for AI) underlines the importance of investing in AI-relevant skills for everyone, and thereby includes the need to ensure societal inclusion (Ministerie van Economische Zaken en Klimaat, 2019b). The need for private-public partnerships to focus on societal problems is mentioned. However, it is not specified how the inclusion of rural areas may play a role in this. AI in agriculture is mentioned several times. In the action plan, the ambition to boost precision farming, to make data accessible for consumers and producers, and the need for safe and transparent data distribution in the agri-food sector are mentioned. In conclusion it can be noticed that SAPAI does address agricultural sector, but rural digitalisation in general is only indirectly addressed.

The ‘Nederlandse Cybersecurity Agenda’ (Dutch cyber security agenda) aims to provide incentives to combat vulnerabilities and threats in the digital domain. The development of digitalisation in rural areas is not discussed in this agenda. However, in agri- and horticulture, the importance of cyber security is increasingly often raised (see e.g., de Beer, 2021). It appears that there is more and more awareness about how important the protection of sensitive data is for the industry.

The ‘I-strategie Rijk 2021-2025’ (Strategy of the Kingdom 2021-2025) has the mission to promote the optimal use of digital technology and ICT of organisations and the government (CIO Rijk, 2021). The first point of attention is the improvement of services to citizens and businesses, the second is a critical review of the information provided by the government, and the third topic is transparency and openness. Similar to the SAPAI, the I-strategie Rijk 2021-2025 briefly touches the topic of digital inclusion, by stating that digital inclusion is necessary for a social and safe society. Digitalisation in agriculture is also mentioned because according to the strategy, digital technologies can be used to e.g. monitor nitrogen levels in the field.

Conclusion: Digitalisation Policies and the Rural

It is striking that most of the digitalisation policies do not directly address the digital transformation in rural areas in the generic sense, but only farmers as a specific target group. Some mention that the connectivity of all inhabitants of the Netherlands is important. The Data Agenda Overheid, SAPAI, and the I-strategie Rijk are specified on a certain area of the digital transformation, which is probably the reason why these are not directly about digitalisation in rural areas. The opportunities to use digital technologies in agriculture are mentioned in most of the digital strategies and agendas. Also, there are more policies regarding digitalisation in the Netherlands, which are not mentioned here, because they are too specific and therefore do not describe the influence of digitalisation on rural areas.

Table 1: National Policies influencing (rural) digitalisation.

Ministry / Authority	Policy	Objective	Expected Impact
Digital Government (Government-wide organisation)	NL DIGIbeter 2020 Agenda Digitale Overheid	To determine what need to change in the way the government works and communicates with digital technologies, how digital services should be organised, and how to deal with social issues around the digital transformation.	Digital inclusion and increase of digital literacy
Ministry of Economic Affairs and Climate Policy	Actieplan Digitale Connectiviteit	To give an overview of most the important results and insights from the consultation on digital transformation by means of high-quality digital connectivity for society and the economy.	Increased investments and digital infrastructure in rural areas
Digital Government (Government-	NL DIGITAAL - Data Agenda Overheid	The goal of this agenda is to collaboratively promote the	Open data and cybersecurity for all

wide organisation)		sharing, combining and analysis of data	
Ministry of Justice and Security	Nederlandse Cybersecurity Agenda	The Netherlands is capable of capitalizing on the economic and social opportunities of digitalisation in a secure way and of protecting national security in the digital domain	Not specified
Ministry of Economic Affairs and Climate Policy	Strategisch Actieplan voor Artificiële Intelligentie (SAPAI)	To explore how AI can help to realise societal and economic opportunities, by considering the public interest and thereby contributing to prosperity and well-being	Better societal inclusion, more data-driven agriculture
Ministry of the Interior and Kingdom Relation	I-strategie Rijk 2021-2025	To ensure that society, parliament, and government have sufficient comparable information for insight into the provision and control of information.	Better societal inclusion

Rural Policies on Digitalisation

The digital strategy for the agricultural sector will be published in Autumn of 2021 (LNV, 2021b). The outline of the strategy, which was recently published in September 2021, comprises the opportunities and barriers around digital agriculture (LNV, 2021a). In the second part of the outline, it is presented how the Minister intends to deal with the barriers and risks. It is repeatedly emphasised that digitisation is not a goal in itself. It is about realising the potential of digitisation as a tool for achieving societal goals. The use of data by farmers may help to reduce the usage and dependency of inputs, like manure, pesticides, and other resources. Other opportunities of digitalisation are the strengthening of food security and reduction of food waste through transparent information exchange, the preservation of biodiversity, and the improvement of climate resilience of vulnerable production systems. The problems need to be addressed by facilitating access to good quality data, increasing insight through data sharing, and increase skills to apply the results of data analysis in business or policy processes.

Another agenda from the agricultural sector on digitalisation is the ‘Nationale Agenda Precisielandbouw’ (National Agenda for Precision Farming; Nationale Proeftuin Precisielandbouw [NPPL], 2020). The strategy is designed to list and monitor actions to alleviate or even eliminate the bottlenecks to faster adoption of precision agriculture. Examples of measures that are planned are the enhancement of farmer's digital skills, the development of more data models and sources, as the standardisation of maps and models.

The ‘Nationale Omgevingsvisie’ (National Strategy on Spatial Planning and the Environment) provides a perspective for our living environment in regard to the transformation towards a sustainable and circular economy and adaptation to climate change (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2019b). It does not concentrate on digitalisation in the Netherlands, but the report

addresses the topics of digital connectivity and digital infrastructure. In the section about digitalisation, the focus is on the growth of data centres at locations where their energy demand can be met on a long-term basis. Also, the topics of sustainable farming and landscape design of rural areas are addressed. It is mentioned that clustering and fragmentation of the landscape, for example through the uncontrolled expansion of distribution centres, should be avoided.

There are more policy documents by the provinces of the Netherlands that thematise the digital transformation in rural areas. These are for example, the rural foresight study by the province of Gelderland ‘Toekomstverkenning platteland Gelderland’ (van Duijne et al., 2017) and the report on digitalisation in agriculture by the province of Flevoland ‘Digitalisering van de Flevolandse landbouw’ (Agro Expert Raad Flevoland, 2021). These will not be summarised in this section because they are similar to the previously described policies.

Table 2: Other (rural) Policies influencing digitalisation.

Ministry / Authority	Policy	Objective	Expected Impact
Ministry of Agriculture, Nature and Food Quality	Inzet van digitalisering voor een duurzame landbouw- en voedselketen en robuuste natuur	To determine the necessary measures to facilitate good working digital systems in agriculture	Increase biodiversity, resilience of farmers
NPPL, Ministry of Agriculture, Nature and Food Quality	Nationale Agenda Precisielandbouw	To help eliminate barriers to the adoption of precision farming technology.	Acceleration of adoption of precision technologies
Ministry of the Interior and Kingdom Relations	Nationale Omgevingsvisie	To provide a sustainable perspective for our living environment, which comprises both the built and the natural environment.	Increase digital infrastructure in rural areas

3.2.3. Policies and Strategies to boost Digital Literacy and tackle the Digital Divide

The Dutch government puts a great amount of effort into the improvement of digital literacy. In addition, the Netherlands works to help people understand the opportunities and risks of digitalisation and thereby increases digital awareness. It is the aim to increase the digital literacy of all people and with that decrease the digital divide. More and more processes in our society become digital. See for example the digital patient dossier of hospitals, online banking, and ‘DigiD,’ which is the digital environment of the Dutch government. In 2021, the Dutch government invests EUR 62 million in the reduction of digital illiteracy (Rijksoverheid, 2021b).

The report ‘Digitale inclusie: iedereen moet kunnen meedoen’ (Digital inclusion - Everyone must be able to participate) concentrates on the set-up of the digital services of the government, in such a way that they are accessible and understandable for everyone (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2018). The report furthermore calls for the support of people who do not know how to use digital technologies. This support should be provided by public bodies, such as the library or the ‘Stichting Lezen en Schrijven’ (foundation for literacy).

In the report, several specific aims and actions to increase *digital inclusion* are mentioned. For example, the ‘Tijdelijk besluit digitale toegankelijkheid overheid’ (Provisional Decree on Digital Accessibility of the Government’) was developed to increase the accessibility of websites and apps (Overheid, 2018). Additionally, in order to access government services, it is sometimes necessary for people to be able to be represented by someone else. The government, therefore, wants to enable digital authorisation. Moreover, the government learned that people who find it hard to use digital tools often get help from their friends and relatives. According to the report, this social network of people needs to be focussed on more. To increase digital literacy, the government offers training courses in the implementation of the ‘Wet Educatie en Beroepsonderwijs’ (Adult and Vocational Education Act’), in both large and small towns and cities. In these courses, people learn to read and write, and they also learn how to go digital.

Digital literacy of students is a frequently occurring topic. The ‘Digitaliseringsagenda primair en voortgezet onderwijs’ (Digitalisation Agenda for Primary and Secondary Education; Ministerie van Onderwijs, Cultuur en Wetenschappen, 2019), the ‘Strategische agenda MBO ICT’ (Strategic Agenda secondary vocational education ICT; MBORaad, 2018), and the ‘Digitale geletterdheid in het voortgezet onderwijs’ (report digital literacy in secondary education; KNAW, 2013) all discuss how digital literacy amongst children can be improved. The report by KNAW (2013) was the starting point of the Digital literacy portal (see Table 3).

Other (decentral or local) government reports also focus on digital inclusion, for example, the action plan for digital inclusion ‘Actieplan Digitale Inclusie’ by the municipality of Helmond (2021) or the ‘Bouwstenen voor digitale inclusie’ (Building blocks for digital inclusion) report by the municipality of Amsterdam (2017). Both are similar to the national report on digital inclusion in terms of the aims to improve the skills of people who do not know how to use the internet, the difference is the target group of these reports. The former concentrates on the inclusion of the elderly, while the latter makes recommendations on how to close the digital gap of the citizens of Amsterdam.

The initiatives listed in Table 3 either aim to increase digital inclusion through the improvement of the *digital infrastructure* (allemaal digitaal, Tel mee met Taal), aim to inform about the digital environment and teach people how to deal with digital tools (Netwerk Mediawijsheid, doe je digiding!, Vakportaal digitale geletterdheid), study the opportunities and risks of digitisation and experiment with digital governance (kennisplatform AI, Proeftuin Lokale Digitale Democratie), or connect people online (#echtcontact). Specific initiatives that help boost digital literacy and digital inclusion in rural areas could not be found. There are, however, lots of initiatives that address the broadband coverage of rural areas in the Netherlands (Salemink & Strijker, 2018). The connectivity to the internet is needed to become digital literate and is therefore the basis for digital literacy.

Table 3: Programmes and initiatives addressing digital literacy and digital divide. (*) International, National, Regional or Local

Initiative	Objective	Key words	Period	Area of impact	Link	Public / Private	Scale of action *	Rural / Generic
Isdatechtzo.nl, Netwerk Mediawijsheid	The aim is to help to appreciate and inform about (dis)information. The website informs visitors about how fake news works and how to recognise whether a message is reliable.	Fake news, social media, deep fake	Not specified	The Netherlands	www.isdatechtzo.nl	Public	National	G
Allemaal digitaal	Collect laptops and tablets so that as many people as possible can participate digitally.	Digital equality, recovery of laptops,	2020-2022	The Netherlands	https://www.allemaal-digitaal.nl/	Public-private	National	G
Tel mee met Taal	Provide an infrastructure for improving the digital skills of low-literates.	Basic digital skills, digital equality	2020-2024	The Netherlands	https://www.telmeemettaal.nl/	Public	National	G
Doe je digiding!	The aim of the programmes by 'doe je digiding' is to strengthen the digital skills of young people and adults.	Basic digital skills, digital equality	2020-	The Netherlands	https://doejedigiding.nl/	Public-private	National	G
#echtcontact	The aim of the campaign is to promote (digital) inclusion and a healthy digital awareness and to be able to connect with each other in the digital world, also in times of the COVID pandemic.	Connect people online, digital inclusion	2020-	The Netherlands	https://echtcontact.nu/	Public-private	National	G
kennisplatform AI - publieke waarden en mensenrechten	Securing important public values and rights by studying the opportunities and risks of digitisation, by developing policy, by putting Dutch positions on the international agenda and by engaging with national stakeholders and citizens.	Digital democracy, digital inclusion	2020-	The Netherlands	https://www.digitaleoverheid.nl/overzicht-van-alle-onderwerpen/nieuwe-technologieen-data-en-ethiek/publieke-waarden/	Public	National	G
Proeftuin Lokale Digitale Democratie	The aim is to enable municipalities to experiment with forms of digital democracy.	Digital democracy, digital participation tools	Not specified	The Netherlands	https://www.digitaleoverheid.nl/overzicht-van-alle-onderwerpen/archief/proeftuin-digitale-democratie/	Public	National-regional	G
Vakportaal digitale geletterdheid	Help pupils to deal with fake news and increase digital skills.	media literacy, information literacy, computational thinking, and ICT basic skills	2020-	The Netherlands	https://www.slo.nl/vakportalen/vakportaal-digitale-geletterdheid/	Public	National	G

3.2.4. Policies and Strategies that incentivise Digital Innovations

In this section, first policies are presented that incentivise digital innovation. These policies appear in practice through initiatives fostering the creation of digital innovation ecosystems in or with influence in rural areas. The Ministry of the Interior and Kingdom Relations makes a total of €6 million available for cooperation and innovation in 2021. In the Netherlands, the top sectors and their alliances play an important role in digital innovations (Overheid, 2021). This can be seen in the key technologies that are said to support the missions by the top sectors, which shows that innovation policy in the Netherlands relies strongly on digital technologies. Some of these key technologies are big data, blockchain, and AI (Topsectoren, 2021). Initiatives, which make use of the governmental fundings, also by the EU and other ministries, boost new digital business models in rural areas agriculture. These are outlined in the following sections.

In a letter from the Ministry of Economic Affairs to the House of Representatives regarding ‘Naar missiegedreven Innovatiebeleid met Impact’ (Towards mission-driven innovation policy with impact) from 2018, the Dutch government formulated a new approach for the topsectors and innovation policy (EZK, 2018a). They call for a stronger connection of actors through *public-private partnerships* to seize the opportunities for addressing societal challenges. In the same year, the Dutch Digital Delta (ICT cooperation of topsectors) has published its Kennis en Innovatieagenda ICT 2018-2021 (Knowledge and Innovation Agenda; Dutch Digital Delta, 2017). In this report, it becomes clear that the ambition to play a leading role in several key technologies such as ICT or AI is the starting point of the actions presented in the agenda. Similarly, the topsector Life Sciences & Health has published an agenda for health and healthcare, the ‘KIA gezondheid en zorg’ (Health-Holland, 2019). In this, the role of social media for healthcare and artificial information supply is mentioned that can support healthcare in the real world.

Also, the Ministry of Economic Affairs wants to stimulate (digital) innovations by Dutch companies through the Wet Bevordering Speur en Ontwikkelingswerk (Promotion of Research and Development Work Act). Actors can request subsidies for research and development from the government. The act reimburses a portion of the costs and expenses of actors that qualify for the reimbursement (Rijksdienst voor Ondernemend Nederland [RVO], 2021).

In Table 4, several initiatives that boost digital innovation are depicted. These initiatives are diverse. The table does not give a complete picture of initiatives that boots digitalisation in rural areas. However, some of the initiatives have a broad impact, since the budget for some of the initiatives is relatively high (e.g., Rural Development Programme POP3+). Also, some of the initiatives focus on innovations in agriculture, for example, the Farm of the Future.

Table 4: Policy instruments influencing digitalisation in rural areas

Initiative	Brief Description	Objectives	Area of impact	Period of implementation	Budget (if any)	Public / Private	Are rural areas specifically mentioned or addressed? Y/N	Link
I-Partnerschap Rijk-Hoger Onderwijs	Students, researchers, and government organisations work together on innovative solutions to social issues from digital practice.	To make a significant contribution to fast, secure, and reliable digital services for citizens and businesses.	National	2020-	Not mentioned publicly	Public	N	https://www.ubrijk.nl/i-partnerschap
Kennis-en Innovatieconvenant (KIC)	The national research fund NWO invests in research in which public and private parties work together.	Today's major challenges offer opportunities for scientists, companies, and public parties.	National	2020-2023	EUR 118 million/year	Public-private	N	https://www.nwo.nl/on-derzoeksprogrammas/kennis-en-innovatieconvenant-kic
Rural Development Programme POP3+	The implementation programme is intended for the development, sustainability, and innovation of the agricultural sector.	The aim is to increase the resilience of farmers and the natural environment through innovation, sustainability, and competitiveness.	National	2014-2022	EUR 1.6 billion	Public-private	Y	https://www.netwerkplatteland.nl/binaries/netwerkplatteland/documenten/publicaties/
Small Business Innovation Research (SBIR)	An instrument through which the government challenges entrepreneurs to come up with innovative products and services through an innovation competition.	Broaden the network of partners who are using new technology to address social issues.	National	2011-	EUR 750.000 / call	Public-private	Y	https://www.rvo.nl/subsidie-en-financieringswijzer/sbir
Startup in Residence	The programme connects start-ups and scale-ups with key challenges. Geronimo AI emerged within the programme.	The program aims to challenge market participants to come up with solutions to social challenges, such as digital illiteracy.	Regional	Not specified	Not mentioned publicly	Public-private	Y	https://startupinresidence.com/
Rijksacademie voor Digitalisering en Informatisering Overheid (RADIO)	Within the program courses are organised, in which participants learn to create of e-learnings, webinars and podcasts.	It is designed to increase the knowledge of civil servants in the areas of digitisation, information, ICT, and innovation.	National	2017-	Not mentioned publicly	Public	N	https://www.it-academieoverheid.nl/
Digital Society	Computer- and data scientists need to work together with social scientists and humanities scholars work together to address issues regarding digitalisation.	Address the digital divide and ethical issues that come with the digitalisation.	National	2016-	Not mentioned publicly	Public-private	N	https://www.thedigitalsociety.info/
Farm of the Future	It serves as an innovation, test, and demonstration facility for new circular agriculture concepts in arable and vegetable farming	Further develop the initiative into a collaborative platform involving other agricultural regions around the Netherlands.	Local – national	2020-	Not mentioned publicly	Public-private	Y	www.farmofthefuture.nl
Data-Driven Integrated Growing Systems initiative	The innovation network offers support in cultivation and business management with the help of big data.	Working on the further development of digital cultivation to improve greenhouse performance.	National	2018-2021	EUR 1.6 million	Public-private	Y	https://topsectortu.nl/nl/data-driven-integrated-growing-systems

3.3. Contributions from the Structural and Investment Funds and the Cohesion Policy

Structural Funds and Cohesion Policy provide support for, amongst others, different initiatives to boost digital transformation (EC, 2021a). The European Cohesion Policy aims to prepare Europe for the digital age. In the programming period of 2014-2020, the EU provided around EUR 20 billion from the European Regional Development Fund (ERDF) for digital investments. The focus of the programme lies on the overcoming of the digital divide, also geographically between rural and urban areas and between EU member states, by harnessing the benefits of digitisation for citizens, companies, and governments. In this section, policies regarding the broadband infrastructure, digital public services, Strategies for Smart Specialisation (RIS3), and Digital innovation Hubs are presented (DIH) that influence digitalisation in rural areas.

3.3.1. Broadband infrastructure

As has been pointed out in the introduction, the broadband infrastructure in the Netherlands is comparably good. The fixed Very High-Capacity Network (at least 100 Mbit/s) coverage is 89% in the Netherlands. The following policies and strategies have a direct influence on the broadband infrastructure in the rural areas in the Netherlands.

The goal of the Dutch government is to spread broadband coverage in the entire country. In the *'Actieplan Digitale Connectiviteit'* (Connectivity Action Plan; Ministerie van Economische Zaken en Klimaat 2018b), the broadband infrastructure, as well as challenges and future actions by the government, are depicted. In the report, the Communication Infrastructure Fund (CIF) is mentioned, which concentrates on the upgrading and renovation of ICT and provided 50,000 households in rural areas with a reliable fixed connection in recent years. Also, the coverage of the fibre optic network is increasing. Most rural areas are now equipped with fibre. It seems as if the rural areas are more likely to connect to the fibre optic network than the urban areas, because the existing infrastructures of rural areas lag behind, which also makes consumers in the rural areas more willing to pay extra for a fibre optic internet connection (Autoriteit Consument en Markt, 2019).

Moreover, to meet the demand for faster and more stable internet, in the future, more frequencies will be available that can be used for 5G. According to the government, in the coming years, additional frequency space (700 MHz band, 3.5 GHz band, and the 26 GHz band) is needed to keep up with developments in the mobile communications market (EZK, 2020c). The policy for issuing these frequencies has been documented in the *'Nota Mobiele Communicatie 2019'* (policy document on mobile communication; Tweede Kamer, 2019).

Following the European Electronic Communications Code (EECC) the Netherlands aims to reduce the costs of constructing broadband networks. The Telecommunications Act will be revised soon based on the EECC. Moreover, in 2021, the new Antenna Covenant went into effect. This covenant contains agreements between national and local governments and internet providers about the placement of antennas (Vereniging van Nederlandse Gemeenten [VNG], 2021). The covenant aims to achieve

careful placement of unlicensed antennas for mobile communications (EU, 2020). In conclusion, much is initiated to increase the broadband coverage even more.

3.3.2. Digital Public Services

The following sections describe the state and use of digital public services in rural areas of the Netherlands. Especially in times of the COVID pandemic it could be seen how important digital services are for society. For example, people could make use of digital healthcare or ordering groceries online. This section concentrates on e-administration procedures, e-health, e-education, digital identity, digital signature, online banking, and some more digital public services in the Netherlands.

According to the most recent report about digital public services, the Netherlands ranks 7th in the EU (EC, 2019b). The digital public service score of the Netherlands grew slower than the EU average. This is because, a few indicators, such as the use of pre-filled forms and online service completion, have worsened slightly (Ibid).

The online accessibility of the government is broadly addressed in the Dutch digitalisation strategies (see for example, NL DIGIbeter 2020 – Digital Government Agenda). In Table 3, the 'Proeftuin Lokale Digitale Democratie' is listed. It is one example of how the Netherlands puts effort in valuable e-governance. The government also launched DIGIbeter. DIGIbeter functions as a central hub for data and information sharing between inhabitants and the government. According to the European Commission, the Netherlands is one of the EU countries with better overall performance in terms of e-governance (EC, 2019b). This can be attributed to the widespread availability of online services and the digitalisation of public administrations (Ibid).

In e-health, the Netherlands is progressive too. This can be seen in goals described in the E-health monitor 2021-2023 (Rijksinstituut voor Volksgezondheid en Milieu, 2020). Especially since the COVID pandemic, more and more initiatives are directed towards the digitalisation of healthcare. There is, for example, a network, called Health-RI, between hospitals and other health organisations that makes effective communication possible. Also, there are networks, like the digital health centre, which look for innovations in healthcare (Digital Health Centre, 2021). Besides, patients can make appointments with their general practitioners online and hospitals provide health records online. In Rennenraedts, et al. (2019) the difference in the accessibility of facilities, like supermarkets and pharmacies, between rural areas and more urban areas is depicted. The distance to facilities, and therefore also to health facilities is higher in rural areas, which is why the increase in e-health initiatives is especially helpful in rural areas.

E-learning initiatives for different groups of people are available in the Netherlands. In Table 4, already a few initiatives have been listed that help to tackle the digital divide. E-learning is for example provided by RADIO (RijksAcademie voor Digitalisering en Informatisering Overheid), an academy for digitalisation. RADIO developed e-learning modules, webinars, and podcasts to help reduce digital illiteracy (Rijksoverheid, 2021).

In regard to e-identity, the government is also becoming increasingly digital. In the Netherlands, there is an electronic identification service, called DigiD. Furthermore, the Netherlands developed a set of standards for access to digital services. The *Afsprakenstelsel Elektronische Toegangsdiensten* (Trust

Framework for Electronic Identification) enables users to confirm their identity and authorisation digitally. It protects organisations, and users from fraud (Ministry of the interior and Kingdom Relations, 2018).

How common the different digital public services are used by Dutch inhabitants is depicted in Table 5. The usage of the services is assessed partly based on the personal perception of the author, since living in the Netherlands helps to make a rough estimate about the use of digital services, and partly by estimating the usage of services based on the policy reports. Many matters, such as registering at the municipality, can be done online in the Netherlands. Therefore, the services of digital signature, online banking, and bills are also believed to be very or extremely common in the Netherlands.

Table 5: Digital Public Services usage in the Netherlands.

		Extremely common	Very common	Fairly common	Not common for most of the population	It is not a possibility nowadays
e-Administration procedures	In general in the country		X			
	In rural areas		X			
e-Health	In general in the country		X			
	In rural areas		X			
e-Education	In general in the country		X			
	In rural areas		X			
Digital identity	In general in the country		X			
	In rural areas		X			
Digital signature	In general in the country		X			
	In rural areas		X			
Online banking (account management, payments)	In general in the country	X				
	In rural areas	X				
Bills (council taxes, water, electricity)	In general in the country	X				
	In rural areas	X				

3.3.3. Research and Innovation Strategies for Smart Specialisation (RIS3)

The Research and Innovation Smart Specialisation Strategy (RIS3) is a regional approach to explore the potentials of the local economies and to implement innovation strategies. How the RIS3, implemented in the programming period of 2014-2020 and strategies presented for 2021-2027, influenced digitalisation in agriculture and rural areas in the Netherlands is presented in this section. The European Union made the RIS3 a condition of the use of funds from the European Regional Development Fund (ERDF) for the member states. The funds are intended to support smart, sustainable, and inclusive growth in the member states. In the Netherlands the Smart Specialisation Strategy (RIS3) is implemented in the four areas of the North (provinces of Friesland, Groningen, and Drenthe), the East (Gelderland and Overijssel), the South (Zeeland, Noord-Brabant, and Limburg) and the West (Zuid-Holland, Noord-Holland, Utrecht, and Flevoland). For all four areas, there already exist strategies for the 2021-2027 programming period.

The OP (operational programme) North Netherlands received funds for the period 2014-2020 that were used “to strengthen the region's potential for research and innovation while at the same time the shift to a resource-efficient, low-carbon economy” (EC, 2020c). In the official report, the goal to develop new digital products and services, as well as the participation of large groups of people in that development, is mentioned (SNN, 2013). While the report for the period 2014-2020 only briefly addresses digitalisation, the report for the period of 2021-2027 more broadly presents the digitalisation goals for the northern provinces (SNN, 2020). It is mentioned that there is a digital component to every social issue and in almost every sector. Furthermore, the report mentions the goals to increase digital connectivity, digital infrastructure, and digital literacy.

The OP East Netherlands has also published a report for the programme period of 2021-2027 (van Barneveld-Biesma, 2020). Similar to the report of OP North Netherlands, digitalisation is addressed concerning the topics of smart industry, digital innovations, cybersecurity, e-health, and others. Furthermore, the report does not address digital transformation in the rural areas of the Netherlands directly.

For the period of 2014-2020 the OP South published a strategy in which it has been pointed out that innovative capacity is, amongst others, linked to the relationship between urban and rural areas, and the environmental qualities of the region. The topics of digital accessibility and digital infrastructure are also addressed (RIS3 Zuid, 2013). In the strategy for 2021-2027, the topic of digitalisation is discussed in more detail. (Digital) innovations to more efficient and personalised care are said to be urgent, especially in rural regions, where an aging population and shortage of labour can be found (Hagens et al., 2020). Moreover, the topics of climate adaptation with digital technologies, digital health, and digital farming are discussed.

Like the other three areas did only briefly address the importance of digital technologies for the economy, does the OP West Netherlands only shortly mention the importance of digital infrastructure (RIS3 West, 2014). In the concept version of the strategy for 2021-2027, in comparison to the other areas of the Netherlands the same topics are addressed (RIS3 West, 2019). The strategies of the four areas thus overall show high overlap and similarities.

3.3.4. Digital Innovation Hubs (DIH)

The Digital Innovation Hubs (DIHs) associated with rural areas and agriculture sectors in the Netherlands are presented in this section. Innovation Hubs are set up to encourage entrepreneurs, researchers, and citizens to start innovating and keep innovating. Some DIHs may not refer to themselves as an innovation hub or innovation centre, which is why the actual number of hubs in the Netherlands that influence digital transformation is probably higher than the hubs presented in this section.

The network of innovative initiatives, experiments, and start-ups in the Netherlands is highly connected, also with organisations outside of the Netherlands. The 'Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek' (TNO; Netherlands Organisation for Applied Scientific Research) connects the Dutch field labs and hubs with the European AI Digital Innovation Network (Rijksoverheid, 2019).

Within the Netherlands, more than 20 DIHs could be found. Most of them are part of the agricultural sector. Therefore, most DIHs can be found within the DIH AgROBOfood by the EU (AgROBOfood, 2019). It contains a total of 49 DIHs of which 11 can be found in the Netherlands. Greenport West-Holland is one of the DIHs listed. The innovation cluster connects companies and organisations active in the field of food and horticulture (Greenport, 2020). Another example is the 'Zuidelijke Land en Tuinbouw Organisatie' (agricultural and horticultural organisation of the southern provinces) which concentrate more on community building and mentoring of farmers. Similar organisations also exist for the North, East, and West of the Netherlands. Similarly, 'LTO bedrijven' (Dutch Farmer's Association) connects farmers in the Netherlands. The impact of LTO bedrijven is broad, since the organisation is also engaged in innovations as e.g., Farmcube, which combines satellite and drone images with crop data to analyse land plots.

Other examples of DIHs in the Netherlands are Roots innovation Hub within Regio Foodvalley NL. Roots innovation Hub offers space to startups that are active in agri and food. Similar to Roots innovation hub, the Agrifood Hub in the Centre for Sustainability and the Starthubs by Hortiheros also connect startups with innovative companies. Next, some DIHs facilitate the cooperation between businesses and research. Examples are the ICT Campus within the Foodvalley NL, OnePlanet centre, which concentrates on chip and digital technologies, and Delft Ag Tech centre.

The *SmartAgriHubs* build up a European network of DIHs. The Netherlands forms the region of North West Europe together with Germany, Belgium, and Luxembourg. It offers funding to develop services for digital transformation and innovation. At the moment, five flagship innovation experiments receive support in the region (SmartAgriHubs, 2021). The SmartAgriHubs rely on the Smart Specialisation Strategies (RIS3). This can be seen in the partners of the SmartAgriHubs, of which some are also included in the thematic partnerships of the RIS3 (Wolfert, et al., 2019).

3.4. CAP National Strategic Plans

The Common Agricultural Policy (CAP) is built around (cross-cutting) objectives on knowledge and innovation, which are also the basis upon which the Netherlands designs its CAP strategic plan. In the National Strategic Plan (NSP), which will be published approximately at the beginning of 2021, the Netherlands will explain how it will contribute to the objectives set by the European Commission. In the Netherlands the 'programmaorganisatie NSP-GLB 23-27' (programme organisation NSP-CAP 23-27), which is a cooperation of national and local officials, is working on the NSP. Even though the NSP has not been published yet, other documents are used as the basis for the NSP. Also, an online brochure on the new national CAP already reveals the outline of the NSP (Gemeenschappelijk Landbouw Beleid [GLB], 2021). The different documents will be elaborated on in the following.

The programme organisation make use of the report by Berkhout and colleagues (2019) to develop the national CAP. In this document, the legal options regarding the aspects of climate, environment, biodiversity, and landscape are made explicit. Also, the report focusses on the choices that can be made in supporting environmental sustainability (Berkhout et al., 2019). Digitalisation is one of the mentioned opportunities. Digital technologies can support the agricultural transformation by increasing the data exchange to improve precision farming, circular agriculture, enhancing competitiveness, and increasing knowledge about environmental factors.

The programmaorganisatie NSP-GLB 23-27 is working on a national strategic plan that adapts the goals of the European Commission to the national scenario (GLB, 2021). These goals are 1. smart and resilient agriculture, 2. protection of the environment and combat climate change and 3. broad rural development. These goals can also be found in the concept of the NSP (Ibid.). The first topic that is addressed is that of future-oriented farmers. Farmers who are willing to invest in climate-friendly measures are more strongly supported by the future national CAP. The reimbursement that will be available for farmers that want to innovate, is meant to reduce the financial risks of the farmers. Another goal of the NSP is to connect the Dutch national agricultural system with agricultural stakeholders abroad. The measures are presented by the programme organisation: As before, the basic subsidies remain the core of the national CAP. Next, the eco-regulations are new. These stimulate eco-activities that farmers can apply to increase the quality of the natural environment, such as water quality. The basic subsidies and the eco-regulations are intended to support individual farmers. In addition, there will be agrarian nature and landscape management (ANLb). Here, several farmers work together on nature management. Finally, there are the non-land-based instruments. These are instruments that are not aimed at the possession of agricultural land. Think of an area-specific approach for specific problems that go beyond one specific plot or farm, for example, the water quality of rivers in the region. Besides, subsidies e.g., young farmers, innovation, and knowledge development are also included in the new national CAP.

The role of digital technologies for future-oriented farmers is not directly addressed. However, since there is more financial support for farmers that are willing to innovate, the new national CAP will likely boost the digital transformation.

3.4.1. CAP Integrated Administration and Control System (IACS)

On the way towards the next CAP grant period (2021-2027), the seven future-proof agriculture pilot projects of the Netherlands exist to gain experiences with performance-based compensation (GLB, 2021). The projects are spread within the entire country to give a broad view on the management of agricultural land (see <https://www.youtube.com/watch?v=q6BF4qRXpcE> for a video on the projects). The seven projects either concentrate on the increasing biodiversity in and around the agricultural fields (see e.g., project De Akkerbelt), on gathering different opinions about how the new national CAP should look like (see project LTO sectorale bouwstenen), or on the development on a score that can be used to monitor how many sustainable measures have been applied by farmers (See project Hoe? Zo!).

Like other countries of the EU, the Netherlands is also engaged with the “New IACS Vision In Action” (NIVA). Several Dutch organisations are involved. These organisations are Wageningen Research, The Ministry of Economic Affairs and Climate, and the ‘Zuidelijke Land- en Tuinbouworganisatie’ (agricultural and horticultural organisation of the southern provinces). Overall, NIVA concentrates on the modernisation of the IACS. Thereby the effective use of digital technologies and online tools supports the creation of methodologies and data sets for monitoring agricultural systems while reducing the administrative burden for farmers (NIVA, 2021).

3.5. Data Management

Responsible use of data by the government contributes to increasing transparency and improving services. This chapter addresses topics related to data management that are not specific for rural areas but might have an important influence on them. These topics are open data strategies and policies, harmonisation of regulation and reliability of data, and data safety or interoperability of data exchange systems. The Dutch government published a data agenda called ‘NL DIGITAAL: Data Agenda Overheid’ which serves as a good overview of data strategies and policies by the Dutch government (Digitale Overheid, 2020b).

The Dutch government wants to make available as much information as possible through *open data* and open standards (Ibid.). The directive on open data and reuse of public-sector information regulates open data at the EU level (EU, 2019a). The Dutch government has implemented the directive through an open data directive known as ‘Wet Hergebruik Overheidsinformatie’ (VNG, 2020). The directive obliges municipalities to make government information available for reuse as open data. Many municipalities already implemented the directive and have an open data portal for inhabitants (see e.g., opendata.arnhem.nl). Moreover, the government pays attention to digital open-source council and state information. Therefore, the open data portal [data/overheid.nl](https://data.overheid.nl) contains general notices, announcements, and notifications by the government that can openly be accessed. This action is in line with the Wet elektronische publicaties (law for web publications) that came into effect in July of 2021.

Furthermore, there is the ‘digitaal stelsel van de Omgevingswet’ (Digital Framework for the Environmental Act). It is a digital platform to support the environmental act, which bundles legislation and rules for space, housing, infrastructure, environment, nature, and water. To make optimal use of

the act, geo-data can be used for several purposes by companies and inhabitants. This is why the government wants to further develop geo data records (Digitale Overheid, 2020b). To analyse the impact of shared data, the Ministry of Infrastructure and Water Management had completed two pilots at the beginning of this year. In the pilots, different actors have agreed on the sharing of asset data and working plan data. One of them was the 'Drought & Flooding' pilot. Data by the water boards were publicly shared (Ibid.).

The Netherlands published the 'Nederlandse Cybersecurity Agenda' (National Cybersecurity Agenda) to be prepared for threats from professional criminals (Ministerie van Justitie en Veiligheid, 2018). While cyberattacks become increasingly complex, the government needs to gain more and more knowledge to maintain national *cybersecurity*. In the Agenda several policy measures are listed that will be implemented in the future. For example, will the 'Nationaal Detectie Netwerk' (National Detection Network) be further developed to create a network that can cope with cyberattacks. Furthermore, the government is constantly updating the 'Nationaal Crisisplan ICT' (National Crisis Plan for ICT) to be prepared for major threats to national security. Besides, the Ministry of Justice and Security together with the Association of Municipalities (VNG) and Statistics Netherlands (CBS) develop a data model for mapping undermining crime (Digitale Overheid, 2020b).

Moreover, through the National Cyber Security Research Agenda III (NCSRA III), the Netherlands pursues the development of cybersecurity research aimed at the development and commercialisation of innovative solutions (Bos et al., 2018). Another research was commissioned by the Ministry of the Interior and Kingdom Relations with regard to algorithms used by the government (Autoriteit Persoonsgegevens, 2019). The report assesses the impact of algorithms and may be used to tighten regulations for algorithmic data analysis by the government.

To standardise the use and access of data the Netherlands will encourage the adoption of international standards, partnerships, and frameworks. The Netherlands wants to proactively join relevant European and global *standardisation and certification* initiatives through the NEN (Royal Netherlands Standardisation Institute) standardisation platform. The government is also going to pursue multilateral cooperation on standardisation for the Internet of Things, amongst others through the Global Forum on Cyber Expertise (GFCE). In a report addressed to the House of Representatives it is described how the use of open standards can be stimulated (Berenschot, 2019). In the agricultural sector, standardisation of data will also play an increasingly important role. In the context of the 'Nationale Agenda Precisielandbouw' (National Precision Farming Agenda) a label for reliable data is being developed to make it easier for farmers to choose the right products.

Another important aspect of data management is the responsible use of data. The Leer- en Expertisepunt Datagedreven Werken (Learn and Knowledge Point for Data-driven Practice) came up with guidelines for *responsible data usage* in public spaces (Digitale Overheid, 2020c). Different municipalities worked together with the government to think about ethical dilemmas that need to be considered in data usage in public spaces. The report 'Behoorlijk Datagebruik in de openbare ruimte' (Proper Data Usage in Public Space) gives an overview of the findings (Ibid). To make people aware of the impact of algorithms on discrimination, the municipality of Amsterdam in cooperation with other actors develop a programme in which it is shown how algorithm work (Digitale Overheid 2020b).

At Wageningen University and Research (WUR) there is the Wageningen Data Competence Centre. The organisation aims to support research and development in data management and data science (WUR, 2021). Since WUR is engaged with agricultural research, the activities of the competence centre are often related to data management in agricultural systems.

Even though most of the policies and instruments presented in this section are not directly influencing rural areas, the handling of data plays a role in the entire country and is therefore also important for rural areas. Moreover, as has been pointed out earlier (see 3.2.2.), there is increasing awareness regarding the access and protection of data in the agricultural- and food sector.

4. Challenges and Opportunities

In order to better address the barriers that digital transformation brings and to better understand the legislation that hinders or supports digitalisation processes in rural areas, this chapter first describes the barriers to digitalisation in the Netherlands. After that, actions to boost sustainable digitalisation are presented that are based on the recommendations to boost digitalisation in rural areas, which will also be described in section 4.2 of this report.

4.1. Barriers to Digitalisation

This section includes an analysis of the main barriers found for digital transition in rural areas and agriculture, including aspects such as economic, technical, legal, and skills and capabilities barriers. In this section, the influence of COVID-19 is also discussed. See an overview of the barriers to digitalisation in rural areas and the influence of COVID-19 in Table 6.

Data availability and *data quality* are playing an important role in rural digitalisation, especially in the transformation of the agri-food sector (van Wassenaar et al., 2020). Data availability is still hindered by low connectivity in some rural areas because in some areas it is not possible to ensure broadband coverage because of technical barriers (LNV, 2021a). Also, farmers are concerned because they have to deal with software that is badly connected to the wider network of farmers and companies (Kempenaar et al., 2020). In Wassenaar et al. (2020) the barriers to blockchain technology in agri-food are listed. Amongst the barriers, they mention the threat of cyberattacks. While the digitalisation is increasing in the agricultural sector, the threat of cyberattacks is also increasing and farmers are mostly not aware of cyber criminality (Nieuwe Oogst, 2020).

During the COVID-pandemic the internet use was much higher than before. However, this was not a problem for the broadband capacity. Nonetheless, a reporting system has been set up so that potential capacity problems can be notified (EC, 2020a). On the other hand, the pandemic exposed the divide between businesses that were able to adopt digital solutions and those that did not. Digital skilled entrepreneurs had an advantage during the pandemic (EC, 2021f).

In the Netherlands, the House of Representatives is, according to research on the implementation of digital policies from 2019, searching for ways to translate a value-driven digitalisation approach into concrete policy measures and legislation (Kaal et al., 2019). However, in the meantime, more and more attention has been regarded towards the digital transformation, as can be seen in the difference

between the RIS3 strategies of the implementation period of 2014-2020 and 2021-2027 (see section 3.3.3.). Moreover, the Ministry of Agriculture, Nature, and Food Quality found that there is a lack of trust regarding data architecture and data ownership and also a lack of digital skills and literacy (LNV, 2021a). In order to use digital technologies, farmers need to have digital skills. For example, they have to understand if the sensors are calibrated or if they have gathered sufficient measuring points (Ibid).

The Netherlands does not have a national fund for broadband development, which is why regional and local areas sometimes have difficulties meeting the demand for connectivity (EC, 2020a). The COVID crisis may even worsen the situation. According to research conducted by Rabobank, is it more difficult for rural areas to recover from the crisis than in urban areas.

Table 6: Barriers to digitalisation

Barriers to digitalisation		Influence of COVID-19
Technical	data availability, data quality hindered in some rural areas	Higher data traffic → no capacity problems
	Cyberattacks	Better infrastructure between hospitals (see 3.3.2)
	Low connectivity in some rural areas	Digital divide affecting entrepreneurs and rural dwellers
Legal	Lack of consistent agreements on data sharing and data ownership	Initiatives to give laptops to people who cannot afford them
Training / Education	Lack of advanced digital skills, digital skills of elderly	disadvantage of children without digital skills, skills of teachers not sufficient (Rijksoverheid, 2020)
Economic	No national fund for broadband development	higher vulnerability due to dependence on seasonal workers (ABN-AMRO, 2021), loss of food export market during pandemic
	Prices of high tech in agriculture → high risk	Increased public interest in local food and short food supply chains

4.2. Actions to boost Sustainable Digitalisation

In this report, we follow the recommendations by Brunori et al. (2021) to elaborate on the challenges and opportunities of rural digitalisation in the Netherlands. Based on these recommendations Table 7 was filled with ideas of actions that should guide the new generation of rural policies, which boost sustainable digitalisation of agriculture and rural areas in the Netherlands. The recommendations are based on the seven principles of digitalisation toward desired futures of agriculture and rural areas, which can be seen in the right column of Table 7 (see Brunori et al., 2021 for explanations of the principles). The principles can be put into practice with the implementation of actions in four key rural development domains, namely: i) Human capital; ii) Innovation; iii) Investments; and iv) Governance. In Table 7, for each principle and rural development domain recommendations are depicted.

The recommendations for actions to boost sustainable digitalisation are based on the barriers that can be found in the Netherlands. In terms of human capital, it is recommended to facilitate government programmes, make use of intermediaries, or facilitate trainings to increase digital skills, one the one hand. On the other hand, the data quality and access also need to be increased to make it more tempting to make use of data. Innovations to boost digitalisation should increase accessibility and connectivity to include more inhabitants in the digital transformation. Also, it is found that innovations that improve the exchange of data would help the local food supply chains. In the key rural development domain of investments, it is recommended to invest in the so called ‘twin transitions’ that combines the digital and green transformation. The twin transformation helps to make agricultural production more sustainable in regard of the natural environment and the financial resilience of supply chain partners. To connect rural production to the consumers in urban areas, it would help to invest in local food hubs for farmers and consumers. In this way short supply chains could be facilitated. In terms of governance, it is recommended to better coordinate between different initiatives. Moreover, it is mentioned to encourage the development of data hubs, which improve the infrastructure in the digital transformation. Policy tools for sustainable digitalisation in the Netherlands which concentrate on sustainable digitalisation in the agricultural sector are in the making. The policy document on digitalisation for sustainable farming by the Ministry of Agriculture, Nature, and Food Quality, will be published approximately in the begin of 2022. This will reveal more concrete actions to boost digitalisation in rural areas in the Netherlands.

Table 7: Actions to boost sustainable digitalisation in the Netherlands (recommendations in grey are from Brunori et al. (2021)).

	Key rural development domains			
	Human capital	Innovation	Investments	Governance
Creating the basic conditions for digitalisation	Promote government programmes to increase digital literacy (section 3.2.3.)	Support innovations for alternative (5G based) connectivity for hardly accessible rural areas (LNV, 2021a)	National funding for broadband development (section 4.1)	Policies for infrastructure of data (van Wassenauer et al., 2020)
Anchoring digitalisation to sustainable development	Facilitate trainings of farmers, rural dwellers, SMEs to use digital technologies (section 4.1); shed light on ethical issues	Align implementation of digital technologies with SDGs	Invest in measuring technology to reduce ammonia emission (Remkes et al., 2020); twin transition of green and digital technologies (EC, 2020d)	better coordination between various initiatives → better understanding of causal relationships between environmental factors and modes of production (LNV, 2021)
Adapting digitalisation to different context	Define different groups with individual needs regarding digitalisation (chapter 2)	Encourage interactive innovation	Align support to investments with local strategies	Community based approaches to digitalisation strategies
Favouring digital inclusion	Good quality and reliable data increase willingness of farmers to invest in digitalisation (LNV, 2021)	Increase the accessibility to data infrastructures for farmers (van Wassenauer et al. 2020)	Support to vulnerable groups	Monitoring DESI indicators progress
Developing digital ecosystems	Digital systems mostly used by selective target (skilled) groups → Accessible intermediate systems needed	lot of local short food supply chains → innovations needed in exchange and usage of data at supra-regional level and between new target groups.	local food hubs linked to efficient food distribution between rural farmers and urban consumers needed	Encourage the development of data hubs as e.g., joindata, agtech centres etc.
Developing adaptive governance models	Planning, coordination and networking among rural digitalisation agencies, Smart Villages, Digital Innovation Hubs, Fab labs, etc.			

Designing policy tools for sustainable digitalisation

Policy by the Ministry of Agriculture, Nature, and Food Quality is in the making; Facilitate more multidisciplinary cooperation to make responsible innovation possible.

5. Conclusions

In the Netherlands digitalisation in agriculture and rural areas is already taking place in a rapid pace. The Dutch policy scenario needs to be looked at while being aware of the specific demographic situation of the country. Only 2% of the Netherlands is considered rural, while at the same time it is one of the smallest countries with the highest exports of agricultural products. Which is why a lot of policies address the agricultural sector. In the near future, the new national CAP will be published, which will encourage farmers to apply more practices that help to increase the biodiversity and reduce emissions. Also, other digital policies for the agricultural sector, such as the national digital policy by the Ministry of Agriculture, Nature and Food Quality, will both boost the digital transformation in agriculture even more.

It is striking that in the Netherlands there is a large variety of national and regional digitalisation policies. Especially in the past couple of years, more and more generic policies have emerged which are directed towards the digitalisation and the reduction of the digital divide. Overall, the Netherlands is advanced in the development of digital systems and skills. Rural areas lag behind a bit, as do some groups of users (especially older people). However, the broadband coverage is addressed by several policies and the use of digital services is increasing, which will make it even more attractive to live in more rural areas in the Netherlands.

It will be challenging to remain the competitive position of the Netherlands in terms of digital innovations (EC, 2021e). However, much effort is going into initiatives and programmes that boost digital innovations as could be seen in section 3.3. There are lots of national and regional programmes that support the increase in digital skills of all people. Since more and more attention is regarded to the safe access to sensible data, the data management by the government is becoming increasingly important as has been pointed out in section 3.4. Finally, in chapter 4 the challenges and opportunities have been discussed. Amongst the challenges, the skills and on the risks of farmers, cybersecurity and access to internet are mentioned. To address the different challenges some actions are presented which may help to boost the digital transformation in the Netherlands. It is notable that several actions are about the improvement of the agricultural and food system, by for example encouraging better coordination between existing cooperation or by encouraging accessible intermediate systems. In conclusion, it can be said that the Netherlands will be successful in remaining one of the leaders in the digital transformation if the policies by the government will be translated into action successfully.

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