European Commission

DIGITALISATION FOR DEVELOPMENT. A TOOLKIT FOR DEVELOPMENT COOPERATION PRACTITIONERS

INTERNATIONAL PARTNERSHIPS (INTPA)

E-Agriculture

InfoSheet nº6

This InfoSheet is part of a series on digitalisation and relevance to EU International Partnerships and development cooperation programmes. The Toolkit is designed to provide key definitions, main opportunities and challenges for global development presented by digital transformation, case studies and suggested further reading. Learn more on Cap4Dev

Introduction

The European Union has put a fair, healthy and environmentally friendly food system, as well as digitalisation, amongst its top priorities. Fighting food insecurity and malnutrition, whilst developing sound economic foundations are furthermore key elements of the EU's work in International Partnerships. These priorities come together naturally in 'e-Agriculture'.

The use of digital technologies has been revolutionizing the agricultural industry. Availability of data, information, and knowledge is essential for a thriving agricultural sector, and it is vital that all agricultural stakeholders can access them. Digital technologies can reduce transaction costs and make information related to production technologies, inputs, prices, markets, climate, and sustainable practices, more widely available and in a timelier fashion. Digital technologies can help increase agricultural productivity, while preserving natural resources and potentially lead to better profitability, including that for small-holder farmers.

This infosheet describes the **key actors, resources and technologie**s, and the main **challenges and opportunities** related to the implementation of e-Agriculture initiatives in partner countries. Furthermore, it highlights key references from the EU in this sector, including **policy** documents and **strategies**, in order to provide an overarching framework to guide the design of e-Agriculture initiatives with partner countries. Finally, a number of **case studies** are presented.

Key Actors and Resources

At the international level, the **United Nations Food and Agriculture Organization (FAO)** has been leading actions on e-agriculture (C7. ICT Applications: e-Agriculture) promoted by the **World Summit on the Information Society (WSIS)**. Since 2007, within this framework, the FAO has co-funded and managed the world's largest publicly hosted Community of Practice on e-Agriculture, which now includes over 14,000 members from 170 countries and territories. Community members include individual stakeholders such as information and communication specialists, researchers, farmers, students, policy-makers, business people, development practitioners, and others. Following the publication of the Global Forum for Food and Agriculture Final Communiqué, in 2019, and in consultation with nine other agencies that are actively working on e-Agriculture[1], the FAO developed a concept note on the establishment of an international Digital Council for Food and Agriculture, to be hosted by the FAO itself. In partnership with the International Telecommunications Union (ITU), the FAO developed the e-Agriculture strategy guide to assist countries in identifying, designing and developing sustainable ICT solutions/services to overcome challenges faced in agriculture and accelerate the achievement of some agricultural goals.

The European Commission is leading the work in the European Union. This infosheet focusses on some key EU policies in this area.

The Consultative Group for International Agricultural Research (CGIAR) is a global research partnership for a food secure future dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources. CGIAR's global network of 15 research centres contributes to an unrivalled mix of knowledge, skills and research facilities able to respond to emerging development issues. They have a local presence in 108 countries with an in-depth knowledge of customs, values and market operations in developing countries.

The **World Bank** has been particularly proactive in the area of ICT in agriculture, starting with the guide "ICT in agriculture: connecting smallholders to knowledge, networks, and institutions" (latest version available published in 2017). More recently, the World Bank created a Knowledge and Learning Platform on data-driven digital agriculture, which offers analytics, innovations, tools, and best

[1] African Development Bank, the International Fund for Agricultural Development (IFAD), International Telecommunication Union (ITU), Organisation for Economic Co-operation and Development (OECD), Technical Centre for Agricultural and Rural Cooperation (CTA), World Bank Group (WBG), World Food Programme (WFP), World Organisation for Animal Health (OIE), and World Trade Organization (WTO).

practices to practitioners, policymakers, innovators, researchers, and experts in this field. An online course providing an overview of digital agricultural technology is freely available. As of 2021, the World Bank team also started to publish Digital Agriculture Profiles (DAPs) of selected countries, which provide an overview of the state of agricultural and digital development and identify public policy entry points to streamline digital transformation of the agri-food sector.

GSMA[2], the association representing the interests of mobile telephone operators worldwide, has an AgriTech team, which developed a toolkit to design mobile services in agriculture, helping mobile network operators to incorporate human-centred design approaches in the design of value added products and services for rural populations.

The International Fund for Agricultural Development (IFAD)[3] launched its Information and Communication Technology for Development (ICT4D) strategy in 2019, focused on leveraging digital technologies to: (a) increase poor rural people's productive capacities; (b) increase poor rural people's benefits from market participation; and (c) strengthen the environmental sustainability and climate resilience of poor rural people's economic activities. Within this framework, IFAD published a toolkit to design digital financial services for smallholder households.

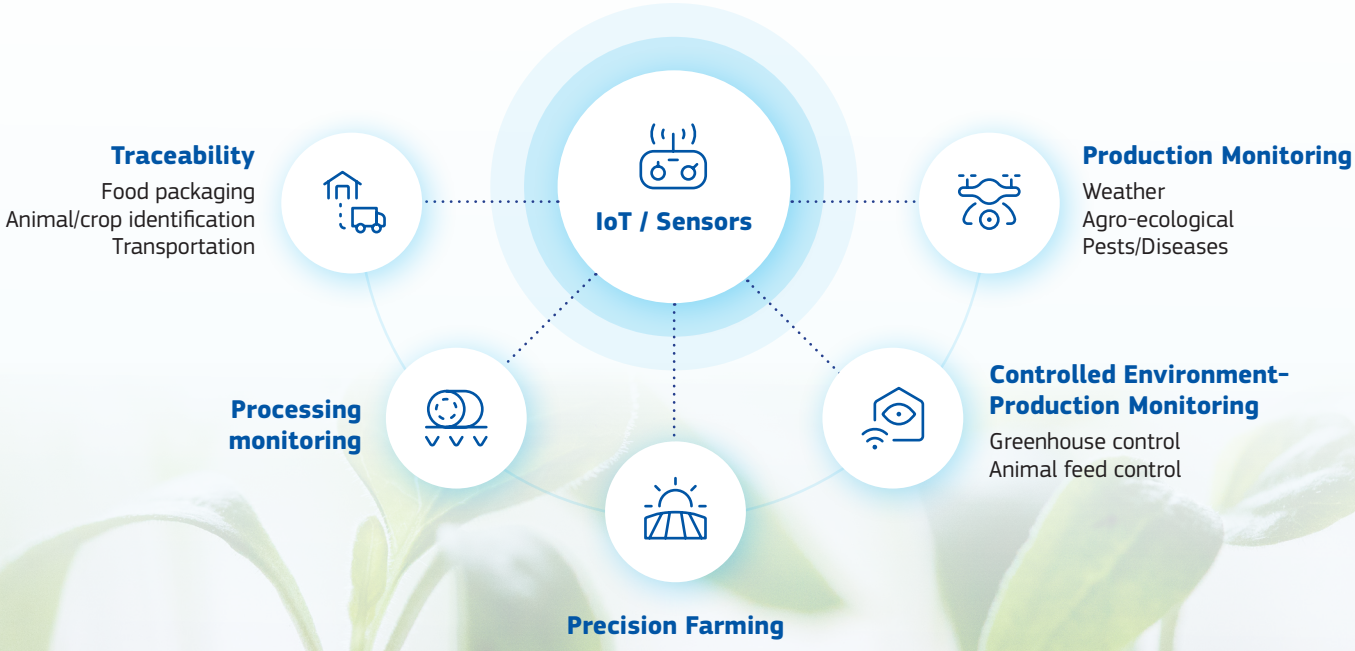
Finally, **Private Sector** organisations have been increasingly active in this sector. Agribusiness incumbents (such as Bayer, Syngenta, BASF) have been expanding their portfolio by including digital agriculture services targeting farmers in developing and emerging regions, which serve both to generate new revenue streams as well as strengthen their market position. Large multinational technology corporations also started to offer digital agriculture services directly to smallholder farmers, as in the case of mobile network operators (e.g., Orange Telecom and Vodafone in Africa, TIM in Brazil) that provide value added services to their customers. Moreover, other dominant technology providers have started to offer services directly to governments for national agricultural planning, advisory service provision, agricultural product sourcing and export. SAP has offered a digital solution to the Government of Uganda to engage smallholders in formal agricultural value chains as part of an agriculture development investment led by IFAD. Airbus has offered Earth Observation tools to support precision farming and agricultural monitoring across developing and emerging regions for a decade.

Key Technologies for e-Agriculture

A variety of technologies have been used to improve agricultural and rural development. Mobile technologies have been the key digital tool transforming rural areas in recent decades. The World Bank´s ICT in Agriculture Sourcebook[4] provides detailed information on the impact of digital technologies across the agriculture value chain. Key technologies include sensors[5] used as part of the Internet of Things (IoT) networks, geospatial technologies, such as those available in the EU's Copernicus programme[6], global navigation satellite systems (GNSS), and geographic information systems (GIS), among others.

By leveraging these technologies, farmers can aim to implement precision agriculture approaches, which can be defined as "a whole-farm management approach using information technology, satellite positioning (GNSS) data, remote sensing and proximal data gathering. These technologies have the goal of optimising returns on inputs (e.g., fertilisers) whilst potentially reducing environmental impacts"[7]. Clearly, the inclusive and successful adoption of these technologies for precision agriculture requires that digital infrastructures are available and accessible; digital services would need to be affordable not only to professional farmers but also to smallholder farmers, and they would need to be aware of their potential as well as being able to use them.

IOT: MANY POTENTIAL APPLICATIONS IN AGRICULTURE



[2] https://www.gsma.com/
[3] https://www.ifad.org/en/
[4] https://openknowledge.worldbank.org/handle/10986/27526
[5] A sensor is a device that detects the change in the environment, converting a physical phenomenon into a digital signal which is then transmitted for reading or further processing.
[6] Please see the infosheet on Copernicus for further information on the Copernicus Programme.
[7] Precision Agriculture: An opportunity for EU farmers – potential support with the CAP 2014-2020: in-depth analysis

Another key and *disrupting* technology is distributed ledger technology (DLT), a decentralized system for **recording transactions** with mechanisms for processing, validating and authorizing transactions that are then recorded on an immutable ledger. Blockchain is possibly the most well-known implementation of DLT. Blockchain-based implementations promise to deliver a transparent, decentralized, secure transaction process, which may also reduce transaction costs. This technology can help in reducing power asymmetries among farmers and intermediaries across value chains, as well as facilitating the formalisation of the whole agricultural sector. It can improve and restore trust among smallholder farmers and downstream stakeholders, strengthening the linkages between consumers and producers and thus leading to more informed citizens as well as smarter farms. Some pilot applications have been successfully implemented to support traceability of value-added products from developing and emerging regions as well as the transfer of financial resources directly to farmers by consumers. Nevertheless, the cost and complexity of operating such solutions in poorer regions and by resource-constrained farming communities hinders its large-scale and quick adoption.

Opportunities and Challenges

There is tremendous potential for the use of digital technologies in the agricultural sector. Digital technologies can support decision-making in the agricultural production cycle through different steps, from planning to agricultural input management, on-farm production management, post-harvest, and access to markets. The infographic presented here shows how digital tools can have an impact throughout the value chain.[8]

Having access to data and being able to process and analyse them quickly would enable agricultural stakeholders to take better decisions on resource management, potentially reducing the need for economies of scale in agriculture and thus making small-scale producers more competitive. Within this framework, digital technologies could make future farms look smaller and smarter than current ones, being based on data collected by drones and sensors and leveraging on robots and autonomous vehicles that allow for better decision-making.

PLANNING	• Help farmers plan what, when to plant • Tighten relationship with buyers, processors • Adapt to climate change • Provide data for farmers to make business decisions on cash flow and maximizing profit
INPUTS	• Reduce counterfeits • Reduce costs and risks for buyers • Increase access to quality inputs • Enable sellers to know demand in advance • Provide convenient and secure ways for farmers to purchase, save, and receive credit inputs
ON-FARMPRODUCTION	• Help extension services reach more farmers • Provide timely reminders/alerts • Use behavior change media to promote best practices among farmers • Increase precision and/or adaptability of farming interventions and crop choices through applied data
STORAGE	• Improve links between farmers, processors • Reduce post harvest loss with digitally-enabled harvest loans and digitally warehouse receipts • Inform harvest practices to reduce post harvest losses • Monitor storage conditions
POST-HARVEST PROCESSING	• Increase farmers' negotiating power by providing market prices • Track provenance for supply chain optimization and grading
TRANSPORT	• Reduce costs of transport • Increase choice of different types of transport for farmers • Increase access to timely information so that farmers know if and when transport is arriving
ACCESS TO MARKETS	• Increase ability of smallholder farmers to sell to larger markets by allowing buyers to track crops to source (certification and provenance) • Increase market information available to farmers so that they have more choices

[8] USAID. 2018. 'How digital tools impact the value chain.'

Farm data[9] can be used not only to optimize operations at a single farm but also to support decision-making across multiple farms as well as for national-level policy making. In the former case, the integration of data from multiple sources combined with the application of Artificial Intelligence[10] technology and techniques allow agribusinesses to monitor the adoption of agricultural practices, assess their impact, and incentivise specific outcomes. In the latter, a good example comes from Indonesia where in 2020 the Agriculture Ministry of the Government of Indonesia announced the creation of an "Agriculture War Room" to gather crop and farm management data in almost-real time.

This way, the Government aims at being able to effectively develop responsive policies for the sector. According to the CTA-Dalberg Digitalisation of African Agriculture Report[11], in Sub-Saharan Africa, e-Agriculture solutions had already reached up to 13% of the continent's smallholder farmers, equivalent to 33 million smallholders, at the end of 2018. These solutions have been generating up to ~€144 million in earned revenue annually, with growing evidence of the sector's positive impact on smallholder farmers.

Key functions that digital technology applied to agriculture can fulfil, based on work presented by K.S. McNamara at the University of Michigan[12]:

- Helping farmers manage a range of **risks**, including providing early warning systems,
- Helping farmers participate in **higher-value** agriculture,
- Improving **land and natural resource management** and addressing environmental pressures,
- Improving public services and **governance** for rural communities,
- Increasing smallholder **productivity** and **incomes,**
- Linking farmers to urban, regional and global **markets,**
- Making agricultural markets more efficient and **transparent, also thanks to mobile technology,**
- Promoting – and including smallholders in – **agricultural innovation,**
- Supporting the emergence of a more **diverse rural economy,** and supporting rural family decisions about their mix of productive activities.

A key role for the inclusive application of digital technology in agriculture is that of farm advisors, who act as data, information and knowledge brokers with farmers and rural communities. Typically, farm advisors are public sector agents or private advisors. Interestingly, young people are well positioned to play such a role thanks to the adoption of digital tools as part of their lives, as highlighted by some development projects.

At the same time, it is worth mentioning that, although the application of ICT to improve the production and distribution of agricultural products could reduce conventional employment opportunities in rural areas, this can be offset by transforming agriculture into a more attractive activity capable of retaining young people in rural areas, and creating new jobs, such as intermediaries of agricultural, agroclimatic information, etc.; data processors necessary to use digital technologies on and off the field; developers of software and digital devices; and experts in capacity development and technology transfer at the farm level.

Finally, bringing connectivity to rural areas remains a challenge in many parts of the world. Higher demand for e-Agriculture could be considered as a driver for connectivity, improving therefore access to services and tools for the benefits of both farmers and citizens in general.

__Digital Connectivity__ will be the main topic of one of the subsequent infosheets of this series.

[9] Farm data is intended here as encompassing both field-level and farm-level data. The former includes spatial location and related parameters (e.g., plot size, elevation, and boundary information), land title, soil data, weather data, crop data (e.g., crop type, variety, type of seeds), crop history, production data (e.g., planting data, crop management activities). The latter includes farmers' personal information and related demographic data, farm administrative data (e.g., registration number, if available), service channel used by the farmer to receive information, labour force available, equipment and machinery, business and financial data.

[10] See the infosheet on AI and Big Data for further information on this family of technologies.

[11] https://www.cta.int/en/digitalisation-agriculture-africa

[12] When is Information Power? Lessons from the ICT-for-development field

The EU Approach

Among the most important policies[13] of the Green Deal in relation to agriculture is the Farm to Fork strategy for sustainable food, which aims at accelerating the EU´s and its partners' transition to a sustainable food system. The strategy intends that the food system has a neutral or positive environmental impact, helps in mitigating climate change and adapting to its impacts, reverses biodiversity loss, ensures food security, nutrition and public health, and finally preserves affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade.

Key pillars of the strategy are research & innovation, targeted investments, and the enhanced use of data for enabling the transition to a sustainable food system. Filling data gaps and promoting evidence-based policymaking will also be among the priorities of the European Commission. The EU will promote a global transition to a sustainable food supply, in line with the sustainable development goals (SDGs), through its external policies, including international cooperation and trade policies. The EU will establish green alliances on sustainable food systems with all its partners, and will encourage and enable the development of comprehensive, integrated responses benefiting people, nature and economic growth.

Finally, a key policy is the EU food safety policy, which is designed to be coherent with Farm to Fork measures and incorporate appropriate monitoring, while ensuring an effective internal market. The implementation of this policy in the EU involves various actions, to be taken into account across development cooperation projects, such as:

- ***Food hygiene:** food businesses, from farms to restaurants, must comply with EU food law, including those importing food to the EU,*
- ***Animal health**: sanitary controls and measures for pets, farmed animals and wildlife include monitoring and managing diseases, and tracing the movement of all farm animal*
- ***Plant health:** detection and eradication of pests at an early stage prevents their spreading and ensures healthy seeds,*
- ***Contaminants and residues:** monitoring keeps contaminants away from food and animal feed. Maximum acceptable limits apply to domestic and imported food and feed products.*

EU External Actions and e-Agriculture

The EU has been leveraging digital solutions to help farmers in developing and emerging regions to improve their livelihoods and overcome challenges. In different countries, such as The Gambia, Ghana, and Fiji, the EU is supporting **market information systems** and **extension services** providing access to updated and reliable information on markets and pricing. The EU, for example, is supporting the development of digital frameworks for animal disease surveillance and reporting, livestock traceability systems, and pests.

Data and **information**, especially on weather and markets, are crucial to smallholder farmers, as they could help them increase productivity, and become more resilient to shocks and improve their livelihoods. The EU has been promoting the digitalisation of data and its management in online databases (e.g., in Senegal, Djibouti, Cameroon). The EU has also been helping to develop and implement a variety of data-driven tools, including but not limited to the development of crop models, crop calendars, and real-time weather information services to deliver customized, geo-located information and agronomic tips to farmers.

Mobile banking is another area where the EU has been supporting initiatives (e.g., in Ethiopia, Burkina Faso, Fiji), such as the promotion of financial and non-financial services adapted to the needs of farmers, the use of mobile money transfer as safety nets during lean seasons or as a resilience building system for the most vulnerable. Through the development of applications and digital platforms, the EU is promoting rural smallholder farmers' access to financial services, as well as the automatisation of Savings and Credits Cooperatives (SACCOs) in order to federate activities under a cooperative bank that could have an easier access to credit lines for specific products.

The use of **early warning systems** (e.g., in Timor-Leste, Dominican Republic, Gambia) has proved very useful to support risk reduction among rural communities. This is done, for example, through the integrated use of automated weather stations providing weather information, community radios and radio listening clubs, mobile phones, and specific training.

Geospatial technologies, including both remote sensing and geographical information systems (GIS), have been employed in EU projects in Afghanistan, Somalia, and Eswatini, among others. Such technologies allowed the improvement of land tenure and drought monitoring, as well as better monitoring of water resources. Remote Sensing systems are helping with the establishment of monitoring and assessment systems for land degradation and flood risk for example. The Nurturing Africa´s Digital Revolution for Agriculture project, funded as part of the EU´s Horizon 2020 programme, incorporated Copernicus, as well as other Earth Observation products and data from in-situ IoT devices, in existing agricultural value chain platforms connecting smallholder and agricultural stakeholders in Senegal and Nigeria. In 2020, the EU also funded the Farming by Satellite competition to encourage young professionals, farmers and students to create new, sustainable, and environmentally friendly solutions for the European and African agricultural sector using Copernicus, EGNOS and Galileo.

[13] See the infosheet on policy and regulation for further information.

CASE STUDY

Plantwise

Plantwise is a global programme led by the Centre for Agriculture and Bioscience International (CABI), which helps farmers lose less of what they grow due to problems related to plant health. The Programme aims at increasing farmers' food security and improving rural livelihoods by reducing crop losses. This is achieved by establishing networks of plant clinics where farmers can find advice for plant protection. Plant clinics are built on a Knowledge Bank, a gateway to both online and offline information. Mobile apps enable offline access to the Plantwise Knowledge Bank with best practices and information updated on a regular basis, to ensure it is always relevant and up to date.

CASE STUDY

Conservation Agriculture Scaling Up (CASU) in Zambia

The CASU project, funded by the EU, aimed at promoting conservation agriculture in Zambia as a means to increase productivity and conserve soil fertility in farming systems. To increase the uptake of conservation agriculture practices among farmers, the project successfully piloted SMS-based advisory services. A group of 75,000 farmers received information about seasonally-appropriate conservation agriculture techniques, with the aim of collecting information in a phone-based conservation agriculture e-resource centre. The project also improved information management thanks to the use of a GIS. A database to provide real time monitoring of redeeming actions by farmers, in terms of value, quantity and type of inputs redeemed by the farmers is also kept updated. Thanks to the use of digital technologies, the project was able to successfully phase out all paper vouchers and convert to smart cards in all 48 districts where the project was operational. A total of 19,503 lead farmers were eligible to redeem inputs using smart cards, of which 17,943 redeemed assorted inputs, representing a 92% success rate.

CASE STUDY

Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP)

The AOTTP offers an interesting evidence-based approach for sustainable management of tuna resources in the Atlantic Ocean. This project is using smartphone technology for collecting and transmitting data on fish movements. Data are transmitted via the Telegram app, and once validated, data are uploaded to a specific relational database designed for the project. Using smartphone technology has enabled data to be sent to AOTTP very quickly from remote locations, in digital form allowing the immediate identification of errors. The rapid upload of the tag-release locations means that tags presented at the tag-recovery offices can be checked for veracity before reward payments are made.

CASE STUDY

CGIAR's Platform for Big Data for Agriculture

In 2008, the International Centre for Tropical Agriculture (CIAT) began exploring a new approach to using big data tools to analyse information and help farmers make better on-farm decisions that lead to improved agricultural outcomes. This approach, referred to as data-driven agronomy, leverages data science to provide smallholder farmers with ad hoc recommendations that help them in deciding which crop to plant, the establishment of crop calendars and optimal crop management. CIAT has been using the approach over the last ten years with a range of partners across Latin America. This work led to the creation of the Platform for Big Data in Agriculture, which connects experts from all over the world in order to tackle agricultural challenges through the use of Big Data technologies.[14]

[14] See the infosheet on big data for more information

Glossary

- **e-Agriculture** describes the whole field focused on the use of information and communication processes and technologies to promote agricultural and rural development.
- **Digital farming** refers to the use of software application providing actionable intelligence and value added to farm management operations from farm and field data.
- **Smart Farming** indicates the application of information and data technologies to optimize complex farming systems, particularly increasing the quality and quantity of agricultural products while optimizing the use of means of production.
- **Precision Agriculture**, also referred to as precision farming or precision agriculture, is a vast group of technologies contributing to make the practice of crop growing and raising of livestock more accurate, optimized, and monitored.
- **Digital agriculture** integrates the concepts of precision farming and smart farming.

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Multimedia links

- Agribusiness TV
- Digital revolution for agriculture to embrace climate action | IISD
- Digital Green
- EU-funded Wazi Up Project
- Fruitchain
- How Big Data can Can Solve Food Insecurity | mStar project
- The future of agriculture | OECD
- Using Drones to secure land rights | World Bank
- What Happens When Farming Goes High-Tech? | National Geographic
- Youth, ICTs and agriculture | IICD

Recommended library

FAO-ITU E-agriculture Strategy Guide Documents

- The E-agriculture Strategy Guide
- The E-agriculture Strategy Guide – a summary
- The brochure for E-agriculture Strategy

FAO-ITU E-agriculture in Action series

- E-agriculture in Action
- E-agriculture in Action: Big Data for Agriculture
- E-agriculture in Action: Blockchain for Agriculture
- E-agriculture in Action: Drones for Agriculture

Other FAO publications on e-Agriculture

- Use Of Mobile Phones By The Rural Poor - Gender perspectives from selected Asian countries
- Success Stories on Information and Communication Technologies for Agriculture and Rural Development
- Information and communication technologies for sustainable agriculture – Indicators from Asia and the Pacific
- Mobile technologies for food security, agriculture and rural development: Role of the public sector

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