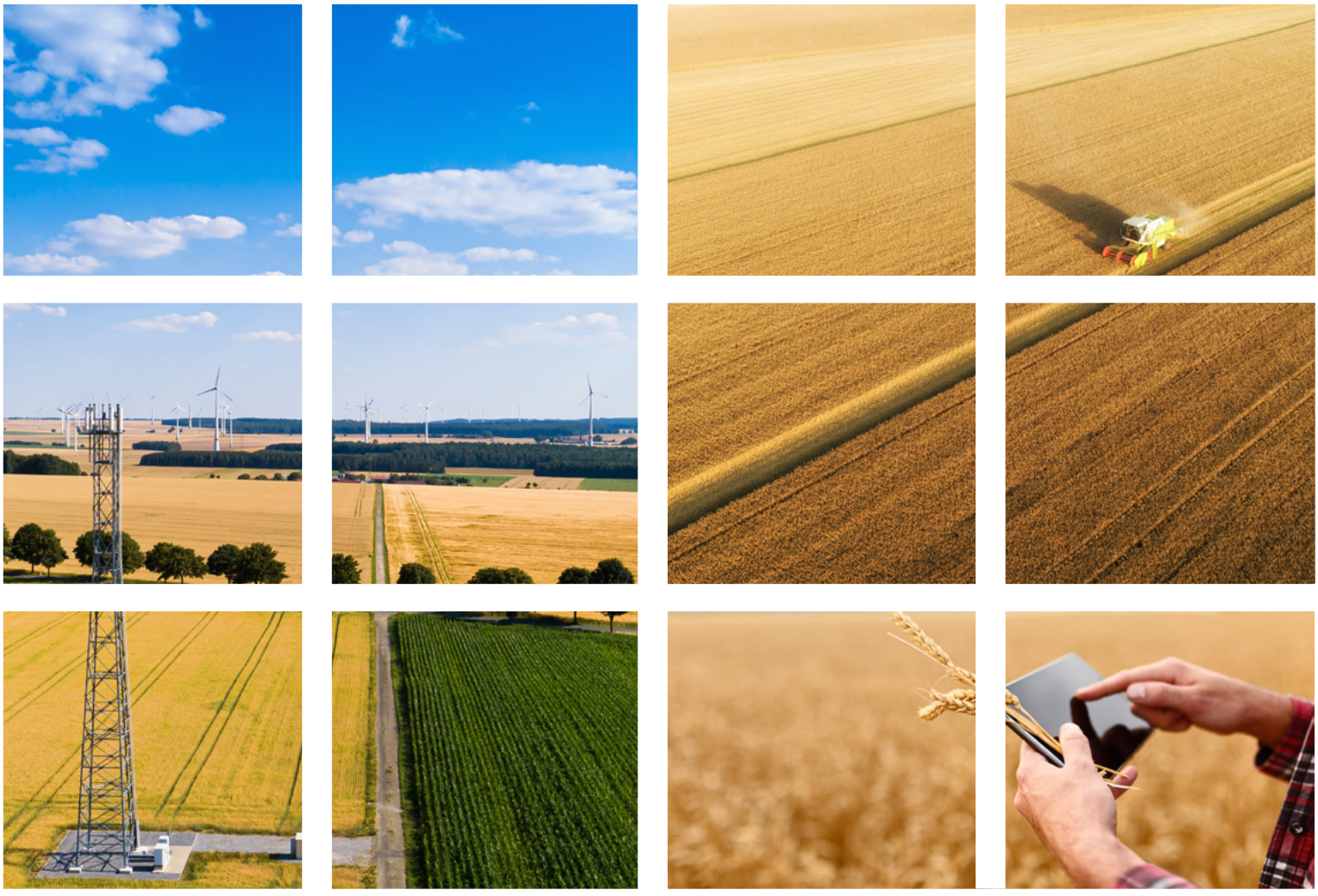
ITUPublications

International Telecommunication Union
Development Sector

Status of Digital Agriculture in 18 countries of Europe and Central Asia



Co-published with:

Food and Agriculture Organization of the United Nations

Status of Digital Agriculture in 18 countries of Europe and Central Asia

Published by
International Telecommunication Union
and
Food and Agriculture Organization of the United Nations

Acknowlegement

This report was prepared for the International Telecommunication Union (ITU) and the Food and Agriculture Organization (FAO) of the United Nations by Mihaly Csoto and Laszlo Gabor Papocsi, with the support and guidance of the ITU Offices for Europe (Jaroslaw Ponder and Lena Lattion) and the Commonwealth of Independent States (CIS) (Farid Nakhli) regions and in collaboration with the FAO Regional Office for Europe and Central Asia (Sophie Treinen and Valentin Nagy).

ITU and FAO would like to express sincere gratitude to the representatives of the 18 countries concerned (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Montenegro, North Macedonia, Russian Federation, Serbia, Tajikistan, Turkey, Turkmenistan, Ukraine and Uzbekistan) for the support and assistance they provided to the ITU experts. They would also like to express appreciation for the support they received from FAO country offices, national focal points in ministries of agriculture and FAO experts in the Regional Office for Europe and Central Asia.

NOTES

Please note that for the purpose of this report, the term Europe and Central Asia refers to the group of countries consisting of the following: Albania, Andorra, Armenia, Austria Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, the Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, the Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, the United Kingdom, Uzbekistan and the Vatican.

DISCLAIMER

ITU and FAO. 2020. Status of Digital Agriculture in 18 countries of Europe and Central Asia. Geneva, Switzerland.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or of the International Telecommunication Union (ITU) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO or ITU in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO or ITU.

COPYRIGHT

Photos credits: FAO

ISBN

978-92-61-31131-5 (Paper version)

978-92-61-31141-4 (Electronic version)

978-92-61-31151-3 (EPUB version)

978-92-61-31161-2 (Mobi version)

FOREWORDS

The year 2020 marks the beginning of the "Decade of Action" proclaimed by the United Nations for achieving the goals and targets set out in the 2030 Agenda for Sustainable Development Agenda. In an increasingly digital world, information and communication technologies (ICTs) play a key role as development enablers that can facilitate countries' capabilities to reach all the 17 Sustainable Development Goals (SDGs).

In the wake of the COVID-19 pandemic which continues to ravage so many of our populations and economies, there can no longer be any doubt that dramatically accelerating progress on the SDGs means dramatically accelerating progress to extend digital connectivity to the 3.6 billion still totally cut off from the online world.

Digital is the foundation on which we can build social and economic resilience. We have never faced a situation of greater urgency, and renewed global recognition of the importance of digital infrastructure, services and skills presents many unprecedented opportunities to make real and rapid progress.

Europe and the Commonwealth of Independent States (CIS), throughout the years, made significant progress, becoming world leader in broadband connectivity. However, a lot remains to be done to bridge connectivity, affordability and digital skills divides across the countries. The impact of policy and regulatory frameworks on the development of digitization in Europe and CIS is positive. In Europe, an increase of 10 per cent in digitization results in 1.4 per cent growth in gross domestic product (GDP) per capita. In the CIS region, an increase of 10 per cent in fixed-broadband penetration would result in 0.63 per cent in GDP per capita.

While Europe leads in digital agriculture development, the e-agriculture sector in many parts of Europe still suffers from underinvestment. As agriculture becomes more and more knowledge-intensive, having access to timely and accurate information tailored to specific locations and conditions is critical to helping farmers enhance their efficiency in agricultural production. E-agriculture centres on designing, developing, and applying innovative methods of ICT use within the agricultural sector in the rural domain.

Many stakeholders have long recognized the need for strategies for national e-agriculture, also known as digital agriculture. However, most countries have yet to adopt or implement a national strategy for the agricultural sector's use of ICTs. E-agriculture strategies will help rationalize financial and human resources, address (holistically) ICT opportunities and challenges of the agricultural sector, generate new revenue streams and improve the lives of people in rural communities.

This review provides the results of a one-year study jointly conducted by ITU and FAO, addressing a broad range of issues related to contemporary policy and practices across Europe and CIS in e-agriculture. The review also features the experiences of countries in their ongoing efforts to develop and implement digital agriculture strategies.

I thank all administration of the 18 countries that have participated in this mapping exercise and commend the Europe and CIS regions for the report. It is an important result of our work carried out under the ITU Regional Initiatives for Europe and CIS on a "*Citizen-centric approach to building services for national administrations*" and on "*Fostering innovative solutions and partnership for the implementation of Internet of Things technologies and their interaction in telecommunication networks, including 4G, IMT-2020 and next-generation networks, in the interests of sustainable development*".

The review is a significant regional milestone in implementing the World Summit for Information Society (WSIS) Action Plan, in particular WSIS Action Line C7: ICT applications: e-Agriculture. It is an important contribution towards achieving the Sustainable Development Goals, in particular SDG 2 and SDG 9.

The Telecommunication Development Bureau remains committed, jointly with FAO, to continuing to develop tools and mechanisms to intensify collaboration and implement actions at the regional and national levels that aim to enhance the role of ICTs in agriculture. Together, we need to bring the benefits of the digital world to the citizens of tomorrow, whilst addressing the risks of the new ecosystem, where the online and offline worlds merge.

Doreen Bogdan-Martin

Director, Telecommunication Development Bureau

Digital technologies are rapidly transforming how people, business and governments work. They affect the entire food system, every actor of that system, and generate significant benefits in agriculture by reducing the costs of information, transactions and supervision. While digital technologies can make significant contributions towards the achievement of the 2030 Agenda for Sustainable Development, including its Sustainable Development Goals (SDGs), they raise economic, social and ethical concerns, in particular with respect to privacy and security, but also in terms of the disruptive impact that they can have on business, employment and markets. While these concerns are common across all sectors of the economy, the transformational impact that digital technology can have specifically on the food and agricultural sector is particularly broad.

Agricultural and rural development in the region of Europe and Central Asia has to overcome various challenges transforming to sustainable food systems and nutrition sensitive value chains. Such challenges include the triple burden of malnutrition undernutrition (overweight, obesity, and micronutrient deficiencies); climate change adaptation; increased food loss and waste; rural divides and urbanization, including the outmigration of young people; small-size farming domination; and aging of farmers in the Western Balkans and the Caucasus.

The COVID-19 crisis threatens the food security and nutrition. In the longer term, the economic consequences can have implications on the functioning of food systems and thus also environmental and social disruptions. Emphasis needs to be given to both short and long-term measures that supports a transition to more sustainable food systems that are in better balance with nature and that support healthy diets – and thus better health prospects- for all. The sustainable nutrition sensitive agriculture value chains from farm to fork require equal access to information and communication technologies (ICTs) for all stakeholders. However, in Europe and Central Asia, the adoption of new technologies is lagging behind for smallholder farmers. The reasons of this rural digital divide are often related to availability and quality of access, connectivity costs, appropriate and adapted content that can be activated. The solutions reside in participatory processes, involving all actors working in partnerships using traditional and new technologies.

The COVID-19 pandemic has been a wakeup call and has accelerated the use of digital technologies in order keep working and stay connected. It also revealed the divides that persist between those who have access or not. Digital technology dividends are not automatic, and not everyone can benefit equally. Hence, there is a critical need for actions at policy level to maximize the benefits and minimize the potential risks, and ensure government commitment to upscale new solutions and create a structured enabling environment for innovation development, support systems and capacity development, which are pertinent for generating a development change through ICTs in agriculture. In accordance with the core principles of the 2030 Agenda for Sustainable Development, governments in the Europe and Central Asia region shall take measures to leave no one behind and close digital, rural and gender divides, known as the triple divide. As mentioned in the UN Secretary General Roadmap for Digital Cooperation, more than ever we need to connect, respect and protect people in digital age. People working in agriculture, forestry and fishery, living in remote and rural areas should not be left behind.

Coordination is needed to sustainably address the digital transformation of agriculture. Responding to the 2020 Global Forum for Food and Agriculture's (GFFA) call, it is proposed that FAO host an International Platform for Digital Food and Agriculture that will i) promote the coordination and strength the linkages between international fora for agriculture and those for the digital economy to enhance the awareness of the international community to issues specific to the digitalization of the food and agriculture sectors; and ii) support governments with policy recommendations, best practices, and voluntary guidelines that can enhance the benefits of digital technology applications on agriculture, while addressing potential economic, social and ethical impacts and concerns.

I would like to thank all the FAO country offices and focal point in the region who participated in the review. FAO and ITU advocate for a participatory policy formulation on e-agriculture linked to agricultural and rural strategy goals, based on a detailed needs assessment of agricultural sectors against the available ICT solutions and mechanism for fostering innovation with Ministries responsible for Agriculture taking the lead while involving other key actors, engaging private sector, academia and civil society. Since 2015, FAO and ITU have joined force to assist countries in developing their national e-agriculture strategies and roadmaps. This collaboration is more than ever needed and will continue.

Vladimir Rakhmanin

FAO Assistant Director-General and Regional Representative for Europe and Central Asia

Table of Contents

List of tables and figures

Tables

Figures

Acronyms and abbreviations

3G/4G/5G	third/fourth/fifth generation of wireless mobile telecommunication technology
AI	Artificial Intelligence
CAP	Common Agricultural Policy
CIS	Commonwealth of Independent States
DSM	Digital Single Market
EBRD	European Bank for Reconstruction and Development
ENPARD	European Neighbourhood Programme for Agriculture and Rural Development
EU	European Union
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GIS	Geographic information system
GPS	Global Positioning System
ICTs	Information and communication technologies
IoT	Internet of Things
IPA	Instrument for pre-accession assistance
ITU	International Telecommunication Union
IVF	International Visegrad Found
LPIS	Land Parcel Identification System
LTE	Long-Term Evolution
NGO	Non-governmental organization
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
WDI	World Development Indicators
WTI	World Telecommunication/ICT Indicators

EXECUTIVE SUMMARY

Digital agriculture has the potential to contribute to a more economically, environmentally and socially sustainable agriculture, while meeting the agricultural goals of a country more effectively. Both information and communication technologies (ICTs) and agriculture are important enablers for achieving the Sustainable Development Goals (SDGs).

And yet, despite the fact that most stakeholders have long recognized the need for strategies for national e-agriculture, also known as digital agriculture, most of the countries covered by this report have not yet implemented a national strategy for the agricultural sector's use of ICTs.

This report on the state of digital agriculture and strategies in 18 countries has been drawn up by the ITU Offices for Europe and the CIS regions, in collaboration with the FAO Regional Office for Europe and Central Asia.

ICTs have been clearly observed to play an emerging role in Europe and Central Asia, acting as an engine for agricultural development, especially as demand grows for reliable and readily accessible information at all levels of the industry. The state of the digital agriculture ecosystem differs from country to country, and from region to region in individual countries. The use of ICTs in agriculture has spawned a tidal wave of innovation, making a digital agriculture strategy a good means of finding the right way forward. The process of integrating countries into regional economic organizations such as the European Union (EU) and the Eurasian Economic Union has been seen to increase the efficiency of institutional systems and spark greater interest and efforts on the part of many governments to formulate a national digital agriculture strategy.

Among the countries reviewed, the following have been identified as having a systematic approach to the development of a national e-agriculture strategy.

1. **Albania:** Albania started laying the groundwork for its national e-agriculture strategy and vision in 2019, with the support of the FAO Regional Office for Europe and Central Asia. The development process continues in 2020.
2. **Armenia:** In the second half of 2018, the EU-funded FAO European Neighbourhood Programme for Agriculture and Rural Development (ENPARD) project, "Technical Assistance to the Ministry of Agriculture of the Republic of Armenia", which benefits from FAO technical cooperation, helped the government develop a vision for the national e-agriculture strategy. FAO continues to support the development of the action plan for digital agriculture in 2020.
3. **Moldova:** In 2014, Moldova decided to develop a national e-agriculture strategy. The review brought to light no trace of follow-up, but the concept of e-agriculture was enshrined in the National Strategy for Agricultural and Rural Development (2014–2020) and the strategic programme for the technological modernization of the government.
4. **Russian Federation:** In the Russian Federation, key stakeholders jointly set up the Digital Agriculture Project and developed, in 2018, the concept for the scientific and technological development of digital agriculture, which encompasses the vision for a national e-agriculture strategy.
5. **Turkey:** The Ministry of Agriculture and Forestry has started developing a national e-agriculture strategy with the technical assistance of FAO. The project inception workshop was held in Ankara and attended by several stakeholders in November 2019. The strategy continues to be developed in 2020.
6. **Kyrgyzstan:** The Digital Roadmap on the implementation of the digital transformation concept, Digital Kyrgyzstan 2019–2023, includes the preparation of an ICT implementing policy for the development of the agricultural sector. The Agricultural Sector Development Programme involves ICTs and includes

an action plan for implementation in 2019–2022. FAO was officially approached in February 2020 to provide technical support for the development of a draft national e-agriculture strategy.

7. **Tajikistan** and **Uzbekistan:** Both countries requested FAO assistance in 2019 for the development of their respective national e-agriculture strategy.

Further conclusions can be drawn in line with the eight components of a national e-agricultural strategy identified in the FAO/ITU E-Agriculture Strategy Guide (see chart).

Source: FAO-ITU e-Agriculture Strategy Guide

Leadership and governance

Despite the declining share of the agriculture sector in national gross domestic product (GDP) most of the 18 countries covered in the report attribute high priority to agricultural development. Digital solutions are almost exclusively designed to promote production, resource efficiency and economic growth. E-agriculture is generally being developed at the junction, not only of the information society and the digital economy, but also as a fundamental element of current and planned agricultural and rural policies in almost all the countries concerned.

Strategy and investment

Almost all the information society strategies and digital agendas formulated in the region in the past few years contain some elements of e-agriculture, and many set out concrete programmes for e-agriculture development. It is questionable whether the very ambitious goals set out in the strategies can be achieved, especially within the strict deadlines set. The strategies' implementation has had mixed results – the existence of a strategy does not guarantee successful implementation. In some cases, concrete measures have dedicated State funding, but private entities are also active, especially in countries where precision farming is a viable option. International donor organizations too have supported initiatives in almost every country studied, providing the opportunity to develop ICT-based services (mainly targeting smallholders and family farms) that would not have been developed by the private sector alone.

Services and applications

One of the most important trends in the development of services and applications is government-to-business (G2B) services, which are based on systems with control functions related to the implementation of agriculture policies. These services are established, based on relationships between organizations of public administration and private enterprises.

Furthermore, services and applications related to precision agriculture play a key role in public and private sector development in countries with larger economies. Varieties of mobile applications have also been developed, the smartphone being the main means of Internet access for farmers in the region.

Infrastructure and interoperability

Wired infrastructure is usually underdeveloped; on the other hand, wireless broadband (3G and LTE) is available in most rural areas. Achieving *interoperability* within the public administration is a priority in many countries. Interoperability can also further digitization of agriculture by improving the availability of the diverse data needed. Monitoring systems are also crucial and are being developed in many countries. In parallel, many countries have to implement new standards for proper data collection.

Content, knowledge management and sharing

In part because databases are being built, agricultural content and applications are growing in the region; knowledge management and information sharing, on the other hand, need to be developed, particularly among smallholder farmers. The agricultural advisory services in some countries are also in need of significant development, withagricultural extension services expected to play a central role in helping smallholders and family farmers embrace digitalization.

Legislation, policy and compliance

Legislation often lags behind the various actions and measures being taken, especially as digital solutions are constantly changing and are a "moving target" in terms of regulation.

Workforce and capacity development

In the countries studied, very few initiatives have been taken to boost the digital literacy of farmers, and data on the level of digital skills of agricultural workers are almost non-existent. The role of intermediaries (connecting farmers with digital technologies) and their training is also important in this respect.

The following suggestions apply to countries and supporting organizations and aim to promote the strategic development of digital agriculture.

- As many countries are developing or upgrading their agricultural data-collection methods and systems, this would be the right time to incorporate agriculture-specific ICT indicators, including gender-disaggregated and smallholder farmers data.
- Special attention is needed in the strategic approaches to introduce and apply digital technologies for smallholder and family farmers.
- The farmer should be at the heart of the strategy – this should not be "forgotten" during the process being promoted by government agencies and other stakeholders isolated from the "end users".
- Collaboration should be promoted, and knowledge shared, via online communities of practice, including existing regional networks and global platforms.
- Horizontal requirements should be formulated for coordination and interoperability when e-agriculture-related systems are developed. For example, such requirements should be part of the general conditions in the terms of reference, calls for procurement, service contracts, etc.
- Greater emphasis should be placed on implementation, monitoring and evaluation right from the start.
- Lessons should be learned from other industries and regions.
- A regional database should be established for ICT-based agricultural services and projects.

1. Introduction

Agriculture is becoming more and more knowledge-intensive: farmers have to make increasingly complex decisions about the use of their farms, the agricultural commodities they plant, the markets on which to sell their agricultural products, and other major issues that affect their livelihoods and the well-being of society as a whole. They therefore have to change the way that they access and use information.

Agriculture also faces many challenges, including those posed by the impact of climate change (such as the growing frequency of natural disasters, biodiversity loss and natural resource base depletion), increased volatility in food prices and dysfunctional supply chains.

FAO forecasts that over 90 per cent of the demand for global food production by 2050 will be met by increasing the yield of current arable land based on advances in agricultural research. Implementing this knowledge – and conveying it to farmers – through successful research-extension linkages and the development of an "agricultural innovation ecosystem" will be key to achieving enhanced production levels. Information enables farmers to change and adapt in order to survive dynamic challenges and improve their livelihoods. Linking knowledge to innovation is critical to resolving the agricultural sector's information and knowledge gaps. Economic growth is driven by the advancement of ICTs, which are also a key driver for innovation and change.

Innovation, however, is a complex mix of people, processes and technologies. Many initiatives place technology alone at the centre of proposed methods to address new and current problems, but in many cases, this is not a sustainable approach. Identifying what technologies can be introduced into existing workflows is crucial to making them more efficient and effective. Parallel to efficiency and technology-driven development, agriculture is also increasingly becoming more knowledge-intensive. Having access to timely and accurate information that is tailored to specific locations and conditions is critical not only for farmers trying to make the most of their resources in often changing circumstances, but also for others in the value chain, including consumers. Dealing with the massive amount of information available nowadays is unimaginable without ICTs.

1.1 ICTs, agriculture and the Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated – that is, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. In this way, both ICTs and agriculture are important enablers for achieving the SDGs.

As the prime connection between people and the planet, food and agriculture can help achieve multiple SDGs. Properly nourished, children can learn, people can lead healthy and productive lives, and societies can prosper. By nurturing the land and adopting sustainable agriculture, present and future generations will be able to feed a growing population. The agriculture sector, covering crops, livestock, fisheries and forests, is the world's biggest employer and the largest economic sector in many countries; it is also the main source of food and income for the extremely poor. Sustainable food and agriculture have great potential to revitalize the rural landscape, deliver inclusive growth to countries and drive positive change right across the 2030 Agenda for Sustainable Development.

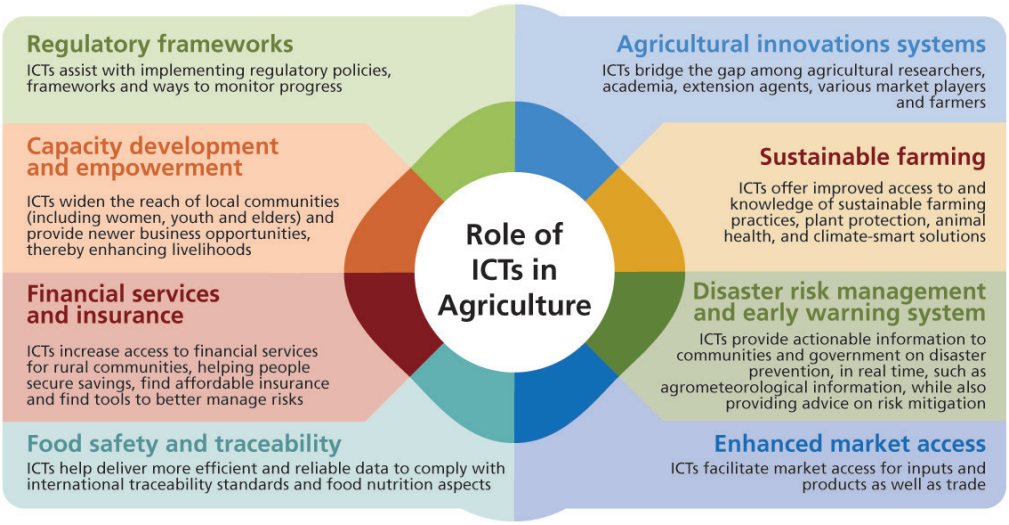
ICTs can help accelerate progress towards every single one of the 17 SDGs. Efficient and affordable ICT infrastructure and services allow countries to participate in the digital economy and to increase their overall economic well-being and competitiveness. ICTs serve to deliver quality goods and services in the areas of health care, education, finance, commerce, governance and agriculture, among others. They can help to reduce poverty and hunger, boost health, create new jobs, mitigate climate change, improve energy efficiency, and make cities and communities sustainable.

1.2 ICTs and agriculture

ICTs have long been recognized as key enablers for bridging the digital divide and achieving the three dimensions of sustainable development: economic growth, environmental balance and social inclusion. They have proved to be instrumental in health, education, finance and trade, providing information and services, and have contributed to greater transparency and accountability. By using ICT-based solutions, problems that have been a burden to the agriculture sector for too long can be solved. However, in order to exploit the latent potential of ICT devices and digital services effectively, the characteristics of the driving forces behind new technologies have to be understood. At the farm level, ICTs can help manage farm operations and functions by collecting, processing, storing and disseminating information. Farm Management Information Systems (FMIS) are complex record-keeping systems that support agricultural production management, helping in particular to reduce production costs, ensure compliance with agricultural standards and maintain product quality and safety. Digital technology can also be used to deliver e-agriculture, a more streamlined agricultural production system often called "precision agriculture", which uses a resource-efficient approach that can also have great benefits in terms of environmental issues (e.g. more efficient use of water, optimization of treatments and inputs, reduced use of fertilizers and pesticides – or "doing more with less"). Looking beyond the farm, e-agriculture has the potential to contribute to a more economically, environmentally and socially sustainable agriculture that meets the agricultural goals of a country or a region more effectively in the following areas (detailed in Figure 1):

- agricultural innovation systems;
- sustainable farming;
- disaster management and early warning systems;
- enhancing market access;
- food safety and traceability;
- financial services and insurance;
- capacity development and empowerment;
- regulatory frameworks.

Figure 1: Role of ICTs in agriculture



The aim of e-agriculture is to enhance agricultural and rural growth by using improved information and communication processes. E-agriculture encompasses conceptualizing, designing, creating, analysing and applying innovative ways of using ICTs in the rural domain, with a primary focus on farming. One way to introduce ICTs into agriculture efficiently and effectively is through a comprehensive national strategy that will prevent e-agriculture projects from being implemented in isolation, resulting in a duplication of efforts and resources, and will instead use synergies to enhance efficiency. An e-agriculture strategy can offer critical support for rationing resources (financial and human) to better harness ICT opportunities. Participatory planning of, and a strategic approach to, agricultural ICT applications help to improve inter-institutional collaboration, transparency and trust. Experts agree that current e-agriculture innovations using new technological developments such as artificial intelligence (e.g. plant disease recognition), sensor networks (e.g. the "Internet of Farm Things") and blockchain technology (e.g. for food chain transparency) are mostly aimed at larger farms and stakeholders. This is not surprising, as these innovations mainly target problems caused by the scale of production and distribution. However, e-agriculture solutions should not only target the larger players: they can also help to solve the problems of smallholders and family farms by leading to productivity gains, narrowing the information gap between small and big players, and supporting sustainable practices and specific, complex farming systems (e.g. organic farming).

Although the need for national e-agricultural strategies has long been recognized, most countries in Europe and Central Asia have yet to implement a national strategy. As general-purpose technology, ICTs can facilitate national and regional agricultural strategies, but it is important to emphasize that, despite the huge potential of new technologies, ICTs can only make a difference if they are part of a strategically implemented vision and concept. Governments play an important role in taking advantage of ICTs by tailoring applications to current needs and problems, and – as holders of countless agricultural data sources – by providing an information ecosystem, including open data policy, regulations and interoperability, of use and accessible to every stakeholder.

In 2015 and 2016, FAO and ITU jointly developed the E-Agriculture Strategy Guide[1], which aims to help countries mainstream ICTs into agriculture and develop or revitalize e-agriculture strategies in line with agricultural goals and priorities. To date, several countries have adopted a national e-agriculture strategy based on the approach set out in the guide.

1.3 EU policy for the development of innovation and ICTs

Agriculture and information society policy-making is strongly influenced by the ambition shared by many countries in the region to join, or cooperate more closely with, the EU. The European Commission's Digital Agenda is one of the seven pillars of the Europe 2020 strategy, which sets goals for EU growth by 2020. The Digital Agenda proposes making better use of the potential of ICT to foster innovation, economic growth and progress. One of the key priorities of the Digital Agenda is the Digital Single Market.

The main policy context for e-agriculture in the EU is also determined at the top level by the Digital Single Market strategy. The objectives of the Digital Single Market include bridging the digital divide between urban and rural areas, and providing high-speed/ultra-fast broadband across the EU by 2020. The Digital Single Market also offers many other opportunities for agriculture and the food value chain – all the way to the consumer – to become smarter, more efficient, more circular and more connected.

Indeed, when it published its Communication, "Digitising European Industry" (COM(2016)180), the European Commission said that the overall objective of the strategy for digitizing industry was to ensure that "…any industry in Europe, big or small, wherever situated and in any sector can fully benefit from digital innovations to upgrade its products, improve its processes, and adapt its business models to the digital change".

[1] See www.fao.org/in-action/e-agriculture-strategy-guide/en/ .

Furthermore, the Cork 2.0 Declaration, “A Better Life for Rural Areas”, states in Point 7: "Rural businesses, including farmers and foresters, of all types and sizes, must have access to appropriate technology, state-of-the-art connectivity, as well as new management tools to deliver economic, social and environmental benefits."

Lastly, the declaration of cooperation on a “smart and sustainable digital future for European agriculture and rural areas” was launched at Digital Day 2019 and signed by nearly all EU Member States. It recognizes the potential of digital technologies to help tackle the important and urgent economic, social, climate and environmental challenges facing the EU's agri-food sector and rural areas. The EU agricultural sector is one of the world’s leading producers of food, a guarantor of food security and quality, and a provider of millions of jobs for Europeans, but it faces many challenges. Digital technologies such as artificial intelligence, robotics, blockchain, High Performance Computing, the Internet of Things and 5G have the potential to increase farm efficiency while improving economic and environmental sustainability. Greater use of digital technologies will also have a positive impact on the quality of life in rural areas, and may attract a younger generation to farming and rural business start-ups. The declaration is part of ongoing efforts to facilitate and accelerate the digital transformation in the EU farming sector and rural areas.

Various sources of funding can be tapped to help launch an agricultural innovation project, for example the European rural development policy under the CAP, the EU's Horizon 2020 research and innovation programme (H2020), or the agricultural European Innovation Partnership programme (EIP-AGRI).

1.4 Information systems in the EU Common Agricultural Policy

The agri-food sector is one of the largest economic sectors in the EU. Around 44 million jobs in food processing, food retailing and catering depend on agriculture, in which around 12 million farmers are currently employed. About half of EU territory is dedicated to farming; rural areas make up half of Europe and are inhabited by about 20 per cent of the EU’s population.

The CAP is the EU’s agricultural policy. It operates a complex system of agricultural subsidies and other support programmes. It was introduced in 1962 and has undergone several changes since then. The CAP has a budget of over EUR 50 billion a year, making it the most expensive of all EU programmes. It accounted for 37.8 per cent of the EU budget from 2014 to 2020, compared with almost 71 per cent in 1984.

The CAP aims sustainably to improve the productivity of European agriculture while ensuring a fair standard of living for farmers in the EU. It strengthens the competitiveness and sustainability of agriculture in Europe through a range of measures such as direct payments, market interventions and rural development.

Most of the CAP budget is managed and controlled by its Integrated Administration and Control System, which works to protect the CAP's financial resources and help farmers make their declarations. The CAP budget is used in three different but interrelated areas; funds therefore have to be allocated coherently.

- Income support for farmers and support for sustainable agricultural practices: Farmers receive direct payments provided they comply with food safety, environmental protection, and animal health and welfare standards. Direct payments are fully funded by the EU and account for 70 per cent of the total CAP budget. Thirty per cent of direct payments depend on adhering to sustainable agricultural practices that improve soil quality, biodiversity and the environment (e.g. crop diversification, maintenance of permanent grassland or conservation of organic land on farms).
- Rural development measures: These measures help farmers modernize their farms and become more competitive while protecting the environment, diversifying agricultural and non-agricultural activities, and contributing to the vitality of rural communities. They are co-financed by the Member States and amount to around 20 per cent of the total CAP budget. Projects typically last more than a year.

- Market support measures: These payments finance market support measures such as export subsidies to food companies, and help when unfavourable weather conditions destabilize markets. They account for less than 10 per cent of the overall CAP budget.

Agricultural Knowledge and Information Systems fall, according to EU standards, into two general categories.

A) Primary Information Systems

1. Agricultural statistics
2. Farm Accountancy Data Network (FADN), for monitoring the financial processes and income position of farms
3. Market Information Systems, for providing market trend data for producers and governments
4. The bulk of systems used to allocate support, including, in particular, the essentially "technical" Integrated Administration and Control System used by the EU administration to post and monitor payments.

B) Secondary information systems that typically use the databases of primary systems.

These systems are designed to meet the specific information needs of certain "narrower" areas, including ICTs for Agricultural Knowledge and Information Systems and farm advisory services.

1.5 Common initiatives and organizations in Europe and Central Asia

Table 1: E-Agriculture-related initiatives and organizations in Europe and Central Asia

Organization	Function	E-agriculture role
European Interoperability Framework (EIF) **https://ec.europa.eu/isa2/eif_en**	The framework gives specific guidance on how to set up interoperable digital public services, so as to improve governance of interoperability activities, establish cross-organizational relationships, streamline processes supporting end-to-end digital services, and ensure that neither existing nor new legislation compromises interoperability efforts.	Standards and interoperability
National Interoperability Framework Observatory (NIFO) **https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory**	NIFO provides its stakeholders with the latest developments on digital government and interoperability across Europe.	Standards and interoperability
Open Government Partnership (OGP) **https://www.opengovpartnership.org**	The vision of the OGP is that more governments become sustainably more transparent, accountable and responsive to their citizens, with the ultimate goal of improving the quality of governance and services.	Standards and interoperability

Organization	Function	E-agriculture role
Global Open Data for Agriculture and Nutrition (GODAN) **https://www.godan.info**	The GODAN initiative encourages collaboration and cooperation across existing agricultural, nutrition-related and open-data activities, prompting stakeholders to solve long-standing global problems. It supports global efforts to make agricultural and nutritionally relevant data available, accessible and usable with restriction worldwide.	Standards and interoperability
European Enlargement Negotiations Policy **https://ec.europa.eu/neighbourhood-enlargement/**	The policy covers five candidate countries and two that have either applied for membership or are preparing to do so. All except Turkey are located in the Western Balkans.	Strategy and investments
IPA, IPARD **https://ec.europa.eu/neighbourhood-enlargement/instruments/overview_en**	The Instrument for Pre-accession Assistance (IPA) is the means by which the EU provides financial and technical assistance for reform in the "enlargement countries". The IPARD is the IPA for rural development and provides beneficiaries with financial and technical help to make their agricultural sector and rural areas more sustainable and align them with the EU's CAP.	Strategy and investments
European Neighbourhood Policy Eastern Partnership **https://ec.europa.eu/neighbourhood-enlargement/neighbourhood**	The joint policy initiative aims to deepen and strengthen relations between the EU, its Member States and its six Eastern neighbours: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine. It enshrines a joint commitment to a stronger economy, governance and connectivity for efficiency, and to environmental and climate change management.	Strategy and investments
ENPARD **https://ec.europa.eu/neighbourhood-enlargement/neighbourhood**	EU's European Neighbourhood Programme for Agriculture and Rural Development (ENPARD) was launched to strengthen the partnership between the EU and neighbouring countries in the field of agricultural and rural policies. It also promotes sustainable agriculture and balanced territorial development as factors of stability and of economic and social progress.	Strategy and investments
EU4Digital **https://eufordigital.eu**	EU4Digital aims to extend the EU's Digital Single Market to Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine, developing the potential of the digital economy and society. This could bring economic growth, generate more jobs, improve people's lives, help businesses, expand e-services and harmonize digital frameworks.	Strategy and investments, Services and applications
EU Smart Specialisation Strategies **https://ec.europa.eu/jrc/en/research-topic/smart-specialisation**	"Smart Specialisation Strategies" focus on identifying niche areas of competitive strength, solving major societal challenges, bringing in a demand-driven dimension, fostering innovation partnerships emphasizing greater coordination between different societal stakeholders, and aligning resources and strategies between private and public stakeholders at different governance levels.	Standards and interoperability

Organization	Function	E-agriculture role
EIP-AGRI **https://ec.europa.eu/eip/agriculture/**	The agricultural European Innovation Partnership (EIP-AGRI) works to foster competitive and sustainable farming and forestry that achieve more and better from less. Many EIP-AGRI professional events and publications focus on digitization and the Agricultural Knowledge and Innovation System.	Content, knowledge management and sharing

1.6 Methodology

The ITU Offices for Europe and the CIS regions, in collaboration with the FAO Regional Office for Europe and Central Asia, are the joint authors of this report on the status of digital agriculture and strategies in each of the following 18 countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Montenegro, North Macedonia, the Russian Federation, Serbia, Tajikistan, Turkmenistan, Turkey, Ukraine and Uzbekistan.

These countries were selected based on ITU and FAO activities, and on the local presence of FAO. Both organizations, as co-facilitators of the "e-agriculture" Action Line of the World Summit on the Information Society Plan of Action, wanted to have a better picture of the regional digital agricultural landscape. The updated information presented here will further understanding of how a national strategy can contribute to a country's socio-economic development.

The methodology used to assess the e-agricultural preparedness of the countries studied comprised several steps and layers.

As a first step, FAO and ITU sent the corresponding government bodies in each country a simplified questionnaire (see Annex 1) about the programmes and strategies existing at the national level and the main focal points. This was followed by a review of literature and online resources. In a second step, two e-agriculture experts commissioned by ITU, using the results of the previous step and systematically gathering and organizing available information sources, requested data additions and clarifications from the focal points in each country. The metrics of the ITU, World Bank and United Nations indicator databases were also used to describe the current situation in each country. Through this expert work, country profiles were created in line with the breakdown of e-agriculture components set out in the FAO/ITU E-agriculture Strategy Guide. Each country profile contains a section on ICT infrastructure in relation to the agricultural sector, with farmers being the main workforce and users of digital technology. It also contains a section on policies, strategies, legislative and governance programmes related, as much as possible, to the theme of e-agriculture. It concludes with a final section on functioning e-services, applications, tools and good examples falling within the scope of the study.

In a third step, the country descriptions thus created were back-checked with the heads and experts of the official bodies in each country.

The COVID-19 pandemic, which broke out after data had been collected for this report, could affect significantly the way digital agriculture evolves. Several countries and organizations are putting in place measures and prioritizing digital solutions to help farmers better manage their farming activities, in particular, timing of planting and harvesting, and mitigating the loss of high-value commodities (perishable products). Some farmers and farm advisors have tested and already use the many online communication channels available today. Usage of these channels (i.e. for timely extension services) will certainly grow, as will usage patterns. Mobile apps and web-based tools support direct sale and delivery of farm produce to consumers. Like other sectors (such as commerce and education), farming has gone more digital during the pandemic. COVID-19 lockdowns have exposed the digital divide and those (especially smallholders and family farmers) who are not using the Internet, have become more excluded than ever before, and have even less support and opportunity during these hard times. Big data analysis can help provide countries with facts and information on how the pandemic is impacting the food chains to make decisions.

2. Country profiles

2.1 Albania

2.1.1 Agriculture, workforce, ICT infrastructure

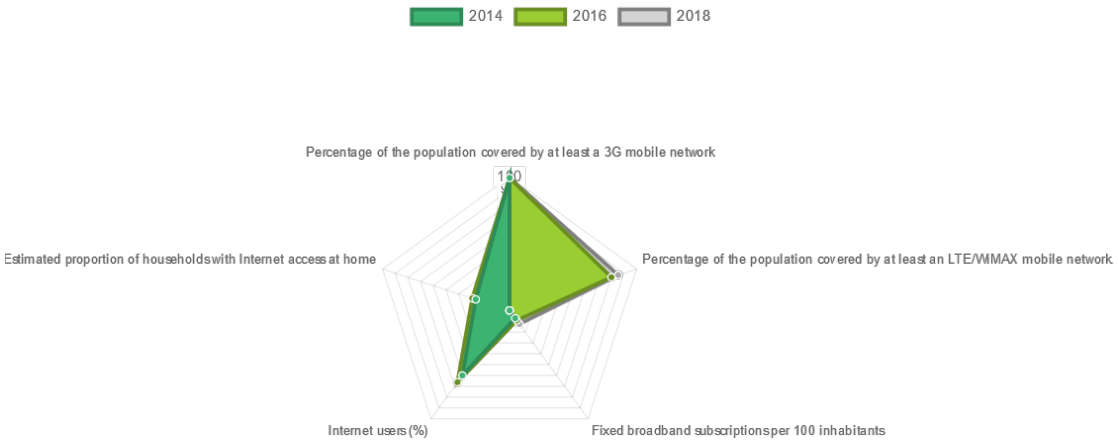
Table 2: Basic agriculture indicators in Albania (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	3002678	2882740	-119938	-3.99
Agriculture, value added (% of GDP)	16.84	18.39	-1.55	9.2
Agricultural land (% of land area)	43.1	43.13 (2016)	0.03	0.07
Rural population (% of total population)	50.01	39.68	-6.66	-20.66
Employment in agriculture (% of total employment)	44.66	38	-14.61	-14.91
Employment in agriculture, female (% of female employment)	56.9	42.29	-2.89	-25.68

Albania is an Eastern European country, and a candidate country waiting to start membership negotiations with the EU. Its population is relatively young and predominantly rural; nearly 40 per cent of people live in rural areas. Agriculture remains one of the most important sectors of the Albanian economy, contributing 18 per cent of GDP and some exports. However, production is mainly characterized by very small family farms oriented towards subsistence. The sector's problems are mainly linked to rural exodus, the limited size of farms and ownership of agricultural land, marketing of agricultural products, irrigation and drainage, low levels of use of modern technologies, and weak organization of farmers. In recent years, considerable numbers of tractors and other agricultural machines have been imported. However, the level of technology used is basic, and farmers remain in sore need of modern machines/equipment for specialized processes.

In 2019, 69 per cent of the population aged 16 to74 was using the Internet; and more than half of the households (57 per cent) had broadband Internet access, with yearly increases of 10 to 15 per cent since 2017 (see Figure 2). However, fixed broadband penetration remains at very low levels compared with other countries in the region and within the EU. Furthermore, there is a huge gap of fixed-line penetration between urban and rural areas. Mobile penetration is higher than fixed, with Long-Term Evolution (LTE) covering over 85 per cent of the population. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.67 on a scale of 7. Albania ranks fifty-sixth for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.87 on a scale of 7).

Figure 2: The basic indicators of ICT access and usage in Albania (ITU WTI Database)



2.1.2 Strategy, policy, legislation

The Government of Albania has identified digital connectivity and broadband infrastructure as a key priority in strategic documents such as the National Strategy for Development and Integration, the Digital Agenda Strategy Economic Reform Programme 2019–2021 and the National Broadband Plan. The second strategic priority of the Digital Agenda 2020, “Policy for the development of electronic communications in all sectors (health, education, environment, agriculture, tourism, culture, energy, transport, etc.)”, outlines the main directions for developing advanced electronic communication infrastructure, together with fast and super-fast broadband.

The cross-cutting strategy, Digital Agenda of Albania (2015–2020), aims to increase efficiency in agriculture (among other sectors) through ICT systems. This entails modernizing production by using ICTs to facilitate compliance, bring the quality of products and services in line with EU directives, and increase exports of agricultural, food and mineral products. Under Strategic Priority 1 of the objective "Minimization of digital differences between regions and cities", theDigital Agenda also aims to establish concentrated or regional digital platforms serving agriculture and tourism.

Albania is moderately well prepared when it comes to the information society and audiovisual media. In the coming years, in order to monitor its progress towards EU compliance and its alignment with the Digital Agenda for the Western Balkans, the country needs to improve the collection of statistical data on digital performance and digital competitiveness.

According to the IPA2 revised Indicative Strategy Paper for Albania (2014–2020), well-functioning and dynamic digital agriculture-related information systems (i.e. continuously updated digital land, farm and animal registers) are to be achieved thanks to EU support.

2.1.3 Services, applications, knowledge sharing

The Government e-Gateway connects various government systems and enables them to share information, and the National Spatial Data Information Geoportal has been populated with data from several institutions. The Immovable Property Registration II system (called ALBSREP) is in production nationwide and has been integrated into the Government e-Gateway; it makes 51 services of the Immovable Property Registration Office available online. Orthophoto maps (2015–2016) have also been produced for the entire territory of Albania and made available free of charge to government and municipal authorities.

According to the European Commission Albania 2019 Report, there has been no progress related to the building of a system to identify land parcels, or LPIS. The Integrated Administration and Control System has yet to be fully implemented, but certain elements thereof – such as a farmer register and an animal register – have been developed. There is no Farm Accountancy Data Network in place, but preparatory work on setting one up has started, and most of the data sources needed for its implementation are available. Under the Economic Reform Programme 2019–2021, Albania will further strengthen the process of cadastral, land and property registration, including clarification of land ownership, with a special emphasis on defragmentation and consolidation of agricultural land. The LPIS will serve as an efficient instrument for implementing the policy for sustainable administration of agricultural land. According to the most recent Sector Review of Agriculture Statistics, the Ministry of Agriculture and Rural Development is still working on models of the Integrated Administration and Control System and the LPIS. It is going to register all farms and work with the Institute of Statistics to prepare a questionnaire and a methodology. It plans to update the list of farms applying for subsidies regularly, but the relevant system is still in the preparatory stages.

The register of vineyards and olive trees has been completed with the support of the EU-funded regional Community Assistance for Reconstruction Development and Stabilisation (CARDS) project. In 2010, an administrative livestock register was established. It consists of two registers: an individual register of animals and an animal holding register. It is managed by the veterinary service and covers all types of livestock (cattle, sheep, goats, pigs, equine, poultry and bees). In Albania, the Annual Agriculture Survey covers land use, crop production, livestock number and animal production, supply balance sheets, agricultural labour input and expenditure statistics. Prices on inputs are collected in quarterly surveys.

Recently, the Agriculture and Rural Development Agency opened the network of "Agro Points" or “Farmer’s Windows” (AGROPIKA). This is a direct service delivery unit that answers to the Ministry of Agriculture and Rural Development and provides farmers with information for applications, access to finance, extension support and other services. In total, 20 Agro Points have been opened, reaching each territorial branch throughout the country. “Farmer’s Windows” provide all farmers and interested parties with information about applications for national support schemes and donors, access to finance and extension support. In 2019, the Agency issued a call for National Schemes applications, which are filed online at 20 Agro Points and 16 Regional Agricultural Extension Agencies through the e-Albania platform, providing farmers with quality, timely and cost-effective services. The FAO Regional Office for Europe and Central Asia is to launch a new project component to assist the preparation of the national e-agriculture strategy vision for Albania in 2020, following the experience of previous activities in similar themes in the country, for example the virtual extension communication network, the farmer single window and the national e-agriculture review.

2.2 Armenia

2.2.1 Agriculture, workforce, ICT infrastructure,

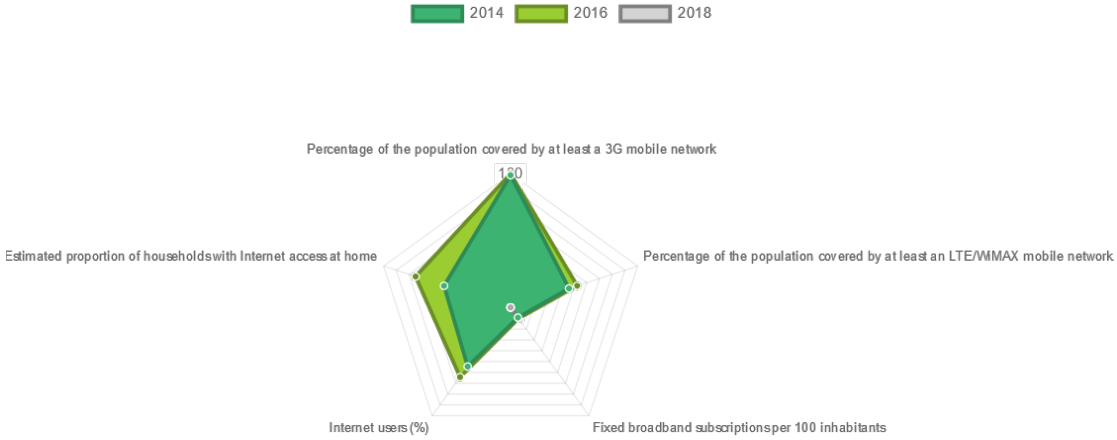
Table 3: Basic agriculture indicators in Armenia (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	2 907 618	2 951 745	44 127	1.52
Agriculture, value added (% of GDP)	17.9 (2012)	13.7	-4.2	-23.47
Agricultural land (% of land area)	61.43	58.9 (2016)	-2.53	-4.12
Rural population (% of total population)	36.36	36.85	0.49	1.35
Employment in agriculture (% of total employment)	37.35	33.29	-4.06	-10.87
Employment in agriculture, female (% of female employment)	44.38	36.59	-7.79	-17.55

Armenia is a small landlocked country of about 29 700 sq. km with different natural zones, from semi-deserts to eternal snows. The total population was slightly less than 3 million (2.951.7 million) in 2018. The population density is 100 inhabitants per sq. km; about 37 per cent of the population lives in rural areas. In recent decades, Armenia has moved from an agriculture-based economy to service provision. Agriculture accounted for the lion's share of GDP in 1993, when it reached 48.2 per cent of total economic output. Its share has declined steadily since, to 13.7 per cent by 2018. Only 7.6 per cent of total agricultural land and 26.7 per cent of arable land are irrigated. The lack of irrigation limits opportunities to expand the agricultural sector, and considerable investments are required to extend the irrigation system. Other factors resulting in insufficient use of arable land are difficult access to machinery, fragmented land parcels, difficulties marketing agricultural products and accessing financial resources, and low profitability.

According to the ITU Measuring the Information Society Report 2017, 64.7 per cent of households had computers, 60.5 per cent had Internet access, and 62 per cent of individuals used the Internet. According to Social Snapshot and Poverty in Armenia (2018), published by the Statistical Committee of the Republic of Armenia, in 2017 96.7 per cent of the population had mobile phones and 88.8 per cent had access to a mobile Internet connection. Armenia was one of the first countries to launch LTE in the CIS region. It has a high level of mobile-broadband coverage: 3G is available to almost 100 per cent of the population (see Figure 3) and LTE coverage is above the CIS region average. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.42 on a scale of 7. Armenia is ranked sixty-first in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.84 on a scale of 7).

Figure 3: The basic indicators of ICTaccess and usage in Armenia (ITU WTI Database)



2.2.2 Strategy, policy, legislation

The Government of Armenia first decided in 2008 to integrate information technologies and use innovations in the public sector, so as to improve the provision of public services and make them more efficient. In 2010, the Government introduced "www.e-gov.am", an electronic governance portal aimed at making all electronic government tools and databases available in one place and at creating a comfortable environment for their use. Also in 2010, it approved the Concept Paper on the Development of the Electronic Society in Armenia. In 2014, it approved the Electronic Governance Strategy, to improve public service provision and solve other issues.

After adopting policy documents on ICT, e-society and e-governance development, the Government moved the provision of a number of public services and broad public access to information and databases to online platforms. Its priorities include to ensure maximum output at minimum cost in all spheres of public administration, based on know-how and technologies; to provide accessible, affordable, reliable, safe, high-quality and internationally competitive services to develop the economy; and to improve the people's quality of life. To achieve these objectives, the Government has decided to:

- put in place contemporary infrastructure ensuring information security, cybersecurity and personal data protection, and develop e-platforms for delivery of e-services by government agencies;
- digitize the information managed by public administration bodies;
- develop unified and comprehensive databases, synchronize State information programmes, and enhance interoperability of information systems and their rational use;
- heighten efficient use of digital technologies by public administration bodies, cut expenditure, maximize output and improve the quality of public information and services;
- design State standards for information security and ensure implementation and control.

The e-governance ecosystem in Armenia is currently being developed thanks to the efforts of the Government and donor agencies.

Credit: Treinen S. – FAO – sensors for irrigation

The Sustainable Agricultural Development Strategy in the Republic of Armenia (Vision 2029) gives primacy to technology-focused modernization: promoting digital agriculture and technological innovation; investing in digitization of the agricultural sector; building the local ecosystem for technological innovation; and boosting regional digital agricultural services leadership. According to the strategy, the agricultural sector currently has poorly developed modern information systems, and this is having a negative impact on the development of more accurate policies and efficient implementation thereof. The following are the most important missing components:

- development and launch of a digital farmer register;
- development and implementation of digital systems for counting and registering livestock;
- creation and application of a database of digitized maps of agricultural lands and agrochemical research;
- development and application of a centralized database of technical and economic performance indicators and standards in the agricultural sector.

2.2.3 Services, applications, knowledge sharing

The main body behind the organization of e-governance tools in Armenia is Ekeng CJSC (e-Governance Infrastructure Implementation Unit), which is responsible for planning, developing and maintaining e-governance solutions. At present, ICTs are used for e-governance purposes in the land registry, taxation, health and many other sectors (such as law and art), with several of the services being offered for more than eight years. There is as yet no centralized electronic system, but solutions exist in the agricultural sector (agro.am, minagro.am, social media groups, start-ups, among others).

The Ministry of Economy is planning to introduce an e-marketing platform that can be used to sell locally produced fresh and processed agricultural products. The e-marketing platform should simplify procedures, promote exports and heighten awareness of Armenian products. In the second half of 2018, the EU-funded FAO ENPARD project, “Technical Assistance to the Ministry of Agriculture of the Republic of Armenia”, which is being implemented with the technical cooperation of FAO, supported

government efforts to develop a vision for the national e-agriculture strategy. In the framework of the programme, "Developing the Capacity of Digital Agriculture Strategy in Armenia", implemented by the FAO, an action plan was developed for three outcomes of Priority 7 (Promote Digital Agriculture and Technology Innovation) of the Sustainable Agricultural Development Strategy (Vision 2029).The digital agriculture strategy and action plan are to be implemented during 2020.

2.3 Azerbaijan

2.3.1 Agriculture, workforce, ICT infrastructure

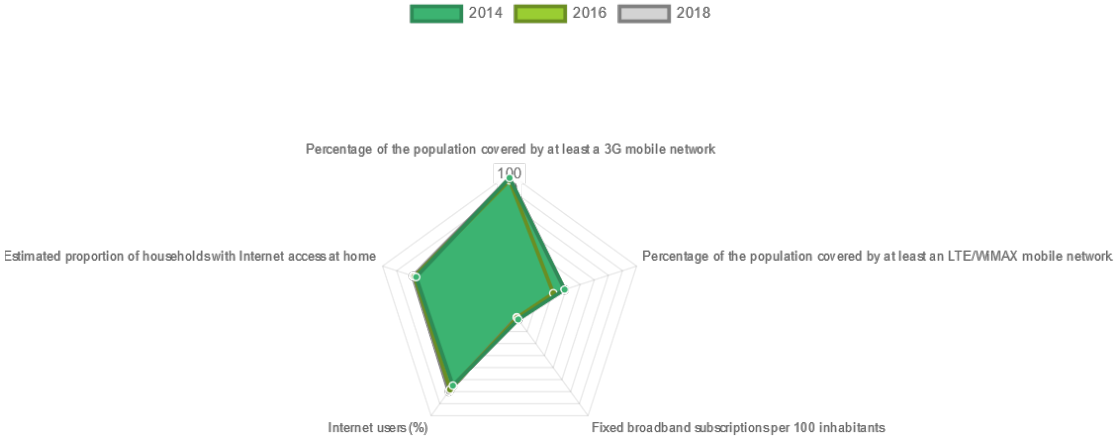
Table 4: Basic agriculture indicators in Azerbaijan (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	8 821 873	9 949 537	1 127 664	12.78
Agriculture, value added (% of GDP)	5.57	5.25	-0.32	-5.75
Agricultural land (% of land area)	57.57	57.74 (2016)	0.17	0.3
Rural population (% of total population)	47.01	44.32	-2.69	-5.72
Employment in agriculture (% of total employment)	39.59	36.13	-3.46	-8.74
Employment in agriculture, female (% of female employment)	40.69	41.94	1.25	3.07

In Azerbaijan, 4.74 million ha, or 57 per cent of the country's total land area, are agricultural land (of which 1.8 million ha are cultivated). In recent years, the agricultural sector has contributed only 5 to 6 per cent of GDP, far less than in 2001 (over 20 per cent). At the same time as other sectors have grown, agriculture's overall share of the economy has fallen because of low agricultural productivity (caused by the way farms are structured – 80 per cent occupy less than 5 ha), limited access to modern farming techniques, and limited knowledge among small-scale farmers. Agricultural growth has also been hampered by the absence of business development services and financial instruments, coupled with fragmented value chains. The sector has around 1 million small farms and employs 36 per cent of the working population. It has substantial potential to meet growing domestic and international demand for assorted fruits, vegetables and dairy products.

In terms of mobile-broadband penetration and coverage, Azerbaijan ranks near the top in Central Asia. The penetration rate in the fixed-broadband market is also above the CIS average. The prices for mobile and fixed telecommunication services are relatively low. Azerfon's deployment of the first 3G network in 2009 was followed by years of rapid development of mobile-broadband networks, including the launch of LTE in 2015. 4G/LTE was deployed in 2015, with coverage reaching around 40 per cent of the population; while coverage is widely available in urban areas, it is limited in rural zones. About 80 per cent of the population in Azerbaijan used the Internet in 2018, which is close to saturation – the rate has increased only 5 per cent in the last five years (see Figure 4). More complex indicators, such as the Network Readiness Index, show that high Internet penetration has not been translated into impactful use. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high; respondents evaluated it at 5.24 on a scale of 7. Azerbaijan is ranked twentieth in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 4.72 on a scale of 7).

Figure 4: The basic indicators of ICT access and usage in Azerbaijan (ITU WTI Database)



2.3.2 Strategy, policy, legislation

Azerbaijan has adopted a strict policy of economic diversification in order to reduce dependency on oil and gas revenues. The "Azerbaijan 2020: Look to the Future" development concept, which places the economic diversification agenda at the heart of the Government's socio-economic policy, provides guidance for other policy documents. The main instrument used by the Government to implement the policy of regional development, which includes rural development, is the State Programme on the Socio-economic Development of Regions of the Republic of Azerbaijan for 2019–2023, which follows on the 2014–2018 State Programme. ICTs are expected to play a leading role in diversifying the economy of Azerbaijan.

Previously, ICTs had been declared a national priority, and the Ministry of Communications and IT was established in 2004. The National Information and Communication Technologies Strategy for the Development of the Republic of Azerbaijan (2003–2012) was also approved. In 2014, the Government adopted a national programme based on the National Strategy of Information Society Development in the Republic of Azerbaijan 2014–2020. The strategy targets the following issues: development of ICT infrastructure, effective regulation, ICT product development, e-government, ICT in education and information security. In 2016, the Government adopted a State programme to implement the strategy.

The Strategic Vision on Production and Processing of Agricultural Products in Azerbaijan by 2020 aims to create a favourable environment for the production and processing of competitive agricultural products on the basis of sustainable development principles, to enable further strengthening of food security, to help diversify the economy and to increase social welfare in rural areas. The 2016 Strategic Roadmap on Agricultural Production and Processing identified key gaps, challenges and priority directions for the sector's development (2020, 2025 and beyond). This includes the establishment of an integrated electronic information portal, so as to create a unified system that incorporates basic principles of data management and to form a comprehensive agricultural information database. Another target was to use the Internet, social media and mobile phones to provide relevant agricultural information to farmers. The roadmap also calls for the establishment of e-agriculture (including improved registration and statistics) and for the design of a system to monitor and evaluate agricultural policy outcomes under Strategic Objective 8 (Enhance State regulation of agriculture and improve the business environment). As ICTs and agricultural development are both high priorities, the Government of Azerbaijan is keen to develop e-agriculture, including by promoting the use of big and open data, creating online public services for rural areas, incubating agri-tech start-ups, and encouraging digital literacy for farmers and rural e-commerce.

2.3.3 Services, applications, knowledge sharing

The Electronic Agricultural Information System (EKTIS) is primarily an operational management tool that has modules covering business processes related to government support for agricultural producers. EKTIS development started in 2015 (with EU funding) and is based on the principles and mechanisms applied by the countries of the EU (the Integrated Administration and Control System-based Information System on Subsidy and Policy). In 2017, an application module on rules for subsidizing agricultural production was created for the e-Services (Customer) Portal and integrated into the e-government portal. The system has seven sub-modules, including a land parcel identification system, a farm register and support for the process of claiming subsidies. In 2020, EKTIS was integrated with the information resources of five government agencies, which means that real-time information exchanges are possible between information resources and the systems of those government agencies. So far, more than 470 000 farmers countrywide have been registered on EKTIS. EKTIS also plays a role in the agrarian sector by expanding the latter's integration into external systems, covering many areas of agriculture and their regulatory and support processes. It thus provides opportunities for analytical reporting and modelling that will be useful for decision-making and lay the foundation for future development.

Work has started with a group of international experts on the technical specifications of an animal identification and registration system. Technical specifications have also been developed for a rural business information system (RBIS) and a GIS portal. For the portal, it will be important to set up national spatial data infrastructure. The RBIS will enhance agricultural market information flows for farmers and the ministry, and the GIS portal, together with other governmental agencies, ministries and the private sector, will make available digital spatial data. A 24-month EU-funded project will start during 2020 for the development of the RBIS.

Within the FAO project, "Capacity and institutional development for improved value chain coordination TCP/AZE/3403", an electronic database (www.aqrarbazar.az) has been launched of the retail and wholesale prices of agricultural products. The database is updated daily and contains the prices of 46 kinds of fruit and vegetables and their varieties based on a simple product classification system (small, medium, large). In 2017, it was expanded to include the prices of a range of products of animal origin.

The Ministry of Agriculture's Agro Research Centre is experimenting with a monitoring system based on the EU's FADN. In addition, a 12-month European Space Agency-funded project, SenSPA ("Sentinels for Sustainable Pasture Management"), will demonstrate the use of Earth observation data and develop an innovative application for sustainable pasture management. SenSPa will address the needs of governmental authorities, local administrations, public and private stakeholders, and farmers/ pastoralists for efficient monitoring and sustainable pasture management.

Azerbaijan also has other agricultural information services, including the Phytosanitary Information System, the Electronic System for Surveillance of Animal Diseases and Control Measures, AGROLEASING and an artificial insemination register.

2.4 Belarus

2.4.1 Agriculture, workforce, ICT infrastructure

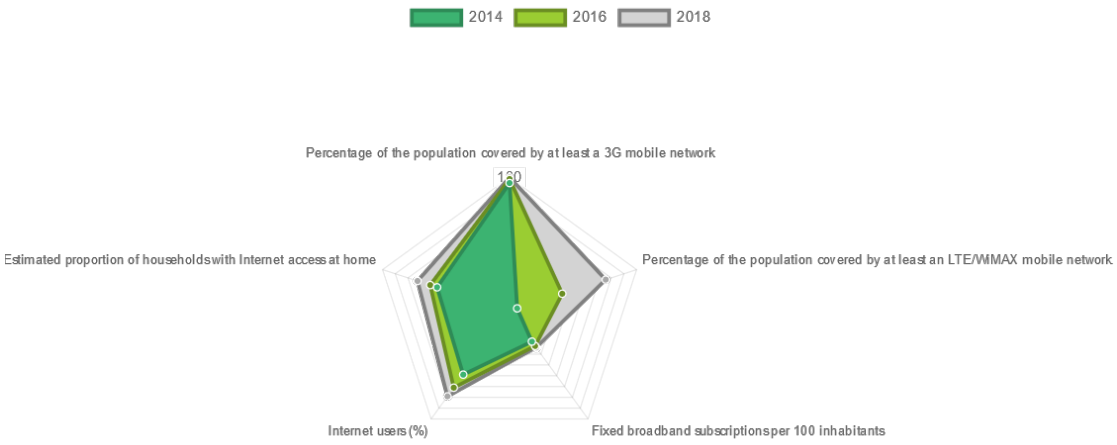
Table 5: Basic agriculture indicators in Belarus (World Bank WDI database)

	2016	2018	Difference	Diff %
Population	9 452 855	9 452 617	-238	-0
Agriculture, value added (% of GDP)	8.67	6.4	-2.27	-26.18
Agricultural land (% of land area)	43.95	42.04 (2016)	-1.91	-4.35
Rural population (% of total population)	26.27	21.41	-4.86	-18.5
Employment in agriculture (% of total employment)	10.39	10.59	0.2	1.92
Employment in agriculture, female (% of female employment)	7.03	7.21	0.18	2.56

Belarus has 1 492 agricultural enterprises cultivating 300 ha or more, of which 1 039 (or 69. 6 per cent) are included in the Ministry of Agriculture system and 70 per cent belong to the Ministry. Belarusian agriculture is developing successfully, with the country going from having a negative trade balance in 2009 to being an active exporter with a positive trade balance for agricultural products.

In Belarus, 79 per cent of people use the Internet, most of them every day. According to the National Statistics Committee, 83 per cent of the urban and 67.9 per cent of the rural population have access to the Internet, and 76 per cent have access to 4G connections (see Figure 5). In 2019, a working group examined the main issues relating to deployment of 5G mobile communication technology in Belarus.

Figure 5: The basic indicators of ICT access and usage in Belarus (ITU WTI Database)



2.4.2 Strategy, policy, legislation

The digital transformation of the economy is one of the key priorities for the development of Belarus. In the middle of the last decade, a number of regulatory legal instruments were adopted on digitization:

- Presidential Decree No. 8, on the development of the digital economy (2017)
- The Strategy of Informatization in the Republic of Belarus for 2016–2020
- The State Programme for the Development of the Digital Economy and Information Society for 2016–2020
- The Resolution of the Security Council of the Republic of Belarus, on the concept of information security (2019), which sets forth measures to ensure digital security.

The Presidential Decree emphasizes that digitization is a dominant factor in the economy of Belarus and creates favourable (legal) conditions for the development of many new technologies, such as blockchain and cryptocurrencies. It also considers the development of the High-Tech Park, a key institute in the country's digital transformation. The main goal of the State Programme is to improve conditions so as to facilitate the transformation of human activities using ICTs, including the formation of a digital economy, the development of the information society, and the improvement of e-government. The State Programme has three sub-programmes and numerous projects, such as national ID cards, e-prescriptions and a national open data portal:

1. ICT infrastructure – national ICT infrastructure development (e.g. optical fibre, Wi-Fi, Cloud, LTE) – 11 projects in total;
2. informatization infrastructure – e-government technology development (e.g. Nationwide Automated Information System, interdepartmental electronic document management, public key infrastructure, open data) – 8 projects in total;
3. digital transformation – the digital transformation of business processes – 52 projects in total.

The development and implementation of digital technologies emphasize both the creation of information and communication infrastructure and the conditions for electronic communication between government bodies, the business community and citizens.

Agriculture is identified as one of the most promising sectors for digitization in Belarus. One indicator of the State Programme is the percentage of energy-intensive agricultural equipment covered by the monitoring system (70 per cent in 2020). The introduction of precision agriculture was also envisaged under the Programme for the Socio-economic Development of Belarus for 2016–2020, based on the widespread use of satellite communication and navigation, automated information collection and process control systems. The plan is to have 30 per cent of land cultivated using new technologies by 2020, but there is no information on how the plan is progressing. The State Programme for the Development of Agricultural Business in the Republic of Belarus for 2016–2020 includes a sub-programme, "Technical re-equipment and informatization of the agro-industrial complex", the chief purpose of which is the introduction of technologies for resource-saving precision agriculture.

2.4.3 Services, applications, knowledge sharing

The digital transformation of the agro-industrial complex is one of the government's priorities, as announced at many conferences and events by the Minister for Agriculture and Food. According to decision-makers, the top priorities are the further improvement of ICTs, the development and implementation of innovative methods of using sophisticated technologies, and the implementation of the "single window" mechanism in the agricultural sector. The main aim is to create a common, cloud-based platform comprising electronic trading platforms, a single digital system of State administration of the agricultural sector, product movement control, and accounting and identification of trade and technical barriers. The platform will involve multiple stakeholders, as the Ministry of Agriculture and Food intends to use it as a data-gathering tool that will also serve as a logbook for producers.

Producers will receive information drawn from the data in the system from the institutes of the Academy of Sciences.

The Ministry of Agriculture and Food is working with the Ministry of Communications and Informatization to integrate all the components of precision agriculture into a common programme. In addition to government initiatives, the private sector has developed and implemented a number of automated information systems in various areas, ranging from crop production and animal husbandry to machinery and equipment inventory and maintenance. For example, in 2019, digital equipment enabling hunters to detect the presence of cattle equipped with a collar and a sensor was tested at the Zhdanovichi agricultural complex (where elements of the precision farming system were first introduced in 2013) in the Minsk region. A project has also been implemented to introduce new technology for the cultivation of grain crops in the conditions prevailing in the Mogilev region, specifically at the volunteer State farm in Klichevsky District. The Snov agricultural *combinat* has also begun to introduce precision farming elements. The IT infrastructure of a major (Turov) dairy plant has been placed on the cloud. In 2017, permission was given to launch a narrowband network from Velcom NV-IoT, which can serve as a base for IoT-based services. Other notable services and institutions in this field are the Centre for Information Systems in Animal Husbandry and the IT enterprise GIVC Minselhozproda, a State organization that provides complex IT services for agricultural companies (e.g. State IT systems, software development and implementation for enterprises). A number of private firms are also working in this field (e.g. OneSoil). One notable information resource in Belarus is AgroWeb Belarus, the national website providing information about selected national agrarian Internet resources.

Under a planned FAO project, "Support and strengthening plant protection activities" (to be approved in the first half of 2020), an electronic database of pest symptoms on different host plants will be developed and connected to a database of pesticides registered in Belarus.

2.5 Bosnia and Herzegovina

2.5.1 Agriculture, workforce, ICT infrastructure

Table 6: Basic agriculture indicators in Bosnia and Herzegovina (World Bank WDI database)

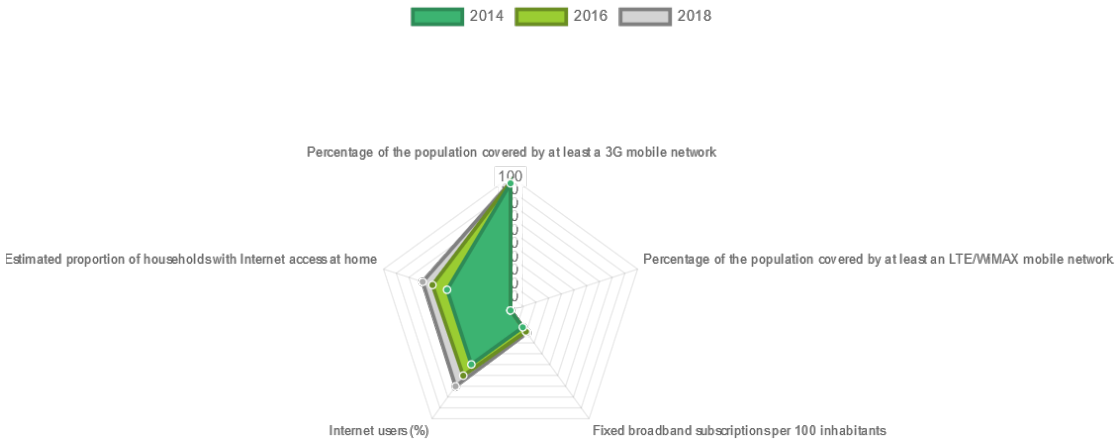
	2008	2018	Difference	Diff %
Population	3 754 271	3 323 925	-430 346	-11.46
Agriculture, value added (% of GDP)	7.21	6	-1.21	-16.78
Agricultural land (% of land area)	41.6	43.14 (2016)	1.54	3.7
Rural population (% of total population)	55.08	51.76	-3.32	-6.03
Employment in agriculture (% of total employment)	17.97	16.5	-1.47	-8.18
Employment in agriculture, female (% of female employment)	18.78	16.73	-2.35	-10.92

According to the Agency for Statistics of Bosnia and Herzegovina, agriculture, forestry and fisheries accounted for 5.6 per cent of GDP in 2017. Agricultural and food products account for a significant portion of the country's foreign trade, with the available data showing that the agriculture sector deficit is going down and that in 2017 the export-to-import ratio was 35 per cent. Around 1 000 legal entities – one third registered as agricultural holdings – and 360 000 rural households in Bosnia and Herzegovina are involved in agricultural production (16 per cent of the population). The average

area of land used per farm is 1.97 ha. Bosnia and Herzegovina is a potential candidate country; it was promised that it would be able to launch membership negotiations with the EU when it is ready.

Penetration rates for both fixed and mobile services are low in comparison not only to European and global rates, but also to most neighbouring countries. Licences to provide 3G services were issued in 2009. While 3G coverage is almost complete in terms of population, mobile-broadband penetration (55.38 per cent) is below the European and global average. This can be explained by the relatively low level of competition within each respective regional market and the relatively high prices for mobile-broadband services. LTE mobile broadband is also not yet available. Seventy per cent of the population uses the Internet, and almost seven out of ten households have access thereto (see Figure 6). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 3.82 on a scale of 7. The country is ranked 137th in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 2.13 on a scale of 7).

Figure 6: The basic indicators of ICT access and usage in Bosnia and Herzegovina (ITU WTI Database)



2.5.2 Strategy, policy, legislation

In May 2017, the Government approved the Policy for the Development of the Information Society of Bosnia and Herzegovina for the Period 2017–2021. According to the European Commission Analytical Report (2019), Bosnia and Herzegovina is at an early stage of preparations in the area of information society and media; the legislative and strategic frameworks are incomplete. That being said, the legal framework required for interoperability of networks and services between public administration institutions is in place.

As a potential candidate for EU membership, Bosnia and Herzegovina is currently designing and implementing several subcomponents of an agricultural information system. It needs to establish the administrative structures and information systems required for the Common Agricultural Policy (including a payment agency, the Integrated Administration and Control System and a Land Parcel Identification System) andset up key elements for the management and control of EU funds under the CAP, including the Farm Accountancy Data Network in line with EU *acquis*. Initial preparations have started for the Land Parcel Identification System and the Integrated Administration and Control System. As agricultural holdings in Bosnia and Herzegovina are very small and fragmented (usually divided into seven to nine smaller parcels), the establishment of the LPIS is a complex task.

The IPA II Annual Action Programme for Bosnia and Herzegovina includes three activities related to the use of ICTs in agriculture. In terms of Result 1.2, policy actions are being implemented, in line

with EU procedures, to improve information systems and registries. This includes needs assessments, methodology reviews, the development of ICT solutions, piloting, training and skills improvement. In terms of Result 2.2, food safety and quality are being improved thanks to an advanced level of food safety policies and EU *acquis*-aligned legislation. This includes policy reviews and upgrades, legal screening and design, ICT systems development, knowledge transfer and skills improvements via on-the-job training, practical demonstrations and so on. In terms of Result 1.1, activities are being undertaken to encourage women, both young and older, by providing specific grants to rural women entrepreneurs and to young farmers, who are the driving force for innovation and the uptake of new technologies, including digitalized farming.

In accordance with the Strategic Plan for the Rural Development of Bosnia and Herzegovina 2018–2021, under strategic measure 6.3.1 the system of professional information, training and advisory services will be strengthened by developing common training programmes, certification systems, an information exchange portal, and monitoring and evaluation of the system's quality. Strategic measure 6.9 aims to support the development of administrative and data support services, with a view to establishing the basic elements of a harmonized agricultural information and administrative system able to support the sector, and to enhancing coordination and cooperation between all governance levels. In line with Chapter 11 of the Agriculture and Rural Development document, the first three components of the Integrated Administration and Control System (register of agricultural holdings, register of beneficiaries, and register of animal identification) are being established, developed or upgraded.

2.5.3 Services, applications, knowledge sharing

The World Bank Agriculture and Rural Development Project had a component covering agricultural information and institutional capacity building, which included support for animal identification and movement control that targets benefits in terms of reduced identification costs using electronic monitoring systems, improved disease control and trace-back, along with increased market compliance. The Animal Identification and Movement Control Schema is currently functional.

In 2017, the Ministry of Agriculture, Water Management and Forestry started the process of developing custom-made software for the processing of payments in agriculture. The new system is to serve as an upgrade of the overall process of subsidy payments in agriculture, facilitating checks and controls, and interconnecting the administrations of 10 cantons and/or 79 municipalities that are part of the overall chain of payment processing. The software will also ensure improved follow-up of implementation of the subsidy programme and more efficient agricultural policy planning based on reliable data providing a clear picture of the state of agriculture. The relevant platform, the Farmer Portal, has been established in the Federation of Bosnia and Herzegovina (farmerportal.ba). Governmental authority in the field of agriculture lies with each entity, and there is nothing similar to the Farmer Portal in the Republika Srpska (63 municipalities), where agricultural producers use standard documents. The Republika Srpska Ministry of Agriculture, Water Management and Forestry has an advisory service division, which runs a knowledge portal (pssrs.net), and there are other (mainly private) portals as well.

There are also some recently established applications, like CARPO (an agrometeorology/plant protection app, supported by UNDP) and Optimilk (optimizing the ration for dairy cows).

The country also plans to set up a geoportal for geodetic and property legal affairs, the main purpose of which is to ensure easier access to and use of the standardized spatial data available to the Federal Administration. The cadastral data include boundaries of cadastral municipalities, parcels, symbols and buildings.

2.6 Georgia

2.6.1 Agriculture, workforce, ICT infrastructure

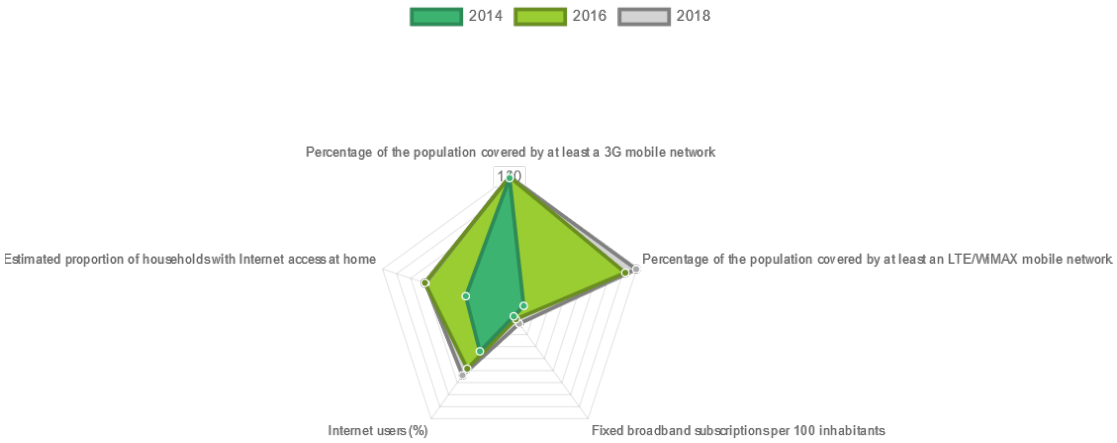
Table 7: Basic agriculture indicators in Georgia (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	4 142 655	4 002 942	-139 713	-3.37
Agriculture, value added (% of GDP)	8.13	6.66	-1.47	-18.08
Agricultural land (% of land area)	36.18	34.45 (2016)	-1.73	-4.78
Rural population (% of total population)	45.24	41.37	-3.87	-8.55
Employment in agriculture (% of total employment)	52.92	42.9	-10.02	-18.93
Employment in agriculture, female (% of female employment)	56.01	45.45	-10.56	-18.85

The share of the agricultural sector in Georgia's GDP is 7 per cent but has been slowly falling in recent years. About 35 per cent of arable land is currently cultivated. Agriculture still occupies about 45 per cent of the country's labour force, and 98 per cent of farmworkers are considered self-employed. Georgia is characterized by altitudinal zonation, a natural layering of ecosystems that occurs at distinct elevations as a result of varying environmental conditions. The variations in elevation can be described as follows: only 39 per cent of arable land is located at 500 m. above sea level; 29 per cent is located at 500–1000 m. above sea level, 21 per cent at 1000–1500 m. above sea level and 11 per cent at over 1500 m. above sea level.

Georgia has a developed mobile-broadband market, with 3G and LTE technologies covering most of the population (see Figure 7). LTE coverage was extended to more than 99 per cent of people in 2017; this was followed by an increase in mobile-broadband subscriptions (45.26/100 inhabitants in 2018). Mobile and fixed-service prices have recently dropped considerably. About two-thirds of the population (64 per cent) were Internet users in 2018. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high; the respondents evaluated it as 3.66 on a scale of 7. In 2018, Georgia ranked sixty-third in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.83 on a scale of 7).

Figure 7: The basic indicators of ICT access and usage in Georgia (ITU WTI Database)



2.6.2 Strategy, policy, legislation

As a World Bank Country Snapshot states, significant reforms in economic management and governance have earned Georgia a reputation as a "star reformer" in the last few years. To bolster the private sector, the country has introduced rules and regulations that make it easier to do business, and its international ratings on governance and the investment climate have soared. In November 2016, Georgia launched the Government Programme 2016–2020, which lists economic and education reform, infrastructure development through spatial planning and public governance reform as key priorities. The current government, which took office in mid-2018, confirmed that the Government Programme remains the country's overall development strategy.

The current Strategy for the Agricultural Development of Georgia 2015–2020 emphasizes the creation of efficient market information collection, processing and dissemination services, to collect data from various stakeholders engaged in the agricultural sector. The strategy also emphasizes the use of modern technologies and innovative methods in practice and calls for an agricultural extension strategy (which was approved in 2017 and revised in 2019, with the support of FAO). The goal of the agricultural extension strategy is to improve the competitiveness of Georgia's agriculture sector by providing knowledge, information and support to farmers and transforming the current information and advisory system into a real needs-based extension service system. The revision of the extension strategy was approved at the end of 2019 (with the participation of EU and FAO representatives).

The new Strategy for Agriculture and Rural Development 2021–2027 was approved in 2019. The new strategy is supported by the EU, UNDP and FAO, and it includes the development of competitive agricultural and non-agricultural sectors, the sustainable use of natural resources, ecosystem conservation, climate change adaptation, food product and animal feed safety, and the development of veterinary and plant protection systems.

2.6.3 Services, applications, knowledge sharing

One of the most important services in Georgia is the Market Information System of the Ministry of Environmental Protection and Agriculture. The system was implemented in 2015 with the technical guidance of FAO under the ENPARD Programme, and the Ministry took full control of it in 2016. The system references agricultural product prices (in 59 municipalities, for over 60 products), collected weekly for most products. The data are made available via the Ministry website.

The Ministry has also built the Data Warehouse, a comprehensive repository of the databases produced by it and its agencies constructed along the lines of the data portal created by the European Commission Joint Research Centre. The Data Warehouse is able to consolidate and analyse data from different databases, and to create semi-automated reports based on common parameters such as product and region. It is therefore a powerful tool for supporting advanced analytics, policy-making and reporting, and can also promote inter-agency coordination. FAO/ENPARD has also provided support for the creation of an online repository of most of the extension materials produced by the Ministry and other partners (NGOs, donors). The materials (including not only texts, but also videos and other resources) are collected and undergo a technical revision before being uploaded to the online extension library (elibrary.mepa.gov.ge), where they can be filtered and downloaded. FAO/ENPARD has also provided support enabling the National Statistical Agency (GEOSTAT) to improve the current quarterly survey of agricultural holdings (Computer Assisted Personal Interviews). The data collection methodology was launched in 2018 and a first survey, on aquaculture holdings, implemented. FAO has also provided support enabling the Ministry and GEOSTAT to produce agriculture-related SDG indicators.

Through its ENPARD programme, the EU helps to modernize Georgian agriculture by supporting the roll-out of the agriculture cooperative model, providing 1 600 cooperatives with financial and technical support. It has also lent support for the establishment of 59 information and consultation centres around the country, at which over 250 000 farmers have been trained to date. One of the main functions of these centres is to provide capacity development for farmers by introducing them to modern technologies/innovations. Under the Rural Development Strategy of Georgia 2017–2020, which was developed with FAO support, and the related action plan, the second priority (Social Situation and Standard of Living) set out a measure aimed at digital skills-related training (digital literacy and programming languages, electronic literacy for entrepreneurs and IT specialist training).

The Government of Georgia has embarked on an extensive project, the State Programme on Broadband Infrastructure Development, to develop high-speed Internet infrastructure. Following the programme's implementation, Georgia will be fully covered by fibre-optic highways designed to promote retail networks and provide Internet access to subscribers via local operators. Financial support will target settlements located in "white zones", where the population exceeds 200 residents and operators do not plan to construct broadband infrastructure for three years after the programme launch. At the same time, the Government of Georgia is supporting the deployment of community networks in less densely populated areas. With the support of the Ministry of Economy and Sustainable Development, the Tusheti (one of the most mountainous regions) community network project was successfully completed in 2017, with 24 villages now connected to the Internet.

In 2016, the International Bank for Reconstruction and Development (IBIRD) financed the Georgia National Innovation Ecosystem (GENIE) Project, which aims to boost innovation by firms and to increase their participation in the digital economy. Between 2019 and 2021, the project will support the training of up to 3 000 information technology specialists, creating the workforce needed for Georgia's digital transformation.

Georgia introduced smart contracts in real estate registrations, in order to enhance transparency and efficiency, and to reduce costs. It is therefore now possible to register land titles in Bitcoin blockchain, making Georgia one of the first countries to use this technology to complete property-related government transactions; the technology is not yet used for agricultural land.

2.7 Kazakhstan

2.7.1 Agriculture, workforce, ICT infrastructure

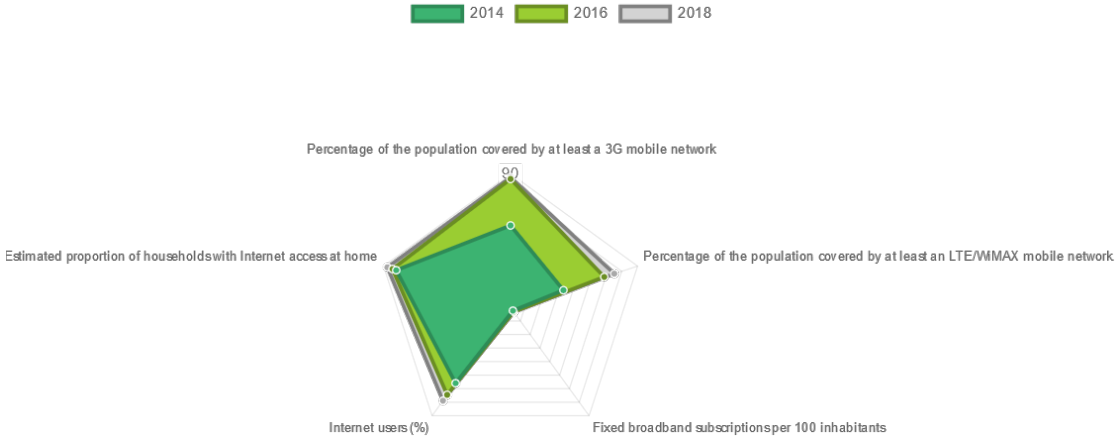
Table 8: Basic agriculture indicators in Kazakhstan (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	15 862 123	18 319 618	2 457 495	15.49
Agriculture, value added (% of GDP)	5.32	4.18	-1.14	-21.43
Agricultural land (% of land area)	78.1	80.38 (2016)	2.28	2.92
Rural population (% of total population)	43.32	42.57	-0.75	-1.73
Employment in agriculture (% of total employment)	30.16	15.01	-15.15	-50.23
Employment in agriculture, female (% of female employment)	29.15	14.21	-14.94	-51.25

Kazakhstan is a landlocked country in Central Asia. It has a population of 18.32 million inhabitants and one of the lowest population densities in the world. The country is rich in oil and mineral resources and has been enjoying steady economic growth since 2000. Although agriculture has declined sharply as a share of GDP (only 4.18 per cent in 2018), it remains an important pillar of economic development, contributing 15 per cent of total employment. Kazakhstan is one of the world's largest exporters of grain, but is import-dependent for several food products.

Kazakhstan has a highly developed mobile-cellular network infrastructure. Prices of telecommunication services are relatively low and continue to fall. As a result, Kazakhstan has the highest level of mobile-broadband penetration in Central Asia. It is also a regional leader in terms of access to computers and Internet use. 3G technology was introduced in 2011. By 2015, 3G covered all settlements of more than 10 000 inhabitants. The first LTE network was launched in 2012. By 2014, LTE networks covered towns with populations above 50 000. According to ITU data, in 2018 LTE covered more than 75 per cent of the population and there were 77.57 mobile-broadband subscriptions per 100 inhabitants. Fixed-broadband is far less common (13.44 subscriptions/100 inhabitants), but this may change as Kazakhstan is planning to continue to provide rural areas with fixed-broadband access. The goals include connecting local State institutions with at least 10 Mbit/s Internet access and deploying FTTx networks in 1 227 rural localities between 2018 and 2020. Between 2021 and 2025, the aim is to use an alternative technology – optical fibre – to cover more than 4 000 settlements. Seventy-nine per cent of the population uses the Internet, and almost nine out of every ten households have access (see Figure 8). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high; the respondents evaluated it at 4.65 on a scale of 7. Kazakhstan was ranked thirty-ninth in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 4.13 on a scale of 7) in the World Economic Forum's Global Competitiveness Report for 2018, which means that the government is responding swiftly to new challenges.

Figure 8: The basic indicators of ICT access and usage in Kazakhstan (ITU WTI Database)



2.7.2 Strategy, policy, legislation

The Government is making significant efforts to develop the ICT sector. The national programme, Informational Kazakhstan – 2020, was approved in 2013. A follow-up programme, Digital Kazakhstan, was developed and adopted in 2017 and covers the period from 2017 to 2021. It focuses on five categories: digitizing industries, transitioning to a digital State, implementing the Digital Silk Road, developing human capital and creating an innovative ecosystem. The digital industries category contains e-agriculture-related measures.

In 2013, the Government of Kazakhstan approved the Agricultural Development Programme for 2013–2020 (also known as Agribusiness–2020). In 2017, it adopted the State Programme for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2017–2021. This multisectoral policy document aims to ensure that competitive products are produced by the agro-industrial sector in response to market demand by:

- involving small- and medium-sized farms in agricultural cooperation;
- saturating the domestic market and developing the export potential of domestic products;
- making effective use of State financial support;
- making effective use of water resources;
- creating the conditions for effective use of land resources;
- increasing the supply of machinery and chemicals for agricultural producers;
- developing the trade and logistics infrastructure;
- providing scientific and technological staff, and information and marketing support to the agro-industrial sector.

The aim is to ensure food stability and good supplies of foodstuffs on internal markets while expanding food exports. The strategy includes a programme for e-agriculture (Е-АПК).

2.7.3 Services, applications, knowledge sharing

The main goal of the e-agriculture programme is to apply the best available tools to the digitization of business processes, to attain 2.5 times higher productivity and exports of processed agricultural products in 2022 than in 2017. As a part of the e-agriculture initiative, 20 digital and 4 000 advanced

farms will be created on State territory, and 100 per cent of processes and State services will be automated. The Ministry of Agriculture distinguishes three levels of farms, depending on the stage of digitalization – digital farms, advanced farms and basic farms – each of which has a defined set of elements and criteria. Further steps will be taken to help farmers improve their use of government support services. A digital evolution chain has been established and is currently being implemented. Basic levels are ensured thanks to the e-agriculture programme, which is digitizing all croplands and updating agrochemical soil condition maps. The plan is to create digital farms in every district, so as to give every Kazakh farmer hands-on experience of digital technologies. Three test sites have already been created: Kaskelen agro park, Shortandy in Barayev Institute, and the Kostanai area in Zarechny. After the pilot stage, and once the demonstration farms have been set up, seminars and training activities will be carried out to promote large-scale adoption of digital methods. IT service providers and other private-sector entities will be involved in the training process as consultants. Other components of the e-agriculture programme include electronic commerce, traceability, e-learning solutions and online lending.

Kazakhstan-MilkProcManagers1FAOMarcoPalombi

Similar measures are to be taken under the first pillar of the Digital Kazakhstan programme, Digitization of economic branches, which aims to take advantage of online possibilities and innovative digital technologies for both large enterprises and small-and medium-sized businesses. Digital Kazakhstan states that the digitization of agriculture boosts production quality, enhances volumes and reduces human participation in the manufacturing process. Three main areas are emphasized in terms of digital farming. This first is “accurate arable farming”, a management system that allows farmers to monitor seeds, humidity, nutrient elements, pests and the probability of precipitation. The second is e-Agrotrade for e-commerce, which includes a unified electronic trading facility for agricultural sector production. The third, livestock and crop monitoring, involves a system to record pedigrees, a system of control in forestry management and the protection, reproduction and utilization of fauna, and a traceability system “from farm to counter”.

There are also working examples. FAO, together with the European Bank for Reconstruction and Development (EBRD), has designed and adapted a mobile app, Collect Mobile, to help milk processors geolocate current and potential raw milk suppliers, most of whom are smallholder or family farmers. This helps to improve the farmers’ production and therefore their livelihoods.

2.8 Kyrgyzstan

2.8.1 Agriculture, workforce, ICT infrastructure

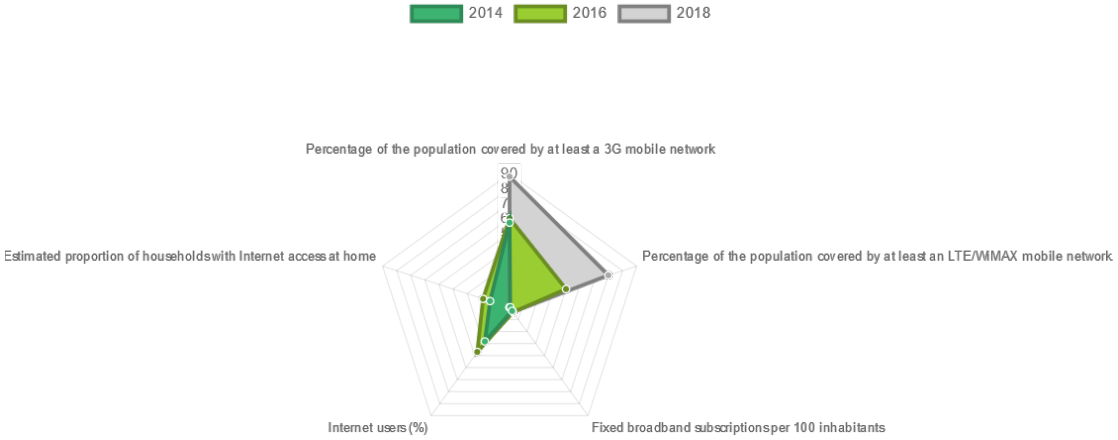
Table 9: Basic agriculture indicators in Kyrgyzstan (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	5 254 979	6 304 030	1 049 051	19.96
Agriculture, value added (% of GDP)	23.49	11.65	-11,.84	-50.40
Agricultural land (% of land area)	55.93	54.96 (2016)	-0.97	-1.73
Rural population (% of total population)	64.72	63.65	-1.07	-1.65
Employment in agriculture (% of total employment)	34.02	26.52	-7,5	-22.05
Employment in agriculture, female (% of female employment)	33.53	27.59	-5,94	-17.72

Kyrgyzstan is a low-income country with a population of around 6 million, of which two-thirds live in rural areas. The country reached both the Millennium Development Goal target and the World Food Summit goal of halving the number of hungry people by 2015. The official absolute poverty rate declined from 37 per cent in 2013 to 25.4 per cent in 2016, with 66 per cent of the poor residing in rural areas. Kyrgyzstan is heavily dependent on agriculture, which accounted for almost 12 per cent of GDP in 2018 and employs 27 per cent of the population. The share of the agricultural sector in total GDP has decreased substantially since 2000 (down from 34 per cent). In Kyrgyzstan, more than 40 per cent of the agricultural land is seriously degraded and over 85 per cent of the total land area is exposed to erosion.

Kyrgyzstan has an open-access and competitive telecommunication market. Mobile services prevail over fixed services. A significant increase in 3G and LTE subscribers is projected to continue in the coming years. 3G services were launched in 2010, LTE services emerged at the end of 2011 and cover the majority of the population (see Figure 9). The largest operator has around 40 per cent of the market, with the remainder being shared equally between two other operators. Some fixed-network operators have also launched LTE services. In 2015, Kyrgyzstan held the first auction of digital dividend frequencies (790-862 MHz) in Central Asia. Fixed-broadband services were launched in 2006, but their development has been hampered by low-level urbanization, relatively high prices and competition with mobile-broadband services (only around 4 subscriptions/100 inhabitants). Thirty-eight per cent of the population uses the Internet, and only slightly more than one out of five households has Internet access at home. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high, with respondents evaluating it at 3.89 on a scale of 7. Kyrgyzstan was ranked 105th in terms of the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.16 on a scale of 7) in 2018.

Figure 9: The basic indicators of ICT access and usage in Kyrgyzstan (ITU WTI Database)



2.8.2 Strategy, policy, legislation

The national strategy for 2013–2017 focused on the implementation of modern technology, particularly for the State customs service, education and banking. In 2017, the Kyrgyz Government launched the "Taza koom" initiative, a national digital transformation programme aimed at building a strong society centred on human rights, freedom, values and potential. The goal of Taza koom was to improve people's lives through the power of technology, digital infrastructure and data. The National Development Strategy of the Kyrgyz Republic for 2018–2040, which was adopted in 2018, outlines the contours of the country's digital transformation. The new digital transformation concept, "Digital Kyrgyzstan 2019–2023", defines the structure, management system and fundamentals of the country's digitization process. The main goals are as follows:

- provide high-quality digital services, increase efficiency, effectiveness, openness, transparency and accountability, curb corruption in public administration, and heighten the level of citizen involvement in government and municipal decision-making processes through digital transformation of the State and municipal governance;
- create new opportunities for people by developing their digital skills;
- ensure economic growth through the digital transformation of priority sectors of the economy, strengthening international partnerships and creating new economic governance clusters.

The president of Kyrgyzstan declared 2019 the Year of Regional Development and Digitization of Kyrgyzstan. Furthermore, 2020 was declared the Year of Regional Development, Digitization of the Country and Child Support in Kyrgyzstan. In February, a roadmap was published for implementation of "Digital Kyrgyzstan 2019–2023". It contains 119 measures in six categories: development of the digital State (40 tasks), development of the digital economy (36 tasks), digital skills development (35 tasks), ensuring cybersecurity (5 tasks), managing the concept implementation process (1 task) and outreach (1 task). One of the most important e-government developments is the Tunduk system, an interoperability service developed along the lines of the Estonian X-Road to connect State bodies, local governments and business structures by electronic means.

At the end of 2019, a report was presented on the roadmap tasks completed and the results. In all, 71 initiatives were implemented. The digital transformation management system was delivered, and digital projects are now being technically coordinated through the Tunduk system. Several digital transformation services have also been launched (e.g. e-payments, identification). In the framework of the pilot concept "The State as a platform", 85 services were made available.

The digitization of agriculture (with education and health care) was among the key priorities for 2020. The roadmap has an e-agriculture section (2.3.2) that calls for the "digitization of agriculture and stimulation of innovations". The first action is to develop an agricultural sector development programme using ICTs and an action plan for 2019–2022; the deadline for the programme was the end of 2019. The other two tasks in the e-agriculture section are developing a system that ensures the traceability of food products from producer to consumer and the introduction of a single integrated management information system for the agricultural sector.

FAO was officially approached in February 2020 to provide technical support for the development of a national e-agriculture strategy.

Credit: Treinen S. – FAO

2.8.3 Services, applications, knowledge sharing

In November 2017, Kyrgyzstan joined the Open Government Partnership and started an open data ecosystem creation project encompassing the core legal, institutional and technological framework, the demand for and use of open data, and the capacity of government to manage complex ICT projects.

The World Bank project Digital CASA is providing support for the digital transformation in Kyrgyzstan. The objective of the USD 50-million project is to increase access to more affordable connectivity, to attract more private investment to the ICT sector and to boost the government's capacity to deliver digital government services. Kyrgyzstan is also planning to implement the Digital Agriculture Project with China, as part of the Belt and Road Initiative.

2.9 Moldova

2.9.1 Agriculture, workforce, ICT infrastructure

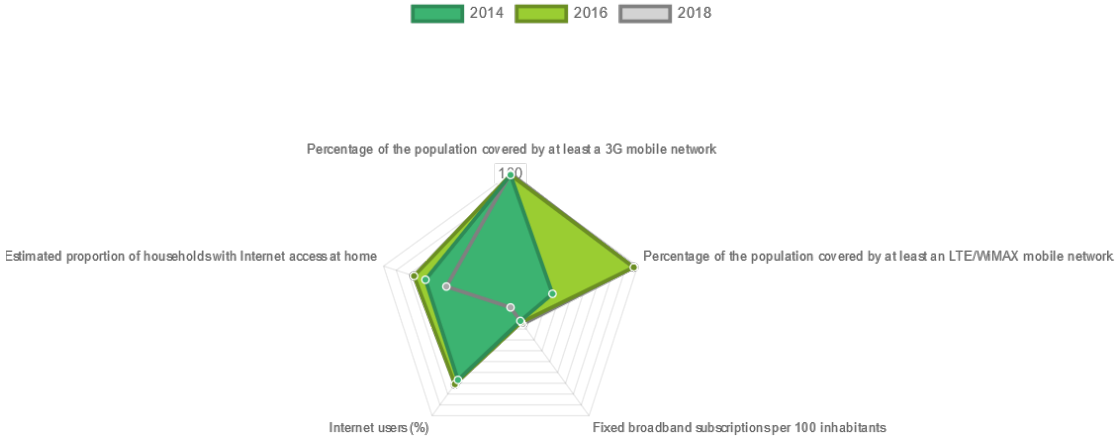
Table 10: Basic agriculture indicators in Moldova (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	4 112 891	4 051 944	-60 947	-1.48
Agriculture, value added (% of GDP)	8.81	10.16	1.35	15.32
Agricultural land (% of land area)	75.43	74.22 (2016)	-1.21	-1.6
Rural population (% of total population)	57.32	57.37	0.05	0.09
Employment in agriculture (% of total employment)	31.06	32.18	1.12	3.61
Employment in agriculture, female (% of female employment)	28.34	27.78	-0.56	-1.98

In the Republic of Moldova, agriculture is becoming a polarizing activity. A small number of large-scale farmers are increasingly able to exploit the expanded opportunities afforded by the free trade agreement with the EU, the country's main agricultural export destination. Smallholders, however, struggle to comply with the strict EU market requirements and therefore target the more accessible CIS markets. Subsistence farming is on the increase and productivity has fallen, leading a quarter of the young rural population to migrate to cities. Smallholders are particularly vulnerable to accelerating climate change as they are the least equipped to adapt to its effects.

Mobile-broadband penetration in Moldova is similar to the CIS region average. The territory and population are widely covered by 3G/LTE (see Figure 10). The first 3G networks were launched in 2008 (population coverage reached 100 per cent in 2018) and LTE services became available in 2012 and currently cover 97 per cent of the population. The number of mobile-broadband subscriptions is increasing; there were 73 subscriptions per 100 inhabitants in 2018 (up 25 points in two years). Seventy-six per cent of the population uses the Internet, and slightly more than half of households have Internet access at home. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.43 on a scale of 7. Moldova is ranked 114th for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 2.99 on a scale of 7).

Figure 10: The basic indicators of ICT access and usage in Moldova (ITU WTI Database)



2.9.2 Strategy, policy, legislation

Moldova considers itself one of those countries focused on enhancing the growth of the IT industry and expanding its potential. This is highlighted in strategic documents such as the national strategy for information society development, "Digital Moldova 2020", and the Strategy for the development of the information technology industry and the digital innovation ecosystem for the years 2018–2023, which continue the Government's efforts to develop the sector. The Strategy contains a series of measures for stimulating the entrepreneurial and IT educational ecosystem, their start-ups and funding mechanisms, and for promoting IT products on various niche markets.

The Government of Moldova considers ICTs as a high priority area that generates great benefits, and has taken active steps in many sectors. One of its flagship initiatives for IT industry development is the law on information technology parks, which paved the way for the creation of the Moldova IT Park. The Moldova IT Park provides a special tax regime and simplified tax administration for the companies registered in the park (for a large number of eligible IT and related activities, such as software development, IT services, digital graphics and design, research and development, educational projects).

In the field of electronic communications, the Broadband Development Programme for the years 2018–2020 was approved and an action plan adopted for its implementation. The programme's overall objective is the development of broadband electronic communication networks, which provide greater data transfer capacity. In order to promote the efficient management of radio spectrum resources and thus ensure the continued development of public broadband electronic communication networks and services, the Radio Spectrum Management Programme for the years 2013–2020 was drawn up.

The Ministry of Agriculture, Regional Development and Environment approved the Strategic Programme for technological modernization of development policies in the agro-industrial sector (e-agriculture) in 2013. The programme aimed to digitize the public services provided by the Ministry's subdivisions, create integrated information systems for preparing and implementing the sector's development strategies, and develop surveillance information systems to ensure food safety and security. The concept of e-agriculture was devised in the context of State food safety and security, the National Strategy for Agricultural and Rural Development (2014–2020), and the strategic programme for the technological modernization of the government (e-Transformation).

The ICT-centric innovation ecosystem country review of Moldova highlights that strategies currently focus on international priorities and should instead refocus on national strengths. Many stakeholders said that specific ICT areas or other economic sectors or specialized niches should be prioritized under

a comprehensive strategy. Some of the suggested areas were nanotechnology, e-agriculture and the aerospace industry. The smart specialization areas identified in Moldova are ICTs, agriculture and food processing, biomedicine and energy (where agriculture also plays a role). The National Action Plan for an open government for the years 2019–2020 proposed to develop the interface and the official page of the Agency for Interventions and Payments in Agriculture in order to ensure interactive and easy access to data on grant applicants by the end of 2019.

2.9.3 Services, applications, knowledge sharing

In order to solve problems in the priority sectoral needs of agriculture and contribute to the implementation of agro-industrial sector development policies, several information systems have been developed:

- the Digital Agricultural Register, to ensure access to operational data on the economic activity of economic agents in the agro-industrial sector and facilitate the provision of public services, including online, according to the single window principle;
- the State Animal Register;
- the System of Identification and Traceability of Animals, a basic subsystem and an integral part of the process of traceability of animal products;
- Management of Strategic Sanitary-Veterinary Measures, to support the preparation, registration and monitoring of the annual strategic plan drawn up by the National Agency for Food Safety;
- Laboratory Management, to generate the information needed for the complete management of sanitary-veterinary and food safety laboratories;
- the Administration of State Agricultural Heritage;
- AGROMAIA, used to monitor and collect operational information on agricultural and harvesting works;
- the Agricultural Equipment Register, used to provide IT solutions for identifying, recording and managing information about the technical potential of economic agents in the agro-industrial sector;
- agricultural subsidy file management, to automate workflows for managing subsidies while offering the possibility of generating different reports and controlling document circulation;
- Wine Register (includes a series of subsystems and modules that automate and ensure the processes of identification, registration, validation, archiving, deletion or modification of the data, according to the activity of the economic agent, to register wine parcels / wineries);
- Management of the Release of Phytosanitary Certificates (includes management of the export and re-export of products of plant origin, the preparation of reports, producer and exporter records, export directives).

In the same context, the Agency for Intervention and Payments for Agriculture is responsible for the creation of the Automated Information System, the Evidence of the Applicants and the Beneficiaries of Grants, and the National Office of Vines and Wine is responsible for managing the Automated Information System of the Wine Register. In addition, the concept of an information system, Soil Registry of the Republic of Moldova, was approved in 2014, and the relevant operating regulations are being drawn up.

Private companies are also involved in providing digital solutions to farmers, including on agrometeorological data. Orange Moldova has started to introduce digital solutions for farmers, including GPS solutions for fuel control and vehicle monitoring – to optimize costs, save fuel, prevent fraud and promote auto-guidance – and digital tools for collecting, storing and analysing weather conditions to protect crops. The services are to be accessed using high-speed Internet all over the country.

A new EU programme, EU4Digital, will provide support for strengthening the digital economy and society in the region. The programme aims to extend the benefits of the EU Digital Single Market to the Eastern Partner States, helping them to expand e-services and harmonizing digital frameworks, among other activities.

A new FAO project will significantly improve data collection and management in respect of Moldovan agricultural and rural statistics from 2020, bringing them in line with international standards and enabling the collection of data on important SDG indicators on labour productivity and smallholder incomes.

2.10 Montenegro

2.10.1 Agriculture, workforce, ICT infrastructure

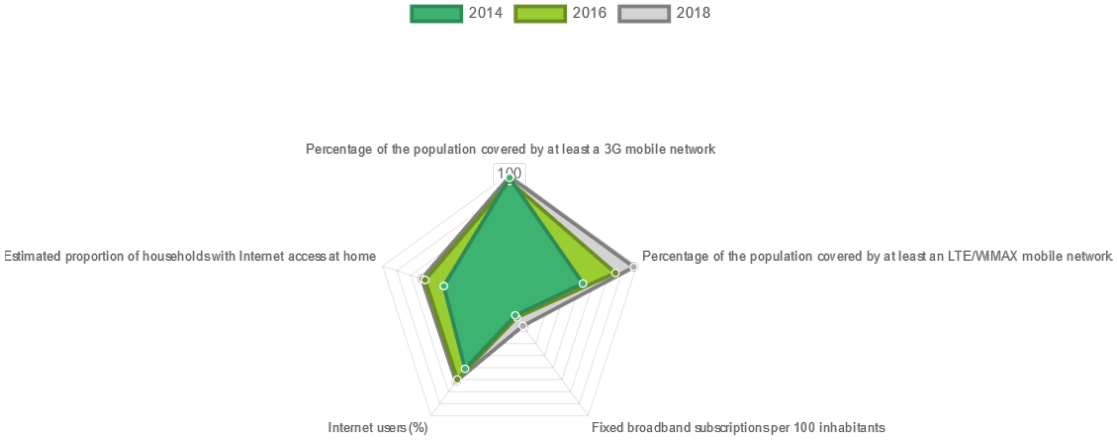
Table 11: Basic agriculture indicators in Montenegro (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	621 320	627 809	6 489	1.04
Agriculture, value added (% of GDP)	7.44	6.85 (2017)	-0.59	-7.93
Agricultural land (% of land area)	38.14	18.96 (2016)	-19.18	-50.29
Rural population (% of total population)	36.53	33.19	-3.34	-9.14
Employment in agriculture (% of total employment)	7.53	7.85	0.32	4.25
Employment in agriculture, female (% of female employment)	6.8	6.84	0.04	0.59

The share of agriculture in Montenegro's GDP is almost 7 per cent (compared to the 2 per cent EU average). Almost one quarter of all people in work in Montenegro are engaged in family farms. Agricultural development continues to be constrained by a number of challenges (a fact that is not reflected in the official figures on agricultural employment). These include fragmented and small parcels with high production costs, limited export opportunities, weak sector organization, limited access to credit, and a lack of qualified labour, proper equipment and infrastructure. Montenegro is in the process of acceding to the EU, with membership negotiations having started in 2012.

The country is one of the smallest telecommunication markets in Europe. The accession process is greatly influencing the telecommunication sector, as regulations have been aligned with EU norms and competition has been strengthened. Mobile-broadband penetration has been rising rapidly, but remains behind the European average and that of most neighbouring countries. Almost the entire population is covered by 3G, and LTE coverage was 98 per cent in 2018 (see Figure 11). Seventy-two per cent of the population uses the Internet, and almost three out of four households have Internet access at home. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.14 on a scale of 7. Montenegro is ranked fiftieth for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.95 on a scale of 7).

Figure 11: The basic indicators of ICT-access and usage in Montenegro (ITU WTI Database)



2.10.2 Strategy, policy, legislation

The Government has adopted the Strategy for the Development of the Information Society of Montenegro for the period 2017–2020, and an action plan for the years 2018–2020; implementation is based on the Digital Agenda for Europe and the Digital Single Market strategy. The government strategy describes the main directions for development and sets an ambitious goal of 100 per cent household coverage with speeds above 30 Mbit/s by 2020 (coverage is currently 26.5 per cent). Another aim is to enhance basic and advanced digital skills (ICT graduates should account for 10 per cent of all graduates and the number of European Computer Driving Licence certificates issued should reach 15 000 by 2020).

The main goal of Montenegro's agricultural policy is to boost the competitiveness of agricultural production and improve living conditions in rural areas. Under the Strategy for the Development of Agriculture and Rural Areas 2015–2020, data on land parcels will be based on statements provided by the owners of agricultural holdings and made available using digital cadastral plans and topographical maps. A digital elevation model will make it possible to visualize agricultural land using orthophoto maps that will also help to define the borders of LPIS parcels. Priority Reform Measure No. 5 of the Montenegro Economic Reform Programme 2019–2021 is to support investment in the food production sector in order to reach EU standards on, for example, specialized machinery and processing equipment. According to the analysis of the economic, research and innovation potential of Montenegro carried out for the Smart Specialization Specialisation Strategy, agriculture has strong research potential and can play a leading role in economic specialization.

Under "Vision 2024" of Montenegro's Smart Specialization Strategy (S3.me), the country has a reputation for agriculture based on knowledge and innovation, and developed in line with the principles of sustainability. This includes preserving rural traditions and values, enhancing the beauty of Montenegrin landscapes and forming a vital basis for the food value chain that offers a wide range of authentic products to the consumer. According to S3.me, ICT – a horizontal priority – allows for synergies between sustainable agriculture and the food value chain – vertical priorities – in the following areas: smart and efficient management of agriculture; use of sensors for monitoring the environment and the production, storing and transport of food (biosensors, smart buoys, smart beehives, etc.); and the BIO-ICT Centre of Excellence. In addition, agri-ICT is one of the areas of intervention in the flagship initiative Digital Transformation.

2.10.3 Services, applications, knowledge sharing

FAO provided Montenegro with assistance for the development of a pilot FADN in 2016; technical assistance was provided by experts from the Hungarian Government Research Institute of Agricultural Economics. The network remains to be completed. An LPIS has been established and is operating on a pilot basis. Preparatory steps are being taken to establish a decentralized branch for the future paying agency.

MIDAS2 is continuing on from the first World Bank-funded MIDAS (Montenegro Institutional Development and Agriculture Strengthening) project. The project aims to improve the competitiveness of the agriculture sector and support Montenegro in the EU pre-accession process by providing assistance for the establishment of an IPARD-compatible system comprising a payment agency, a farm registry and a pilot grant scheme to support investments in agriculture and the introduction of agri-environmental measures.

As part of the HERIC "INVO" project led by the Ministry of Science and funded by a World Bank loan, a grant scheme has been implemented for research and development projects. Within this project, the BIO-ICT Centre of Excellence was established as an independent organizational unit within the University of Montenegro and officially started operating on 28 May 2018. BIO-ICT is intended to be a specific innovative ecosystem focused on the development and implementation of novel bioinformatic technologies, translating research results into innovative products and services such as the BlueLeaf platform, digital soil mapping, sea water monitoring (IoT), a smart irrigation system, disease control at vineyards.

In September 2018, the Ministry of Science announced a call for new centres of excellence. One of the winning applicants is the Centre of Excellence for Digitization in the Field of Food Safety and Food Authenticity, "FoodHub", implemented by the University of Donja Gorica. The overall goal of FoodHub is to offer reliable, science-based solutions for food safety risk elimination and hazard identification, digitized food safety risk assessment tools, reliable certification and tracing of food authenticity, promotion and ready-to-use applications for the food production industry and tourism sector. FoodHub plans to work on innovative solutions for data gathering and processing, the introduction of contemporary knowledge in sensory equipment, different levels of data validation, education of relevant stakeholders, training of food chain participants and trial installation of novel biosensor-based food safety tracking systems. Project implementation was expected to start in January 2020.

2.11 North Macedonia

2.11.1 Agriculture, workforce, ICT infrastructure

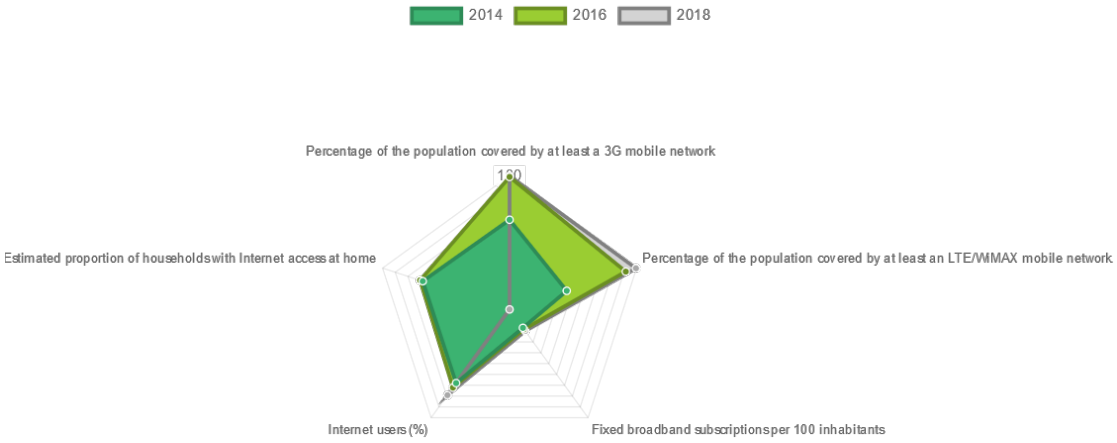
Table 12: Basic agriculture indicators in North Macedonia (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	2 067 313	2 082 957	15 644	0.76
Agriculture, value added (% of GDP)	11.44	7.24	-4.20	-36.71
Agricultural land (% of land area)	42.13	50.16 (2016)	8.03	19.06
Rural population (% of total population)	42.83	42.04	-0.79	-1.85
Employment in agriculture (% of total employment)	18.41	16.11	-2.3	-12.49
Employment in agriculture, female (% of female employment)	17.67	15.72	-1.95	-11.04

Agriculture and food production play a vital role in the North Macedonian economy, accounting for around 7-8 per cent of GDP and employing more than one-sixth of the national workforce. Because of the highly fragmented farm structure – each farm is smaller than two ha, on average – farms are less productive and competitive than those in other countries in Europe. Small-scale farmers are responsible for about 87 per cent of the country's total agricultural production value. Arable agricultural land totals 1 261 000 ha, or 50.1 per cent of the total territory.

The Republic of North Macedonia, as an EU candidate country, is largely aligned with EU regulatory frameworks. With a less developed fixed network (only 20 fixed-broadband subscriptions per 100 inhabitants), mobile is very important and penetration rates are relatively high for mobile-cellular and rising for mobile-broadband services. Mobile-broadband penetration is somewhat below the European average at 67 subscriptions per 100 inhabitants. 3G licences were first awarded in 2008 to MakTel and Vip (later to become one.Vip). LTE services were launched commercially at the end of 2013. Almost the entire population of North Macedonia is covered by 3G (99.88 per cent) and LTE (99.53 per cent). Seventy-nine per cent of the population uses the Internet, and seven out of ten households have Internet access at home (see Figure 12). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 3.62 on a scale of 7. North Macedonia is ranked 120th for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 2.88 on a scale of 7).

Figure 12: The basic indicators of ICT-access and usage in North Macedonia (ITU WTI Database)



2.11.2 Strategy, policy, legislation

North Macedonia is a candidate country waiting to start membership negotiations with the EU. Since receiving the status of candidate country in 2005, North Macedonia has been working to bring its national agricultural policy in line with the EU CAP. Thus, the Law on Agriculture and Rural Development (effective from 2008 and the current legal framework for the country's agricultural policy) has two parts – one regulating agricultural markets and the other for rural development – and represents a gradual transition to the CAP.

The Strategy for Public Administration Reform 2018–2022 and its Action Plan, adopted in North Macedonia in 2018, also address e-procurement and interconnectivity of base registries. The Strategy and Action Plan for Open Data 2018–2020 were adopted in July 2018. The National Cybersecurity Strategy and Action Plan 2018–2020 were adopted in August and December 2018, respectively.

The European Commission expects the country to prepare a long-term ICT strategy. In terms of the information society, a strategy on the development of digital skills has not yet been developed, but

the new education strategy lists digital literacy as a priority. The application of electronic signatures is limited to a few institutions that provide services to businesses. The interoperability system is used by only a few institutions despite the equipment and software having been installed. E-government is at an early stage of preparation.

The country has started drafting a long-term national ICT strategy on the basis of a roadmap developed in 2018; it has also adopted the Law on Electronic Services and Electronic Management, which regulates the work of ministries, other State administrative bodies, managing organizations and local self-governments when it comes to the exchange of data and documents in electronic form, i.e. implementation of electronic services. The law regulates issues related to the establishment and functioning of the National Portal for Electronic Services, the Catalogue of E-Services and the One-Stop Shops. North Macedonia is establishing base registers and enabling a safe and reliable environment for standardized data exchanges between institutions. To ensure that citizens and businesses receive fast and good-quality services, it is currently in the final phases of building a catalogue of e-services and the National Portal for Electronic Services. In the initial phase, the portal will offer the 50 most-required services from several institutions online.

2.11.3 Services, applications, knowledge sharing

In the case of North Macedonia, several issues related to e-agriculture are covered in the General Agricultural Strategy developed by the Ministry of Agriculture, Forestry and Water Economy. As a result, some financial support has been provided to farmers who have invested in ICT-related technologies. As of 2007, the Ministry introduced elements of the Integrated Administration and Control System, including the Single Registry of Agricultural Holdings (referred to as the Farm Registry) and the LPIS.

According to the findings of a survey conducted by the International Visegrad Fund project, "Agricultural Extension in V4 and WB", besides the conventional and broadly accepted digital tools such as radio and television (98 per cent), farmers have significant know-how when it comes to using ICT devices such as smartphones (55 per cent), computers (70 per cent) and the Internet (60 per cent) – a good indication that there is a sound basis for the introduction of digital technologies in agriculture. On the other hand, farmers have little awareness or knowledge about more advanced technologies based on ICTs, such as automated systems, GPS or GIS systems, and other tools for precision agriculture. In addition, while farmers are moderately aware of the significance of conventional ICTs (television, radio, mobile phones) for business results, they have little or moderate awareness of the impact of smartphones on agribusiness, even though the devices are widely used in rural areas.

The European Commission expects North Macedonia to finalize the national Farm Accountancy Data Network legal and procedural alignment with the *acquis* in 2019 and 2020, and to have improved data quality and widened data use for policy and research purposes. Concerning the LPIS, new orthophoto maps have been produced and agricultural land is being digitized. However, the cadastral data records are still used as references for area-based payments, as the LPIS and the claim systems are not yet fully connected. Designing a state-of-the-art forest monitoring system tailored to the country's needs and conditions has been the focus of a two-year project run by FAO and the North Macedonian Ministry of Agriculture, Forestry and Water Economy.

A remote sensing survey has been carried out, using high-resolution satellite imagery, to generate information on land use and changes. Another project led by FAO, "Land Resources Information Management Systems (LRIMS)," is a data management and analysis system that integrates various functionalities and methodologies into one processing environment. LRIMS offers a suite of information management and analysis tools organized into a toolbox; provides access to organizational data and metadata; contains query, analysis and map-building functions that allow standardized analysis, monitoring and forecasting; and enables assessments of the physical/socio-economic conditions of the land together with evaluations of the benefits and constraints of different options by simulating various scenarios. The project has also led to the development of a web platform (agroekologija.

mk) hosting a wealth of content on agri-environmental indicators in digital spatial format, including training materials. The platform provides open access to digital maps on evapotranspiration, climate, yield suitability projections and more; all can be viewed on the website and downloaded for further processing and analysis. The country's Soil Information System (MASIS) was launched in 2015. It was developed with support from FAO and its Global Soil Partnership.

Credit: FAO

2.12 Russian Federation

2.12.1 Agriculture, workforce, ICT infrastructure

Table 13: Basic agriculture indicators in the Russian Federation (World Bank WDI database)

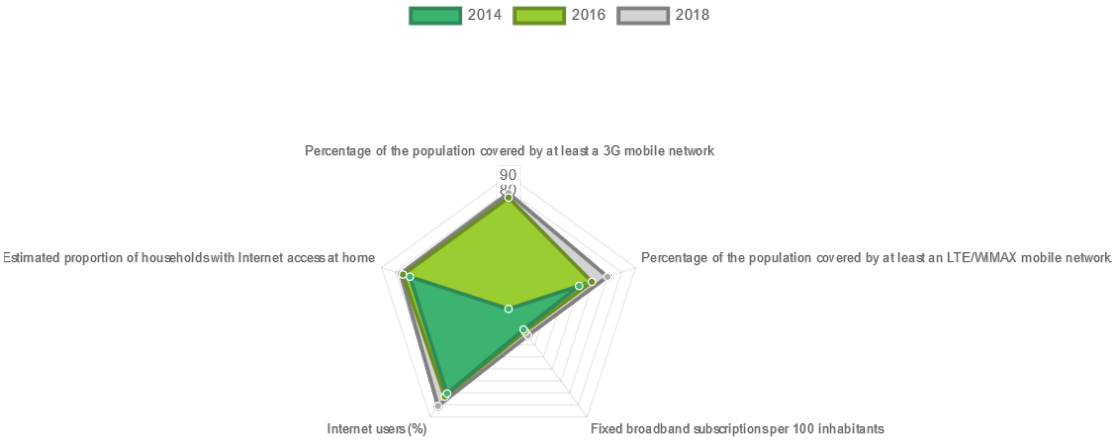
	2008	2018	Difference	Diff %
Population	143 248 764	145 734 038	2 485 274	1.73
Agriculture, value added (% of GDP)	3.75	3.15	-0.6	-16
Agricultural land (% of land area)	13.16	13.29 (2016)	0.13	0.99
Rural population (% of total population)	26.4	25.57	-0.83	-3.14
Employment in agriculture (% of total employment)	8.53	5.84	-2.69	-31.54
Employment in agriculture, female (% of female employment)	6.6	3.99	-2.61	-39.55

The Russian agriculture sector has experienced significant growth in recent years and has become a leader in Russian exports and a champion in import substitution, as major Russian agribusinesses have driven the adoption of state-of-the-art digital technologies in farming practices. In 2017, the agriculture sector accounted for 5.8 per cent of national employment and added value of between 3 and 4 per cent to GDP. According to the 2016 All-Russian Agricultural Census, the country had 36 100 agricultural organizations, including 7 600 large, 24 300 small and 4 200 auxiliary agricultural enterprises and non-agricultural organizations; 174 800 peasant (farm) households and individual

entrepreneurs; 23.5 million personal subsidiary plots and other individual households of citizens, including 15.1 million in rural settlements; and 75 900 non-profit associations of citizens.

The telecommunication market is dynamic, with operators offering innovative technologies and services. Despite the size of the territory, telecommunication services are accessible to most of the population at relatively low prices. The first Code Division Multiple Access 2000 networks emerged in 2002, Evolution-Data Optimized in 2005 and 3G/UMTS in 2007. LTE commercial services started being offered in 2011. The first UMTS-900 network was launched in 2012. At the beginning of 2018, around a third of mobile base stations offered LTE services. MTS and Ericsson have agreed to work together to foster 5G development. In 2017, the State Radio Frequency Commission adopted a series of decisions allocating frequency bands for the establishment of test areas for 5G networks. In 2018, the State enterprise Rostelecom, in collaboration with the company MegaFon, planned to carry out research and field tests on matters relating to ensuring the electromagnetic compatibility of 5G network radio systems with other radio systems. The population coverage for wireless broadband networks is 78 per cent for 3G and 70 per cent for LTE. The number of mobile-broadband subscriptions per 100 inhabitants – 87.28 – is high. Eighty-one per cent of the population uses the Internet, and more than three-quarters of households have Internet access at home (see Figure 13). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.83 on a scale of 7. According to the Rosstat 2017 report, 63 per cent of large agribusinesses, 42 per cent of small farms and 16 per cent of individual farms are connected to the Internet. The Russian Federation is ranked fifty-fourth for the Global Competitiveness Index indicator “Future orientation of government” (with a value of 3.87 on a scale of 7).

Figure 13: The basic indicators of ICT access and usage in the Russian Federation (ITU WTI Database)



2.12.2 Strategy, policy, legislation

Key stakeholders in the Russian Federation developed the concept for the scientific and technological development of digital agriculture in 2018, and it contains the vision for the national e-agriculture strategy. The main national strategies and policies taken into account are:

- presidential decree, 2018, on national goals and strategic objectives of the development of the Russian Federation for the period until 2024;
- presidential decree, 2016, on the Strategy for Scientific and Technological Development of the Russian Federation;
- presidential decree, 2016, on measures to implement the State scientific and technological policy in the interests of agricultural development;

- government programme, 2018, Digital Economy of the Russian Federation;
- decree, 2018, on budget appropriations for the implementation of Digital Economy of the Russian Federation priority programme activities;
- government decree, 2017, on approval of the Federal Scientific and Technical Programme for agricultural development for 2017–2025;
- Order of the Government, 2018, Strategy for the innovative development of the Russian Federation until 2020;
- forecast for the scientific and technological development of the Russian Federation for the period until 2030, approved by the Government in 2018;
- Order of the Ministry of Agriculture, 2017, on approving the forecast for the scientific and technological development of the agro-industrial complex of the Russian Federation for the period up to 2030;
- government decree on the procedure for the development and implementation of comprehensive scientific and technical programmes and a full project innovation cycle in order to implement the priorities of scientific technological development of the Russian Federation.

The agriculture sector's digital transformation was highlighted in the presidential decree of May 2018 as a top priority for export growth.

2.12.3 Services, applications, knowledge sharing

New digital technologies are already spreading in Russian agriculture, but mainly at the level of large commercial agribusinesses that have large land and livestock holdings, are backed by financial resources and management know-how, and use satellites, variable rate application of inputs and hyper-local weather information. The use of advanced e-services allows farmers to plan and track the use of farm equipment, find buyers and sellers for their products, detect pests and diseases remotely (using digital imagery from drones and satellites) and deploy rapid responses.

The National Soil Database is in the experimental stage of development. It is compatible with similar databases in the EU, the United States, FAO and the World Reference Base for Soil Resources. There are also currently several blockchain pilots. These include applications to improve meat product traceability and to streamline payments and other financial transactions.

Owing to the insufficient pace of digital transition in Russian agriculture, work started in 2018 on the development of the Digital Agriculture Project. Once finalized, the project will be submitted for approval to the Russian Government. Its goals are ambitious and include increasing agricultural exports from USD 20 billion in 2018 to USD 45 billion by 2024. The project aims to mobilize all the key players in the digital agriculture ecosystem behind the goal of accelerating the sector's digital transition by providing fixed- and mobile-broadband connectivity; enhancing data collection, storage, management and analysis; implementing digital platforms in the sector; launching innovative financing mechanisms; and taking advantage of the latest developments in artificial intelligence and IoT technologies. Participants in the digital agriculture ecosystem mobilized by this project include key government and private sector contributors, NGOs and the academic and scientific communities, *inter alia* the Ministry of Agriculture, the Timiriazev Agrarian University, the Higher School of Economics, Sberbank (the largest Russian public bank and a leader in digital transformation), the Skolkovo Foundation, Rostech (a leading Russian technology company), Mobile Telesystems, agricultural equipment producers such as Rosselmash, agriculture production unions, IoT and Internet associations, and regional government administrations and ministries in, for example, the Tambov, Kaliningrad, Moscow, Stavropol and Belgorod regions, and the Republic of Tatarstan. The Digital Agriculture Competencies Centre was established in June 2018. It is expected that the project will set the stage for Russia's Smart Agriculture Strategy, contribute to the FoodNet initiative, and be integrated into the Russia Digital Economy Programme.

Several new platforms are being introduced in connection with the Digital Agriculture Project. The "Land of knowledge" platform provides databases alongside educational and crop monitoring services. It is being developed as the "55th agrarian university", a digital educational agrarian system, to provide users with access to numerous professional digital programmes and courses. Between 2019 and 2021, more than 55 000 specialists from Russian agricultural companies are expected to be trained by this project. The "Teleagronom" service will monitor, model and diagnose crop diseases. The "Efficient hectare" is an agricultural land parcel information database that can be used to assess the condition and potential of agricultural parcels and to provide digital technologies for land use. The "Agri-products tracking system" aggregates data about the production and transportation of agricultural goods. The "Russian green brand" is a system for controlling the production, storage, transportation and marketing of organic agricultural products in what is a paper-free document flow.

2.13 Serbia

2.13.1 Agriculture, workforce, ICT infrastructure

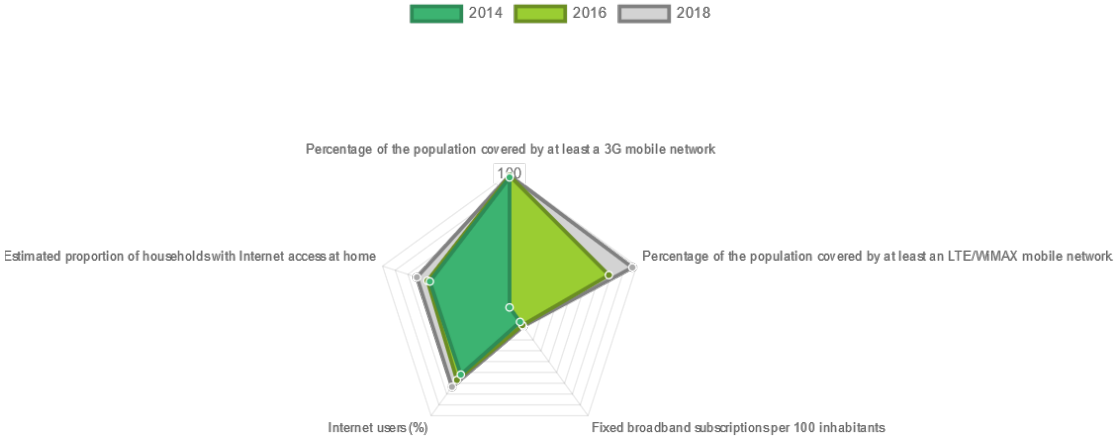
Table 14: Basic agriculture indicators in Serbia (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	9 060 103	8 802 754	-257 349	-2.84
Agriculture, value added (% of GDP)	7.44	6.2	-1.24	-16.67
Agricultural land (% of land area)	41.2	39.33 (2016)	-1.87	-4.54
Rural population (% of total population)	45.45	43.91	-1.54	-3.39
Employment in agriculture (% of total employment)	25.05	17.08	-7.97	-31.82
Employment in agriculture, female (% of female employment)	25.97	14.74	-11.23	-43.24

Agriculture plays an important role in Serbia's economy, as evidenced by the multiyear indicators of the share of agriculture in GDP (6–7 per cent), overall employment (17–18 per cent) and overall exports. That nevertheless represents a drop in recent years, the share of agriculture in GDP and overall employment having fallen from 11 per cent (GDP) and 23 per cent (employment). The country started membership negotiations with the EU in 2013.

According to the EU annual country report, Serbia needs to improve competition within the electronic communication and ICT sectors and to promote the ability of traditional industries to compete and innovate through ICT improvements, training and digital skills development. The fixed market was liberalized relatively late, on 31 December 2011, and fixed-broadband penetration remains low compared with the European average. Serbia's mobile-cellular and mobile-broadband penetration (67.02) is relatively high compared with neighbouring countries and around the European average. LTE services were launched in March 2015; by the end of 2017, the three mobile operators covered more than 85 per cent of the population with the LTE signal. The availability of fast mobile Internet resulted in a significant increase in transmitted data. Seventy-three per cent of the population uses the Internet and almost three-quarters of households have Internet access at home (see Figure 14). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.16 on a scale of 7. Serbia is ranked eighty-first for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.55 on a scale of 7).

Figure 14: The basic indicators of ICT access and usage in Serbia (ITU WTI Database)



2.13.2 Strategy, policy, legislation

In the National Programme for Rural Development (2018–2020), the Government adopted an action plan for EU accession that includes a detailed timetable for establishing the Integrated Administration and Control System and developing a pilot LPIS. The outline of a strategy for the implementation of LPIS and broader Integrated Administration and Control System requirements was also developed. The first phase of the LPIS pilot project has been finished, and the LPIS methodology, the Technical Specification for LPIS Software in Serbia and the Technical Specification for Land Cover completed. LPIS software will be acquired and the second phase of the LPIS pilot project launched in the near future. In April 2018, Serbia adopted the Law on the National Spatial Data Infrastructure.

One of the priority domains of Serbia's new Smart Specialization Strategy will be related to ICTs and food for the future. The BioSense Institute is active in the fields of micro- and nanoelectronics, communications, signal processing, remote sensing, big data, robotics and biosystems; its aim is to support the development of sustainable agriculture and the integration of ICT solutions in order to provide information for the sector.

The Republic Geodetic Authority has established the Centre of Excellence for Geospatial Information Management and the GeoSerbia portal (geosrbija.rs). The portal provides access to a number of databases including land cover, geoscientific information, biota, inland waters, boundaries and transportation.

2.13.3 Services, applications, knowledge sharing

A survey conducted to ascertain the reasons underlying the low adoption rate of advanced technologies in Serbian agriculture revealed that only 14 per cent of farmers interviewed had adopted smart farming technologies. Eighty-one per cent cited equipment cost as the most important reason for not doing so, while 94 per cent said that they would adopt such technologies if supported through subsidies.

The digital platform "AgroSense" was released in 2017 for public use and has been widely accepted, with a number of large-, medium- and small-scale farmers registering to use it. The platform helps farmers and agricultural companies monitor crop status and plan agricultural activities. It brings the benefits of IT to the end users, providing all with free tools for record keeping and for better decision-making based on remote sensing.

Krivaja DOO is a digital demonstration farm in Serbia that showcases smart farming tools and equipment for precision agriculture management. Its field events and presentations on the use of new technologies in agriculture have attracted many farmers. “agroNET” is a suite of smart agriculture solutions designed by DunavNET, a technology provider that develops interoperable IoT solutions for smart farming, manufacturing and cities.

Sub-component 2.2 of the World Bank Serbia Competitive Agriculture Project aims to develop an agriculture business intelligence information system that will pull together relevant data, playing an important role for the spatial tracking, traceability and connectivity of production and market demand, and thus contributing to improved product positioning, sales and overall competitiveness. The system is intended to support the advisory services in Serbia and can be linked to digital applications on-farm, ensuring two-way communication on plant and animal health, and on other potential constraints on agricultural productivity and competitiveness. By including weather and climate information modelling, the project plans to promote early warning systems, helping producers to better prepare and adapt to changing climatic conditions.

Credit: Treinen S. - FAO

FAO, in collaboration with the EBRD, is carrying out a study to identify promising digital technologies in agriculture, focusing on private sector-driven technologies. The study will conduct a scoping exercise so as examine in depth technologies such as digitally enabled agricultural credit appraisal and farmer decision support systems, to better understand their potential and constraints. The study will be completed in the course of 2020.

2.14 Tajikistan

2.14.1 Agriculture, workforce, ICT infrastructure

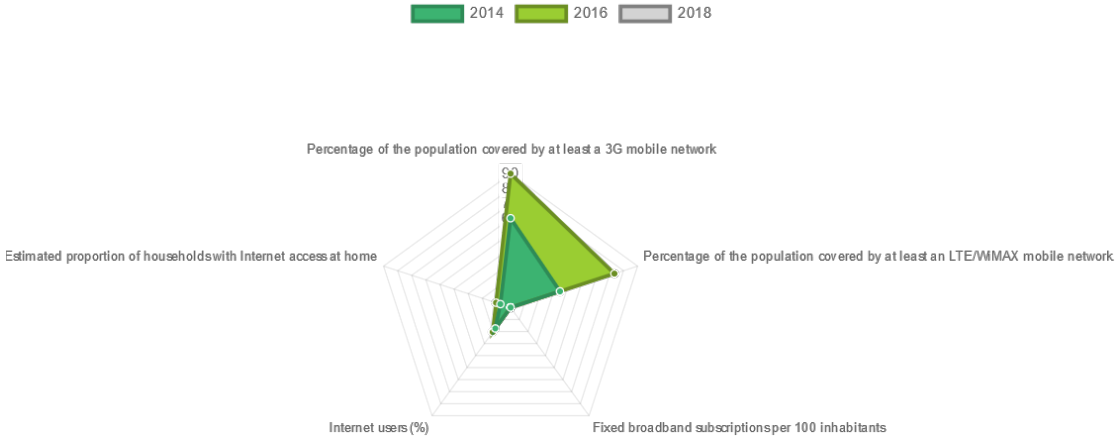
Table 15: Basic agriculture indicators in Tajikistan (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	7 209 930	9 100 835	1 890 905	26.23
Agriculture, value added (% of GDP)	19.87	21.22 (2017)	1.35	6.79
Agricultural land (% of land area)	33.77	34.14 (2016)	0.37	1.1
Rural population (% of total population)	73.48	72.87	-0.61	-0.83
Employment in agriculture (% of total employment)	53.58	51.06	-2.52	-4.70
Employment in agriculture, female (% of female employment)	71.37	68.97	--2.4	--3.87

Tajikistan is a low-income country and currently the poorest among the former Soviet Republics. More than 70 per cent of the population lives in rural areas and depends on agriculture. Tajikistan is 93 per cent mountainous, making it difficult to increase and intensify agricultural output. Agriculture is very important for the country's economy, contributing around 20 per cent of GDP. The sector employs over 50 per cent of the total population. Pressing issues in Tajikistan include the need to rebuild infrastructure, to improve the environment for doing business, and to attract foreign investment.

While the coverage of mobile-broadband services in Tajikistan is higher than the CIS average (90 per cent for 3G and 80 per cent for LTE), penetration rates are relatively low (22.83). One reason may be the high price of mobile and fixed services, which are among the most costly in the region. Five telecommunication operators make up the mobile cellular market. The first 3G-UMTS network was launched in 2005. WiMAX-based services started in 2007, and LTE emerged in 2012 and is in the process of development. There is a significant telephone network availability divide between urban and rural areas. Another reason for the low mobile-broadband penetration rate is the low number of Internet users, as only 22 per cent of the population uses the Internet, and about one out of ten households has Internet access at home (see Figure 15). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high; the respondents evaluated it at 4.46 on a scale of 7 (which basically means that those who are using the Internet have a fair knowledge about it). In 2018, Tajikistan ranked twenty-seventh for the Global Competitiveness Index indicator "Future orientation of government" (with a surprisingly high value of 4.46 on a scale of 7).

Figure 15: The basic indicators of ICT access and usage in Tajikistan (ITU WTI Database)



2.14.2 Strategy, policy, legislation

The ICT strategy for the development of Tajikistan was adopted by the Government of Tajikistan in November 2003 and a set of national programmes has since been implemented. Pursuant to the programme to develop and implement ICT in Tajikistan, issued in 2004, public institutions were supplied with computers and local area network construction got under way. The 2011 e-Governance Concept promoted government support to enhance the use of ICTs in the economy. In 2014, the President of the Republic approved the Regulation on the Council on Information and Communication Technology under the President of the Republic of Tajikistan, which leads and coordinates the development and spread of ICTs, implementation of the State information policy and the development of e-government in Tajikistan. In 2016, the Tajik Government decided to establish a centre for international telephone and Internet traffic control. Currently, the main documents aimed at accelerating the development of a national e-agriculture strategy are the National Development Strategy of the Republic of Tajikistan for the period to 2030 (approved in 2016, the strategy has agriculture-, fishery- and forestry-related components) and the Concept of Digital Economy in the Republic of Tajikistan (adopted in December 2019).

These documents are relevant to e-agriculture development in that they contain certain general measures or goals (e.g. “Overcoming the digital gap between different regions, especially in rural and remote areas”). As part of its support for the implementation of Tajikistan’s Agrarian Reform Programme (2012–2020), FAO is providing the Ministry of Agriculture with support valued at EUR 5 million for institutional development and capacity strengthening under an EU-funded project. The Ministry is gaining greater knowledge and expertise in relevant areas of policy-making, financial and policy analysis, disease surveillance and data management.

2.14.3 Services, applications, knowledge sharing

The Asian Development Bank regional technical assistance project, “Digital Solutions to Improve Agricultural Value Chains”, was approved in December 2019. The project aims to widen the use of digital technologies in Bangladesh, Pakistan, Tajikistan and Viet Nam, so as to increase the productivity and efficiency of production and marketing systems within agricultural value chains. It further aims to boost access to location-specific, reliable and real-time information on weather forecasts and alerts, irrigation scheduling, market information and analytics, and agricultural extension services. Helpline call centres set up in each country will provide information on best practices to improve crop production.

Another project, "Towards Rural Inclusive Growth and Economic Resilience" (TRIGGER II), aims to strengthen the economic resilience of small-and medium-sized enterprises, including smallholder farmers, and young and/or female entrepreneurs. The three-year project (2019–2021) is intended to improve the links between different market participants and to increase the added value of products and services in Tajikistan. Digitization is one of the cross-cutting issues it addresses, and its support is focused on four main areas of inclusive value-chain development, including access to market information for smallholder farmers via digital applications.

There are other World Bank projects in Tajikistan (Rural Economy Development Project, Agriculture Commercialization Project). One of the most important services in Tajikistan is Agroinform.Tj. The Agricultural Information Marketing System, which provides information services for representatives of agribusiness (e.g. farmers have access to data on seeds, weather and pests, and can share information with each other), was developed by Neksigol Mushovir, a public organization. The information can be obtained in many ways: via smartphone, a web portal, SMS services or a monthly newspaper.

The EU and FAO are supporting numerous projects and initiatives in the country. Computers were handed over to the Ministry of Agriculture of Tajikistan as part of the EU-funded project to strengthen the Ministry's institutional capacity. Office equipment has been distributed to district agricultural departments in order to advance data collection in the field and thus improve analysis and reporting by agricultural experts. Laboratory equipment to enhance the food quality and safety control system was given to the Committee for Food Security. FAO and the EU are also providing support for the introduction of a unified statistical system for agricultural production data, which is vital for agricultural planning and policy-making. In the summer of 2019, a pilot agrometeorological network was launched with EU and FAO support; it consists of three automatic agrometeorology stations in Tursunzoda, Konibodom and Balkhi districts. The network will introduce new methods for collecting and analysing weather data, in order to give farmers early notice about the environment, plant diseases and yields.

In December 2019, the Ministry of Agriculture asked FAO for assistance in the implementation of innovative technologies for agriculture, including in terms of digitization, strategy development and implementation, database development and a map of farms.

2.15 Turkey

2.15.1 Agriculture, workforce, ICT infrastructure

Table 16: Basic agriculture indicators in Turkey (World Bank WDI database)

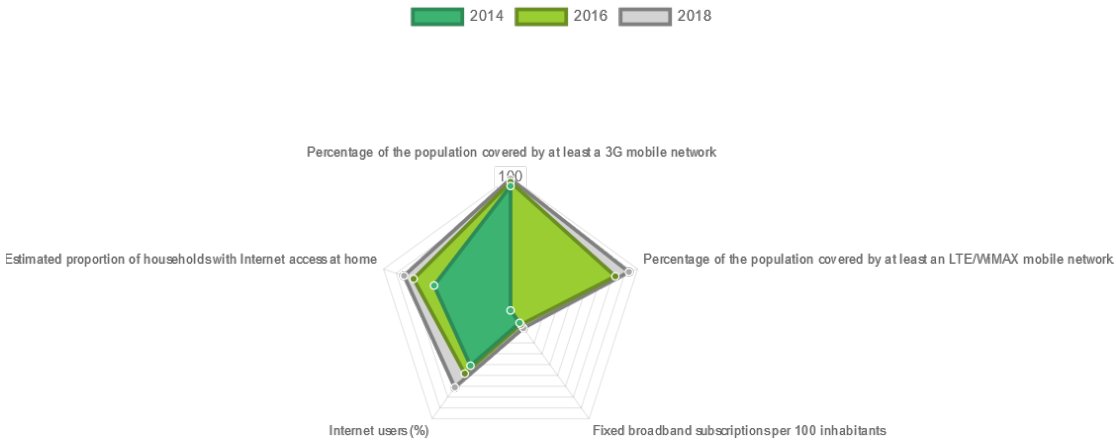
	2008	2018	Difference	Diff %
Population	70 418 604	82 340 088	11 921 484	16.93
Agriculture, value added (% of GDP)	7.48	5.77	-1.71	-22.86
Agricultural land (% of land area)	50.83	49.8 (2016)	-1.03	-2.03
Rural population (% of total population)	30.35	24.86	-5.49	-18.09
Employment in agriculture (% of total employment)	23.08	19.2	-3.88	-16.81
Employment in agriculture, female (% of female employment)	40.11	27.89	-12,22	-30.47

Historically, the agricultural sector has been Turkey's largest employer and a major contributor to the country's GDP, exports and rural development. Its share has been declining in proportion to the industrial and service sectors, but it continues to play a fundamental role, accounting for 5.8 per

cent of GDP, employing about a quarter of the workforce, and generating most of the income and employment in rural areas. Turkey started official membership negotiations with the EU in 2005.

Turkey has a relatively large telecommunication market with a huge potential for growth. Mobile and fixed penetration rates are below the European average, but are increasing rapidly. The country has a dynamically growing mobile-broadband market fuelled by a young population open to new trends in technology. 3G services were launched in 2009 and networks have since expanded rapidly, covering almost the entire population. LTE was launched in 2016, and uptake (89.3 subscriptions per 100 inhabitants) and coverage (98 per cent for 3G and 93 per cent for LTE) are on the rise. Seventy-five per cent of the population aged 16–74 uses the Internet, and 88 per cent of households have Internet access at home (see Figure 16). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is quite high; the respondents evaluated it at 3.38 on a scale of 7. Turkey is ranked sixty-fourth for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 3.82 on a scale of 7).

Figure 16: The basic indicators of ICT access and usage in Turkey (ITU WTI Database)



2.15.2 Strategy, policy, legislation

The Strategic Plan 2019–2023 adopted by the Ministry of Agriculture and Forestry addresses the development of information technology systems in several areas, including the improvement of institutional capacity using software, hardware and new services, and expanded e-services in agriculture offered through the E-government Gate. Strategies have been determined in this area under the objective of "Developing Information Systems and Ensuring Information Security".

Under the strategic plan, studies are being conducted to follow technological developments, take measures relevant to information security and reliability, determine policies and principles, and produce solutions that comply with public information standards.

The use of technology in agriculture has recently gained greater prominence. The Department of Agricultural Technologies and Mechanization was established under the General Directorate of Agricultural Reform. A related unit has been designated to develop policies and strategies pertaining to the use of advanced technology and mechanization in agriculture, work with the public and private sectors and universities on the digital transformation of agriculture, conduct conformity tests of new agricultural technologies in terms of agricultural practice, and disseminate the use of these technologies.

The Ministry of Agriculture and Forestry has begun studies to update the legislation on experiments and inspections of agricultural technologies and mechanization tools. It plans to start work on legislation for the establishment of the National Agricultural Machinery and Technologies Council, which will be convened annually and bring together all the stakeholders in the sector.

2.15.3 Services, applications, knowledge sharing

The Ministry of Agriculture and Forestry offers 27 e-services via the E-government Gate, such as the farmer registration system, the agricultural parcels information service, the livestock identification service (which allows searches for cattle by ear tag number) and the land consolidation service. By 2018, the Farm Accountancy Data Network had been extended to all 81 provinces and integrated into the agricultural production and registration system. A new EU-supported project, "Target 2020", for improving the network's data quality and capacity to analyse agricultural policies, is scheduled to be implemented in 2020.

The public and private sectors, working with academics, have established the Intelligent Precision Agricultural Platform, also referred to as the Smart Farming Platform. The platform website provides frequent updates on news and events regarding e-agriculture in Turkey, and links to reports, scientific publications and blogs about smart farming and precision agriculture. Turkey has also introduced the Meteorological Observation System, whose 1 867 stations provide minute-by-minute data. In 2018, 798 agrometeorological warnings were issued and sent to 52 000 authorized persons via SMS.

According to the latest release of the Ministry of Agriculture and Forestry, Integrated Administration and Control System software that is completely unique in the EU context has been developed and field-tested in two pilot regions. It combines the expertise and experience of EU Member States with an analysis of local requirements. In Turkey, the Integrated Administration and Control System, called TRIACS, is a web-based system comprising numerous modules; it is expected to enhance the administration and control of the agricultural support payments disbursed to more than two million farmers in Turkey and to be used by more than 10 000 Ministry staff members. Development of the LPIS, which constitutes the main component of the new Integrated Administration and Control System in Turkey, has been completed with EU support.

The Vodafone Farmers' Club is made available on the network as a package offering both special tariffs and agricultural information to help smallholder farmers improve their farming practices, increase productivity and income, and gain better access to markets. In collaboration with Tabit (tabit.com.tr), a social enterprise specializing in ICTs in agriculture, Vodafone is also developing the Smart Villages Project, which combines advanced technology with the capabilities of traditional farming methods. In collaboration with the financial and agricultural sector, Vodafone has also launched the "Digital Agriculture Project", installing an initial 10 Digital Agricultural Stations in one district; these will be followed by 20 more stations installed elsewhere at a later date. Farmers can use the stations to monitor their fields remotely for soil moisture and quality, and to receive early warnings about risks related to weather and pests.

Tarfin (tarfin.com) is a digital platform that enables farmers to obtain agriculture inputs thanks to instant financing solutions. The system uses transactional and farm-level data algorithms to evaluate applications. Doktar is an agri-ICT company offering digital products and services that provide agronomic advice, operational optimization techniques and market insight. Its goal is to optimize yields and minimize input cost by applying machine-learning algorithms and phenological development models to data collected from various sources. The Filiz agricultural mobile app by Turkcell aims to increase farm productivity and savings in irrigation. Toros Ciftci (torosciftci.toros.com.tr) is a mobile app that helps farmers decide when and where to apply fertilizer based on meteorological data and plant phenology models.

The Smart Technologies Design, Development and Prototyping Centre will be established and operationalized as part of a new project, supported by the IPA II in Turkey, to increase the research and development capacities of agricultural machinery and equipment manufacturers in Konya region, enabling them to transform their conventional products into smart products.

According to the updated FAO Country Programming Framework for Turkey 2016–2020, under government priority 3 (Institutional Capacity Enhancement of Public and Private Sectors), one of the main planned outputs is the strengthening of agricultural extension services, including through ICTs in agriculture. At least five training sessions for extension services and relevant stakeholders were to be held by 2020 on the use of ICT tools in agriculture and on the concept of e-agriculture development.

The Ministry of Agriculture and Forestry is drafting the National E-Agriculture Strategy, which is expected to take shape in the course of 2020, in collaboration with FAO. The drafting process started with the inception workshop, which was held in Ankara in November 2019 and organized by the General Directorate of Agricultural Research and Policies, and the project team has been set up. The next steps are being taken in a timely manner.

FAO, in collaboration with the EBRD, is carrying out a study to identify promising digital technologies in agriculture, focusing on private sector-driven technologies. The study will conduct a scoping exercise so as to examine in depth technologies such as digitally enabled agricultural credit appraisal and farmer decision support systems, to better understand their potential and constraints. The study will be completed in the course of 2020.

Credit: Treinen S. – FAO – mushroom farm management system

2.16 Turkmenistan

2.16.1 Agriculture, workforce, ICT infrastructure

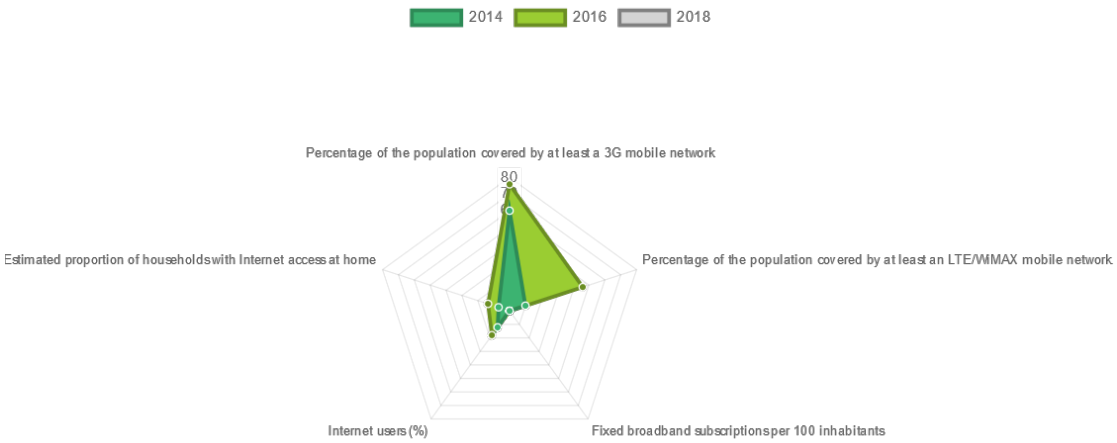
Table 17: Basic agriculture indicators in Turkmenistan (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	4 935 767	5 850 901	915 134	18.54
Agriculture, value added (% of GDP)	10.72	9,3 (2015)	-1.42	-13.25
Agricultural land (% of land area)	73.1	72.01 (2016)	-1,09	-1,49
Rural population (% of total population)	52.13	48.41	-3.72	-7.14
Employment in agriculture (% of total employment)	24.49	22.78	-1.71	-6.98
Employment in agriculture, female (% of female employment)	23.58	21.96	-1.62	-6.87

Turkmenistan depends directly on irrigated agriculture for food security and the economic livelihoods of about half of its 5.85 million people. Agriculture contributes 10 per cent of GDP and employs one-fifth of the population. Livestock, wheat and cotton are the main sectors of economic activity.

The mobile-cellular market is expanding rapidly in Turkmenistan. Public institutions are being connected to the Internet and the number of Internet users is growing. 3G was launched in 2010 by Altyn Asyr (it covered 76 per cent of the population in 2017) and the same company put an LTE network into operation in 2013 (it covered 67 per cent of the population in 2017). Mobile services are becoming more affordable, but mobile-broadband penetration is only 22.83. In 2015, Turkmenistan launched its first telecommunication satellite. About 21 per cent of the population uses the Internet and about one out of ten households (11.09 per cent) has Internet access at home (see Figure 17).

Figure 17: The basic indicators of ICT access and usage in Turkmenistan (ITU WTI Database)



2.16.2 Strategy, policy, legislation

In 2018, under Turkmenistan–UNDP cooperation, the Turkmen Academy of Sciences developed the Digital Turkmenistan State Programme. The main objective is to stimulate the development of ICTs, improve the sector's contribution to GDP and eliminate the digital divide. The programme is to be implemented in three phases: in 2019, between 2020 and 2023, and during 2024 and 2025. The first phase will concentrate on Internet provision, which is among the most important goals. The programme was approved by the president in a decree stipulating that ministries, sectoral departments, regional and city administrations, companies, institutions and organizations of all ownership type, and private entrepreneurs were to ensure its implementation. The final concept outlines the goal, objectives and main directions of development of the Turkmen digital economy, together with measures to increase the contribution of ICTs to GDP and to improve the digital sphere of the national economy. The country has recently enacted legislation on cybersecurity and plans to adopt legislation on electronic documents and an electronic document management system.

2.16.3 Services, applications, knowledge sharing

Big investments are being made in agriculture, mainly for integrated modernization of infrastructure and procurement of highly productive agricultural equipment from leading world producers. At the same time, measures are being taken to implement a digital system to operate mechanical works. These measures include the system for electronic management of the agricultural complex. In this regard, close attention is being paid to education and science, and to the expansion of information and advisory services. The development of a land registry for accurate record keeping is a high priority, because the State Land Cadastre includes information about land depending on its type, amount, qualitative characteristics, economic cost and location, and a single State geological information system developed by the land owners.

In November 2018, the Government of Turkmenistan and John Deere International GmbH met in Ashgabat to sign a memorandum of understanding on the development of cooperation in the agricultural sphere. In accordance with the memorandum of understanding, the Ministry of Agriculture and Environmental Protection will transition to a telemetric digital system in three stages between 2019 and 2022, and the high-performance John Deere and Claas agricultural machinery purchased by Turkmenistan from 2013 to 2019 will be equipped with telemetry in the next few years. This will enable the operators to remotely track the machinery's location and measure its fuel consumption, actual operating time, load and many other parameters. The State also plans to create a national data centre that will store and process data, host server and network equipment, and connect subscribers to the Internet. Work is currently being done to enable the use of Turkmenistan's satellite, which functions in many other industries, in the agricultural sector, with the new equipment from leading manufacturers.

2.17 Ukraine

2.17.1 Agriculture, workforce, ICT infrastructure

Table 18: Basic agriculture indicators in Ukraine (World Bank WDI database)

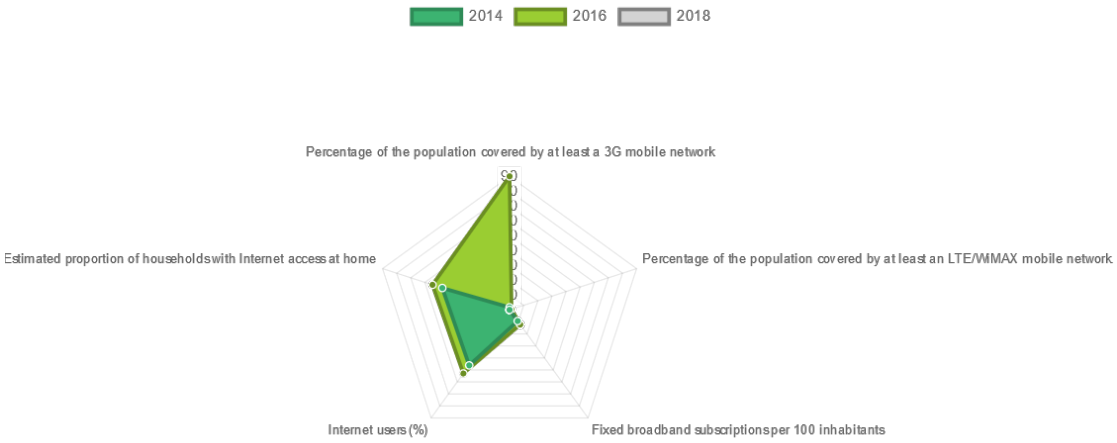
	2008	2018	Difference	Diff %
Population	46 186 430	44 009 214	-2 177 216	-4.71
Agriculture, value added (% of GDP)	6.86	10.14	3.28	47.81
Agricultural land (% of land area)	71.28	71.67 (2016)	0.39	0,55

	2008	2018	Difference	Diff %
Rural population (% of total population)	31.68	30.65	-1.03	-3.25
Employment in agriculture (% of total employment)	20.38	15.33	-5.05	-24.78
Employment in agriculture, female (% of female employment)	19.66	12.97	-6.69	-34.03

Agriculture is one of the main sectors of the Ukrainian economy, as the country's arable land area is equivalent to almost 30 per cent of arable land in the EU and accounts for about 25 per cent of the world's most fertile black soil. Recently, the agricultural sector moved to the forefront of the Ukrainian economy, contributing 10-12 per cent of GDP (nominal) and employing approximately 15 per cent of the working population. Agricultural and food product exports rose from 20 to 40 per cent between 2012 and 2018. The Ukrainian agricultural sector is dominated by large farms and agro-holdings, with about 70 agricultural companies engaged in relative monoculture on 25 per cent of the arable land. Besides the large entities, an estimated 900 000 or so unregistered smaller or family farms produce crops with higher added-value for local markets and generate most job opportunities in rural areas. Because of the very favourable conditions (climate and rich soils), Ukraine's agricultural sector has great potential for improvement and further development.

Ukraine also has strong potential for mobile- and fixed-broadband market development. Operators are eager to introduce new services and attract new subscribers. In 2014, the National Commission for the State Regulation of Communications and Informatization announced a tendering process to acquire frequency bands for UMTS deployment. As a result, in 2015 frequencies in the 30 MHz band were acquired by Kyivstar, MTS/Vodafone and Astelit/Lifecell. This boosted mobile-broadband market development, and 3G coverage increased significantly, from 1.7 per cent of the population in 2014 to 90 per cent in 2017, as did the number of subscriptions (from 7.56 in 2014 to 45.23 in 2018). Fifty-nine per cent of the population uses the Internet, and about three out of five households have Internet access at home (see Figure 18). According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.43 on a scale of 7. Ukraine is ranked 115th for the Global Competitiveness Index indicator "Future orientation of government" (with a value of 2.98 on a scale of 7).

Figure 18: The basic indicators of ICT access and usage in Ukraine (ITU WTI Database)



2.17.2 Strategy, policy, legislation

The Agricultural and Rural Development Strategy 2020, which was approved at the end of 2015, is the guiding document for agricultural and rural policy in Ukraine. It focuses on the following priorities: land reform, food security, agri-food value chain development, and rural development and the revival of the Ukrainian village. Other strategies and action plans exist, some of them in the making or awaiting endorsement, e.g. a fisheries strategy and draft action plan, a forestry strategy, and an irrigation and drainage strategy prepared jointly by an expert team from the World Bank, FAO, and local governmental and scientific organizations. Following the presidential elections, Ukraine's governmental architecture has been undergoing structural changes. A new strategy for the development of agriculture is one of the key actions that the new government is planning to complete. Work has started on the strategy's development, in which digitization of agriculture is expected to be one of the priorities, and is to be completed in the first half of 2020.

The digitization of government services and their accessibility to citizens have been set as priorities in Ukraine. The Strategy of Public Administration Reform for 2016–2020 was adopted in June 2016 and revised in 2018. The strategy and its action plan provide for several very concrete actions in the e-government area, including interoperability, a single portal for e-services, and an electronic intragovernmental document management system. To further accelerate the pace of reform in the e-governance sector, Ukraine has adopted the Concept of e-Governance Development until 2020 (E-Governance Concept) and its Implementation Plan, which set ambitious targets for the development of e-government in Ukraine. In 2017, Ukraine adopted the Concept of Development of the Digital Economy and Society of Ukraine for 2018–2020 and its Implementation Plan.

In September 2019, the Ukrainian Government established the Ministry of Digital Transformation, which is responsible for formulating and implementing State policy in the sector of digitization. The newly established Ministry is planning to make all public services available online, including those related to agriculture.

In 2019, the European Commission also supported related developments under the European Neighbourhood Instrument, including with regard to e-governance, the digital economy, agriculture and small farm development. As an analysis notes in relation to e-government developments, the Ukrainian Government's strategic documents set very ambitious goals. In some areas, progress has been made, albeit not always systematically. The Ukrainian Government is aware of this and has made digital transformation one of its key priorities, with the Digital Agenda for Ukraine. The agenda focuses on overcoming digital inequality, building the country's innovative infrastructure and digital transformations, and further aligning with the EU Digital Single Market. The agenda also addresses the problem of the digital divide and aims to make digital technologies more accessible, including by ensuring public access to broadband Internet, especially in smaller cities and remote areas.

In the agenda's digital economy section, there is a digital agriculture subsection that stresses the fundamental role of digital technologies in the agricultural sector's development in the next 50 years. The agenda refers essentially to precision agriculture, citing the economic, environmental, health-related and social benefits thereof. There are a number of advantages and preconditions that support the development of precision agriculture in Ukraine: favourable natural conditions, the rapid development of agriculture, numerous agrotechnology companies and successful experience with precision farming in different regions of Ukraine. The agenda calls for support for the production, technical, educational and scientific aspects of precision agriculture, the training of qualified specialists and the creation of a milieu that can facilitate the "digitization" of the agricultural sector. It also considers that the "digitization" of agriculture should be viewed as part of a broader programme of "digitization" of the countryside, bridging the digital divide and promoting the socio-economic revival of rural areas.

Ukraine adopted the National Cybersecurity Strategy and Action Plan in 2016.

2.17.3 Services, applications, knowledge sharing

Public administration as well as agriculture and rural development policy documents both emphasize the development of the State Land Cadastre, as complete and accurate information is crucial to the functioning of the agricultural land market, including fraud prevention. The Ministry for Development of Economy, Trade and Agriculture is planning to unite all existing registries (e.g. farmers' registry, animal registry, land cadastre) into one national information system. Meanwhile, the Ministry of Energy and Environment Protection is developing two information platforms: a timber tracking system and a system of fisheries vessel monitoring, in order to ensure traceability and combat illegal logging and illegal, unreported and unregulated fishing.

Access to agricultural extension and business advisory services – the range of services supporting business creation and growth – is low. According to one 2015 study, the country has failed for years to design and support the establishment of sustainable agricultural extension schemes and there are almost no active extension services in Ukrainian rural areas. This further worsens the plight of small farms, which have not been provided with effective advice on how to develop and integrate with value chains, and lack the funds and knowledge needed to take advantage of such services when they exist.

On the positive side, over the last few years, Ukraine has demonstrated significant interest in new technologies in agriculture. There are around 70 agritech start-ups at various stages of development and involved in different phases of activity: farm management solutions (hardware developers), precision farming solutions (hardware developers), drone-based and remote sensing solutions, and urban farming start-ups. The domestic start-up ecosystem, including business accelerators and venture capital companies, is growing around the Ukrainian agritech industry. One of the most notable examples is AgroHub, a collective impact organization that brings together players from across the sector to realize multiple collective benefits. Some notable start-ups in Ukrainian agritech that made deals in the last five years are eFarmer, a precision farming start-up; Agrieye, a producer of multispectral cameras for remote sensing; the agricultural drone developer Drone.ua (which also received funding from Moldova); Kray Technologies, a developer of unmanned aerial vehicles for spraying crops; and BIOsens, the developer of a mobile food-quality testing laboratory (which won the Intercontinental Start-up Battle in San Francisco in April 2017). Also, large Ukrainian agricultural holdings are becoming increasingly involved in proprietary and joint agritech projects, working with e-agriculture companies such as Bitrek (telemetry equipment producer) and Craftscanner (automating adjustments of soil cultivation depth). There is also an association, AgTech Ukraine, to promote the role of IT in agriculture.

FAO, in partnership with the European Bank for Reconstruction and Development, is carrying out a case study on digital technologies in the grains and oilseeds sector, focusing on the adoption of specific precision agriculture tools and machinery by producers. The study is expected to be completed in the spring of 2020.

2.18 Uzbekistan

2.18.1 Agriculture, workforce, ICT infrastructure

Table 19: Basic agriculture indicators in Uzbekistan (World Bank WDI database)

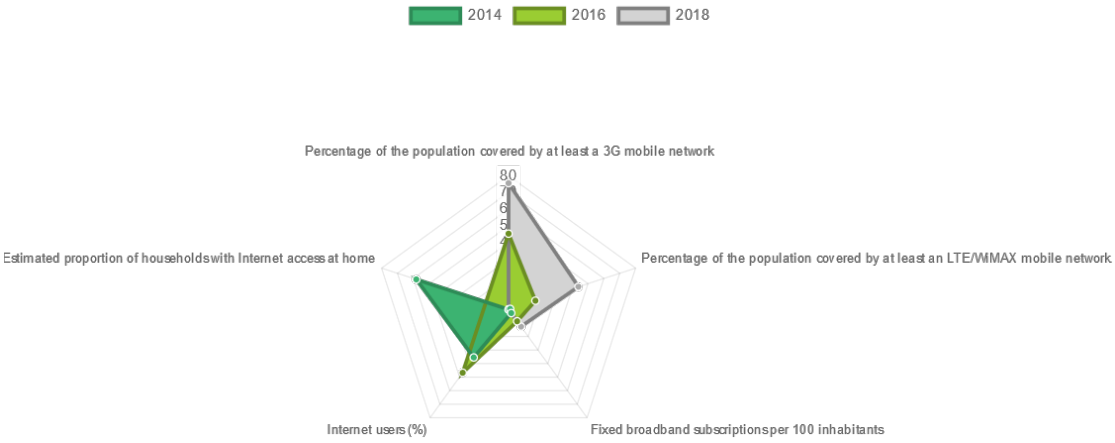
	2008	2018	Difference	Diff %
Population	27 626 982	32 476 244	4 849 262	17.55
Agriculture, value added (% of GDP)	19.69	28.79	9.1	46.22
Agricultural land (% of land area)	62.62	62.93 (2016)	0.31	0.5

	2008	2018	Difference	Diff %
Rural population (% of total population)	50.01	49.52	-0.49	-0.98
Employment in agriculture (% of total employment)	35.41	33.36	-2.05	-5.79
Employment in agriculture, female (% of female employment)	39.19	37.38	--18.81	-4.62

Uzbekistan has a total area of 44.8 million ha. About 4.5 million ha are arable, of which 4 million ha are under irrigation. Agriculture plays a major role in the economy: it employs 33 per cent of the country's 32 32 million people, is growing at an annual rate of 1.7 per cent and contributes 28 per cent to GDP. Uzbekistan's economy has been performing well in recent years, with economic growth driven primarily by State-led investments in and exports of natural gas, gold and cotton. Uzbekistan has reformed the agricultural sector, creating private commercial farms that are typically 20 to 100 ha in size, thus avoiding the land fragmentation that has occurred in other CIS countries.

The country has one of the most prospective mobile-broadband markets in Central Asia. LTE network deployment and Internet access tariff changes are among the main telecommunication market growth factors. All GSM operators deploy LTE networks. In the first half of 2017, the Uzbekistan Government reallocated 900/1800 MHz radio frequency bands among mobile telecommunication operators to facilitate market competition. According to the latest ITU data, LTE coverage is 44 per cent. In order to develop Internet broadband access, more than 1 800 km of optical fibre lines were laid in 2015. The ratio of wireless broadband subscriptions is 62.36 per 100 inhabitants. In Uzbekistan, about half of the population uses the Internet (52 per cent), and about eight out of ten households (79.9 per cent) have Internet access at home (see Figure 19), but the household data are likely to be distorted by the fact that the survey did not use the ITU standard methodology.

Figure 19: The basic indicators of ICT access and usage in Uzbekistan (ITU WTI Database)



2.18.2 Strategy, policy, legislation

In Uzbekistan, the latest agricultural policies are aimed at promoting crop diversification and environmentally friendly production systems that result in high-quality products with better market access. In this regard, the growth of organic farming is recognized as a promising path for the enhancement of domestic product competitiveness and the development of export potential. The Government has set out a longer-term strategy to diversify and intensify crop production, adopting a presidential decree, "Measures for agricultural reform and promotion from 2016 to 2020", in 2015.

Uzbekistan's Agriculture Development Strategy for 2020–2030 was approved in October 2019. In general, the strategy identifies nine strategic priorities for the development of agriculture, among them the development of a system of agricultural science, education, information and advisory services (which is important as the country has no national extension service) and of a reliable system of industry statistics. In 2017, the Uzbekistan Government that took office in 2016 adopted a development strategy, the holistic Five-Area Development Strategy for 2017–2021. The strategy defines five priority areas as top priorities for all government agencies and their officials:

- improving the system of State and public construction;
- ensuring the rule of law and further reforming the judicial system;
- realizing economic development and liberalization;
- developing the social area;
- developing the field of security, interethnic and implementing a balanced, mutually beneficial and constructive foreign policy.

The National Action Strategy seeks to have Uzbekistan achieve high-middle-income country status by 2030 while maintaining social stability and undertaking structural transformation of the economy. In October 2018, the Government of Uzbekistan approved its National Sustainable Development Goals until 2030 by decree of the Cabinet of Ministers.

From 1995 to 2010, a set of ICT development programmes was implemented. The programme activities were mostly national telecommunication network construction and renovation. The national government and international organizations subsequently took action to promote the digital economy in Uzbekistan, in terms of strategic planning, resource mobilization and implementation. At a strategic level, from 2012 onwards, a series of presidential resolutions was adopted on the development of ICTs. At programme level, the national government, especially the State Committee for ICT, has been active in areas such as e-government, blockchain and artificial intelligence. Its activities include developing ICT infrastructure, establishing online portals for government services, creating the State Blockchain Development Fund, and training people in the use of ICT facilities. The country also has an open data portal (data.gov.uz/en).

2.18.3 Services, applications, knowledge sharing

In 2019, Uzbekistan published a plan to incorporate smart farming and agro-innovation. The first move in this direction was the agreement between the Ministry of Agriculture, OneSoil and Boston Consulting Group on the use of satellite data in agriculture in Uzbekistan. The project will be implemented in a pilot region using satellite images of crops in the fields in the multispectral range. International agencies such as the World Bank and the United Nations have also been supporting Uzbekistan's digitization.

As part of its Digital CASA Project, the World Bank is attempting to make ICTs more affordable in Uzbekistan by encouraging private investment in the ICT sector and enhancing the government's capacity to deliver digital government services. The World Bank-supported Villages Project (accepted in November 2019) will also help improve the quality of basic infrastructure, including Internet service. The United States Agency for International Development (USAID) developed an application for Uzbek farmers, especially those with orchards and vineyards. The main goal of the project is to meet the high demand for horticultural value-chain information. The application is called "Mobile Extension Value Added Application" (Meva App). USAID also introduced social media and later messaging applications in the Agricultural Value Chain (AVC) project, growing and sustaining engagement. UNDP has provided support to a young scientist from Inha University in Tashkent, who developed a combination weather station–pheromone trap and a special software that allows farms to keep records and sends out SMS alerts about the spread of plant diseases and pests. The system's main advantages are affordability, accuracy (based on the localization of algorithms used for prediction) and the availability of an Uzbek interface.

3. Conclusions

ICTs have been clearly observed to play an emerging role in Europe and Central Asia, acting as an engine for agricultural development, especially as demand grows for reliable and readily accessible information at all levels of the industry. The state of the digital agriculture ecosystem differs from country to country, and from region to region in individual countries. The use of ICTs in agriculture has spawned a tidal wave of innovation, making a digital agriculture strategy a good means of finding the right way forward. The process of integrating countries into regional economic organizations such as the EU and the Eurasian Economic Union has been seen to increase the efficiency of institutional systems and spark greater interest and efforts on the part of many governments to formulate a national digital agriculture strategy.

For countries in the process of EU accession, the main motivation and driving force for systematic coordination of agricultural information management is the need to meet CAP requirements. Candidate countries are already applying IPARD or IPARD-like programmes, which are similar to those of EU Member States and require harmonization of the institutional and implementing framework, including the information systems in place. In this regard, the most central system is the Integrated Administration and Control System, which connects the main functional components of the national agricultural information system, such as the LPIS, the farm registry, the livestock registration and identification system, and the payment management systems for subsidies and grants to be operated by the paying agencies. Other CAP-related systems, such as the FADN, the national statistical service and the market price information system, are also being developed.

According to the European Commission annual country progress reports, the preparedness of these systems is varied, but the process is advancing. What is important to highlight here, in relation to the need to develop national e-agriculture using a strategic approach, is that all these ongoing projects should be closely coordinated at the highest level following the main strategic principles of the ITU/FAO E-Agriculture Strategy Guide[2], such as the need for standards and interoperability, service orientation, capacity development and farmer support.

Among the countries reviewed, a number have been identified as having a systematic approach to the development of a national e-agriculture strategy.

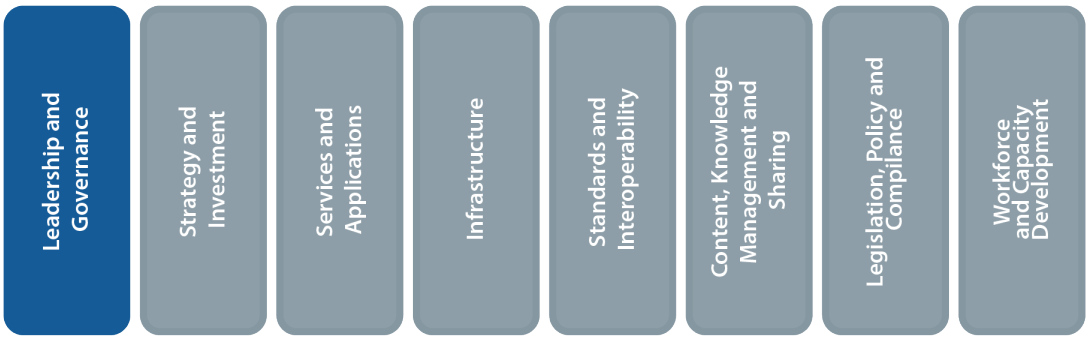
1. **Albania** is laying the groundwork for the development of its national e-agriculture strategy and vision, with the support of the FAO Regional Office for Europe and Central Asia. The process started in 2019 and continues in 2020.
2. In the second half of 2018, the EU-funded FAO ENPARD project, "Technical Assistance to the Ministry of Agriculture of the Republic of **Armenia**", which benefits from FAO technical cooperation, helped the Armenian Government develop a vision for the national e-agriculture strategy. FAO continues to support the development of the action plan for digital agriculture in 2020.
3. In 2014, **Moldova** decided to develop a national e-agriculture strategy. The review revealed no trace of a follow-up, but the concept of e-agriculture was enshrined in the National Strategy for Agricultural and Rural Development (2014–2020) and in the government e-Transformation programme.
4. In the **Russian Federation**, key stakeholders jointly set up the Digital Agriculture Project and developed the concept for the scientific and technological development of digital agriculture, which encompasses the vision for the national e-agriculture strategy, in 2018.
5. In **Turkey**, the Ministry of Agriculture and Forestry has started developing a national e-agriculture strategy with the technical assistance of FAO. The project inception workshop was held in Ankara and attended by several stakeholders in November 2019. The strategy continues to be developed in 2020.

[2] see www.fao.org/in-action/e-agriculture-strategy-guide/en/ .

6. In **Kyrgyzstan**, the Digital Roadmap on the implementation of the digital transformation concept, Digital Kyrgyzstan 2019–2023, includes the preparation of an ICT implementing policy for the development of the agricultural sector. The Agricultural Sector Development Programme involves ICTs and includes an action plan for implementation in 2019–2022. FAO was officially approached in February 2020 to provide technical support for the development of a draft national e-agriculture strategy.
7. Tajikistan and Uzbekistan requested FAO assistance for the development of their respective national e-agriculture strategy in 2019.

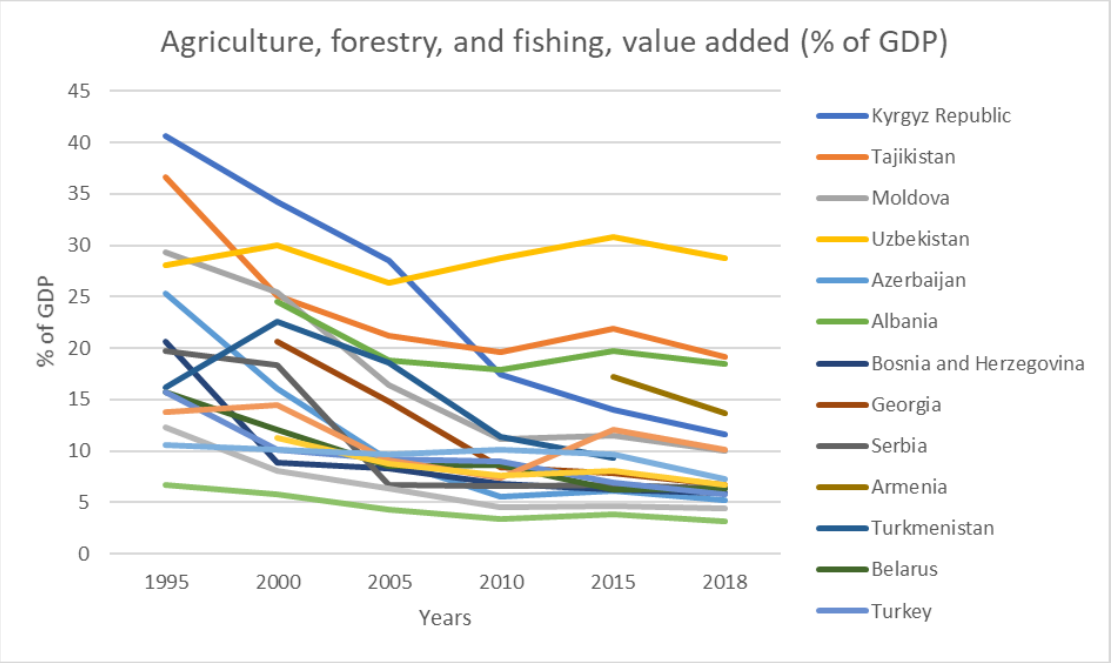
Further conclusions can be drawn in line with the eight components of a national e-agriculture strategy identified in the FAO/ITU E-Agriculture Strategy Guide (see diagram).

Leadership and governance:

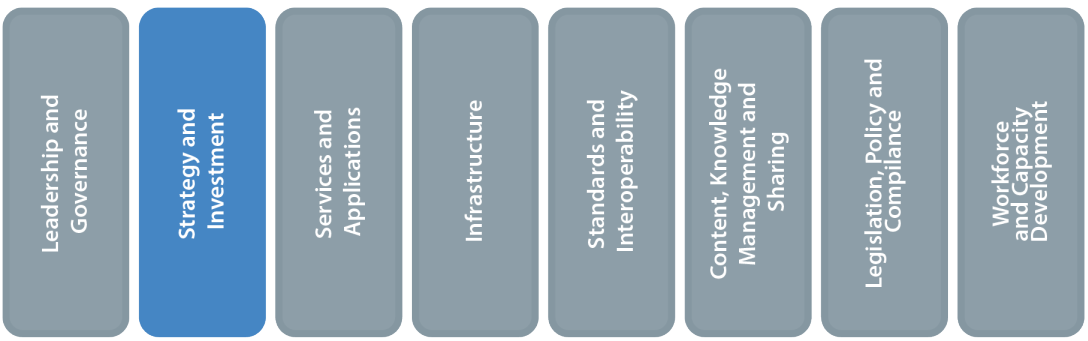


Despite the declining importance of the farm sector to national (see Figure 20)economies, most of the 18 countries reviewed assign high priority to agricultural development.

Figure 20: Agriculture, forestry, and fishing, value added in the studied countries (% of GDP, 1995-2018) (World Bank WDI database)

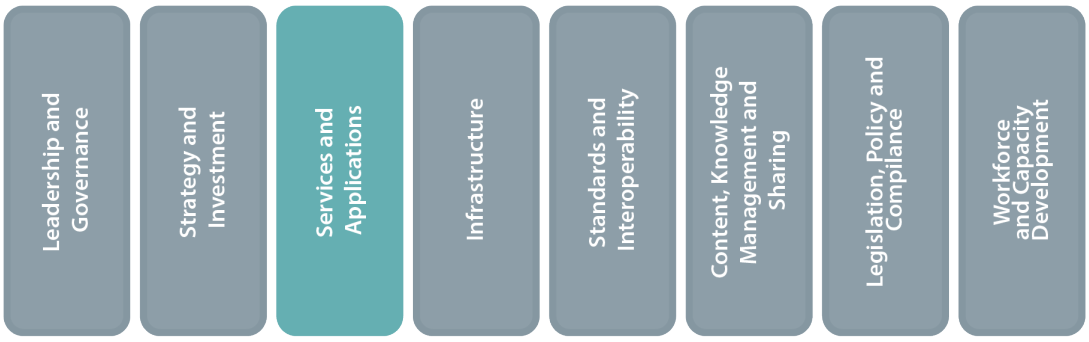


Digital solutions are almost exclusively designed to promote production, resource efficiency and economic growth. E-agriculture is generally being developed at the junction, not only of the information society and the digital economy, but also as a fundamental element of current and planned agricultural and rural policies in almost every country in the region. The majority of governments have a clear understanding of what e-agriculture means (although different governments emphasize different elements of the concept) and how can it help to achieve their agricultural development goals. In many countries, new organizational units are being set up for digital development tasks, and they have to work with existing agricultural institutions. One of the obstacles to formulating a strategy can be lack of cooperation between the players in the e-farming ecosystem, which makes it difficult to develop a horizontal strategy. There are only several "champions" (people or agencies) in this area who organize and coordinate IT developments in agriculture more systematically. The complexity of agriculture – which is characterized by numerous types of participant, sectors, regulations, biological factors, etc. – is an important reason why it is more difficult to initiate and implement a successful e-strategy in this sector than in some others. Underestimating that complexity is another risk that has sometimes been observed in the case of ICT development experts with no relevant sectoral experience.



Strategy and investment: Almost all the information society strategies and digital agendas formulated in the region in the past few years contain some elements of e-agriculture, and many set out concrete

programmes for e-agriculture development (in various forms, e.g. a State e-agriculture system, an initiative or action plan, a dedicated section in a general action plan, or a separate action plan for agriculture). Table 20 summarizes the most significant documents and initiatives in this field. In many cases, it is questionable whether the very ambitious goals set out in the strategies can be achieved, especially within the strict deadlines set (and in some cases already passed, with the goals only partially met). The strategies' implementation has often had mixed results – the existence of a strategy does not guarantee successful implementation. The strategy itself does not resolve the challenges, but it can create an environment in which solutions can be found. The implementation of a national strategy for digital agriculture is no guarantee of success, but without it the efficiency and performance of the entire sector are likely to be significantly lower. Concrete measures have dedicated State funding, but private entities are also active, especially in countries where precision agriculture is a viable option. International donor organizations too have supported initiatives in almost every country studied, providing the opportunity to develop ICT-based services (mainly targeting smallholders and family farms) that would not have been developed by private sector alone.



Services and applications: One of the most important trends in the development of services and applications is the government-to-business (G2B) services, based on systems with control functions related to the implementation of agricultural policies. These services are established, based on a relationship between organizations of public administration and private enterprises. Furthermore, services and applications related to precision agriculture play a key role in public and private sector development in countries with larger economies. A variety of mobile applications have also been developed, the smartphone being the main means of Internet access for farmers in the region. Take, for example, online public services. For the purpose of accessing the available metrics at the regional level, the 18 countries were divided into three main regional groups and their values used to calculate the regional averages provided in Figures 21 and 22. Using the United Nations E-Government Development Index (and one of its main components, the Government Online Service Index, which reflects differences in levels of e-government development among countries), it can be seen that the index is highest in the second group (Armenia, Azerbaijan, Belarus, Georgia, Russian Federation, Ukraine), while the Government Online Service Index is around 0.70 for both the first (Albania, Bosnia and Herzegovina, Moldova, North Macedonia, Montenegro, Serbia, Turkey) and the second groups, and that Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) has lower scores in both comparisons. Of the countries examined, the Russian Federation, Belarus and Kazakhstan have the highest E-Government Development Index scores.

Table 20: Digital economy and e-agriculture-related policy documents in the 18 countries reviewed in the report

Country	Government initiative (statement) on digital economy	Digital economy vision (draft, concept, etc.)	Digital economy strategy (plan, project, etc.)	Government initiative (statement) on e-agriculture)	E-agriculture vision (draft, concept, etc.)	E-agriculture strategy (plan, project, etc.)
Albania			Digital Agenda of Albania (2015–2020) Digital Agenda Strategy Economic Reform Programme 2019-2021 National Broadband Plan		In progress	
Armenia				Sustainable Agricultural Development Strategy – Vision 2029	In progress	
Azerbaijan	Azerbaijan 2020: Look to the Future		The National Strategy of Information Society Development in the Republic of Azerbaijan 2014–2020	Strategic Roadmap on Agricultural Production and Processing		Electronic Agriculture Information System (EKTIS)
Belarus	Presidential Decree No. 8, on the development of the digital economy		Strategy of Informatization in the Republic of Belarus for 2016–2020 State Programme for the Development of the Digital Economy and Information Society for 2016–2020	Programme for the Socio-Economic Development of Belarus for 2016–2020 State Programme for the Development of Agricultural Business in the Republic of Belarus for 2016–2020		Part of the State agriculture complex development programme

Table 20: Digital economy and e-agriculture-related policy documents in the 18 countries reviewed in the report (continued)

Country	Government initiative (statement) on digital economy	Digital economy vision (draft, concept, etc.)	Digital economy strategy (plan, project, etc.)	Government initiative (statement) on e-agriculture)	E-agriculture vision (draft, concept, etc.)	E-agriculture strategy (plan, project, etc.)
Bosnia and Herzegovina			Policy for the Development of the Information Society of Bosnia and Herzegovina for the Period 2017–2021			Strategic Plan for the Rural Development of Bosnia and Herzegovina 2018–2021 (measures 6.3.1 and 6.9)
Georgia			State Programme on Broadband Infrastructure Development	Strategy for the Agricultural Development of Georgia 2015–2020 Rural Development Strategy of Georgia 2017–2020 Strategy for Agriculture and Rural Development 2021–2027		Market information e-system, data warehouse
Kazakhstan			"Digital Kazakhstan" State programme	State Programme for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan	National e-agriculture vision	Programme for e-agriculture (Е-АПК)
Kyrgyzstan		Vision team has been formed	Digital Kyrgyzstan 2019–2023 Roadmap for implementation of the digital transformation concept "Digital Kyrgyzstan 2019–2023"			Agricultural Sector Development Programme using ICTs and an action plan for its implementation for 2019–2022 National e-agriculture strategy in process

Table 20: Digital economy and e-agriculture-related policy documents in the 18 countries reviewed in the report (continued)

Country	Government initiative (statement) on digital economy	Digital economy vision (draft, concept, etc.)	Digital economy strategy (plan, project, etc.)	Government initiative (statement) on e-agriculture)	E-agriculture vision (draft, concept, etc.)	E-agriculture strategy (plan, project, etc.)
Moldova			National strategy for a digital economy "Digital Moldova 2020" Strategy for the development of the information technology industry and the digital innovation ecosystem for the years 2018–2023 Broadband Development Programme for the years 2018–2020			Strategic programme for e-agriculture in 2013 The concept of e-agriculture was enshrined in the National Strategy for Agricultural and Rural Development (2014–2020) and the strategic e-Transformation programme.
Montenegro			Strategy for the Development of the Information Society for the period 2017–2020, and an action plan for the years 2018–2020			Smart Specialization Strategy S3.me Centre of Excellence programme Agri-ICT a key area of intervention in the flagship initiative Digital Transformation

Table 20: Digital economy and e-agriculture-related policy documents in the 18 countries reviewed in the report (continued)

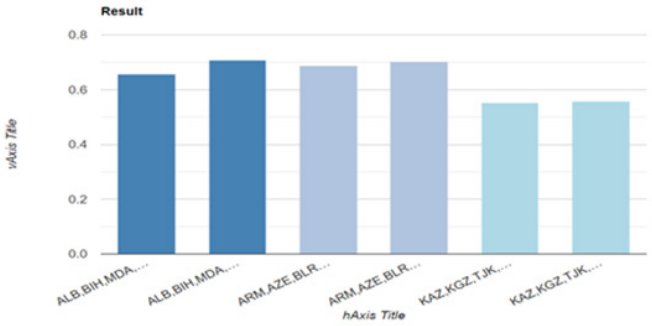
Country	Government initiative (statement) on digital economy	Digital economy vision (draft, concept, etc.)	Digital economy strategy (plan, project, etc.)	Government initiative (statement) on e-agriculture)	E-agriculture vision (draft, concept, etc.)	E-agriculture strategy (plan, project, etc.)
North Macedonia			Strategy and Action Plan for Open Data 2018–2020 A long-term national ICT strategy is being drafted on the basis of a roadmap developed in 2018. Strategy for Public Administration Reform 2018–2022			
Russian Federation	Adoption of the national project		National project Government programme, 2018, Digital Economy of the Russian Federation	Ministerial project (Ministry of Agriculture)	Scientific and technological development of digital agriculture	Proposed by academics and policy-makers, not yet adopted
Serbia				National Programme for Rural Development (2018–2020)		Smart Specialization Strategy will be related to ICTs and food for the future
Tajikistan		Concept of digital economy in the Republic of Tajikistan	National Development Strategy of the Republic of Tajikistan for the period to 2030			

Table 20: Digital economy and e-agriculture-related policy documents in the 18 countries reviewed in the report (continued)

Country	Government initiative (statement) on digital economy	Digital economy vision (draft, concept, etc.)	Digital economy strategy (plan, project, etc.)	Government initiative (statement) on e-agriculture)	E-agriculture vision (draft, concept, etc.)	E-agriculture strategy (plan, project, etc.)
Turkey			Digital Turkey Roadmap	In progress – the Strategic Plan 2019–2023 of the Ministry of Agriculture and Forestry addresses the development of information technology systems in several areas	In progress	
Turkmenistan		Draft version, not published	Digital Turkmenistan State Programme			
Ukraine		Digital economy vision	Digital Agenda for Ukraine (with digital agriculture subsection)	New strategy for the development of Agriculture is in progress and expected to cover the digitization of agriculture		The digital economy section of the Digital Agenda has a digital agriculture subsection.
Uzbekistan	Government statement Presidential decree "Measures for agricultural reform and promotion from 2016 to 2020"					

Figure 21: The E-Government Development Index and the Online Service Index in three regional groups of countries (United Nations E-Government Survey, 2018)

Indicator name	Country	Year	Value
Egovernment_Index	ALB,BIH,MDA,MKD,MNE,SRB,TUR	2018	0.6565
Online_Service_Index	ALB,BIH,MDA,MKD,MNE,SRB,TUR	2018	0.7064
Egovernment_Index	ARM,AZE,BLR,GEO,RUS,UKR	2018	0.6864
Online_Service_Index	ARM,AZE,BLR,GEO,RUS,UKR	2018	0.7014
Egovernment_Index	KAZ,KGZ,TJK,TKM,UZB	2018	0.5502
Online_Service_Index	KAZ,KGZ,TJK,TKM,UZB	2018	0.5556

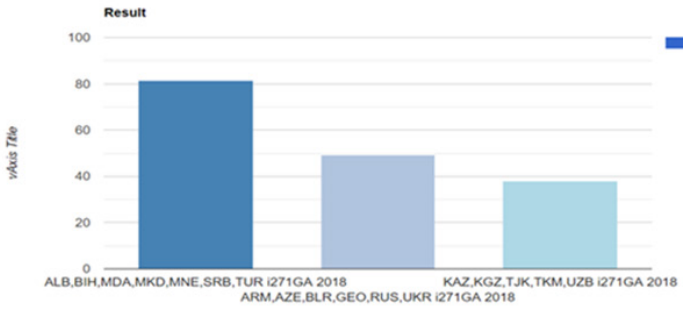


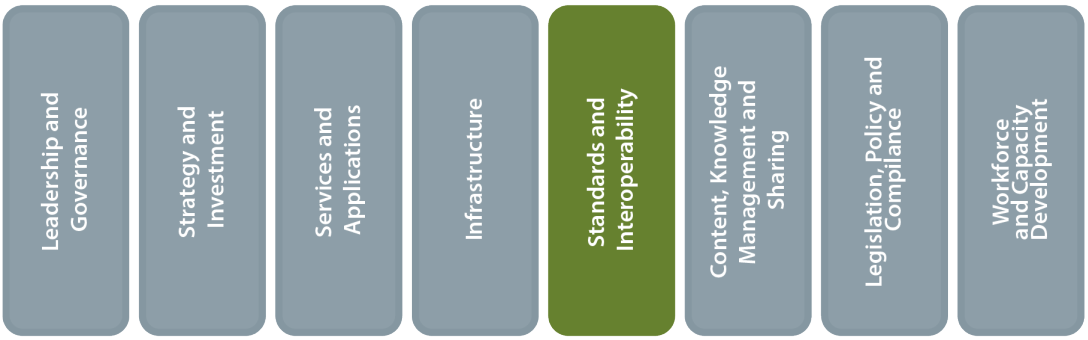
Infrastructure: In the majority of the countries reviewed, the percentage of Internet users is above 70 per cent; however, in some countries it is only around 20 per cent. Wired infrastructure is usually underdeveloped; on the other hand, wireless broadband (3G and LTE) is available in most rural areas. In some countries, electronic payment solutions and the introduction of ATM or mobile payment solutions are also part of the development agenda. Regarding one of the important ICT indicators, the first group of countries has the highest next-generation/LTE mobile network coverage: more than 80 per cent of the population is covered by an LTE/WiMAX network in these countries, a figure that is under 50 per cent in the other two groups (see Figure 22).

Figure 22: LTE/WiMAX coverage in three regional groups of countries (ITU WTI Database)

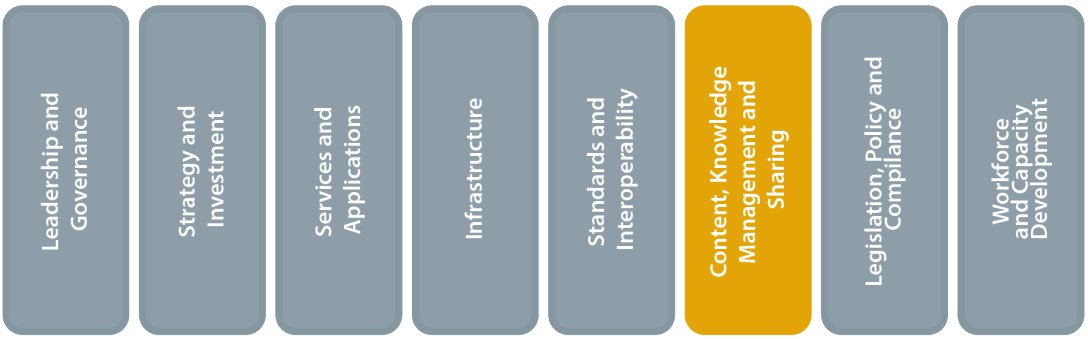
Font too small

Indicator name	Country	Year	Value
Percentage of the population covered by at least an LTE/WiMAX mobile network.	ALB,BIH,MDA,MKD,MNE,SRB,TUR	2018	81.4143
Percentage of the population covered by at least an LTE/WiMAX mobile network.	ARM,AZE,BLR,GEO,RUS,UKR	2018	49.07
Percentage of the population covered by at least an LTE/WiMAX mobile network.	KAZ,KGZ,TJK,TKM,UZB	2018	37.86

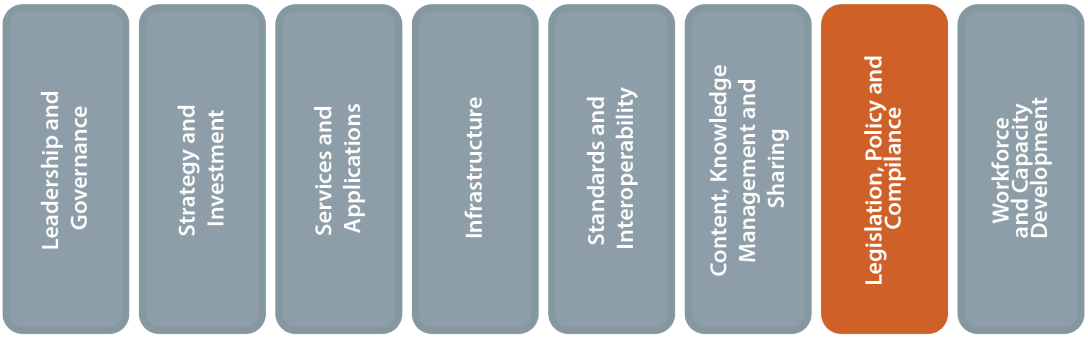




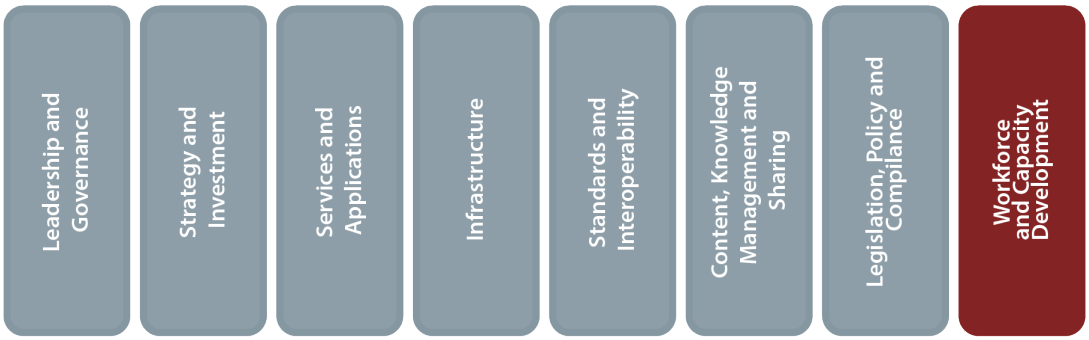
Standards and interoperability: Achieving interoperability within the public administration is a priority in many countries. Interoperability can also further digitization of agriculture by improving the availability of the diverse data needed. Monitoring systems are also crucial and are being developed in many countries. In parallel, many countries have to implement new standards for proper data collection.



Content, knowledge management and sharing: In part because databases are being built, agricultural content and applications are growing in the region; knowledge management and information sharing, on the other hand, need to be developed, particularly among smallholder farmers. The agricultural advisory services in some countries are also in need of significant development, especially as theseservices are expected to play a central role in helping smallholders and family farmers embrace digitization.



Legislation, policy and compliance: Legislation often lags behind the various actions and measures being taken, especially as digital solutions are constantly changing and are a “moving target” in terms of regulation.



Workforce and capacity development: Very few field initiatives have been taken to boost the digital skills of farmers, and data on the level of digital skills in the sector are almost non-existent. The role of intermediaries (connecting farmers with digital technologies) and their training) is also important in this respect. With the exception of Central Asia (where the economic importance of agriculture is clearly highest), most of the population is already using the Internet, but non-users are traditionally overrepresented in rural areas.

3.1 Recommendations, suggested next steps

The following suggestions apply to countries and supporting organizations working for the strategic development of digital agriculture.

- Currently, only the secondary metrics (the primary purpose of which is not to measure e-agriculture development) made available by various international organizations, such as ITU and FAO, serve to gauge each country's e-agriculture readiness. It is therefore indispensable to create primary indicators and to introduce a system for collecting and incorporating them into existing systems. As many countries are developing or upgrading their agricultural data-collection methods and systems, now would be the right time to incorporate agriculture-specific ICT indicators, including gender-disaggregated and smallholder farmers data.
- Participants in the Small Holder Innovation Platform (SHIP), supported by FAO and WeAreNet, suggest that collaboration and knowledge sharing should take place through online communities of practice, including existing regional networks, such as ESCORENA and AGROWEB, and global platforms such as the e-Agriculture Community of Practice. Such an approach would serve to disseminate conceptual models, methodologies and good practices – including in respect of innovative technologies, interoperability standards and open-data access – for the effective use of ICTs in agriculture, often based on strategic approaches. The development and implementation of national strategies for digital agriculture as part of national ICT and/or agricultural strategies should be a more straightforward rather than a stand-alone practice. It can be useful to identify the corresponding measures that already exist in the agricultural and information sector and are sometimes isolated. While these will not necessarily be formulated in a full national e-agriculture strategy in the near future in every country, it is recommended that the horizontal requirements for the coordination and interoperability of these systems be formulated, for example by making them part of the general conditions in the terms of reference, calls for procurement and service contracts.. It should therefore be ensured that existing strategies can be reviewed and transformed into national strategies for e-agriculture, with a view to moving towards digital transformation and attainment of the SDGs thanks to assistance from governments, international organizations, especially ITU and FAO, and relevant stakeholders. In addition, strategic partnerships should be built with other government organizations responsible for the process and the partnership ecosystem. As e-agriculture is a broad concept, usually several ministries and governmental agencies are responsible for its different aspects. It would be important to appoint a coordinating entity (even a "champion") for e-agriculture development.

- Greater emphasis should be placed from the outset on implementation, monitoring and evaluation, since the process usually loses its orientation by the end of the planning phase (strategy development) and in the subsequent steps.
- Lessons should be learned from other industries and regions. National e-strategies that work have been adopted in other sectors in the region (e.g. e-health), and some countries outside the region have functional national e-agriculture strategies (e.g. Sri Lanka, Bhutan, the Philippines, and Hungary and Spain in the EU). Developing a common government architecture or a common digital platform is a key driver for digitization across sectors not only in e-agriculture but also in e-health, e-education, and so on. For instance, the Smart Villages project in Niger is an example of a common digital platform developed thanks to collaboration between several ministries and organizations, including ministries of agriculture, health, education and ICT; telecommunication regulators; United Nations agencies such as ITU, FAO, WHO and UNESCO; and local telecommunication operators and start-ups. It is worthwhile to study both types of example carefully and to learn from their experience. There are numerous examples of e-agriculture in the ITU and FAO communities that can serve as a starting point.
- A regional database should be published for ICT-based agricultural services and projects. The successes and failures of current and previous digital agriculture projects in the region can serve both as positive reasoning for decision-makers developing political strategies and as useful lessons for all those involved in the strategy development and implementation process. Studying the practices contained in the repository for e-agriculture-related projects and functioning services at national and regional level can further the implementation of a comprehensive e-agriculture strategy.
- Regional peculiarities mean different success stories and insights gained. In the EU, greater emphasis is placed on ICT systems that facilitate the flow of subsidies and on the corresponding legislation, control and payment mechanisms (InVeKoS, LPIS, INLB, etc.), while in the other countries production, technology and innovation (increased yield, risk management, etc.) usually play a more important role. It therefore makes sense to attract decision-makers with examples of problems and solutions that are also at the centre of their political and professional interests.
- The farmer should be at the heart of the strategy – this must not be “forgotten” during the process being promoted by government agencies and other stakeholders isolated from “end users”. Departments tend to look no further than the limits of their own tasks and responsibilities, and expect positive effects from the strategy that promises to solve their problems first. The strategy should therefore be planned and implemented to ensure a win-win situation for both farmers and the government (and other stakeholders). It should always be people-centred and not technology-driven.
- Special attention is needed in the strategic approaches to introduce and apply digital technologies for smallholder and family farmers, using responsible innovation methods, respecting practical experience, tradition, attitude, mindset, relevant local farming and livelihood issues, assisted by a well-functioning rural advisory service in place.

4. List of resources

[1] A vision of national e-agriculture; Russian Federation, 2018

[2] Abstract- National Strategy for the Development of the Information Society "Digital Moldova 2020"; Government of Moldova, 2013

[3] Agriculture in Russia: Going Digital; https://www.maff.go.jp, 2019

[4] Agrometeorology alerts in Turkey; MGM- General Directorate of Meteorology, 2019

[5] agroNET; DunavNet, 2019

[6] Albania 2019 Report; European Commission, 2019

[7] Albania Voluntary National Review on SDGs; 2018

[8] Analysis of the agricultural and rural development policies of the Western Balkan countries; Joint Research Centre, 2016

[9] Analytical Report; European Commission, 2019

[10] ARDA opens the call for National Schemes applications 2019; ipard.gov.al, 2019

[11] Azerbaijan 2020: Look into the Future; The president of Azerbaijan, 2012

[12] Azerbaijan: Country Digital Development Overview; Asian Development Bank, 2019

[13] BIO-ICT CE for ICT technologies in the areas of sustainable agriculture; European Commission, 2016

[14] Chapter 11 Agriculture and Rural Development; Directorate for European Integration, 2018

[15] Characteristics of the LPIS as the main subcomponent of the Agriculture Information System; University of Sarajevo, 2013

[16] Climate-Smart Agriculture in Moldova; World Bank, 2016

[17] Commission Assessment of Economic Reform Programme of Montenegro (2018–2020); European Commission, 2018

[18] Consolidated Report on the practices in V4 and WB partner countries; IVF AE WB ICT project, 2017

[19] Country fact sheet on food and agriculture policy trends; FAO, 2017

[20] Country fact sheet on food and agriculture policy trends; FAO, 2018

[21] Country Strategic Opportunities Programme 2019–2024; International Fund for Agricultural Development, 2019

[22] Cross-cutting strategy Digital Agenda of Albania 2015–2020; European Commission, 2015

[23] Digital Agenda for Ukraine; Government of Ukraine, 2016

[24] Digital agriculture management system is implemented in Turkmenistan; Turkmenistan Today, 2019

[25] Digital Agriculture Practices in the Context of Agriculture 4.0; Manisa Celal Bayar University, 2017

[26] Digital farms to be created in Kazakhstan; AzerNews, 2018

[27] Digital Government Factsheet 2019 Republic of North Macedonia; European Commission, 2019

[28] Digital Government Factsheet 2019 Ukraine; European Commission, 2019

[29] Digital Solutions to Improve Agricultural Value Chains; Asian Development Bank, 2019

[30] Digital Transformation in the Kyrgyz Republic; National Information Technology Center, 2019

[31] Digital transformation of Belarusian agriculture named high priority; BELTA, 2019

[32] E-agriculture strategy vision development in Albania from 2020; FAO, 2019

[33] E-agriculture strategy vision development in Armenia; FAO, 2019

[34] Economic Reform Programme 2019–2021; Republic of Albania, 2019

[35] EU and UN FAO provide computer equipment to Tajikistan's Agriculture Ministry; Times CA, 2019

[36] EU4Digital; EU Neighbours, 2019

[37] EU Member States join forces on digitalisation for European agriculture and rural areas; EU, 2019

[38] FACTS AND FIGURES ABOUT EU-GEORGIA RELATIONS; EU, 2018

[39] FAO assist Moldova to boost agrifood promotion, improve data collection; FAO, 2019

[40] FAO CPF; FAO, 2019

[41] Filiz; Turkcell, 2019

[42] Geoportal of the Federal Administration for Geodetic and Property Legal Affairs; Bosnia and Herzegovina, 2019

[43] Georgia to use smart contracts in real estate registrations; Agenda.ge, 2018

[44] Georgia, 2019–2023 – Developing Caucasus's Gateway to the World; Asian Development Bank, 2019

[45] Global Competitiveness Report; World Economic Forum, 2018

[46] Global Competitiveness Report; World Economic Forum, 2019

[47] Hanehalkı Bilişim Teknolojileri (BT) Kullanım Araştırması; TUIK, Turkish Statistical Institute, 2019

[48] Integrated Administration and Control System in Turkey; Hilal Ar- Republic of Turkey Ministry of Agriculture and Forestry, 2019

[49] ICT-centric innovation ecosystem country review: Republic of Moldova; ITU, 2018

[50] Identifying Smart Specialisation Areas for the Republic of Moldova; Information Society Development Institute, 2019

[51] Information and Communication Technologies (ICT) usage in Households and by Individuals; Institute of Statistics, Albania, 2019

[52] Implementation of Agenda 2030 and the Sustainable Development Goals in Bosnia and Herzegovina; United Nations, 2019

[53] Intelligent Precision Agricultural Platform; akillitarim.org, 2019

[54] IPA II- Indicative Strategy Paper for Serbia; European Commission, 2014

[55] IPA II Annual Action Programme for Bosnia and Herzegovina for the year 2018; European Commission, 2018

[56] IPA2 revised Indicative Strategy Paper For Albania (2014–2020) adopted on 03/08/2018; European Commission, 2018

[57] ITU Global Climate Fund; European Commission, 2019

[58] Kazakhstan's agro industry goes digital; AstanaTimes, 2019

[59] Key achievements in advancing the digital agenda in the Republic of North Macedonia; 2019

[60] Land Resources Information Management System (LRIMS); FAO, 2019

[61] Measuring the Information Society Report 2018 – Volume 2; ITU, 2019

[62] MIDAS2; European Commission, 2019

[63] Ministry of Agriculture and Natural Protection to enter into contract with John Deere; Turkmenistan Today, 2019

[64] Ministry to implement agricultural payment processing software; Ministry of Agriculture, Water Management and Forestry, 2017

[65] Montenegro 2019 Report; European Commission, 2019

[66] Montenegro Economic Reform Programme 2019–2021; European Commission, 2018

[67] Montenegro FADN Pilot; GAK, 2016

[68] National Action Plan for an open government for the years 2019–2020; Republic of Moldova, 2018

[69] National E-agriculture Strategy Environment and Development in Armenia (consultant report); FAO, 2019

[70] National E-agriculture Strategy Project; Hilal Ar – Republic of Turkey Ministry of Agriculture and Forestry, 2019

[71] North Macedonia 2019 Report; European Commission, 2019

[72] North Macedonia ready for national forest monitoring; FAO, 2019

[73] Opportunities for precision agriculture in Serbia; BioSense/WUR, 2018

[74] Orange Moldova digital solutions for farmers; Orange Moldova, 2016

[75] Organic Agriculture in Uzbekistan: Status, practices and prospects; FAO, 2019

[76] Parliament of Turkmenistan to develop a law on electronic document management system; Azernews, 2019

[77] Plans for digital transformation of Belarusian agriculture explained; BELTA, 2018

[78] RI Roadmap Montenegro revised; Ministry of Science, 2019

[79] Russia Digital Economy Report, September 2018, Competing in the Digital Age: Policy Implications for the Russian Federation; World Bank, 2018

[80] Scaling-Up Climate-Resilient Practices in Agriculture and Water Management in Turkmenistan; UNDP/Green Climate Fund, 2017

[81] Sector Review of Agriculture Statistics of the Republic of Albania; European Commission, 2018

[82] Serbia 2019 Report; European Commission, 2019

[83] Serbia Competitive Agriculture Project (SCAP); World Bank, 2019

[84] Serbias Smart Specialisation Strategy; EU SCIENCE HUB, 2019

[85] Sikeresen zártuk azerbajdzsáni projektünket; Vialto, 2017

[86] System of Identification and Traceability of Animals; Information Technology and Cyber Security Service, 2007

[87] Situation analysis in World Bank partner countries; IVF AE WB ICT project, 2017

[88] Smart Specialisation Strategy of Montenegro; Ministry of Science, 2019

[89] Smart Technologies Design, Development and Prototyping Centre; TED, 2019

[90] State Programme for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2017–2021; FAOLex Database, 2017

[91] Status of Implementation of E-agriculture in Central and Eastern Europe and Central Asia; FAO, 2018

[92] Strategic Plan 2019–2023 of the Ministry of Agriculture and Forestry; Ministry of Agriculture and Forestry, 2019

[93] Strategic Plan for the Rural Development of Bosnia and Herzegovina 2018–2021; Ministry of Foreign Trade and Economic Relations, 2018

[94] Strategic Roadmap on Agricultural Production and Processing in the Republic of Azerbaijan; Centre for Analysis of Economic Reforms and Communication, 2017

[95] Strategy for the Development of Agriculture and Rural Areas 2015–2020; Government of Montenegro, 2015

[96] Summary of the strategy for sustainable agricultural development in the Republic of Armenia – Vision 2029; Government of Armenia, 2019

[97] SWG Annual Report; SWG, 2018

[98] Tajikistan and FAO; FAO, 2019

[99] The draft of the National Strategy for Agricultural Extension in Georgia 2018–2019 discussed; EU, 2018

[100] The Open Government Partnership Fourth Open Government National Action Plan for Albania 2018–2020; opengovpartnership.org, 2018

[101] The Potential of ICT in Serbia: An Emerging Industry in the European Context; Joint Research Centre, 2019

[102] The President of Turkmenistan sets objectives for improvement of efficiency of agricultural complex; Times CA, 2019

[103] The Republic of Macedonia EU Instrument for Pre-Accession (IPA) Rural Development Programme 2014–2020; IPARD PA MK, 2015

[104] The State of Macedonian Agriculture; AgriTeach4.0 project, 2017

[105] The Strategy for Agriculture and Rural Development of the Republic of Serbia in the Process of its Accession to the European Union;2015

[106] The World Bank in Georgia Country Snapshot; World Bank, 2019

[107] Toros Ciftci; TED, 2019

[108] Towards Rural Inclusive Growth and Economic Resilience (TRIGGER II) factsheet; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2019

[109] Turkey 2018 Report; European Commission, 2018

[110] Turkey 2019 Report; European Commission, 2019

[111] Turkmenistan approves Digital Economy Development Concept; Azernews, 2018

[112] Turkmenistan Digitizes Telecommunication and Farming; Business.tm, 2019

[113] Turkmenistan's economy on the verge of becoming digital; Strategeast, 2019

[114] TVET; UNESCO, 2019

[115] TVET Policy Review Uzbekistan; UNESCO, 2019

[116] Ukrainian Agri Sector Overview; National Investment Council, 2018

[117] Vodafone Digital Agriculture Project; Vodafone in Turkey, 2019

[118] Vodafone Turkey Farmers' Club; Vodafone, 2015

[119] Voluntary National Review on Sustainable Development Goals Albania; 2018

[120] World Bank project for agriculture and rural development; World Bank, 2016

[121] The implementation of information and communication technologies using satellite navigation systems in the agricultural sector in Belarus: problems and outlook; Igor L. Kovalëv, 2017

[122] State Programme for the Development of the Digital Economy and the Information Society for 2016–2020; ; government.by, 2016

[123] Sanarip Kyrgyzstan. 2019 Report;; National Information Technology Centre, 2019

[124] The digital economy—an opportunity for Belarus; M.M. Kovalev, G.G. Golovenchik, 2018

[125] "Support to Development of a Rural Business Information System"; TED- tenders electronic daily, 2019

Annex 1: FAO and ITU questionnaire on e-agriculture

Does your country have a digital strategy? *

- o Yes
- o No
- o Other:

If yes, is agriculture (forestry and fishery) part of this digital strategy?

- o Yes
- o No
- o Other:

Is the digital strategy publicly available? If yes, can you provide a copy of the existing strategy? (either a link or document) *

Please provide the name and email of the focal point in your institution for the digital strategy.

Does your country have a strategy for agriculture, fishery and forestry? *

- o Yes
- o No
- o Other:

If yes, is digital agriculture a part of it?

- o Yes
- o No
- o Other:

Is it publicly available?

- o Yes
- o No

Could you provide a copy of the existing strategy? (either link or document)*

Please provide the name and email of the focal point in your institution for the agriculture strategy.

Does your country have a strategy on e-agriculture or digital agriculture? *

- o Yes
- o No
- o Other:

Is it publicly available?

- o Yes
- o No

Could you provide a copy of the existing strategy? (either a link or document)*

If your country does not have a specific e-agriculture strategy, do you plan to develop one?

- o Yes
- o No
- o Yes, we have already started to develop one

Annex 2: Country response status

Country	Responded through
Albania	FAO and ITU
Armenia	FAO
Azerbaijan	FAO
Belarus	FAO
Bosnia and Herzegovina	FAO and ITU
Georgia	FAO
Kazakhstan	FAO
Kyrgyzstan	FAO
Moldova	ITU
Montenegro	ITU
North Macedonia	FAO and ITU
Russian Federation	FAO
Serbia	FAO and ITU
Tajikistan	FAO
Turkey	FAO and ITU
Turkmenistan	-
Ukraine	FAO and ITU
Uzbekistan	-

FAO Regional Office for Europe and Central Asia

20 Kalman Imre utca
H-1054 Budapest
Hungary

Tel: +36 1 4612000
Fax: +36 1 3517029

E-mail: FAO-RO-Europe@fao.org

FAO Subregional Office for Central Asia

Ivedik Cad. No. 55, 06170 Yenimahalle
Ankara, Turkey.

Tel: +90-312-307 95 00
Fax: +90-312-327 17 05

E-mail: FAO-SEC@fao.org

Office of the Director
International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435
Fax: +41 22 730 5484

Office of Deputy Director and Regional Presence
Field Operations Coordination Department (DDR)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdeputydir@itu.int
Tel.: +41 22 730 5131
Fax: +41 22 730 5484

Digital Networks and Society (DNS)
Email: bdt-dns@itu.int
Tel.: +41 22 730 5421
Fax: +41 22 730 5484

Digital Knowledge Hub Department (DKH)
Email: bdt-dkh@itu.int
Tel.: +41 22 730 5900
Fax: +41 22 730 5484

Partnerships for Digital Development Department (PDD)
Email: bdt-pdd@itu.int
Tel.: +41 22 730 5447
Fax: +41 22 730 5484

Africa

Ethiopia
International Telecommunication Union (ITU) Regional Office
Gambia Road
Leghar Ethio Telecom Bldg. 3rd floor
P.O. Box 60 005
Addis Ababa
Ethiopia

Email: itu-ro-africa@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon
Union internationale des télécommunications (UIT)
Bureau de zone
Immeuble CAMPOST, 3e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé
Cameroon

Email: itu-yaounde@itu.int
Tel.: + 237 22 22 9292
Tel.: + 237 22 22 9291
Fax: + 237 22 22 9297

Senegal
Union internationale des télécommunications (UIT)
Bureau de zone
8, Route des Almadies
Immeuble Rokhaya, 3e étage
Boîte postale 29471
Dakar - Yoff
Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 859 7010
Tel.: +221 33 859 7021
Fax: +221 33 868 6386

Zimbabwe
International Telecommunication Union (ITU) Area Office
TelOne Centre for Learning
Corner Samora Machel and Hampton Road
P.O. Box BE 792
Belvedere Harare
Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 4 77 5939
Tel.: +263 4 77 5941
Fax: +263 4 77 1257

Americas

Brazil
União Internacional de Telecomunicações (UIT)
Escritório Regional
SAUS Quadra 6 Ed. Luis Eduardo Magalhães,
Bloco "E", 10º andar, Ala Sul (Anatel)
CEP 70070-940 Brasilia - DF
Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados
International Telecommunication Union (ITU) Area Office
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown
Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343
Fax: +1 246 437 7403

Chile
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Merced 753, Piso 4
Santiago de Chile
Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Colonia Altos de Miramontes
Calle principal, Edificio No. 1583
Frente a Santos y Cía
Apartado Postal 976
Tegucigalpa
Honduras

Email: ituteguciglapa@itu.int
Tel.: +504 2235 5470
Fax: +504 2235 5471

Arab States

Egypt
International Telecommunication Union (ITU) Regional Office
Smart Village, Building B 147,
3rd floor
Km 28 Cairo
Alexandria Desert Road
Giza Governorate
Cairo
Egypt

Email: itu-ro-arabstates@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia-Pacific

Thailand
International Telecommunication Union (ITU) Regional Office
Thailand Post Training Center
5th floor
111 Chaengwattana Road
Laksi
Bangkok 10210
Thailand

Mailing address:
P.O. Box 178, Laksi Post Office
Laksi, Bangkok 10210, Thailand

Email: ituasiapacificregion@itu.int
Tel.: +66 2 575 0055
Fax: +66 2 575 3507

Indonesia
International Telecommunication Union (ITU) Area Office
Sapta Pesona Building
13th floor
Jl. Merdan Merdeka Barat No. 17
Jakarta 10110
Indonesia

Mailing address:
c/o UNDP – P.O. Box 2338
Jakarta 10110, Indonesia

Email: ituasiapacificregion@itu.int
Tel.: +62 21 381 3572
Tel.: +62 21 380 2322/2324
Fax: +62 21 389 5521

CIS

Russian Federation
International Telecommunication Union (ITU) Regional Office
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation

Email: itumoscow@itu.int
Tel.: +7 495 926 6070

Europe

Switzerland
International Telecommunication Union (ITU) Office for Europe
Place des Nations
CH-1211 Geneva 20
Switzerland
Email: eurregion@itu.int
Tel.: +41 22 730 5467
Fax: +41 22 730 5484

International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland

ISBN: 978-92-61-31141-4

9 789261 311414

Published in Switzerland
Geneva, 2020
Photo credits: Shutterstock