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E-agriculture: the Use of Information and Communication Technologies (ICTs) for the Development of Sustainable and Inclusive Food Systems and Trade Integration

Executive Summary

Traditional and innovative information and communication technologies (ICTs) offer unprecedented opportunities for accelerating agricultural development towards more sustainable and integrated agriculture and food systems and achieving United Nations (UN) Sustainable Development Goals (SDGs), including food and nutrition security. ICTs bring new models for service delivery, fair and inclusive trade, and social and financial inclusion, among others. However, digital technology dividends are not automatic; in order to allow everyone to benefit from the technologies at minimized risk, FAO advocates for a participatory e-agriculture strategy formulation and implementation at the national level.

This paper aims at discussing practical methods, concrete policy options and priority actions related to the digital transformation of the food and agricultural sectors in the region, while enhancing exchange on benefits and challenges in applying ICTs in agriculture, food livestock, forestry and fisheries. Members will be called upon to provide guidance, to share good practices with a focus on strategy formulation, identify policy options and specify needs for FAO support in e-agriculture.

This background paper defines the terms related to e-agriculture, presents its multiple benefits against the technology challenges in Europe and Central Asia, and builds the case for a national e-agriculture strategy. Policy options are identified, and areas for FAO assistance are proposed.

Guidance sought from the Regional Conference

The Regional Conference may wish to encourage its Members to:

1) share good practices and lessons learned from traditional and innovative e-agriculture initiatives and applications.
2) emphasize the importance of combining digital technological innovations with other innovations, including biological improvement and agroecology as well as enhanced capacities of all actors in order to promote a development change and provide exclusive solutions in food and agriculture systems.
3) develop a structured approach to foster and implement innovative solutions to strengthen the national e-agriculture strategy towards digitalizing food and agriculture systems, in dialogue with key stakeholders, including ICT-solution developers, farmer organizations and communities, advisory services and academia.
4) develop and apply international standards, including on interoperability, open data and data sovereignty.
5) take full advantage of the inclusive, multistakeholder approach for e-agriculture policy formulation and implementation piloted by FAO.
6) request FAO to:

    - continue assisting the countries in Europe and Central Asia in transforming their agricultural sectors and leveraging the livelihoods of farmers, both women and men, through e-agriculture as a cross-cutting issue and in the framework of the three Regional Initiatives; [1]
    - collect and analyse good practices, tools and mechanisms for knowledge sharing and provide policy advice and capacity development to maximize the benefits and minimize the risks of e-agriculture technologies;
    - develop, in collaboration with national, regional and international partners, a capacity-development framework in e-agriculture at all levels (policy-makers, institutions and people);
    - provide a neutral regional platform to share knowledge on, and support the implementation of, the national e-agriculture strategies for countries in Europe and Central Asia; and
    - establish a national and regional digital innovation ecosystem, in collaboration with public and private partners, to foster cross-sectoral dialogue and support youth entrepreneurship to identify and accelerate innovative solutions using new technologies in a structured way.

[1] Results and Priorities for FAO in the Region (ERC/18/5)

I. Introduction

1. Agriculture and food remain important sectors in the countries of Europe and Central Asia; they also are a major source of employment. Yet, the region demonstrates high heterogeneity with respect to macroeconomic indicators, availability of resources, agricultural practices and policy goals for food and agriculture. For instance, agriculture accounts for 1.5 percent of the GDP in the 28 member countries of the European Union (EU28) on average and up to 25 percent in some countries in the Western Balkans, the South Caucasus and Central Asia. Agricultural and rural development in the region is shaped by several drivers[2] and has to overcome various challenges towards the shift to sustainable food systems and improved trade integration. Such challenges include the triple burden of malnutrition; 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.

2. E-agriculture (FAO, 2015) is recognized as a key enabler of agricultural and rural development through improved information and communication processes. It involves designing, developing and applying innovative ways to use information and communication technologies in the rural domain, with a primary focus on agriculture and food, including fisheries, forestry and livestock. Technological application, facilitation, support of standards and norms, capacity development, education and extension belong to the broader concept of e-agriculture.[3]

3. The potential for data acquired through e-agriculture to fundamentally change food and business systems is real and immediate. With the introduction of big data analytics, cloud computing, cheap and improved sensors, and high-bandwidth mobile communication, a revolution in e-agriculture has been observed in the past decade, known as Agriculture 4.0. It paves the way for the next (r)evolution, consisting of unmanned operations and autonomous decision systems. Agriculture 5.0 will be based around robotics and artificial intelligence. Hence, the impact of those new technologies is still unknown and requires further socio-economic assessment and strategic and participatory planning, and structured environments to explore and assess innovation proposals led by FAO and member countries.

4. In the Europe and Central Asia region, Internet penetration ranges from 28 percent in Central Asia up to 98 percent in some European Union Member States. ICT indicators, such as mobile phone subscriptions, individuals using the Internet, households with Internet access, and mobile broadband subscriptions (ITU, 2017), as well as the preparedness of governments to take advantage of ICTs and the status of business IT environments (World Economic Forum [WEF], 2016), show great variations among the countries in the region. The analysis of countries' indicators allows the clustering of countries in Europe and Central Asia according to their preparedness to formulate and implement policy measures aimed at transforming their agricultural sectors through digitalization (FAO, 2018b).

5. However, digital technology dividends are not automatic, and not everyone can benefit equally. Support systems and capacity development are pertinent for generating a development change through ICTs in agriculture. 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.

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[2] Rural livelihoods and rural poverty; farm structure; sustainability of food production and food systems; food insecurity, and agricultural trade policy (FAO Regional Strategic Review Paper, Europe and Central Asia), 2016 http://www.fao.org/3/b-i6102e.pdf

[3] More details provided in paragraphs 2-6 and Fig.1 and 2 of the ERC/18/3/Web Annex

6. Acknowledging the heterogeneity of the agriculture and food sectors in countries in the Europe and Central Asia region, the diversity of food and agriculture national policies and objectives, and the great variability in their preparedness to adopt e-agriculture, country-specific e-agriculture policy options closely aligned to the national agriculture and rural development policy goals are needed. Countries that are part of trade integration processes shall consider common actions to close the digital divide among countries, such as harmonizing regulatory and capacity frameworks and applying common standards and platforms.

7. FAO advocates 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 of Agriculture taking the lead while involving other key actors, engaging private sector, academia and civil society. In 2016, to assist countries in developing their national e-agriculture strategies and roadmaps, FAO and the International Telecommunication Union (ITU) jointly published a national e-agriculture strategy guide and toolkit.

II. Multiple benefits from e-agriculture

A. E-agriculture for integrated sustainable agriculture and food systems and social, economic and financial inclusion

8. Europe and Central Asia countries have embarked on transforming their food and agriculture sectors into sustainable agriculture and food systems (SFS). The SFS approach has three aspects: (i) integrating agriculture and food sectors into the overall economy; (ii) ensuring integration along the global value chain; while (iii) making SFS more sustainable.[4] With increased globalization, agriculture increasingly becomes less isolated and more connected with other spheres of the economy. A unique and integrated ICT-based platform can serve a holistic integration by channeling data from agriculture, environment, health and transportation and providing or making information available to consumers on products and quality, ensuring timely transportation of products to market, and empowering farmers through stronger linkages among small-scale producers, markets and financial services. Access to information allows stakeholders to make the best possible decisions and to optimize the use of the resources available, increasing access to information and advisory services, and engagement with consumers and beneficiaries with decision-making processes.

9. E-agriculture offers solutions, platforms and applications that go beyond the sole increase of production and help market inclusion, nutrition, management of food loss and waste, food safety and traceability along the value chain. An example is the creation of a virtual platform accurately estimating food losses and waste that can significantly contribute to meeting the objectives of the 2030 Agenda's Sustainable Development Goal 12. [5,6] (ICT in Agriculture, G20 report, 2016).

10. E-agriculture promotes efficiency and financial and economic inclusion throughout the SFS: Many tasks can be carried out at low cost, and many services can reach people who previously lacked access, contributing to closing the triple divide and increasing inclusion. The adoption and integration

[4] FAO has formulated five principles for sustainable food and agriculture:

1. improving efficiency in the use of resources is crucial to sustainable agriculture
2. sustainability requires direct action to conserve, protect and enhance natural resources
3. agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable
4. enhanced resilience of people, communities and ecosystems is key to sustainable agriculture
5. sustainable food and agriculture requires responsible and effective governance mechanisms

[5] SDG 12.1 Target - to halve per capita global food waste at the retail and consumer levels and reduce food losses along the production and supply chains, including post-harvest losses by 2030

[6] Under the presidency of Turkey in 2015, the G20, FAO and International Food Policy Research Institute (IFPRI) launched the G20 Technical Platform on the Measurement and Reduction of Food Loss and Waste.

of ICTs in many Europe and Central Asia countries has reduced information and transaction costs, improved service delivery and product quality, created new jobs, generated new revenue streams and saved resources.

11. Digitalization is a net job creator: for each job loss due to digitalization, 2.6 job positions are created as a result of introducing ICTs to an economy (WEF, 2013). However, the impact of digitalization by country and by sector is uneven. The World Economic Forum (WEF) (2013) recommends three types of policy measures to harness the varying effects of digitalization on the labour market: create strategies for sectors, which would be most considerably affected by digitalization; develop capabilities and ICT enablers; and create a multistakeholder ICT ecosystem to foster the development of innovative solutions, products and services to contribute to Agenda 2030.

12. In implementing the Agenda 2030's firm commitment on social inclusion of "leaving no one behind," e-agriculture can play (and has already played) a significant role in reducing the vulnerability of rural people living in geographically isolated areas. For example, social media tools are increasingly helping farmers form networks to exchange knowledge, find employment, or market for products. Rural communities are empowered through access to information and advisory services to participate in decision-making processes and political debate.

13. FAO (2013) elaborates on the ICT uses for inclusive agricultural value chains and distinguishes (i) ICTs for production system management, including on short- and long-term productivity and crisis and risk management; (ii) ICTs for market access services, such as pricing, virtual trading floors and holistic trading services; and (iii) ICTs for financial inclusion, such as transfers and payment, credits, savings, or insurances.

B. E-agriculture for trade integration

14. The digitalization of the economy and e-agriculture in particular offer invaluable opportunities for increased efficiency related to trade integration. For example, new ICT tools can facilitate cross-border e-commerce and participation in global agricultural markets for smaller and newer farm holdings. They have boosted the abilities of firms of all sizes and origins to find a niche in global value chains and gain access to new markets. The Internet provides a platform on which agricultural entrepreneurs can construct new businesses and commercialize their ideas, lowering entry barriers and freeing up resources for innovative activities. New technologies such as blockchain[7] will transform how food products move from one location to another, bringing improved accountability and transparency in food traceability, as well as enhanced support to smallholders in accessing emerging markets. On a macroeconomic level, the movement of data across borders is an essential component of new and rapidly growing ways of supplying agricultural goods and services, particularly in the context of trade integration. Harmonized platforms on agricultural produce and livestock according to recognized standards, such as the FAO/World Health Organization (WHO) Codex Alimentarius on food safety and e-traceability systems, will facilitate cross-border trade. E-traceability systems can trace in real-time a food product from farm to fork, indicating its origin, ingredients, allergens, nutritional value, sustainability credentials and industry certifications; they can also incorporate other types of food safety data that are valuable for the consumer, thus enhancing the trust along the value chain and promoting sustainability and protect and improve the livelihoods of local producers. E-traceability systems are also important for combating illegal fishing and contributing to fair trade by requiring catch documentation to import fish into the European Union, for instance.

[7] A blockchain is a digitized, decentralized, distributed public ledger for transactions. By design, a blockchain is inherently resistant to modification of data. The technology was originally devised for digital currencies but it is now finding uses in other areas, such as agricultural supply chains and land registers.

C. Attainment of UN Sustainable Development Goals through ICTs

15. ICTs have long been recognized as key enablers for achieving the three dimensions of sustainable development: economic growth, environmental balance and social inclusion. Policies that explore the full potential of ICTs can accelerate progress towards the attainment of the SDGs. The SDGs with the ICT components already set as targets, combined with the targets of the FAO Regional Initiatives and priorities, are 1.4, 2.a, 2.c, 2.4., 5.b, 8.2, 8.3, 12 and 15.

D. E-agriculture for improved governance in managing resources for food and agriculture, transparency, public awareness and participation in decision-making, and food security and nutrition

16. ICTs contribute to improved governance in food and agriculture. The digital technology tapping into satellite imagery is revolutionizing the way countries can assess, monitor and plan the use of their natural resources, including monitoring deforestation, crop and water management and desertification, or illegal fishing vessels. Access to easy-to-use digital tools **that monitor forest cover, land-use patterns, fishing activity in exclusive economic zones (such as the Black Sea), and changes over time are destined to become increasingly important as Europe and Central Asia countries implement** measures to adapt to and mitigate climate change in the most vulnerable sectors of the population, namely rural, mountainous and coastal communities dependent on natural resources. Coupled with other new technologies, satellite imagery can help inform early warning and disaster risk reduction systems.

17. Digitalization can increase transparency, help fight corruption and facilitate monitoring and reporting on many food system aspects, such as yield forecasts in Kazakhstan or local food loss and waste deployments, thus contributing to improved governance. Digitalization also allows for increased public awareness, access to information and participation in advocacy or in the decision-making processes of rural and geographically isolated communities, among others.

18. The use of ICTs can help Europe and Central Asia governments fight the triple burden of malnutrition (FAO, 2017) and meet the objectives of ICN2[8] Rome Declaration on Nutrition and Framework of Action. Inability to integrate, analyse and consolidate numerous scientific and health data into meaningful policies is described as a key obstacle in progressing with a sustainable nutrition agenda. Big data, especially when combined with open data, has the potential to enable quicker data collection from multiple sources and sectors and quicker transfer and analysis of nutrition monitoring, which can inform decision-making in a timely manner. The integration of clinical, research, genomic, nutritional, behavioural and food industry data can enable the provision of personalized solutions for each individual, help formulate knowledge-based food security nutrition policies and assist in their impact monitoring (Drewnowski and Kawachi, 2015).

E. E-agriculture for climate change mitigation and adaptation

19. The Europe and Central Asia region faces a substantial threat from climate change, with a number of the most serious risks already in evidence, such as average temperature increases of 0.5 degrees Celsius in the south to 1.6 degrees Celsius in the north (Siberia), with overall increases of up to 2.6 degrees Celsius expected by 2050. The climate effects are being demonstrated through floods and droughts, with both South Eastern Europe and Central Asia at risk for severe water shortages.

20. ICTs can help to develop early warning and disaster risk reduction models and study the impacts at global and regional levels, or by investigating climate change issues within specific sectors (e.g. to simulate the growth of specific crops under different climate change scenarios). Usually these tools are site-specific, but they can be applied at national and/or regional levels through a link to an appropriate

[8] FAO/WHO Second International Conference on Nutrition (ICN2)

geographic information system (GIS). Such tools can be converted to training tools for farmers and extension agents to increase their preparedness. In addition, tools such as Serious Games[9] can facilitate simulated trainings, enhancing access to and quality of capacity development for sustainable development and humanitarian response. Decision-support systems on climate-smart agriculture can focus on a variety of factors, influencing climate change and related responses. Those factors can be either exogenous (e.g. government policies, economy, etc.) or endogenous (e.g. location, scale, etc.) in relation to a specific farming system. As a result, these systems facilitate the planning of adaptation responses into a set of actions at farm and regional levels, from comprehensive assessments of the impacts of climate change and different farming techniques on crop productivity and agro-ecological systems sustainability to supporting the adoption of appropriate agronomy techniques or setting up an agro-technology transfer system.

21. ICTs provide actionable information such as agrometeorological information to communities and governments on disaster prevention, water, drought and frost management, in real time, while also offering advice on risk mitigation.

F. E-agriculture for smallholders and family farmers

22. ICTs can help single smallholder and family farmers (FAO, 2014) coordinate their planning and monitoring of production and marketing systems by virtually aggregating data. This provides them with a better analysis of their production and cost-saving opportunities. With proper tools and skills, they can make appropriate decisions on whether to join a cooperative for better market integration and reaching an economy of scale, or to continue managing their farms individually.

23. Access to credit, financial services and insurance services for smallholders and family farmers has been a major constraint to improving agricultural practices, productivity and incomes. With the increasing availability of mobile phones and the Internet, smallholder farmers can now access financial services much more easily, for instance in Azerbaijan and Turkey. Many Europe and Central Asia governments are developing different e-platforms to improve transparency and access to services for farmers. Such examples include "single window" or "one-stop-shop" systems in Albania (with FAO support), Republic of Moldova and Uzbekistan, while regional integration processes (European Union and Eurasian Economic Union accession) trigger development of e-specific platforms such as the Integrated Administration and Control System, animal identification systems and more.

III. E-agriculture challenges in Europe and Central Asia region and the way forward

24. Notwithstanding the unprecedented opportunities for more efficient and integrated agriculture and food systems, along with entirely new models for inclusive trade, new ICT technologies have the potential, if no mitigation measures are taken, to disrupt agriculture and food systems and provoke social and economic turbulences. Some of the ***technology challenges*** are discussed below:

25. **Triple divide: digital, rural and gender:** the 2016 World Development Report found that these "digital dividends" are not automatic and that not everyone benefits equally due to the fact that the necessary enabling capacities, adequate policies, infrastructure and regulations; newly required skills; and accountable institutions, are not equally present everywhere and accessible for everyone. Usually, these types of challenges are described as a "triple divide" consisting of the digital, rural and gender

[9] https://www.redr.org.uk/RedR/media/RedR/SCUK-Gamification.pdf

divides (FAO 2018a, Box 1). Advancing on inclusive, sustainable agriculture and food systems and trade integration is implausible if the triple divide is not significantly narrowed; thus it has to be dealt with as a priority.

26. **Complexity of using large sets of data and their analysis:** use of larger sets of data can potentially increase reliability but can also lead to more biases, due to existing disparities in access to digital technology. With big data, it is important to pay due attention to the validity and reliability of the information. New methods will therefore need to be scientifically developed, requiring adequate investment in research and development (R&D) in this area and increased collaboration with academic institutions and private sector industry experts. This is especially challenging for transition economies, in which R&D already suffers from lack of funds and proper linkages with all innovation actors. In addition, the use of large data sets and their analysis and translation into meaningful information is a very challenging task for farmers and consumers that requires coordination of efforts and capacity development at both production level and at end user and ICT developer levels.

27. **Open data:** open data is data that has been made freely accessible to the public, including tailored and localized data and information to meet the needs of smallholder farmers. Presenting open data from various sources to users via the Internet (e.g. via mobile applications) can have an important impact on development. Local communities can act both as providers and users of information. Users can also help validate and improve the quality of data. Promoting open data on weather, climate, and transboundary water flows is important in order to address climate change and improve natural resource management (World Bank Group, 2016), including disaster risk reduction and good governance (e.g. financial transparency, accountability and parliamentary openness) (Third International Open Data Conference, 2015). Open data is gaining significant traction in the agriculture sector; however, it increases the need to improve coordination and cooperation among actors and apply insights and experience in support of sustainable development. For instance, the Global Open Data for Agriculture and Nutrition (GODAN) supports the proactive sharing of open data to make information about agriculture and nutrition available, accessible and usable to help deal with the urgent challenge of ensuring world food security.

28. However, opening access to data is still a challenge for many countries worldwide, including in Europe and Central Asia (IODC, 2016), since stricter regulations and better guidance are needed for the sector that generates the data. For example, public research data should be, by default, open data; however, often these data are not accessible or are not in a suitable format for use by farmers. FAO supports the movement for Coherence in Information for Agricultural Research for Development (CIARD), which aims at providing specific guidance to research and knowledge institutions on open data provision.

BOX 1. Triple divide: digital, rural and gender aspects

Digital divide: This term refers to the gap between demographics and regions that have access to modern ICTs and those that either do not have access or have restricted access. In 2017, the ITU reported that the proportion of individuals using the Internet in Europe (79.6 percent) and in the Commonwealth of Independent States (CIS) (67.7 percent) is quite high compared with the world average (48 percent). Mobile-broadband subscription rates are much higher in Europe and the Americas than in other regions and are more than three times those of Africa. Closing the digital divide in Europe and Central Asia will contribute to better trade integration processes. Therefore, both the European Union and the Eurasian Economic Union are adopting strategies to boost digital economy.

Rural divide: This term refers to the gap between urban and rural areas in access to ICTs. Due to poor infrastructure and geographic and mobile isolation, rural communities in Europe and Central Asia are disadvantaged. Low incomes and a lack of digital skills are additional barriers to possible adoption of ICTs. The FAO study "Status of Implementation of e-Agriculture in Central and Eastern Europe and Central Asia: insights from selected countries in Europe and Central Asia" (2018) demonstrates that differences in connectivity and access to ICTs exist between cities and rural areas across the whole region, which can be a serious obstacle in the penetration of digital technologies in the agricultural and rural sectors.

Gender divide: Women and men do not have the same access, use and control over ICTs. The ITU (2017) reports that the proportion of women using the Internet worldwide is 12 percent lower than that of men. While the gender gap has narrowed in most regions since 2013, including in Europe and in the CIS, it has widened in Africa and worldwide. In 2017, the gender gap in Internet penetration in the CIS stood at 5.8 percent, while in Europe it was higher (7.9 percent) and is closing more slowly than in the CIS. Adding to the issue of access to ICTs, the increased digitalization of the agricultural sector may create misbalanced job opportunities for women and men, youth and elderly in the absence of equal digital skills. Furthermore, most of the commercial applications in use today in agriculture, such as drones and other precision farming technologies, have not been designed to serve the needs of the most vulnerable – smallholders and family farmers, both women and men.

29. **Data ownership and data sovereignty:** the service providers that market digital agriculture systems and data storage platforms are very often commercial providers. No standardized rules exist that govern the ownership of data generated and collected by machinery and technology on the farm, and it needs to be clarified whether those data should be owned by the farmer, by the service provider, or by the government. Concerns exist regarding the potential misuse of data by the service provider, such as third-party data use (often of data validation and method improvement). This will require the development of appropriate regulatory framework. Furthermore, data ownership needs to be further discussed and regulated in relation to the promotion of open-access data and the mitigation of security concerns.[10]

30. With digitalization, data becomes increasingly an economic good; thus, the value of data increases. Therefore, *data sovereignty* – which can be defined as entities (countries, physical and legal) being in control of their data – becomes a challenge, requiring greater regulation and effective governance. Creating and implementing data sovereignty standards can foster digital trade and business interaction, since it allows for data sharing while maintaining ownership over the data.

[10] Reference is made to paragraph 8 of the ERC/18/3/Web Annex.

31. **Interoperability:** this describes the extent to which systems and devices can exchange data and interpret that shared data. Interoperability becomes increasingly important when governments are developing many different platforms that need to communicate and exchange data with each other, instead of duplicating the effort of collecting and inserting the data for each and every concrete use. Smart agricultural machinery used in precision agriculture currently is not interoperable with devices from other brands, which together with the cost of the smart machinery is a serious obstacle for smallholders and family farms to applying precision agriculture. To that end, the platforms and devices need to be designed and built taking into account special interoperability protocols. The government's role would be to require the use of those protocols in systems and platforms of strategic significance as well as to provide brokerage between farmers and commercial providers. Implementing common interoperability standards can significantly boost trade integration processes. This highlights the need for the harmonization and standardization of digital technologies, especially as food suppliers often cross international boundaries for primary and secondary processing before reaching final consumers and thus need to be traced along the whole value chain.

32. **The agricultural sector is lagging in the adoption of ICT technologies:** in 2015, FAO's e-agriculture 10 Year Review Report concluded that, while substantial progress has been made in making ICTs available and accessible for rural communities, challenges remain with respect to the following seven critical factors for success. The report provided specific recommendations (Box 2).

BOX 2: Seven factors of success (Source: FAO 2015)

1. Provide adapted and reliable content from trusted sources.
2. Develop capacities in three dimensions: the enabling environment, organizational capacity and individual capacity.
3. Mainstream gender and diversity.
4. Increase access and participation.
5. Engage in partnerships, especially public-private.
6. Identify the right mix of technologies.
7. Ensure economic, social and environmental sustainability.

33. There are multiple reasons behind the slower than desired adoption of e-agriculture in the Europe and Central Asia region. Some of them stem from lower connectivity and infrastructure in rural areas; lack of access to affordable services; lack of relevant and localized content for farmers; lack of content tailored to different gender needs; lack of skills and capacities of the rural population, public administration, the education sector and extension services to engage with ICTs; challenges in optimizing returns of investment in ICTs, particularly for smallholders and family farms in Europe and Central Asia; insufficient access to/unavailability of credits and other financial schemes for use of ICTs in agriculture; farmers traditionally being the risk-averse type of entrepreneurs; lack of (access to) a solid body of evidence on the benefits of ICTs in agriculture; available IT solutions being less adequate to the farming practices in Europe and Central Asia; etc.

IV. The case for e-agriculture strategies. FAO national e-agriculture strategy guide

34. Much like other innovations, ICTs can substantially leverage national agricultural goals and assist in achieving the SDGs, including in the monitoring of their implementation, only if an appropriate enabling environment for the generation and adoption of innovations as **policies, institutional frameworks and capacities** is established. Yet in many Europe and Central Asia countries, the agricultural sector is only just beginning to explore more systematic and system-based approaches (FAO, 2015a).

35. An e-agriculture strategy is instrumental in increasing agricultural productivity and sustainability, while closing the digital divide in agriculture and rural areas as well as the triple divide more holistically, ensuring equal prospects for rural women and men, young and old, to access ICTs, increasing the pace of digital innovation and its adoption, facilitating incomes and job opportunities, in particular youth entrepreneurship. Agricultural research, education and extension can also greatly benefit from a national e-agriculture strategy, which can help establish rules for open data and interoperability, thereby ensuring promotion of national research outputs and timely sharing of global knowledge regulated by e-governance systems. Engagement with the private sector, such as solution developers, mobile operators and the agro-industry, is key to advancing e-agriculture through technological expertise and investment in sustainable e-agriculture tools within their business model. This has the potential to increase revenue and through access to new market opportunities if it contributes to national e-agriculture policies through the development of targeted and needs-responsive products.

36. An e-agriculture strategy guide and toolkit,[11] jointly prepared by FAO and ITU, has been produced to assist countries in developing or revitalizing their national e-agriculture strategy to mainstream ICTs in agriculture and develop an ecosystem to foster innovation in a systematic way. The guide has been piloted in several countries in the Asia and the Pacific region and in Albania. It consists of targeting ICT solutions for concrete problems on several levels, farm, institutional, or governance, aligned with the national agricultural and rural goals; preparing a roadmap and action plan using a multi-actor approach; implementing that plan; and evaluating it. Key steps in the formulation of strategy are ensuring inter-institutional cooperation through a coordination mechanism with telecommunication ministries and regulators on connectivity and infrastructure issues; developing a regulatory environment and standards for such issues as interoperability, open access, security and data ownership; facilitating the dialogue among private-sector IT developers, agribusiness and smallholders; ensuring the inclusion of the rural population, both women and men, focusing on youth and entrepreneurship ensuring alignment with national agricultural and rural strategy goals and implementation and monitoring of SDGs.

37. FAO developed a regional eAGRI index[12] assessing Europe and Central Asia countries' demand and preparedness to formulate and implement a strategy towards transforming their agricultural sectors through digitalization. The index is based on 90 existing indicators on the status of adoption of ICTs in the country, along with the enabling environment for ICTs and agriculture-related macroeconomic indicators. It provides guidance on the areas of emphasis/de-emphasis of national e-agriculture strategies, such as infrastructure, rural and gender divides, business environments, government preparedness to use ICTs, etc., thus offering a possibility for cost-efficiency during the strategy implementation while also indicating knowledge transfer opportunities with relevant Europe and Central Asia champion countries.

[11] www.fao.org/3/a-i5564e.pdf

[12] Details provided in paragraph 9, tables 1 and 2 and figure 3 of the ERC/18/3/Web Annex

V. Policy recommendations

38. Developing and implementing a national e-agriculture strategy is a key step for any country planning to use ICTs for agriculture to help reduce poverty, increase food security and nutrition and reach specific agricultural goals and priorities. FAO is encouraging member countries to take full advantage of the FAO e-agriculture strategy guide, facilitating tools and indicators by enriching the proposed indicator sets with data at the national level and adapting them to a national context.

39. More specifically, the following recommendations are made for governments' and other actors' consideration and for possible FAO action, to be endorsed by the FAO constituency and thus reflected in future work planning:

1) Contribute to bridging the triple divide by:

- addressing connectivity and infrastructure issues in rural areas;
- supporting the development of capacity for public administration, education, rural people and farmers to engage with ICTs, tailored to the needs of women and men, youth and elderly and the most vulnerable;
- ensuring access to information, knowledge and financial services on e-agriculture for smallholders and family farmers;
- strengthening the role of agricultural innovation systems, in general, and education and extension services, in particular, in engaging with e-agriculture; and
- enhancing (with the assistance of FAO) member countries' in-house skills of all stakeholders in e-agriculture by developing a capacity-development framework and enabling environment for e-agriculture at all levels, thus helping digital innovation take place in a systematic and sustainable way.

2) Develop a regulatory environment and apply standards, such as for interoperability, open access, security and data ownership and sovereignty, including through:

- enforcing open access data and interoperability;
- partnering with the private sector, academia and civil society; and
- cooperating and exchanging good practices at national and regional levels.

3) Enable the agricultural sector to innovate through ICTs by maximizing benefits and minimizing risks by:

- ensuring strong facilitative leadership of the line ministries responsible for agriculture and rural development while ensuring collaboration and coordination with other bodies and stakeholders;
- generating and ensuring access to a solid body of evidence on the benefits and risks of ICTs in agriculture and to statistics on the uptake of digital technologies, in particular for smallholders and family farms;
- reviewing the agricultural research agenda to incorporate topics related to e-agriculture, in particular for public goods (climate data, etc.); and
- creating incentives for commercial ICT developers to provide solutions for agriculture, including for smallholders and family farms, and an innovation ecosystem for the exchange and development of new solutions through a participatory framework.