Food and Agriculture Organization of the United Nations

Regional forum on e-agriculture for Central and South-East Europe

"Precise and integrated response for sustainable farming and inclusive food systems"

HIGH-LEVEL OFFICIALS ROUND TABLE DISCUSSION

13 November 2017,

Hotel Park, Novi Sad, Serbia

BACKGROUND PAPER

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Executive summary

In a resource-constrained world, the information and communication technologies (ICTs) offer the unprecedented opportunities for accelerating agricultural development for more efficient and integrated food systems, from production to consumption, entirely new models for service delivery and fair and inclusive trade, and social and financial inclusion, among others. The *high-level round table* on e-agriculture will aim at intensifying the dialogue and regional exchange on benefits and challenges in applying ICTs in agriculture, food livestock, forestry and fisheries; will call the membership upon sharing good practices associated with e-agriculture and identify policy options and need of FAO support in the region.

In preparation for this session, the present background paper will define the terms related to e-agriculture; discuss its multiple benefits against the background of the challenges in Europe and Central Asia and in particular in Western Balkans; and build the case for e-agriculture strategy at national level and share FAO experience. Policy options will be identified and FAO assistance explored.

Guidance sought

1. Country representatives are invited to take note of, and comment on, the demand and mechanisms for e-agriculture implementation.
2. In particular, the country representatives are encouraged to take full advantage of the inclusive multistakeholder approach for e-agriculture policy formulation, developed and piloted by FAO.
3. Country representatives may wish to provide guidance on FAO's future work to:

- continue efforts to assist the countries in Europe and Central Asia to transform their agricultural sectors and leverage the livelihoods of farmers (men and women) through e-agriculture;
- in particular, by collecting and analyzing good practices and mechanisms for knowledge sharing, policy advice and capacity development that have maximized the benefits and minimized the risks of (modern) e-agriculture technologies
- provide a meeting ground for countries in the region and worldwide and act as neutral broker for sharing knowledge on digital transformation of agriculture in Europe and Central Asia, in particular in Western Balkans.

Contents

1. Introduction and definitions

E-agriculture refers to designing, developing and applying innovative ways to use information and communication technologies (ICTs) 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. The definition *extends beyond the e-government aspect of agriculture*, since it includes not only agricultural services provided by governments to citizens (e.g. farmers, rural communities) via ICTs, but encompasses a whole range of products, services and infrastructure provided by government, the private sector, public research and extension, NGOs and farmers' organizations.

Information and Communication Technologies (ICTs) that can be harnessed for e-agriculture may include devices, networks, services and applications. These can range from *cutting edge* Internet-based technologies and sensing tools, such as *big data*, *internet of things (IoTs)*, and *machine to machine (M2M),* to *well-known and less complex* technologies e.g. radio, telephones, mobile phones, television and satellites.

New generation of information and communication technologies

Big data refer to large volumes of information, which can come from different sources such as telecom records, social media, sensors, point-of-sale terminals, GPS devices, and so forth. Using innovative tools, these large volumes of granular data can be analyzed to produce meaningful information serving agricultural and food sectors, livestock, fisheries, etc. This can continuously provide information in real time and at a lower cost.

Machine- to-machine (M2M) refers to direct communication between devices using any communications channel, including wired and wireless. Machine-to-machine communication can include industrial instrumentation, enabling a sensor or meter to communicate the data it records to application software that can use it.

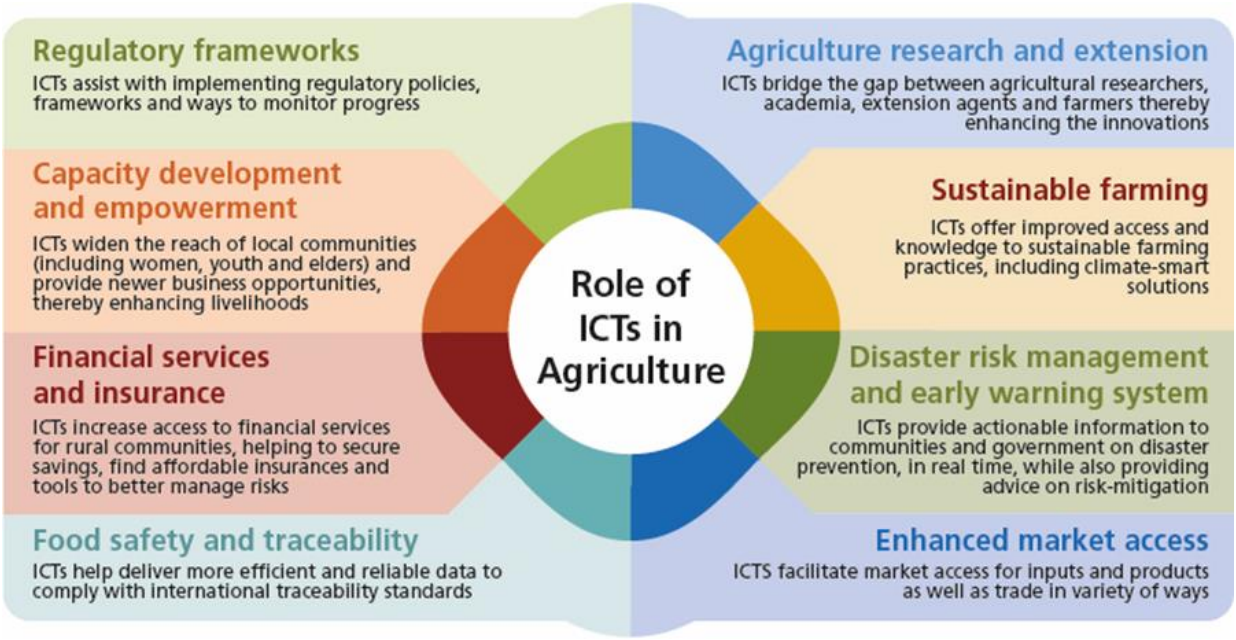
Internet of things (IoTs) is a combination of sensors and various tiny devises embedded in physical objects and linked through wired and wireless networks that generate huge data volumes (often bid data) analyzed in dedicated applications. IOTs offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications.

Food and Agriculture Organization of United Nations (FAO) and the International Telecommunication Union (ITU) have been using the term ***e-agriculture*** since the World Summit on the information Society in 2003 and 2005**.** Since then, other terms have appeared such as *smart farming*, *precision agriculture* or *digital agriculture.* The latter definitions place stronger emphasis on the challenges brought by the new generation of ICTs, while FAO and ITU refer to a broader definition that would provide diverse technological solutions in resolving existing problems in agriculture and rural development.

Regardless of the definition used, the aim is to boost agricultural and rural development by improving access to valuable data, information and knowledge that can help people whose livelihoods depend on agriculture to make the best possible decisions, and use the resources available in the most productive and sustainable manner.

2. Multiple benefits from e-agriculture

Information and Communication Technologies (ICTs) have long been recognized as key enablers for achieving the three dimensions of sustainable development: economic growth, environmental balance and social inclusion. ICTs have proven to be instrumental in delivering information and services in health, education, trade, commerce and other fields, and have contributed to increased transparency and accountability. The large adoption and integration of ICTs has reduced information and transaction costs, improved service delivery, ***created new jobs*****,** generated new revenue streams and saved resources. Hence, digital technologies promote efficiency and ***financial and economic inclusion*** – many tasks can be carried out at low costs and many services can reach people that previously lacked access.



Nowadays, no one can ignore how the data revolution and digital transformation are changing the world. This change is happening at different places and at different rates, but these processes increasingly have an impact on one another as the world is more and more interconnected. In Europe and Central Asia, the Internet penetration ranges from 28% in Central Asia up to 98% in some EU member states. Faster even, on average 8/10 individuals in the developing world already own a mobile phone (World Bank Group, 2016).

At broader level, the new generation ICTs technologies can contribute to ***improved governance***. 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 and desertification. Access to easy-to-use digital tools that monitor forest cover, land-use patterns and their changes over time are destined to become increasingly important as countries around the world implement measures to adapt to and mitigate climate change.

The cross-sectoral nature of ICT propels growth in other sectors. A unique *ICT-based platform* can serve several sectors, such as agriculture, health and transportation by offering information to consumers on products and quality, by ensuring timely transportation of products to market, and by empowering farmers through stronger linkages between small-scale producers and markets. Many governments across the world, including in Europe and Central Asia 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), Moldova and Uzbekistan, while regional integration processes (EU and EAU accession) triggers development of e-specific platforms, such as Integrated Administration and Control System (IACS), animal identification systems etc.

ICTs can help ***smallholder and family farmers*** (FAO, 2014) coordinate their planning and monitoring of production and marketing systems by virtually aggregating data, without cooperatives having to take over the land or do the decision making for their farms. Access to credit, financial and insurance services for

smallholders and family farmers has been a major constraint to improving their farming and incomes. With the increasing availability of mobile phones and the internet, smallholder farmers can now access financial services much more easily. FAO has been promoting the use of ICTs in agriculture and has focused on ICT innovation in improving agricultural production and value chains. Examples show that:

- Food traceability systems using ICT as an important risk-management tool have allowed food business operators or authorities to contain food safety problems and promote trust in the value chain;
- GIS and agro-meteorological technologies have contributed to better land use planning, crop forecasting and early warning systems. Space technology is also essential to monitoring threats from the growing number of natural disasters;
- The use of mobile phone technology for information exchange such as disease surveillance and pest tracking has become routine in many countries in Europe and Central Asia;
- In Europe and Central Asia, FAO has implemented projects on the establishment of a rural radio in Armenia, national online networks enhancing collaborative action among national agricultural innovation system actors in Albania and Armenia and has assisted national AGROWEB platforms and thematic networks for food safety, medicinal and aromatic plants, fisheries and many more.

Other benefits of modern e-agriculture include:

- Increased Production – Optimized crop treatment such as accurate planting, watering, pesticide application and harvesting directly affects production rates.
- Water Conservation – Weather predictions and soil moisture sensors allow for water use only when and where needed.
- Real-Time Data and Production Insight – Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.
- Lowered Operation Costs – Automating processes in planting, treatment and harvesting can reduce resource consumption, human error and overall cost.
- Increased Quality of Production – Analyzing production quality and results in correlation to treatment can teach farmers to adjust processes to increase quality of the product.
- Accurate Farm and Field Evaluation – Accurately tracking production rates by field over time allows for detailed predicting of future crop yield and value of a farm.
- Improved Livestock Farming – Sensors and machines can be used to detect reproduction and health events earlier in animals. Geofencing location tracking can also improve livestock monitoring and management.
- Reduced Environmental Footprint – All conservation efforts such as water usage and increased production per land unit directly affect the environmental footprint positively.
- Remote Monitoring – Local and commercial farmers can monitor multiple fields in multiple locations around the globe from an internet connection. Decisions can be made in real-time and from anywhere.
- Equipment Monitoring – Farming equipment can be monitored and maintained according to production rates, labor effectiveness and failure prediction.

Source: WUR

With the recent advancement of information and communication technologies that allowed for (i) Cheap and improved sensors and actuators; (ii) Low cost micro-processors; (iii) High bandwidth cellular communication , (iv) Cloud based ICT systems and (v) Big data analytics, a new boost e-agriculture can be observed around the early 2010s, which became popular as AGRICULTURE 4.0. In analogy to the fourth industrial revolution (Industry 4.0), it stands for the integrated internal and external networking of farming operations. This implies that information in digital form exists for all farm sectors and processes; communication with external partners such as suppliers and end customers is likewise carried out electronically; and data transmission, processing and analysis are (largely) automated. The use of Internet-based portals can facilitate the handling of large volumes of data, as well as networking within the farm and with external partners. Agriculture 4.0 paves the way for the next evolution of farming consisting of unmanned operations and autonomous decision systems. Agriculture 5.0 will be based around robotics and (some form of) artificial intelligence.

3. Challenges in Europe and Central Asia and the way forward

Modern e-agriculture technologies are rapidly evolving to be a much bigger story than individual pieces of technology. The potential for data acquired through e-agriculture to fundamentally change food and business systems is real and immediate. As e-agriculture technologies mature it is becoming obvious that the impacts of data collected on-farm and post-farm will reach well beyond the point in the supply chain that the data originated from. Notwithstanding with the unprecedented opportunities for more efficient and integrated food systems, including food loss and waste, entirely new models for service delivery and fair and inclusive trade, the new ICT technologies have the potential, if no adequate actions are taken, to disrupt the way agriculture is done now and provoke social and economic turbulences. Some of the ***challenges*** are discussed below:

- **Triple divide**

The 2016 World Development Report found that these 'digital dividends' are not automatic and that not everyone benefits equally. This is because the analogue capacities which are needed to enable these benefits - adequate policies, infrastructure and regulations, newly required skills and accountable institutions - are not equally present everywhere and accessible for everyone. Usually, those type of challenges are described as *triple divide*.

The triple divide: The triple divide consists of the digital divide, the rural divide and the gender divide. The digital divide refers to the gap between demographics and regions that have access to modern ICTS, and those that don't have access, or have restricted access. The rural divide refers to the gap between urban and rural areas in access to ICTs. The gender divide refers to the differences between women and men in access to ICTs, resulting in rural women being relegated to the most disadvantaged position.

Digital divide: The International Telecommunications Union (ITU) has estimated that nearly 3 billion people (40.4 percent of the global population) had access to the Internet in 2014. Of the approximately 4.4 billion people still unconnected, 90 percent live in the developing world[1].

[1] ITU. 2014. Measuring the Information Society Report, Geneva, Switzerland, http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf

Rural divide: Due to poor infrastructure, lack of electricity and the fact that they many of the most remote areas are still beyond the reach of a mobile signal, rural communities in developing countries are even more disadvantaged. Low incomes and high levels of illiteracy are additional barriers to possible adoption of ICTs[2].

Gender divide: The Broadband Commission has estimated that worldwide, women are 21 percent less likely than men to own a mobile phone. The gap between female and male users is the largest in the developing world[3].

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" demonstrates that differences in connectivity and access to ICTs exist between the cities and rural areas across the whole region, which can be a serious obstacle in the penetration of digital technologies in agricultural and rural sector. Furthermore, most of the commercial applications in use today in agriculture, such as drones or other precision farming technologies, have not been designed to serve the needs of the most vulnerable, i.e. smallholders and family farmers, men and women.

- **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 equally important as with traditional data to pay due attention to the validity and reliability of the information one wishes to use. New methods will therefore also need to be scientifically proven. This also explains why there is a need for development investment in this area and for collaboration with academic institutions. In addition, the use of large data sets makes their analysis and translation to a meaningful information for farmers and consumers a very challenging task that require coordination of efforts and join capacity development at both production/end users' and IT developers' levels.

- **Open data**

Open data is about making data freely accessible to the public. Data can be more or less 'open' depending on the nature of the data (primary instead of aggregated data; complete; timely), the format in which they are made available (unstructured versus using open standards which allow for others to easily reuse the data; language used) and their accessibility (costs and procedures involved to access the data; permissions granted to use the data). Presenting open data from different sources via internet-based or mobile applications to users 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 trans-boundary water flows is, for example, of critical importance to tackle climate change, improve natural resource management, and support agriculture (World Bank Group, 2016). Open data can also be instrumental for disaster risk reduction and good

[2] GSMA. 2014. GSMA, 2014, Digital inclusion, www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/11/GSMA_Digital-Inclusion-Report_Web_Singles_2.pdf

[3] Broadband Commission. 2013. Doubling digital opportunities, Enhancing the inclusion of women and girls in the information society, Geneva, Switzerland, www.broadbandcommission.org/Documents/working-groups/bb-doubling-digital-2013.pdf

governance (e.g. financial transparency, accountability, parliamentary openness), among others (Third international Open Data conference, 2015).

However, opening access to data is still a challenge for many countries worldwide, including Europe and Central Asia since stricter rules 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 not in suitable format to be used by the farmers. FAO participates actively in Coherence in Information for Agricultural Research for Development (CIARD) movement, aiming at providing specific guidance to research and knowledge institution on the provision of open data. 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 deal with the urgent challenge of ensuring world food security. The initiative focuses on building high-level support among governments, policymakers, international organizations and businesses.

- **Data ownership**

The service providers that are marketing digital agriculture systems and data storage platforms are all commercial providers. Uncertainty exists on the rules that govern the ownership of data generated and collected by machinery and technology on the farm. In principle, those date should be owned by the farmer. However, concerns exist of the potential misuse of data by the service provider, such as data use of third party (often of data validation and method improvement) which require development of appropriate regulatory environment, the latter being a new and complex task. In addition, data ownership needs to be further discussed and regulated in relation to promoting open access data.

- **Interoperability**

Interoperability describes the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user. The interoperability becomes increasingly into picture when governments are developing many different platforms that need to communicate and exchange data with each other, instead of duplicating the effort of collecting the data and inserting it for each and every concrete use. To that end however, the platforms need to be designed and built with special interoperability protocols. The role of the government in this case would be to require the use of those protocols in systems and platforms of strategic significance.

- **Security concerns**

Cybercrime includes “offences against confidentiality, integrity and availability of information and communication infrastructure”; “computer-related traditional crimes” (such as illicit financial flows, fraud, child pornography, human trafficking); “content-related offences”; “offences related to infringements of copyright and related rights”. High usage of the Internet enhances one’s vulnerability to those crimes. The costs of cybercrimes are economic, political and social. (UNCTAD, 2014). It is therefore important to extend conventional crime legislation to cover online activity and new forms of crime as listed above.

- **The agricultural sector is lacking behind in the adoption of ICT technologies**

There are multiple reasons behind this fact, some of which stemming from worse connectivity and infrastructure in rural areas; lack of capacities of rural population and extension services to engage with

ICTs, especially new generation 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; traditionally, farmers being more risk-averse type of entrepreneurs; lack of (access to) solid body of evidence on the benefits of ICTs in agriculture; available IT solutions are less adequate to the farming practices in Europe and Central Asia, etc.

4. The case for e-agriculture strategies. FAO guide for e-agriculture strategy formulation.

Although the share of agricultural sector in GDP in the different countries in Europe and Central Asia varies significantly and has decreasing trend, the sector plays considerable role in improving the livelihoods of rural population and preventing migration to cities, especially of young people. ICTs hold great potential to improve livelihoods, and provide eco-services, create jobs, decrease or stop the pace of migration, *inter alia*. Hence, actions at system level to overcome the challenges and systematic commitment from the government to upscale, including the creation of an enabling environment, are pertinent for generating a development change.

Alike other innovations, ICTs only can leverage substantially national agricultural goals if an appropriate enabling environment for the generation and adoption of innovations as policies, organizational structures and capacities, is established. Yet in many countries in Europe and Central Asia, the agricultural sector, responsible for feeding humans and animals, is only just beginning to explore more systematic and system-based approaches.

The existence of a comprehensive national strategy can prevent e-agriculture projects from being implemented in isolation, avoiding duplication of efforts and resources. It also helps to develop efficiency gains from intra-sector and cross-sector synergy. An e-agriculture strategy can pave the way for policy options to bridge the technology divide in rural areas, and ensure equal prospects for rural men and women, young and old, to access ICTs – quickening the pace of innovations, increasing incomes and job opportunities in the process. Agricultural research, education and extension can also greatly benefit from a national e-agriculture strategy, which can help to establish rules for open data and interoperability, thereby ensuring promotion of national research outputs and timely sharing of global knowledge. The private sector – such as solution developers, mobile operators and the agro-industry – may profit from an increased clientele, and provision of better targeted, needs responsive products. Building such a strategy is likely to prove invaluable for countries just setting out on the e-agriculture path. But equally, developing a national e-agriculture strategy will prove useful to countries that have already invested significantly in digital agriculture and are endeavoring to scale up and scale out.

An e-agriculture strategy guide and toolkit[4], jointly prepared by the Food and Agriculture Organization of the United Nations (FAO) and the International Telecommunication Union (ITU), has been produced to assist countries in developing their national e-agriculture strategy to mainstream ICTs in agriculture and develop or revitalize a country's e-agriculture strategy in alignment with the national agriculture goals and priorities. The guide has been piloted in several countries in Asia and Pacific region, as well as in Albania.

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

Developing a national e-agriculture action plan enables a government to draw up a roadmap for its strategy on the use of ICTs for agriculture that implies identifying all activities and their management, coordination and funding, and identifying key actors for the design and implementation of the e-agriculture strategy.

Any effective roadmap for e-agriculture will require a holistic, multi-stakeholder approach, with cross-cutting support spanning various government ministries, including those dealing with innovations, food production and processing, rural development, irrigation and water management, disaster management, telecommunication, governance, transportation, finance and commerce.

In spite of the demand of interinstitutional cooperation, the guide strongly advocates for a solid facilitative leadership of the Ministries of agriculture in the region to elaborate a coordination mechanism with the telecommunication ministries and regulators on connectivity and infrastructure issues; develop regulatory environment and standards such as for interoperability, open access, security , and data ownership; facilitate the dialogue between the private sector IT developers, agribusiness and smallholders; ensure inclusiveness of vulnerable rural population, man and women; and ensure alignment with the national agricultural and rural strategy goals.

5. Policy recommendations

Setting in place a national e-agriculture strategy is an important step for any country planning to use ICTs for agriculture to help reduce poverty, increase food security and further its specific agricultural goals and priorities. The following recommendations are made, both for the governments' and other actors' consideration, and for possible FAO action, to be endorsed by the country representatives and thus reflected in the future work planning.

1. **Contribute to bridging the triple divide**

- Addressing connectivity and infrastructure issues in rural areas
- Supporting capacity development for rural population, including farmers to engage with ICTs, tailored to the needs of men and women, youth and elderly
- Adapting content to local needs, in appropriate languages and adapted to local contexts
- Enforcing open access data
- Ensuring access to information, knowledge and financial services on ICTs for all stakeholders, men and women, and family farmers
- Strengthening the role of agricultural innovation systems in general and extension services in particular in engaging with ICTs in agriculture

2. **Develop regulatory environment and standards such as for interoperability, open access, security, and data ownership**

- Partnering with private sector, academia and NGOs at country level
- Cooperating and exchanging good practices at regional level
- Support from international community and specialized UN agencies may be required

3. **Enable the agricultural sector to innovate through ICTs by maximizing the benefits and mitigating the challenges**

- Ensuring strong facilitative leadership of the Ministries of Agriculture
- Generating /ensuring access to a solid body of evidence on the benefits and risks of ICTs in agriculture
- Reviewing the agricultural research agenda to incorporate topics related to ICTs in agriculture, in particular for public good (climate data etc.)
- Creating incentives for commercial ICT developers to provide solutions for agriculture, including for smallholders and family farms.