DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

NATIONAL POLICY ANALYSIS

SWITZERLAND

03RD DECEMBER 2021

National Policy Analysis | Switzerland

Project name	**DESIRA	Digitisation: Economic and Social Impacts in Rural Areas**
Project ID	818194
H2020 Type of funding scheme	Research and Innovation Action (RIA)
H2020 Call ID & Topic	H2020-RUR-2018-2 / RUR-02-2018 Socio-economic impacts of digitisation of agriculture and rural areas
Website	www.desira2020.eu
Document Type	Working document
File Name	WD 4.2– National Policy Report	Switzerland
Status	Final
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Content

Executive Summary

Overall, the digitalisation process is well advanced in Switzerland, and the gap between rural and urban areas is also being reduced. The 2020 I-DESI shows that the average connectivity dimension score for Switzerland (69.2) was comparatively high compared to most countries although lagging behind Japan (74.5), Iceland (71.7), the top four EU28 (70.4), and USA (69.8). In the area of digital public services, though, the level of digitalisation still appears to be comparatively low. We also observe a substantial gender gap among households on Internet use. However, this gender gap tends to decrease over time, and quite sharply.

Switzerland is not part of the EU but continuously develops and adapts national policies that aim at influencing the digital situation in rural areas and the forestry and agricultural sectors. This takes place under the frame of the Swiss agricultural policy but also on higher policy levels and/or other policy areas.

An example of a key national policy is the *resource efficiency payments* ("*Ressourceneffizienzbeiträge*"), where digital techniques (since 2014) with a proven positive effect on the sustainable exploitation of natural resources and/or the efficient use of production means are financially supported throughout Switzerland. The support conditions vary depending on the canton, region, altitude, and value chain concerned.

There is a "Digital Switzerland Strategy", which was adopted by the Federal government in September 2020. This strategy provides the guidelines for governmental action and indicates where and how authorities, academia, the private sector, civil society and politics must work together in order to shape the transformation process for the benefit of everyone in Switzerland.

The key objectives of this "digital Switzerland Strategy" are as follows:

o   Enabling equal participation for all and strengthening solidarity

o   Guaranteeing security, trust and transparency

o   Continuing to strengthen people's digital empowerment and self-determination

o   Ensuring value creation, growth and prosperity

o   Reducing the environmental footprint and energy consumption

A substantial number of projects or initiatives are supported through public funding in order to develop, improve, and boost digitalisation in Switzerland, including in rural areas. The improvement of process efficiency and productivity are often at the core of those projects or initiatives that focus on rural areas. This is due to the fact that Switzerland faces particular challenges over the competitiveness of its agricultural sector on the European and international market.

Main issues towards digitalisation are the lack of digital skills with for example 45% of the Swiss population that does not use e-government services because they are not familiar with them, as well as data protection and process transparency concerns over digitalisation procedures.

A specific focus should be made on developing digital skills of the population; working on new concepts that can overcome data security/privacy issues; and performing more studies on the real impacts of digital tools, including in terms of farm incomes and equality. A more digital literate society, coupled with effective data security laws should lead to an increase in trust in data-sharing. Moreover, a strengthened cooperation between all Swiss cantonal and federal levels appears to be key.

1. Introduction

Digitisation encompasses the use of various new technologies such as sensors, robots, and GPS but also Information and Communication Technologies (ICTs). These technologies are relevant for agriculture in Switzerland if their use helps to achieve agricultural policy objectives and to improve the competitiveness of the Swiss agricultural sector.

The competitiveness of the Swiss agricultural sector is still an important issue given the very high public financial support of the sector in European and international comparison. This lack of competitiveness is due mainly to the small farm family structure and high living costs. In 2020, Switzerland had about 49'000 farms, with an average surface of 21.2ha. It occupies about 102'000 full-time workers.

In addition, Switzerland also has the particularly to be an alpine country, which affects the type and structure of the farms as well as their agronomic and economic potential. This, in turn, impacts on digitalisation processes in the country. That said, Switzerland is very well ranked for innovativeness and can play a major role in that area in terms of digitalisation.

Switzerland is not part of the EU but continuously develops and adapts national policies that aim at influencing the situation, including in rural areas and the forestry and agricultural sectors. This takes place at the Federal level under the frame of the Swiss agricultural policy but also on higher policy levels and/or other policy areas. Authorities acknowledge that digital transformation is a process that must make an essential contribution to the sustainable development of Switzerland and to the achievement of the Sustainable Development Goals (SDGs) of the United Nations Agenda 2030.

It must be emphasised that the Swiss governmental system is quite specific, highly decentralised, with a lot of power granted to the cantonal level (26 cantons). This implies specific challenges in terms of cooperation, but also potentially allows a better connection with rural actors and to answer their specific needs, which also depends on the particular contexts.

There is a "digital Switzerland Strategy" at the Federal level, which provides the guidelines for governmental action and indicates where and how authorities, academia, the private sector, civil society and politics must work together in order to shape the transformation process for the benefit of everyone in Switzerland. In agriculture and the agrifood sector, it is of paramount importance to have in-depth exchanges of views and to establish increased cooperation between all stakeholders in the use of agricultural data. This is why, under the leadership of FOAG (Federal Office for Agriculture) and in line with this overall strategy, a Charter on digitisation in Swiss agriculture and the agrifood sector was drafted in 2018, defining general basic principles.

In international comparison, ICT (Information and Communication Technologies) personnel in Switzerland are characterised by both their high availability and qualifications. Switzerland is among the countries with the highest proportion of ICT-specialists in employment (ca. 5%), which can be attributed to immigration and to the increasing intensity in training activity in ICTs.

This report provides the reader with an overview of the context, current state of the art, policies and initiatives related to digitalisation in Switzerland.

2. Context for (rural) digitalisation

2.1. Current context for digitalisation

Based mainly on the **International Digital Economy and Society Index (I-DESI)**[1] and results from the **project 'Broadband Coverage in Europe (BCE)'**, the following sections present the level of digitisation in Switzerland. However, the I-DESI scores does not differentiate between rural and urban areas. Thus, we will start by an introduction on differences between rural and urban areas in terms of Internet use by citizens, using other sources. It will also include some related available information, including about the gender gap. Then, as to the I-DESI, we will outline the results for each of the 5 dimensions of I-DESI, i.e. digital connectivity, digital skills, use of internet services by citizens, integration of digital technology by businesses, and digital public services. In a third section, we present the overall I-DESI score, taking account the same five dimensions (composite indicator). In the fourth part, we will report information on the overall fixed broadband coverage and Next Generation Access (NGA). Finally, we will present the level of coverage by technology (incl. NGA) in Switzerland, at country level **and in rural areas**.

⁜ Use of internet by citizens

An analysis by the Federal Office of Statistics (OFS, 2012) has shown that, in 2010, according to the degree of urbanisation of the residence area, there is a lower internet user rate in sparsely populated areas, but the difference remained modest. In the same study, more differences were observed between females and males as well as across age classes and the financial situation of the household. In percentage of the population aged 15 years old or more, and taking a period of 3 month in 2010 (before the survey was implemented), 84% of males were using Internet while only 72% of the females did so. The difference was even bigger when only considering the group of frequent users (daily use or for 6 hours or more per week): The share of users that frequently used Internet was 49% for males and only 35% for females.

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[1] The International Digital Economy and Society Index (I-DESI) mirrors and extends the EU Digital Economy and Society Index (DESI) by utilising 24 datasets to enable trend analysis and comparison of the digital performance of 45 countries.

Table 1 provides further details on the differences in the year 2010 (OFS, 2012).

Then, Table 2 (OFS, 2020) presents the evolution from 2012 to 2020 on the frequency of Internet use as well as well its evolution in relation to the gender gap and financial situation (household incomes). We see in particular that the gender gap has been divided by about two from 2012 to 2020 among the frequent Internet users' group. From 2012 to 2020, the share of frequent Internet users has increased by about 10 points, while it has increased by around 7 points in the intermittent users' group. Furthermore, we observe a substantial increase in Internet use across all household financial situation groups, though the increase in the 'richest' group (>CHF 10'000/month) is more modest (ca. 10 points compared to ca. 4 points).

Table 1: Internet use in Switzerland in 2010

Internet users	In % of the population aged >=15 (for use of Internet during the last 3 months)	Share of users (>=15 years old) that use frequently Internet (daily use or for 6 hours or more per week)	Share of users (>=15 years old) that use a mobile phone (with or without another device)
Gender			
Males	84	49	29
Females	72	35	18
Age			
15-24	100	57	32
25-34	95	51	34
35-44	91	42	27
45-54	87	36	20
55-64	69	31	11
65-74	45	25	( )
>75	20	( )	( )
Financial situation (household)			
Good	84	45	27
Fine	68	36	18
Difficult	64	41	( )
Urbanisation			
Densely populated area	79	46	25
Moderately populated area	78	40	21
Low populated area	71	34	24

Source: Based on OFS, 2012

Table 2: Internet use in Switzerland, 2012-2020

| | Frequency | | Gender | | Regular users (several times a week) | | | |
| | | | | | Monthly income | | | |
Period	Regular users (several times a week)	Intermittent users (use in the last 6 months)	Females	Males	CHF <4'001 (1CHF=0.95€)	CHF 4'001 to 8'000	CHF 8'001 to 10'000	CHF >10'000
Oct. 12-March 13	79	85	74	84	51	75	90	94
Oct. 13-March 14	81	87	76	87	52	77	93	97
Oct. 14-March 15	83	87	78	88	51	80	93	96
Oct. 15-March 16	84	89	81	88	55	82	93	97
Oct. 16-March 17	86	90	82	89	57	83	95	98
Oct. 17-March 18	86	90	82	89	61	83	95	98
Oct. 18-March 19	88	91	85	91	62	87	96	98
Oct. 19-March 20	89	92	86	92	63	87	97	98

Source: Based on OFS, 2020

The gap observed among people about digitalisation is in part reflected in the fact that 1.5 million people between 16 and 65 have little or no ICT skills, which represents around 20% of the population, according to the Federal State (Domenjoz, 2021). This phenomenon of digital literacy is to be compared with illiteracy, the situation of adults who have attended school but cannot read or understand a simple text of everyday life. According to the ALL 2003 survey - the only study available on this subject - there are around 800'000 illiterate people in Switzerland (16%). People with illiteracy (would) have the greatest difficulty independently performing simple tasks with a computer because of their great difficulty in interpreting information presented in textual or graphic form.

I-DESI score by category

1. **Digital connectivity:** Deployment of broadband infrastructure and its quality.

   According to the 2018 International Digital Economy and Society Index (I-DESI), in 2016, the average connectivity dimension score for Switzerland (78.9) was comparatively high and ahead of Norway (75.8), the top four EU28 (75.2), and the EU average (62.9). However, Switzerland was ranked second from the studied countries, slightly behind the leading country South Korea (79.8). The score for Switzerland was only 61 in 2013, showing an increase by 29% in 3 years time.

   The 2020 updated (with updated calculation formula) I-DESI shows that, in 2018, the average connectivity dimension score for Switzerland (69.2) was still comparatively high compared to most countries but behind Japan (74.5), Iceland (71.7), the top four EU28 (70.4), and USA (69.8).

2. **Digital skills:** Skills needed to take advantage of the possibilities offered by digital.

   According to the 2018 I-DESI, in 2016, the average human capital (digital skills) dimension score for Switzerland (64.7) was comparatively medium but ahead of the EU average (58.0). However, Switzerland was ranked only twelfth from the studied countries, quite far behind Australia (80.5), Iceland (80.2), New Zealand (79.3), South Korea (75.6), and the EU top 4 (74.7).

The 2020 updated I-DESI shows that, in 2018, the average human capital (digital skills) dimension score for Switzerland (55.8) was hence comparatively high compared to most countries but behind USA (65.7), the top four EU28 (58.6), and Australia (57.4).

3. **Use of Internet Services by citizens:** Variety of online activities, such as the consumption of online content (videos, music, games, etc.) video calls as well as online shopping and banking.

According to the 2018 I-DESI, in 2016, the average citizens internet use dimension score for Switzerland (77.5) was comparatively high and far ahead the EU average (59.7). However, Norway was the leading country (85.2) from the studied countries, followed by the EU top 4 (78.5).

The 2020 updated I-DESI shows that, in 2018, the average citizens internet use dimension score for Switzerland (64.2) was still comparatively high compared to most countries but behind Iceland (75.4), Norway (73.3), USA (68), and the top four EU28 (66.7).

4. **Integration of Digital Technology by businesses:** Digitisation of businesses and e-commerce.

According to the 2018 I-DESI, in 2016, the business technology integration dimension score for Switzerland (80.3) was comparatively very high and ahead of all the studied countries. Iceland was ranked second (75.7), followed by the EU top 4 (72.8). Comparatively, the EU average score was only 51.3. The score for Switzerland was only 68 in 2013, showing an increase by 18% in 3 years time.

The 2020 updated I-DESI shows that, in 2018, the business technology integration dimension score for Switzerland (86.1) was even comparatively higher compared to all of the other countries. Israel was ranked second with a score of "only" 76.4, followed by the EU top 4 (75.6). Comparatively, the EU average score was only 41.1.

5. **Digital Public Services:** Digitalisation of public services, focusing on eGovernment and eHealth.

According to the 2018 I-DESI, in 2016, the average digital public services dimension score for Switzerland (48.3) was comparatively low and behind all studied countries apart from Turkey (43.2) and the EU bottom 4 (41.1). The EU average was 63.1 and the EU top 4 was 84.7. The leading country was Australia (88.9), very far ahead Switzerland.

The 2020 updated I-DESI shows that, in 2018, the average digital public services dimension score for Switzerland (50.1) was still low compared to the other countries studied. By comparison, the first country, South Korea, obtained a score of 85.3 and the EU average score is 56.

🞣 Overall I-DESI score

The overall I-Desi score is calculated based on the five above-mentioned dimensions, i.e. digital connectivity, digital skills, use of internet services by citizens, integration of digital technology by businesses, and digital public services.
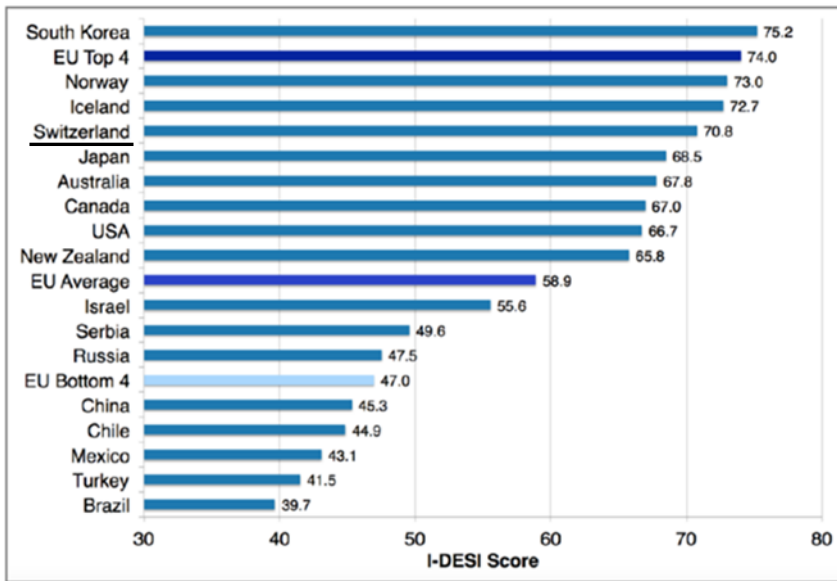
Figure 1 : Switzerland and other Non-EU countries normalised performance scores for I-DESI in 2016

Figure 1 provides an overview of the overall performance scores across all dimensions of the 2018 I-DESI based on the year 2016. The leading non-EU country was South Korea (75.2). Switzerland came fourth of the non-EU countries studied, with a score of 70.8. This score was far above the EU average (58.9), but below the EU Top 4 score (74.0) comprising Denmark, Finland, the Netherlands and the UK.
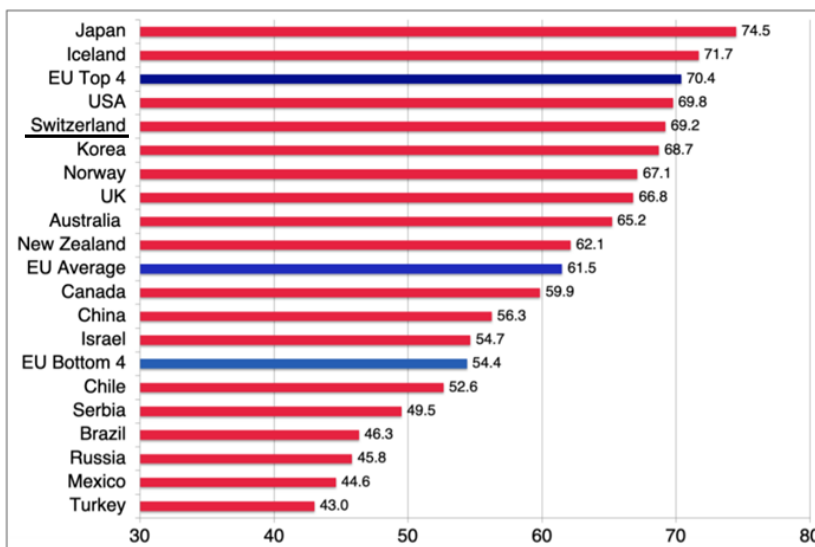

Figure 2: Switzerland and other Non-EU countries normalised performance scores for I-DESI in 2018

Figure 2 provides an overview of the overall performance scores across all dimensions of the updated 2020 I-DESI, representing the Swiss situation in the year 2018. The leading non-EU country was Japan (74.5). Switzerland came fourth of the non-EU countries studied, with a score of 69.2. This score was substantially higher than the EU average (61.5), but a little below the EU Top 4 score (70.4) comprising Finland, Iceland and Denmark. Compared to the 2016 situation, the position of Switzerland has remained steady.
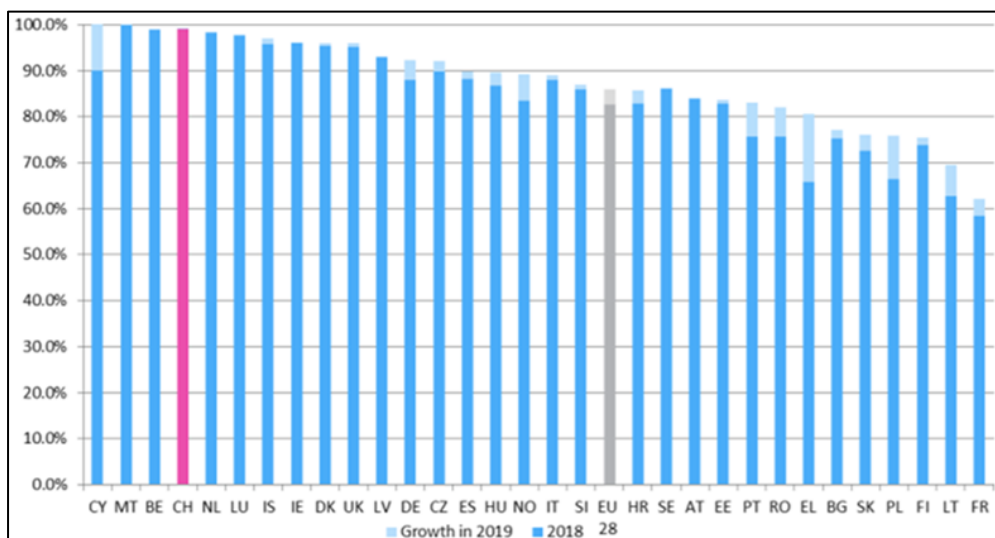
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Source: Broadband Coverage in Europe 2019, a study by HIS Market, Omdia and Point Topic for the European Commission.

Figure 3: Overall fixed broadband coverage by country, 2019.

Figure 3 shows that the fixed broadcast coverage is very high in Europe, with 23 countries of the 31 studied that even had a coverage of above 95% in 2019. However, a few countries had a coverage below 90%: Slovakia, Romania, Lithuania and Poland. In Switzerland, almost 100% (99.8%) of homes had access to at least one fixed broadband in 2019.

+ Connectivity on the Next Generation Access (NGA)

Source: Broadband Coverage in Europe 2019, a study by HIS Market, Omdia and Point Topic for the European Commission.

Figure 4: Overall NGA coverage by country, 2019.

The next generation access (NGA) include the following technologies: FTTH, FTTB, Cable Docsis 3.0, VDSL and other superfast broadband (at least 30 Mbps download). In 2019, there were still significant differences between European countries in terms of NGA coverage. Cyprus, Malta, Belgium and Switzerland were the four most advanced countries, reaching or being very close to 100% coverage.

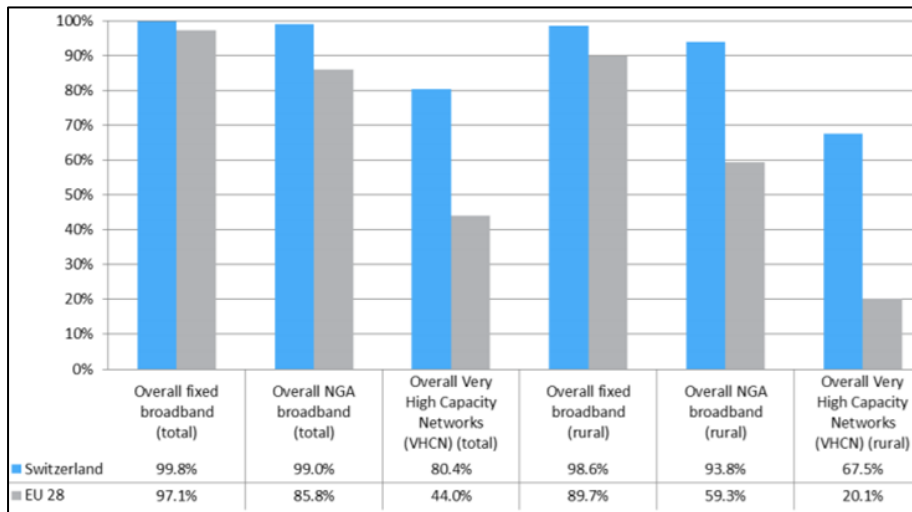⊞ <u>Coverage by technology in Switzerland, overall and in rural areas</u>

Source: Broadband Coverage in Europe 2019, a study by HIS Market, Omdia and Point Topic for the European Commission.

Figure 5: Overall NGA coverage by country, 2019.

As previously indicated, in 2019, both the Swiss total fixed broadband and total NGA coverage were very close to 100% (respectively 99.8 and 99.0%). The total coverage of Very High Capacity Networks (VHCN) was significantly lower (80.4%), though, much higher than the EU 28 average (44%). In Swiss **rural areas**, the fixed broadband coverage is very similar to the domestic average (98.6%) while the NGA broadband coverage is slightly lower but still very high (93.8%). In terms of the VHCN, we observe a quite important difference between the Swiss rural coverage (67.5%) and national average (80.4%). However, Switzerland enjoys an important advantage compared to the EU level, where the VHCN coverage was of only 20.1% in rural areas in 2019.

3. Policy framework for (rural) digitalisation

3.1. National Policies

As Switzerland is not part of the EU, policies such as the Digital Single market do not apply here. Hence the following subsections will exclusively focus on specific Swiss policies influencing the situation in rural areas and the forestry and agricultural sectors.

Table 3: National Policies

Ministry / Authority	Policy	Objective	Expected Impact
Federal office for Agriculture FOAG	Resource efficiency payments ("*Ressourceneffizienzbeiträge*"): Since 2014, digital techniques with a proven positive effect on the sustainable exploitation of natural resources and/or the efficient use of production means are financially supported throughout Switzerland. The support conditions vary depending on the canton, region, altitude, and value chain concerned	Optimising resources	Increased sustainability; optimised used of resources
Cantonal agricultural centers of Liebegg (AG), Arenenberg (TG) and Strickhof (ZH) as well as the Aargau Farmers' Association, Thurgau Agriculture Association and Zürich Farmers Association Federal office for Agriculture FOAG	Since 2019 and until 2026, the cantons of Aargau, Thurgau and Zürich are implementing the project "Plant protection optimisation with precision farming" (PFLOPF)	- Efficient use of pesticides as far as possible without undesirable side effects and negative ecological consequences - Reducing pesticides use by at least 25%	Increased sustainability; optimised use of pesticides
Agroscope (centre for agricultural research, affiliated with the Federal Office for Agriculture (FOAG)	Experimental station on digitalisation in Tänikon: With the **Swiss Future Farm**, there is an agricultural pilot operation for digital technologies at the Tänikon site under typical Swiss conditions	Examining the possibilities and limitations of digitalisation as well as the new and networked technologies	Sustainable digital transformation of Swiss agriculture
Federal Council Innosuisse (Swiss Innovation Agency)	<u>Under the Impulse programme digitalisation framework</u>: - Funding projects at the interface between research and technology transfers that Swiss companies conduct together with research institutions in the digitally oriented "Industry 4.0 and Modern	Switzerland to remain one of the leading countries in the development and application of digital technologies	Maintained influence of Switzerland in terms of the development and application of digital technologies

	manufacturing technologies" segment - Supporting digitalisation in the energy and mobility segments via the Swiss Competence Centre for Energy Research (SCCER)		
Federal Department of Economic Affairs, Education and Research EAER; **Federal Office for Agriculture FOAG**	'Charter' on digitalisation: The charter's members actively contribute to the digitalisation of the Swiss agriculture and food industry, giving concrete expression to and complementing the fields of action and objectives of the "Digital Switzerland Strategy" for agriculture and the agrifood sector.	Nurturing a shared awareness which promotes cooperation, to indicate areas where action is required and lastly to implement the strategy	Ensuring that digitalisation strengthens sustainability and the competitiveness of actors along the value chain, enhances efficiency at the federal and cantonal level, and reduces administrative costs, as well as further improving animal welfare, the protection of natural resources and resource-use efficiency

3.1.1. National Digital Agenda / strategies

The first "Digital Switzerland Strategy" was presented in September 2020. This strategy provides the general guidelines for governmental action and indicates where and how authorities, academia, the private sector, civil society and politics must work together in order to shape the transformation process for the benefit of everyone in Switzerland.

The key objectives of this overall "Digital Switzerland Strategy" are as follows:

o **Enabling equal participation for all and strengthening solidarity**: Switzerland intends to take advantage of the opportunities offered by digitalisation to improve the well-being of its population. Specifically, the strategy aims to strengthen, through digitalisation, the inclusion of all groups of people in various spheres, incl. the social, political and economic dimensions. It is expected that the "fair distribution" of opportunities and perspectives among the population will improve the 'living together'.

o **Guaranteeing security, trust and transparency**: Switzerland wants its population to have a safe access to digitalisation. In particular, people must be protected from digital abuse and from unjustified persecution. In addition, the country wants to promote transparent and data-based services with a view to strengthening trust, personal development and people self-determination.

o **Continuing to strengthen people's digital empowerment and self-determination**: The strategy also intends to strengthen "ex-ante" the skills of the Swiss population, so that they can take part in the digital world in better conditions. In other words, the objective is to enable people to use digital technologies on their own and in an effective manner. The increased use of digital technologies, in

turn, aims to increase the participation of the population in "digitalised political, social, cultural and economic processes" and to better evaluate their own actions.

o **Ensuring value creation, growth and prosperity**: Through digitalisation, Switzerland wants to further develop its competitive advantage as "an innovative and globally networked national economy", thus fostering economic growth and strengthening international trade and prosperity in the long-term. In order to ensure this development, Switzerland recognises the possible need to optimise their general legal conditions.

o **Reducing the environmental footprint and energy consumption**: Switzerland acknowledges that digitalisation could significantly contribute to achieving its climate and environmental goals. To ensure this, the consumption of energy and resources required by the information and communication technologies (ICTs) must be limited and not raise in the same way as the increasing use of ICTs. In other words, they must be used in an efficient manner.

These objectives are translated into fields of action and action plans. We distinguish 9 fields of actions:

o **Education, research and innovation**: The process of digital transformation requires skills in handling the new technologies as well as creative and critical thinking. This is why Switzerland must promote the necessary skills – in the sense of lifelong learning. Efforts have already been made towards this direction and would need to be maintained and encouraged.

  ✓ Contribution of the field of action to the UN's sustainable development goals (SDGs):

  - Goal 4: to ensure inclusive and equitable education and promote lifelong learning for all

  - Goal 5: to achieve gender equality and empower all women and girls

  - Goal 8: to promote long-term, inclusive and sustainable economic growth, productive full employment and decent work for all

  - Goal 9: to build resilient infrastructures, promote broad-based and sustainable industrialisation and foster innovation

o **Infrastructure**: The Confederation attempts to make sure that the basic conditions are shaped in such a way that the most efficient technologies can be used in both the fixed and mobile telephone networks. To do so, cooperation between all Swiss federal levels is recognised to be key.

  ✓ Contribution of the field of action to the SDGs:

  - Goal 7: to ensure access to affordable, reliable, sustainable modern energy for all

  - Goal 9: to build resilient infrastructure, promote broad-based and sustainable industrialisation and foster innovation

  - Goal 11: to make cities and settlements inclusive, safe, resilient and sustainable

o **Security**: High cooperation between all Swiss cantonal and federal levels is recognised to be key. International networking is also acknowledged as being essential. It is intended to increase the security-related skills of individuals and businesses entities. Note that digitalisation also contribute to earlier detection of dangers and a quicker response to problems.

  ✓ Contribution of the field of action to the SDGs:

  - Goal 9: to build resilient infrastructure, promote broad-based and sustainable industrialisation and foster innovation

  - Goal 16: to promote peaceful and inclusive societies for sustainable development

o **Environmental protection, natural resources and energy**: Switzerland takes measures to increase ICT resources and efficiency in order to mitigate negative climate and environmental impacts. Such measures include a smart use of ICT, creating know-how, and new forms of public procurement systems e.g. through novel forms of financing. Also, there is an increased coordination between actors in order to fully exploit the potential of digitalisation in increasing process flexibility, for example in terms of controlling production levels.

   ✓ Contribution of the field of action to the SDGs:

   - Goal 7: to ensure access to affordable, reliable, sustainable and modern energy for all

   - Goal 12: to ensure sustainable consumer and production patterns

o **Political participation and e-government**: Emerging online platforms and social media affect the existing media by making available new channels and forms of communication, including interactive communication. E-government is being required to use technological developments to enhance administrative activity, in particular to optimise interaction between the authorities on the one side and the population and companies on the other.

   ✓ Contribution of the field of action to the SDGs:

   - Goal 10: to reduce inequality within and between states

   - Goal 16: to promote peaceful and inclusive societies for sustainable development

   - Goal 17: to strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

o **The economy**: In order to strengthen its business attractiveness, Switzerland will be "creating the most favourable framework conditions" for digital business models and innovations that optimise the use of public finances and support the common good. All areas **including rural areas** are aimed to benefit from this development. Switzerland's' strengths in terms of liberalism, including the market labour flexibility, are to be further optimised as well as the excellence in school/training, and research & development. Also, there is the objective to take out obstacles and to centrally manage communication between companies and authorities.

   ✓ Contribution of the field of action to the SDGs:

   - Goal 1: to end poverty everywhere and in all its forms

   - Goal 2: to end hunger, achieve food security and improve nutrition and promote sustainable agriculture

   - Goal 8: to promote long-term, inclusive and sustainable economic growth, productive full employment and decent work for all

   - Goal 11: to make cities and settlements inclusive, safe, resilient and sustainable

o **Data, digital content and artificial intelligence**: Part of the strategy is to develop new and cooperative forms in which people and companies can exercise the greatest possible control over their data. It is also acknowledged the need to address risks related to an increased data-based decision-making, including a possible unequal treatment among people.

   ✓ Contribution of the field of action to the SDGs:

   - Goal 8: to promote long-term, inclusive and sustainable economic growth, productive full employment and decent work for all

   - Goal 16: to promote peaceful and inclusive societies for sustainable development

- o **Social affairs, healthcare and culture**: Innovative technologies for older persons, the disabled, immigrants and people with special needs are increasingly important. It is seen as crucial that the needs of these groups are considered and that innovative possibilities are being developed. Their effects must also be analysed and solutions developed to improve equal-opportunities. Knowledge transfer and cooperation between transversal digital projects should be reinforced.

    - ✓ Contribution of the field of action to the SDGs:

        - Goal 3: to ensure healthy life and well-being for all at all ages

        - Goal 9: to build resilient infrastructures, promote broad-based and sustainable industrialisation and foster innovation

- o **International commitment**: In its Foreign Policy Strategy (FPS) 2020-23, the Federal Council defined digitalisation as one of the top four priorities.

    - ✓ Contribution of the field of action to the SDGs:

        - Goal 9: to build resilient infrastructure, promote broad-based and sustainable industrialisation and foster innovation

        - Goal 16: to promote peaceful and inclusive societies for sustainable development

        - Goal 17: to strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

By defining its "Digital Switzerland Strategy", the Federal Council is initiating a dialogue in order to network all the stakeholders in the digital transition. In agriculture and the agrifood sector, it is of paramount importance to have in-depth exchanges of views and to establish increased cooperation between all stakeholders in the use of agricultural data. This is why, following a broad consultation conducted under the leadership of FOAG (Federal Office for Agriculture), a **Charter on digitisation** in Swiss agriculture and the agrifood sector was drafted in 2018, defining general basic principles. The charter was launched in 2018 under the umbrella of the Federal Office for Agriculture FOAG. The Charter (El Benni et al., 2020) contains 12 guidelines on the use of digital data and applications in agriculture and food production. By the end of 2021, it had been signed by more than 110 institutions in the industrial, agricultural, processing, retail and administrative sectors related to the Swiss agrifood system. The community of those who signed the Charter strives to create a shared understanding, promote cooperation, identify further areas where action is required and ultimately contribute to implementing Switzerland's digitalisation strategy (El Benni et al., 2020).

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

As Switzerland is not part of the EU, the contributions from the Structural and Investment Funds and the Cohesion Policy do not apply here. In the following section, we will therefore focus directly on national policy.

3.2.1. Broadband infrastructure

Compared to other countries, Switzerland invests substantially in its telecom infrastructure. In fact, in a study performed by the OECD (2015), Switzerland was found to be the first investor worldwide in public investment per capita in 2011 and 2013.

This is due to the very dynamic competition in the telecom network infrastructure sector, with around 200 powerful operators in a small country with a complicated topology, including national providers like Swisscom and cable operators, as well as regional companies with their own cable and fiber optic networks. With an annual investment volume of around CHF 1.6 billion, Swisscom makes about 2/3 of the total investments in Swiss IT and network infrastructure (Swisscom, 2021). Swisscom shares are listed on the Zurich Stock Exchange (SWX). Currently the Swiss Confederation holds 51% of the share capital and therefore has the majority of votes in the company as prescribed by law (DETEC, 2021). In other words, the company is public to 51%, and decisions are significantly driven by the public policy strategy. However, as in private companies, operational management is the responsibility of the board of directors and management. The Federal Council recognises the management autonomy of Swisscom. It simply sets out the broad outlines and examines each spring to what extent Swisscom has achieved the strategic objectives during the past year.

Strategic objectives assigned to Swisscom AG by the Federal Council from 2022 to 2025: The Federal Council defines every four years the objectives that the Confederation intends to achieve as the majority shareholder of the company. The Federal Council has several expectations towards Swisscom, including: (1) Swisscom is managed according to the rules of business economics, is competitive and customer-oriented; (2) Swisscom strives to develop and operate a modern and reliable network and IT infrastructure taking into account market needs, technological progress and security, in particular cybersecurity, telecommunications secrecy, data protection and security; (3) Swisscom is making an important contribution to connecting all regions of the country to very high-speed and mobile infrastructure - It is a candidate for future universal service concessions; (4) Swisscom successfully develops, produces and markets services in the converging telecommunications, information technology, broadcasting, media and entertainment markets, thereby contributing to the digitisation of all regions of Switzerland.

It is interesting to observe that investment growth in telecoms infrastructures primarily benefits rural cantons, which obviously also need more investments in order to close the gap with urban areas. In 2016, for instance, the investment growth was about +75% in rural areas compared to +51% in the other cantons. In the years before 2016, the gap of investment growth was even higher between rural and other cantons, with a peak in 2012 where the investment growth equalled +110% in rural cantons but only +9% in other cantons (Swisscom, 2018). Rural areas are gradually catching-up urban areas.

3.2.2. Digital Public Services

- e-administration procedures

The digitalisation in Swiss public administrations is developing rather slowly compared to other countries and is faced with challenges such as the scaling-up of automated administrative procedures. Another barrier is the lack of skills. 45% of the Swiss population does not use e-government services because they are not familiar with them (eGovernment Monitor, 2020). 50% of the population believes that personal contact is important and easier. Other barriers for 40% of people are data protection concerns as well as fears of consequences in case data are not fully completed on the dedicated online platform (eGovernment Monitor, 2020). Actually, Switzerland is not well placed in Europe in terms of transparent government processes. In the last Open Data Report from the EU commission, Switzerland was ranked only 27th (eGovernment Monitor, 2020).

- e-health

The eHealth Suisse was created in 2006 with a view to introducing the electronic patient record (EPD) through making recommendations. eHealth Suisse acts on behalf of the Swiss Confederation. The EPD was passed into federal law in 2017. eHealth Suisse also wants to give impetus to other topics, for example on mobile data exchange in the health sector ("mHealth").
As early as in 2007, the Federal Department of the Interior (FDHA) and the Swiss Conference of Cantonal Health Directors (CDS) agreed on a framework agreement to implementing the "Swiss eHealth Strategy", however, there is not yet very concrete advancements in practice, in terms of implementing and using e-health services by Swiss customers.

A Digital Trends Survey by the Swiss medical association (2021) focused on the use of digital technologies during treatment. It reported that the population is interested in opening an EPD (55%). Up to 20% of respondents say they want to change their doctor if the latter did not offer an EPD. Self-registration of data in the doctor's office and the exchange of information with the attending physician are highly valued by the population (85%), as is the use of digital forms in administrative processes (82%). In addition, we note the strong disposition of the population (51%) to prefer a
Telemedicine consultation rather than direct personal contact with the family doctor (47%). Conversely, only half of the surveyed population supports the use of an intelligent computer system for diagnosis (48%) or treatment decision-making (54%). At the same time, another study (Careum, 2021) has shown that in the case of digital health competence, no less than 72% of the Swiss population find it difficult to manage digital information and services, showing a very low digital literacy.

- e-education

e-education is still relatively little developed. Online education has been partly taking place during the peak of the Covid-19 crisis, but has remained temporary. Also, this took place mainly in universities, which are located in cities, not in rural areas.

A study performed by the Swiss Coordination Center for Educational Research (2021) on the state of digitisation of schools (up to and including secondary II) on 6'000 pupils and apprentices has shown that following the closure of schools in the spring of 2020, almost a third of private households have acquired new digital equipment. With 35%, the proportion of families having acquired new equipment is clearly higher in German-speaking Switzerland than in the other linguistic regions (21.5% in French-speaking Switzerland and 20% in Ticino). There are still significant gaps in terms of fast and efficient wireless internet access, both in schools and within families. Overall, 74% of students say their school has internet access, 11% say it doesn't and 15% don't know.

The use of digital tools (hardware and software) at school is not very intense and limited to the teaching of certain subjects. Nevertheless, for the vast majority of students, computers are part of everyday school life. In total, 82% of the students surveyed use a computer at school. That said, one in five children and youth say they do not use a computer at school. However, the number of students who say they never use a computer, not even privately, is very low (1%).

Digitisation in continuing education seems to be the most advanced, implying not only that the handling of new technologies must be learned, but that these new technologies are also included and used in education. Note that in the Swiss educational context, the national curriculum provides for not only that specialised teachers, ensure that young people achieve the stated e-competence goals, but also that teachers with different specialisations are included in the development process of computer skills.

- Digital identity

The topic of digital identity is delicate in Switzerland. An electronic identity system was proposed to the Swiss population by the Federal government but it was rejected by referendum by the Swiss population in March of 2021. Final results have been showing 64% of voters coming out against the planned law. At stake was the creation of the legal basis for a digital identity verification system, to be licenced and controlled by the state but provided mainly by private companies. The single access point was aimed at simplifying the use of online services offered by commercial businesses as well as contact with public institutions via e-government channels. It has been reported that the mistrust in private companies was the main driver of the refusal. The Federal Council will determine the key parameters for a new eID proposal, and the consultation on a new eID Act is expected to begin in May 2022.

- Digital signature

Digital signature systems are increasingly being used by the Swiss population. SwissID is a common digital signature system that offers two different levels of identification. Using this system makes it possible for the Swiss population to eventually log securely into the online portals of insurance providers, banks, the post, and other services. It only requires creating a SwissID account. About 2 million users (ca. 25% of the Swiss population) rely on SwissID to access some online services.

- On-line banking (transferences, account management, payments)

Digital banking operations are commonly used in Switzerland. A 2019 study from the Swiss national bank has shown, however, that the situation is quite diverse depending on the type of operations. While the level of digitalisation in mortgage lending to corporates was quite low (about 10 to 20%), it was quite high for mortgage to households (about 20 to 60%) but only in larger banks. It remained low in smaller banks (about 10 to 20%).
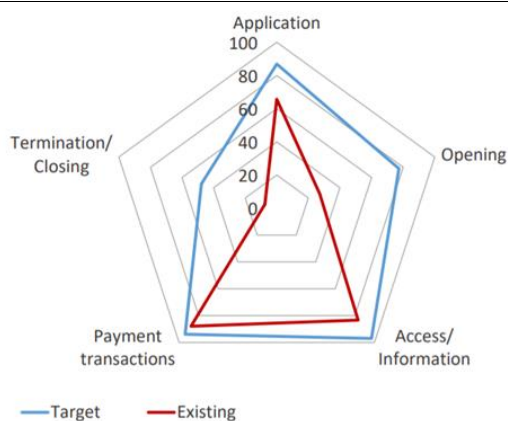
Figure 6: Level of digitalisation in mortgage lending to households - Larger banks (share in %)

Figure 7: Level of digitalisation in mortgage lending to households – Smaller banks (share in %)

Figure 8: Level of digitalisation in deposits/payments – All banks (share in %)

Figure 9: Level of digitalisation in mortgage lending to corporates – All banks (share in %)

On-line banking was already substantially developed in Switzerland in 2019. It has accelerated during the Covid-19 outbreak and this dynamic trend is expected to sustain once the Covid crisis has gone. A key driving for banks to promote a more digital banking system is the cost. The demand for on-line operations is also increasing. In a recent survey conducted by the Deloitte institute (2019) on 1'500 working-age people living in Switzerland, it was found that almost 20% of bank customers have used for the first time, at least one service during the Covid-19 outbreak. Only 6% of bank customers did <u>not</u> use any online banking services during the crisis. In addition, the majority of those first users expect to continue using at least some online services after the Covid crisis has terminated.

A study performed by the same institute in 2019 found that bank services users in Switzerland had concerns about security and also that they did not see the need for online banking. In this sense, the Covid-19 outbreak played a major role in changing their mind (to some extent). The 2021 Deloitte survey even shows that for every customers still refusing to use online banking during the Covid-19 outbreak, three new users were trying online banking for the first time. They also found the services to be satisfactory. Just about 51% of these first-time users intend to use a mix of online and in-branch services once the crisis is over, and 14% say they will switch to online banking.
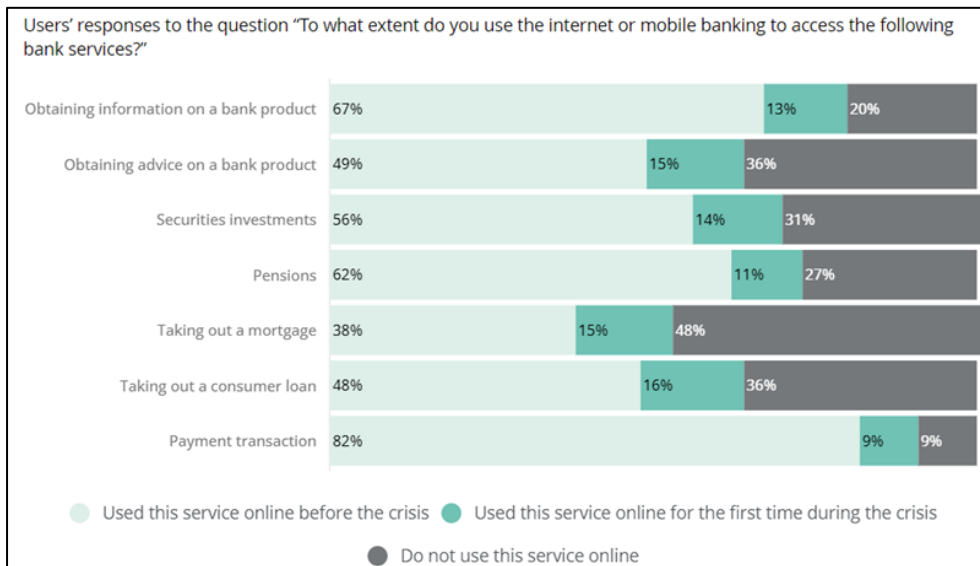
Figure 10: Use of services before and during the Covid-19 crisis

Figure 10 shows that the use of diverse banking online service has increased during the Covid-19 outbreak: 9% of respondents have made online payments (Item: "payment transaction") for the first time, and only 9% were left with non-digital methods of payment.

The biggest increase in the use of digital services has been the online applications for consumer loans (16% using it for the first time). Many first-time users have also been taking out a mortgage partly through an online process (15%) and in obtaining advice on a bank product (15%).

Only a minority of first-time users envisage to exclusively use online services. Many still value personal contact and 35% of respondents mentioned that they will return to non-digital banking once the crisis has passed.

- Bills (council taxes, water, electricity)

eBill is an initiative established as the digital invoicing standard, on behalf of the Swiss financial center, and that enables the digital payment of invoices. Switzerland processes a high volume of invoices per year (> 1 billion), which pushes the demand for efficient processes.

Recently, the so-called "QR-bill" was created, which can be seen as the "e-bill 2.0". Compared to the older system, the QR system not only allows digital transactions, but the invoice itself is created digitally.

e-Bill works in a way that invoice issuers invoices directly to the online banking system of their customers. Customers have to be registered to the e-bill system. Customers can then see all information related to the invoice and validate the payment on the online banking platform.

e-Bills has about 2 million users (ca. 25% of the Swiss population).

- Others

In terms of "digital public services", the Swiss confederation, villages and cities are increasingly cooperating to develop and improve the management and use of those services. In April of 2020, the Federal Council and the Plenary Assembly of the Conference of the Cantonal Governments of Switzerland (CCG) agreed on a collaborative project where existing human and financial resources will

be merged in a new common organisation. In June of 2021, the Federal Council and cantonal governments then approved the principle of "digital public services" as framed. In addition, the Federal Council decided on additional funding totalling CHF 15 million for 2022 and 2023 to finance the planned "DPSS national infrastructures and basic services" agenda. The law framework related to "digital public services" has already been approved by the Federal council and CSG and is expected to be approved by the cantonal governments by the end of 2021.

Generally speaking, the use of e-Services in Switzerland has substantially increased in 2019 (eGovernment Monitor, 2020). It was reported that about 60% (+2) of the Swiss population used an e-government service in 2019 (eGovernment Monitor, 2020). There is a certain divide between rural and urban areas, as around two third of people living in urban areas use a least one of the digital government services while a bit more that 50% of those living rural areas use them. In addition, the demand for online governmental services has substantially increased during the Covid-19 crisis (eGovernment Monitor, 2020). In details, 12% have increased their use of e-government services, 3% gave used an e-service for the first time and 70% said they will increase their use of online services after the COVID-19 outbreak. It is also important to emphasise that about 75% of the Swiss population was satisfied by the set of online services (eGovernment Monitor, 2020).

eMovingCH is an example of e-government service that is used substantially. This is an online platform on which citizens can report their change of address to the authorities. It is used in 18 cantons out of 26. Overall, around 41% of communes are connected to the portal. About 300 changes of address are processed on a daily basis, from which half are submitted by smartphones. In 2020 the number of notifications doubled compared to the previous year (e-government, 2021).

The electronic tax returns is another example of e-government service that is extensively used. 60% of Swiss taxpayers use electronic tax returns, with 90% being satisfied, 85% finding the process easy, and even 97% saying that they will the service again (eGovernment Monitor, 2020).

The planning committee of *e-government* has been supporting the following innovations in 2021:

o **Project CH+ Games for Democracy (Zurich University of the Arts)**

This is a collaborative project involving game designers, voters and politic experts that are developing a "voting assistant" system that aims to support in particular young voters in their voting decisions in a friendly manner. The project is being tested until 2023 and at the occasion of cantonal elections, and refined accordingly.

o **IciGov (city of Biel)**

Online counters are not yet much matured and users still use extensively physical counters. As most users visiting physical counters also own a mobile phone, the project provide physical counters with a QR code link, giving them access to a dynamic platform and thus to online available information and services.

o **RPA@SG – Robotic process automation in the city administration (city of St. Gallen)**

Based on the fact that people working in office spend a substantial amount of time (on average) on administrative issues, a pilot project developing a robotic process automation was developed in the city of St. Gallen. The system allows reducing the time spent on administrative tasks and

therefore increase the available time of workers to focus on their core activities. The Pilot will be tested in the areas of police, interview process, and waste management system.

o   Digital literacy: using simulations to boost media skills (canton of Zurich)

This project was launched end of 2020 in the canton of Zürich and aims to develop a tool for reflection on digital opinion-forming and media skills. The tools allows participants to experience and discuss in particular the influence of information they receive, including false information, on their opinion-making. A first prototype was developed. A second one ("2.0") will be developed and supported financially by "*e-government*" Switzerland.

Table 4: Digital Public Services usage

		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	
On-line 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	

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

As Switzerland is not part of the EU, the RIS3 does not apply to the country.

3.2.4. Digital Innovation Centres (DIH)

In terms of digital innovation platforms, the following apply to Switzerland:

- The "**Swiss Future Farm**": Experimental station located in Tänikon. It is owned by Agroscope, which is the Center for agricultural research affiliated with the Federal Office for Agriculture (FOAG). The Swiss Future Farm is Switzerland's demonstration farm for smart farming practices and Switzerland's competence centre for digital and data-based sustainable agriculture (see e.g. El Benni et al. (2020)). It aims to make smart farming tangible and has the following three objectives: 1) making digitalisation tangible for practical applications, 2) supporting research and development, and 3) enabling knowledge transfer. The core task of the Swiss Future Farm is the transfer and exchange of knowledge involving all partners, which is done in joint events and in events organised by the individual partners for farmers and other interested stakeholders, advisory services and researchers.

- **Agroscope experimental station "Smart technologies"** in the cantons of Schaffhausen and Thurgau: Agroscope pursues a decentralised approach with several experimental stations spread across the country. These experimental stations are intended to answer application and practice-oriented research questions in the relevant geographical and climatic context. One such experimental station focuses on the testing of new technologies under practical conditions, with a focus on plant production and animal husbandry. Based on the tests, new technologies are to be optimised for practical use. This experimental station is directly linked to the Swiss Future Farm (see above). The cantons of Schaffhausen and Thurgau are involved in the cooperation. They provide the network of facilities necessary for the tests and provide support for the farms.

- In November 2018, the Federal Office for Agriculture (FOAG) hosted its first **two-day workshop on innovation** in agriculture and the agrifood sector. Since then, this event has taken place every year. The purpose is to bring together agronomy students and young farmers to develop innovative (digital) ideas and solutions.

- In August 2019, FOAG organised a **study trip** to the Netherlands in collaboration with AGRIDEA, an extension organisation, in order to discover examples of successful digital innovation and to exchange ideas with other participants interested in innovation - mainly agronomy students and young farmers.

3.3. CAP National Strategic Plans

This section is irrelevant to Switzerland since the country is not part of the EU.

3.4. Other policies and strategies influencing (rural) digitalisation

This section presents an overview of other policies and strategies that are not necessarily specific to rural areas but that aim to boost digitalisation and as such have or might have an influence on agriculture, forestry, and rural areas.

3.4.1. Policies and strategies to boost digital literacy and tackle the digital divide

The planning committee of *e-government* has supported a specific project on digital literacy in 2021. This project was launched end of 2020 in the canton of Zurich and aims to develop a tool for reflection on digital opinion-forming and media skills. The tools allows participants to experience and discuss in particular the influence of information they receive, including false information, on their opinion-making. A first prototype was developed. A second one ("2.0") will be developed and supported financially by "*e-government*" Switzerland.

There is a "Digital Switzerland Strategy", which was presented in September 2020. This strategy provides the guidelines for governmental action and indicates where and how authorities, academia, the private sector, civil society and politics must work together in order to shape the transformation process for the benefit of everyone in Switzerland.

One of the key objectives of this "Digital Switzerland Strategy" is as follows: Switzerland intends to take advantage of the opportunities offered by digitalisation to improve the well-being of its population. Specifically, the strategy aims to strengthen, through digitalisation, the inclusion of all groups of people in various spheres, incl. the social, political and economic dimensions. It is expected the "fair distribution" of opportunities and perspectives among the population will improve the 'living together'.

Older people are more and more familiar with the digital world. During the spike of the coronavirus pandemic, many seniors used WhatsApp messaging or video calls (Swissinfo, 2020). A digital senior study has shown that 74% of people aged 65 and more use the internet compared to only 38% in 2009 (Swissinfo, 2020). In addition, mobile web use for people aged 65 and above has increased from 31% in 2014 to 68% in 2020 (Swissinfo, 2020).

Table 5: Policies 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 / General
Digital literacy of vocational school teachers	In order to gain a clear overview of the situation and ensure targeted efforts to promote digital technology in vocational schools, the project will be structured as follows: - assessment of the current level of digital literacy of vocational school teachers; - identification of the best practices enabling digital technologies to be included in the pedagogical approaches used in vocational education and training; - Reassessment of the level of digital literacy at the end of the project, once the measures to improve digital literacy in vocational schools in Switzerland have been developed at national level.	digital literacy, teacher, school	Jan. 2020 to June 2022	Human resources, skills	https://www.sfuvet.swiss/project/digital-literacy-vocational-school-teachers	Public	National	General
Using simulations to boost media skills (canton of Zurich)	This project was launched end of 2020 in the canton of Zürich and aims to develop a tool for reflection on digital opinion-forming and media skills. The tools allows participants to experience and discuss in particular the influence of information they receive, including false information, on their opinion-making. A first prototype was developed. A second one ("2.0") will be developed and supported financially by "*e-government*" Switzerland.	digital opinion-forming, information		Human resources, skills, awareness	https://www.zh.ch/de/politik-staat/kanton/kantonale-verwaltung/digitale-verwaltung/strategie-impulsprogramm-digitale-verwaltung.html	Public	Regional	General
Agripath- Sustainable agriculture through effective and efficient digital pathways	The project aims to bring sustainable agriculture to scale. By providing farmers and extension services with tailored digital solutions focused on sustainable agricultural practices, female and male smallholders are supported in increasing their agricultural productivity, income, and climate resilience.	Sustainability, digital literacy, equality		Human resources, skills, social	https://www.cde.unibe.ch/research/projects/agripath__sustainable_agriculture_through_effective_and_efficient_digital_pathways/index_eng.html	Public funding	International (sub-Saharan Africa (Burkina Faso, Uganda, and Tanzania) and Asia (India and Nepal))	Rural
BeLearn	A new association bringing together several universities has set itself the objective of accelerating the digitisation of education in Switzerland in a targeted manner. The new BeLearn competence center has been created for this purpose. The University of Bern has set up this hub, in collaboration with the EPFL, the canton of Bern, the Bern University of Applied Sciences, the Bernese Teaching College, as well as the Federal University for Vocational Training (HEFP). It is about acquiring new knowledge from research and translating it into practical solutions.	digital literacy, teaching, universities	BeLearn will be in place by the end of 2021 and the network is expected to grow further	Human resources, skills, social	https://docplayer.org/186388304-Belearn-swiss-das-lernen-der-zukunft-im-zentrum.html https://www.ictjournal.ch/news/2021-09-23/cinq-hautes-ecoles-sunissent-pour-booster-la-numerisation-de-lenseignement-en	Public	National	General

3.5. Projects and initiatives with influence in rural areas

Table 6: Projects and initiatives influencing digitalisation in rural areas

Initiative	Brief Description	Objectives	Area of impact	Period	Budget (if any)	Public / Private	Rural areas Y/N	Link
Agrolora	The availability of water is an important problem in the canton of Freiburg. Farmers started to create water unions with the goal to increase the water availability when needed. The project tests the reliability of an irrigation system, controlled automatically, using data collected by sensors.	Sustainable farm and irrigation management system through developing a new, automatised, and precise irrigation system using the Long Range Wide Area Network (LORAWAN) technology.	- Reduced use of water - Increased productivity - Skills required - Increased use of energies due to computation - Reduced stress / More "worker-friendly"	2018-	About €24'ooo/year (incl. internal salaries)	Largely public funding	Y	
DigiLand dashboard	Identification and assessment of key technological developments in digital farming through use of a dashboard and related data entry and computation process. The data serve to analyse the performance (cost, efficiency, etc) of diverse technologies at different supply chain levels, and therefore to better plan technology development (planning change) through providing advises to relevant actors.	Creating a competitive advantage for agriculture (food value chains) in the Lake Constance region			Total budget/expenditure of the Digiland project : EUR 576 722.74 - Incl. European Union funding: EUR 303 695.37 - Incl. Co-financing sources: ERDF, Third-country contribution Lead **Partner (Swiss):** FHS St. Gallen, Hochschule für Angewandte Wissenschaften - **Total budget:** EUR 280 032.10	Public funding	Y	https://agrodigital.ch/
Digitisation of Grassland-based Swiss Milk Production	The use of sensors is becoming increasingly important in dairy production. In indoor livestock systems, sensors inform us *inter alia* about the behaviour and location of animals, as well as milk yield. At the interface with outdoor work, in forage production and in pasture management, information on forage quality is of key importance. The linking of these two aspects offers enormous potential for structuring animal husbandry in a more efficient, more animal-friendly manner. Here, the focus lies on the refinement of pasture technologies and on health monitoring.	Making milk production more sustainable and efficient	Sustainability, efficiency		Not made available	Public	Y	https://www.agroscope.admin.ch/agroscope/en/home/topics/economics-technology/smart-farming/research-projects/digitisation-milk-production.html?lang=en
Basic principles for evaluating mechanised milk production	Although international standards ensure the functionality of milking systems, they do not guarantee the health and welfare of the animals. Consequently, milking technology must be adjusted to the individual farm's needs. Agroscope develops methods for evaluating milking systems. Vacuum measurements in the milking cluster as well as ethological, physiological and clinical parameters	Improving methods for evaluating milking systems	Better Understanding of the Interface between Animals and Technology Optimised milking system			Public	Y	https://www.agroscope.admin.ch/agroscope/en/home/topics/economics-technology/smart-farming/research-projects/evaluating-mechanised-milk-production.html?lang=en

	are used by default at start-up to test and optimise the farm-specific settings of the milking system.							
Modules for implementing Smart Farming	Digitisation offers agriculture a wealth of new options for recording states, controlling processes, and last but not least, for improving documentation and traceability. The wide variety of agricultural applications requires an equally wide variety of suitable, specially adapted solutions.	Refining and Implementing Smart Farming Practices	More efficient management of crops			Public	Y	https://www.agroscope.admin.ch/agroscope/en/home/topics/economics-technology/smart-farming/research-projects/smart-farming-practices.html
Digital Data for Efficient Management of Greenhouse Crops	This project aims to get a clear picture of the plant and fruits in vivo in order to extract relevant information (nutrition, water, disease, lighting, etc.) to make management of the crops more efficient. This information will need to be digitised and wirelessly transmitted to allow for its use in quasi-real time.	Growing greenhouse crops efficiently	Digital information for a more-efficient management of greenhouse cropping			Public	Y	https://www.agroscope.admin.ch/agroscope/en/home/topics/economics-technology/smart-farming/research-projects/digital-data-management-greenhouse-crops.html
Expert panel at the World Food and Agriculture Forum	In January 2019, FOAG organised a round table on "Digital agriculture: challenges and opportunities for farmers towards more sustainable food systems" at the Global Forum for Food and Agriculture (GFFA) as part of International Green Week in Berlin.	Improved sustainability of food systems	Sustainability of food systems	Jan, 2019		Public	Y	https://www.blw.admin.ch/blw/fr/home/politik/digitalisierung.html
Blockchain	FOAG organised a symposium in March 2019 on concrete applications of blockchain technology in agriculture and the food industry. The topics identified during this event were included in the Swiss Blockchain Hackathon in June 2019, of which FOAG and Agroscope were the main partners.	Encouraging/Empowering rural actors in developing digital tools in this area	Human resources, skills	Mar. 2019		Public	Y	https://www.blw.admin.ch/blw/fr/home/politik/digitalisierung.html https://hackathon.trustsquare.ch/portfolio/agriculture-and-food/
Open Farming Hackdays	FOAG participated as a partner in the first "Open Farming Hackdays" in September 2020. The participants in this congress focused on a series of previously identified topics.	Developing digital solutions to urgent problems	Human resources, skills, knowledge	Sept. 2020		Public	Y	https://www.blw.admin.ch/blw/fr/home/politik/digitalisierung.html
Use of robots for efficient weed control	In Switzerland, around 2'200 tonnes of active ingredients for pesticides are sold every year (Agricultural Report 2016), of which around 40 % are herbicides. A decrease in their use can be achieved by using robots (targeted use of pesticides or precise and automated hoeing).	The Federal Action Plan for Plant Protection aims to reduce herbicides use significantly	Environment, efficiency, productivity	Jan.2018 – Dec. 2021	€1.1 million	Public funding	Y	https://www.fibl.org/en/themes/projectdatabase/projectitem/project/1422
Cover Crop Banding with high guidance system accuracy	Cover-crop banding allows the existing mechanisation, such as seed drill and cultivator, to be used in combination with a guidance system with RTK accuracy for an alternative cultivation method.	The aim of the experiment is the smart use of existing mechanisation by incorporating the repeatable accuracy of the RTK correction signal.	Environment (erosion, leaching)		Not made available	Public	Y	https://www.swissfuturefarm.ch/index.php/projects-details/cover-crop-banding-with-high-guidance-system-accuracy-smart-preparation-for-no-till-corn
Influence of deep fertilizer placement on yield in canola	Concentrated fertilizer deposition in deeper soil layers, which dry out less frequently, can ensure nutrient uptake of phosphorus and potassium. The repeatable RTK accuracy of ± 2 cm of the automatic guidance system aims to enable the implementation of the settled method.	Research questions: (1) Does deep fertilisation combined with targeted loosening promote taproot development as well as drought tolerance in canola? (2) Does targeted deep fertilisation improve yield, nutrient availability and plant health?	Environment, productivity			Public	Y	https://www.swissfuturefarm.ch/index.php/projects-details/deep-fertilizer-placement-in-canola
Variable Rate nitrogen fertilisation with digital technologies	The project is a collaboration between Agroscope, ETH Zurich and the Swiss Future Farm. Testing various rate of nitrogen fertilisation using digital technologies (auto guidance system) in winter wheat.	Research question: Can drone, satellite imagery, and field data be used to optimise nitrogen application under field conditions and improve crop nitrogen fixation rates?	Efficiency, sustainability	2018-2021		Public	Y	https://www.swissfuturefarm.ch/index.php/projects-details/site-specific-nitrogen-fertilisation-with-digital-technologies

Weed control strategies in silage corn	Comparing various weed control strategies in silage corn Applied technologies: GPS, camera	Research question: Which weed control measures prove successful in terms of weed elimination success and cost-effectiveness?	Efficiency, productivity			Public	Y	https://www.swissfuturefarm.ch/index.php/projects-details/comparison-of-weed-control-measures-in-silage-corn
Effect of planting depth, down force and liquid starter fertilizer on sugar beet yield	A single application of Conviso herbicide is made with the band sprayer, which reduces the number of field passes. A single application of fungicide against leaf spot disease and powdery mildew is made as needed. Applied technologies: GPS, Sensors	Research question: What influence do different planter settings for planting depth and down force as well as liquid starter fertilizer have on sugar beet yield?	Sustainability			Public	Y	https://www.swissfuturefarm.ch/index.php/projects-details/influence-of-planting-depth-down-force-and-liquid-starter-fertilizer-at-planting-on-sugar-beet-yield
Digital.swiss	The dashboard developed by digital.swiss measures the progress of digitisation in Switzerland. 120 partners and 19 partner cities/cantons nationwise	Identifying needed action for the digital transformation	Sustainable digital transformation			Private/Public	N	https://digitaltag.swiss/about/

3.6. Data management

The European Union implemented its Data Protection Regulation (GDPR) into effect in May 2018. Swiss companies that offer products or services to people in the EU must comply with it.

In Switzerland itself, the processing of personal data is regulated by the Federal Act on Data Protection of 19 June 1992 (FDPA) as well as by the Ordinance to the Federal Act on Data Protection (DPO) and the Ordinance on Data Protection Certification (ODPC). Furthermore, the processing of personal data by the public sector and regulated markets is restricted by additional laws. Personal data are defined as all information relating to an identified or identifiable natural or legal person. The FDPA protects sensitive personal data, which includes personality profiles as well as religious, ideological, political, and trade union related views, health, intimacy, racial origin, social security measures, administrative and criminal proceedings, and sanctions.

The Federal Data Protection and Information Commissioner (FDPIC) is the Swiss authority that supervises federal and private bodies, advises and comments on the legal provisions of data protection, and assists federal and cantonal authorities with data protection. However, the FDPIC does not have specific direct powers to enforce the data protection. It informs the public about its findings and recommendations, and maintains and publishes the register for data files. The processing of personal data by private persons does not usually have to be signalled or registered. However, private persons must register their data files before the data files are opened, if (1) they regularly process sensitive personal data or personality profiles, or (2) they regularly disclose personal data to third parties unless exemptions apply such as the data processed by journalists.

Yet there is no general requirement under Swiss data protection law to appoint a data protection officer. The data controller must notify the FDPIC of the appointment of a data protection officer and the company will be listed on the public list of companies exempt from the requirement to register their data files.

Also, there is no explicit statutory requirement to notify the FDPIC or the affected data subjects of data security breaches under the FDPA. Depending on the scale and severity of a breach, notifying the data subjects may be necessary based on the data controller and processor's obligation to ensure data security. The following principles apply to Swiss regulations regarding the collection and processing of personal data (including data of legal entities): (1) Personal data may only be processed lawfully; (2) Its processing must be carried out in good faith and must be proportionate; (3) Personal data may only be processed for the purpose indicated at the time of collection, that is evident from the circumstances, or that is provided for by law; (4) The collection of personal data and in particular the purpose of its processing must be evident to the data subject; (5) If the consent of the data subject is required for the processing of personal data, such consent is valid only if given voluntarily on the provision of adequate information; (6) Consent must be given expressly in the case of processing of sensitive personal data or personality profiles.

Moreover, the Swiss government has an open data strategy running from 2019 to 2023. The objective is to make all data from the federal administration available to the people. Data are shared on the open data Swiss portal, which is the Swiss public administration's central for open government data. In some instances, the platforms also keeps record of third party data that are of interest to the public, but personal data are never published. The portal is managed by the Federal Statistical Office (FSO). The

FSO more generally supports organisations in publishing their open data. The following organisations provide support in managing and developing the online platform:

o The **opendata.ch association** that regularly brings data users through various events
o **Geocat.ch** that manages the publication of open geo data.
o **OGD-D-A-CH-LI** that enhances cooperation between German-speaking stakeholders
o **Opendatabeer.ch** that offers a series of network events.

In the near future, other data, from lower levels (cantons, communes), will also be made increasingly available to the public. Moreover, there is a Swiss website, agate.ch, referred as the "online counter of agriculture". The Agate portal allows the user to access a multitude of applications used by agriculture as well as companies and organisations in the agrifood sector. The main users of the portal are farmers, breeders, equine owners, municipal, cantonal and federal administrations, as well as various unions and associations (producer unions, creators of labels, etc.). In addition, farmers have the possibility of authorising the sharing of data communicated to federal or cantonal services.

4. Challenges and Opportunities

4.1. Barriers to digitalisation

Table 7 presents general barriers to digitalisation in Switzerland in the following domains: Technical, Legal, Training/Education, Economic, Social, and others. It also reports on the eventual influence of Covid-19 on those barriers.

Table 7: Barriers to digitalisation

Barriers to digitalisation		Influence of COVID-19
Technical	Limited interconnection between digital tools	None identified
	Digital tools, in agriculture, not always adapted to Swiss conditions/particularities (e.g. small farm size, slope, etc)	None identified
Legal	- Concerns over data ownership and profitability - Fears of consequences in case data are not fully completed on the online system.	None identified
Training / Education	Lack of digital skills - e.g. 45% of the Swiss population does not use e-government services because they are not familiar with them.	Their use has increased during the crisis (still on-going)
Economic	Lack of evidence of return on investment	None identified
Social	- 50% of the population believes that personal contact is important and easier - Data protection concerns /lack of trust in data sharing - Lack of transparent government processes - Mistrust in private companies in terms of data handling - Concerns about security of online banking operations	The crisis has changed to some extent the mind of the Swiss population with respect to the security of online banking operations

Others	Scaling-up of automated administrative procedures e-health: The COVID-19 pandemic clearly shows the difficulties encountered in Switzerland in the exchange of data between the different actors (health professionals, authorities, etc.).	None

4.2. Actions to boost sustainable digitalisation

Table 8 is filled with ideas of actions that should guide the new generation of rural policies that boost sustainable digitalisation of agriculture, forestry and rural areas in Switzerland.

Table 8: Actions to boost sustainable digitalisation

	Key rural development domains			
	Human capital	Innovation	Investments	Governance
Creating the basic conditions for digitalisation	If possible, reducing constraints on immigration of highly skilled workers	Supporting an increased cooperation among AKIS actors	Increasing private and public infrastructure investments in mobile broadband	Promoting the attractiveness of Switzerland's infrastructure for finance-oriented digital infrastructure
Anchoring digitalisation to sustainable development	Performing (more) studies on impacts on sustainability	Supporting an increased cooperation among AKIS actors	Further funding projects focusing on the area of sustainability	Further relying on SDGs related to the topic
Adapting digitalisation to different context	- Encouraging peer-to-peer networking; assessing needs of users - Encouraging peer-to-peer networking; assessing needs of users		Introduce funding mechanisms that fill the gap between seed money and large investments	Strengthened cooperation between all Swiss cantonal and federal levels
Favouring digital inclusion	Pursuing digital literacy programs, both formal and informal	Encouraging peer-to-peer networking	Supporting vulnerable groups	Monitoring DESI indicators progress
Developing digital ecosystems	Training and digitalisation brokering.	- Encouraging peer-to-peer networking - Encouraging Living Lab approaches	Pursuing investments in digital infrastructures, with a particular focus onto rural areas	Cooperation between federal and cantonal level to help cantons understand that current taxation policies, in which startups are taxed based on their external valuation, are potentially detrimental to the Swiss startup ecosystem

Developing adaptive governance models	Identifying business models for the exploitation of open government data providing shared value to businesses and public administration
Designing policy tools for sustainable digitalisation	Developing policy tools that allows digitalisation to proceed without major concerns about data security, data privacy and the lack of transparency in governmental actions and digitalisation procedures

5. Conclusions

Overall, the digitalisation process is well advanced in Switzerland, and the gap between rural and urban areas is also being reduced. The 2020 I-DESI shows that the average connectivity dimension score for Switzerland (69.2) was comparatively high compared to most countries although lagging behind Japan (74.5), Iceland (71.7), the top four EU28 (70.4), and USA (69.8). In the area of digital public services, though, the level of digitalisation still appears to be comparatively low. We also observe a substantial gender gap among households about Internet use. However, the gender gap tends to decrease over time, and quite sharply.

An example of key national policy is the resource efficiency payments ("*Ressourceneffizienzbeiträge*"), where digital techniques (since 2014) with a proven positive effect on the sustainable exploitation of natural resources and/or the efficient use of production means are financially supported throughout Switzerland.

A "digital Switzerland Strategy" was presented in September 2020. This strategy provides the guidelines for federal governmental action and indicates where and how authorities, academia, the private sector, civil society and politics must work together in order to shape the transformation process for the benefit of everyone in Switzerland.

A substantial number of projects or initiatives are supported through public funding in order to develop, improve, and boost digitalisation in Switzerland, including in rural areas. The improvement of process efficiency and productivity are often at the core of those projects or initiatives. This is associated to the fact that Switzerland faces particular challenges over the competitiveness of its agricultural sector on the European and International market.

Main issues are the lack of digital skills with for example 45% of the Swiss population that does not use e-government services because they are not familiar with them, as well as data protection and process transparency concerns over digitalisation procedures.

A specific focus should be made on developing digital skills of the population; working on new concepts that can overcome data security/privacy issues; and performing more studies on the real impacts of digital tools, including in terms of farm incomes and equality. A more digital literate society, coupled with effective data security laws should lead to an increase in trust in data-sharing. Moreover, a strengthened cooperation between all Swiss cantonal and federal levels appears to be key.

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