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MAIN ARTICLE

# Implementation of Information and Communication Technology to Support Agricultural Development in Indonesia

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## Introduction

The development of information and communication technology (ICT) is snowballing. Digital technologies allow people, even those in remote areas, to connect across the globe at high speeds and at any time through telephone or Internet facilities.[1] ICT has a potentially important role in transferring information on agricultural practices from researchers to farmers, among farmers themselves and even from farmer to researcher. ICT allows farmers to obtain relevant up-to-date information, thus, it can help in decision-making processes to improve agricultural productivity. Along with information of on-farm practices, ICT is also able to offer information for post-harvest farming. ICT provides an easy way for farmers to access market information, such as bidding price, staple commodity price, information about consumer trends, as well as mobile applications for online markets that enable producers to advertise or sell their products through cellular phone applications.

In practice, ICT in agriculture also requires the active participation of farmers, not only in an information end-user role, but in supplying data and information on the amount of harvest, harvest conditions, selling price of crops, and on pest and disease outbreaks. ICT can improve communication and enhance interaction among agricultural researchers, extension workers, farmers and other stakeholders in agricultural innovations and rural development.

Agriculture is important in Indonesia as 31.7 per cent of its labour-force works in the agriculture sector.[2] It sees that effective ICT integration into the agricultural sector will support economic development and poverty reduction, and is also a strategy for achieving the Sustainable Development Goals (SDGs). In addition, it is believed that competitive farmers can increase agricultural productivity and manage the market through good quality agricultural products, therefore capacity-building for farmers is a high priority. The Indonesian Ministry of Agriculture with support from the World Bank during 2007-2013 developed a farmer empowerment project namely Farmer Empowerment through Agricultural

[1] Gartner, 2016. Top 10 Technology Trends Signal the Digital Mesh. Gartner Inc. Accessed online 12 December 2017 at: https://www.gartner.com/smarterwithgartner/top-ten-technology-trends-signal-the-digital-mesh/

[2] Badan Pusat Statistik, 2016. The New Statistical Table (Tabel Statistik Terbaru). Accessed online 12 December 2017 at: https://www.bps.go.id/statictable.html

Technology and Information (FEATI). FEATI was expected to address the geographical constraints of Indonesia as an archipelagic country and the low number of Indonesian extension workers; that is, 44,000 extension workers for 72,000 potential agricultural villages,[3] where one extension worker for each village is the ideal as stated in Law Number 19 Year 2013 on Farmers Protection and Empowerment.

## Opportunity and challenges of ICT in agriculture

Global agriculture requires small farmers to adopt sustainable agriculture practices. Hence, there has been a shift from input-intensive agriculture to knowledge-intensive agriculture. Knowledge-intensive agriculture involves dissemination of information on sustainable agriculture practices, which focus on capacity-building, knowledge exchange to address needs of small farmers, and enhancing links between research and extension. Experts suggest that some technologies could generate enormous advantages for agricultural information management.

### Utilization of ICT to support sustainable agriculture development

Access to appropriate information at the proper time plays a significant role in the agriculture supply chain, and ICT makes this possible. Precision agriculture has been growing, and it is now possible to collect large quantities of data and to control and monitor individual plants. Greater efficiencies of time, cost and quality of services and products can be attained using ICT. The following is an explanation of the role of ICT in assisting crop production at each stage of the three-stage farming life cycle: (1) pre-cultivation; (2) crop cultivation and harvesting; and (3) post-harvest.

#### 1. Pre-cultivation

At the local level, farmers can use ICT to match cropping practices to climatic trends by using the Cropping Calendar Information System (discussed later). They can also access information and tutorials on farming practices for pre-cultivation preparation. A recent development in telemetry, i.e. GIS, allows the agriculture sector to build, access and use maps of land ownership, soil profiles, watersheds, landscape, cropping patterns and profiles at seasonal levels. The telemetry data can be stored and accessed through a big data facility. Big data allows information to be distributed at high speed and low cost, thus allowing efficient decision-making.

#### 2. Crop cultivation and harvesting

Farmers can access timely weather information, information about on-farm management and various tutorials on farming practices. Inputting data from monitoring and evaluation and applying statistical or modelling software makes it possible to see crop productivity trends and develop reliable productivity projections. Digital data is also easier to disseminate, facilitating the exchange of information with other parties. Farmers can use ICT to identify and control pests and diseases, as well as report an outbreak on their own farmland or in their neighbourhood.

#### 3. Post-harvest

The use of ICT at the post-harvest stage can include marketing, transportation, packaging, food processing and product traceability. ICT applications vary, ranging from simple spreadsheets to more sophisticated tailor-made applications. ICT improves efficiency and predictability, and reduces waste in value chains, with a positive impact on all market actors.[4] The producer can use ICT to sell their products through the online market, and manage inventories and rural distribution networks using applications that enable communication with the buyer, orders to be processed and electronic invoices to be issued. Buyers can use a range of management information systems to order the goods, track where the purchased goods are and ensure the food safety of the product by tracing it along the market chain from individual farms to the retail shelf by using cell phone systems and barcodes.

(continues on page 4)

[3] Kompas Online, 2017. Indonesia Lack of 28,000 Agriculture Extension (Indonesia Kekurangan 28.000 Penyuluh Pertanian). Accessed online 12 December 2017 at: http://ekonomi.kompas.com/read/2017/08/09/190000126/indonesia-kekurangan-28.000-penyuluh-pertanian

[4] World Bank, 2011. ICT In Agriculture, Connecting Smallholders to Knowledge, Networks, and Institutions.

## FROM CAPSA

**Dear Palawija Readers,**

We are pleased to share the December 2017 edition of CAPSA Palawija Forum. This edition will highlight the issue of “Technological innovation approach for sustainable and resilient agriculture”. Agriculture holds the key to supporting economic, social and environmental structures to strengthen our sustainable society. In addition, sustainable and resilient agriculture is critically important to achieving goals from other sectors, such as the sustainable use of water and energy, employment, equitable development and climate change adaptation. Accelerating technological innovation and facilitating the transfer of useful technologies across Asia and the Pacific is a key strategy to meet such challenges in the agriculture sector.

This edition of Palawija Forum presents three articles and one case study focusing on the above issue. The main article discusses the opportunities and challenges in the implementation of information and communication technology (ICT) to support agricultural development in Indonesia. The Farmer Empowerment through Agricultural Technology and Information (FEATI) project developed by the Indonesian Ministry of Agriculture is also highlighted in the article.

The second article elaborates the Sri Lankan Department of Agriculture's initiative to develop various farmer-centric services by adopting ICT tools to improve rural farming and ensure food security. Some successful ICT innovations are also showcased.

The third article describes some important technologies for enhancing agricultural resilience to natural disasters and climate change in Lao People's Democratic Republic (PDR). The article concludes that the country's Agriculture Development Strategy to the year 2025 (ADS 2025) will focus on the development of agricultural technology.

This edition also shares a case story of the Republic of Korea in developing smart farms by using ICT applications for resilient agriculture, and a review on the updated edition of the World Bank Source Book, entitled *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions.*

We hope that you find the information in this Forum useful.

**CAPSA Palawija Team**

### Important Notice

The fourteenth session of the Governing Council of CAPSA was held in Bangkok, Thailand, on 13 December 2017, and adopted, among others, the decision that CAPSA will transition to a new intergovernmental organization outside the United Nations system as of 1 July 2018. In this regard, the issuance of Palawija Forum will be suspended during the transition period.

CAPSA will nevertheless continue the electronic dissemination of its information products, including, among others, E-Flash, monthly updates on sustainable agriculture policy issues in the Asia-Pacific region and beyond. Check out our website at www.uncapsa.org for more updates and follow our social media channels on Facebook and Twitter.

## Opportunity

Rural agricultural development can be boosted through ICT initiatives that can disseminate information to rural communities, exchange information between rural farmers, improve research and extension linkages and promote rural agricultural growth. The increasing number of mobile phone and internet users, as well as the improved electricity infrastructure and transmitter networks that have reached remoter areas provide great opportunities for ICT in agricultural development.

Datkata (2017)[5] found that the number of cell phone subscriptions in Indonesia is increasing rapidly, from 282 million in 2015[6] to 371 million users in 2017. This figure is equal to 142 per cent of total Indonesian population of 262 millionpeople. Even though the information on the number of cell phone users in rural area is insufficient, the primary support of mobile transmitter networks has spread to rural and remote areas across Indonesia.[7] Mobile phones and mobile broadband connections are affordable and are driving the growth of Internet access in Indonesia. Currently, the number of Internet users is 132.7 million people[8] or almost 51 per cent of the total population of Indonesia. Indonesia is ranked sixth in the world in terms of Internet users after China, USA, India, Brazil and Japan.

Widespread broadband connectivity and cloud computing with fourth-generation technology (4G), which has been operating in Indonesia since 2010, is bringing almost unlimited capacity for farmers and other actors to connect with each other and engage in complex agricultural market

**Number of Internet users in Indonesia per January 2017**


Source: Hootsuite, 2017

[5] Datkata, 2017. Indonesia Cellular Phone Users Reach 142% of Population (Pengguna Ponsel Indonesia Mencapai 142% dari Populasi). Accessed online 13 December 2017 at: https://databoks.katadata.co.id/datapublish/2017/08/29/pengguna-ponsel-indonesia-mencapai-142-dari-populasi

[6] Ramadhan, B. 2016. Number of Cellular Phone Users in Indonesia is Exceeded the Number of Population (Jumlah Pengguna Ponsel di Indonesia Melebihi Jumlah Populasi). Accessed at https://www.goodnewsfromindonesia.id/2016/01/21/data-terbaru-ternyata-jumlah-ponsel-di-indonesia-melebihi-jumlah-populasi

[7] Kemeninfo, 2017. Indonesia Ranked the Sixth Internet User in The World (Pengguna Internet Indonesia Nomor Enam Dunia). Accessed online 13 December 2017 at: https://kominfo.go.id/content/detail/4286/pengguna-internet-indonesia-nomor-enam-dunia/0/sorotan_media

[8] Hootsuite, 2017. Digital in 2017: South East Asia

chains to access and use information for decision support. Smartphone technology and cloud-based computing can effectively be used to transform smallholder agriculture in developing countries.

### Challenge

ICT utilization in Indonesian agriculture, however, faces some challenges in its adoption:

- The spread of the population across an archipelago makes the distribution of ICT devices and infrastructure costly and time-consuming.
- Power supplies in some remote areas are still insufficient and Internet connection networks are still limited.
- The telecommunication infrastructure such as transceiver base station and technical control facilities is still relatively expensive.
- The amount of resources and capacity of government personnel is low, preventing agriculture data input and processing from running optimally.
- Budget allocation for operational application of ICT in agriculture from local government or other parties is limited.[9]
- Lack of capacity and knowledge of extension workers and small-scale farmers in implementing ICT on agricultural practices.
- From a sociocultural point of view, culture sharing is still not entrenched. The culture of information and knowledge is still insufficient and the culture of documenting information and data is not routine, especially for small-scale farmers.[9]

## Lessons learned from FEATI project

The Indonesian Ministry of Agriculture, with support from the World Bank, managed the FEATI project during 2007-2013. The objectives of the project were to empower farmers and farmers' organizations in improving productivity, income and welfare through increased accessibility to information, technology, financial capital, production facilities, agribusiness development and business partnerships. The implementation of the FEATI project involved agricultural researchers, non-governmental organizations working in agriculture, farmers, agricultural extension workers and the private sector/entrepreneurs in agriculture and government.

The main key activities of FEATI project include:

1. Provision of ICT facilities
2. Training needs assessment
3. Training and workshops on ICT in agriculture
4. Internal staff capacity-building (i.e. audiovisual training, scientific writing)

Two approaches were considered in implementing the FEATI project: (1) providing ICT facilities, training and capacity-building for extension workers; (2) only providing ICT facilities to extension workers. The evaluation revealed that there are significant differences resulting from these two approaches. The first approach made extension workers more independent, more knowledgeable and confident in utilizing ICT and disseminating it to farmers. In contrast, the second approach made extension workers less independent and less confident in utilizing and disseminating ICT to farmers as they had to teach themselves how to use the ICT and they had little support.

Lesson learned from FEATI project were:

- ICT can be used as a strategic tool to support agricultural development at each stage of the farming life cycle, including pre-cultivation; crop cultivation and harvesting; and post-harvest.
- ICT in agriculture is also part of disaster risk reduction efforts, because ICT can help in disseminating early warnings of pest and disease outbreaks, presenting information on cropping calendars in accordance with climate predictions and providing information of food stocks (staple food).
- Capacity-building for extension workers in utilizing the ICT in agriculture is needed.
- Aspects of the FEATI project were continued after the main project ended: the web portal, **Cyber Extension** and **Cropping Calendar Information System** application are still operated. This continuity is due to commitment from the government to follow up and maintain the project results by allocating human resources and funding.

[9] Sumardjo, Lukman M. Baga, and Retno S. H. Mulyandari, 2009. Kajian Cyber Extension. Faculty of Agriculture. Bogor Agricultural University

**a. Cyber Extension**

The Cyber Extension, which can be accessed at http://cybex.pertanian.go.id/ is an information portal that aims to support extension workers throughout Indonesia in providing agricultural information among regions. This information includes news, and location-specific agricultural technology and market information. It is expected that communications between agricultural extension workers and other extension workers in Indonesia will improve.

Activities include:

- Provision of ICTs tools and facilities to extension workers
- Training for extension workers on how to operate various type of ICTs and how to produce extension material, including how to upload it into Cyber Extension
- Development of a web application that provides extension workers with agricultural materials and a platform for sharing information among extension workers.

Conventional counselling meant extension workers had to wait for agricultural information materials (such as leaflets, brochures, posters) and in electronic information (such as films, interactive dialogues, radio broadcasts) to be prepared by the Ministry of Agriculture. This information was limited, often late and relatively expensive. The ICT-based extension system is expected to increase the level of interactivity (communication), add speed (information), deepen two-way communication, expand the range of communication, increase quality/quantity of information, reduce costs, improve speed and be accessible anywhere, anytime and by anyone.

**b. Cropping Calendar Information System (CCIS)**

This application provides recommendations on cropping season and appropriate innovations based on climate conditions at a subdistrict level. It has been launched as web and android versions. The information provided by CCIS include:

1. Information on season and rainfall predictions
2. Information on cropping season and potential planting area
3. Information of endemic areas, droughts and floods
4. Recommendation of varieties
5. Recommendation of fertilizers
6. Recommendation of tools and machines

The ability of CCIS in presenting the information as mentioned above and recommendation of adaptive technology according to climate prediction, allows farmers to determine (1) time planting and cropping patterns; (2) potential planting area for each season on rainy, normal, and dry conditions; (3) adaptive technology on varieties, fertilization systems and pest control mechanism.

## Room for improvement

There is now growing evidence of how new ICTs are creating a discontinuity between agricultural development in developed and developing countries. The issues for smallholders, beyond adopting and adapting technology as its cost declines, are in availability and access to relevant, timely and useful content. This requires the significant transformation of current agricultural organizations and how they address farming. These organizations will need to be able to manage and promote effective use of data and information that the new ICTs will generate to improve production efficiency for all actors. These organizations will also need to make the entire information-sharing process participatory. The agricultural information manager now has to consider the challenges of using new ICTs and transforming organizations to enable community participation for agricultural development and progress.

Provisions of standards, norms, methodologies and tools, as well as the development of individual and institutional capacities, and policy support are all key components of ICT in agriculture. Some of the areas to be developed include:

- Capacity-building for extension workers on the implementation of ICT into agriculture practices
- Intensive training for smallholder farmer groups
- Providing information on agricultural extension material to extension workers
- Increasing the number of extension workers with a target of one village one extension worker
- Disseminating information and agricultural ICT to all stakeholders
- Providing adequate ICT equipment and its infrastructure
- Enabling policy support

# ICT Innovation to Improve Rural Farming and Ensure Food Security in Sri Lanka

SHORT ARTICLE

**By R. D. Siripala**

## Introduction

Agriculture is the backbone of the Sri Lankan economy; it contributes significantly to export income and contributes approximately 7.5 per cent of gross domestic products (GDP).[1] Over 30 per cent of Sri Lankans are employed in the agricultural sector.[2] Demand for agricultural produce at the national level has grown exponentially over the decades due to population growth. At the same time, the agriculture sector is vulnerable to changes in climate making agriculture more challenging and resulting in declines in productivity. To meet this expanding demand, farmers must become more adept at anticipating climate changes, supported by the development of a Training & Visit (T&V) System by the Government of Sri Lanka. The T&V system initially significantly contributed to agricultural development, but the system is unable to address the current needs of the farmers.

Through the Information and Communication Technology Act No. 27 of 2003, (ICT Act), the Government of Sri Lanka has taken the breakthrough decision to use information and communications technology (ICT) tools in national development. The agriculture sector is a main target for empowermnet through ICT. The aim is to improve the accessibility of agricultural technical and market information and other farmer-centric government and private-sector services. It is hoped that these measures will ensure the food security of the country through planned food crop production, while ensuring farm incomes are optimized.

## ICT innovation by the Department of Agriculture

The traditional extension system of the Department of Agriculture (DOA), which has been operating for many decades in the country, has its own strengths in respect of strong infrastructure and capacities. The extension system together with agricultural development research has ensured the food security of the nation. However, the DOA is currently taking measures to merge ICT-supported agriculture extension systems with the traditional systems to strengthen and improve the efficiency of the extension system by using ICT.

### Crop-based information repositories on interactive multimedia CD-ROMs

Interactive multimedia CD-ROMs (IMM CD-ROMs) are stand-alone applications developed

**Figure 1. Interactive multimedia CD-ROM on food crops in Sinhala and Tamil languages**

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[1] Central Bank of Sri Lanka, 2016. Central Bank of Sri Lanka Annual Report
[2] World Bank, 2017. Employment in Agriculture. Accessed at https://data.worldbank.org/indicator/

using multimedia authoring tools. Each IMM CD-ROM includes technical information on a food crop or other agricultural subject, such as integrated pest management, micro-irrigation or protected agriculture. The production of IMM CD-ROMs has helped to pool almost all of the technical information on new crop varieties, good agricultural practices, post-harvest technologies, value addition, success stories, etc.

Considering the low computer literacy of extension workers, as well as farmers, a familiar concept, similar to reading a book, is used for the interface, including a page-turning facility. The contents are organized into chapters, topics and subtopics and users can also print each page.

## Television programmes on agriculture

Television programmes are the most common means of mass media activity and are highly effective in technology transfer, especially in the field of agriculture. Three videos have been produced by the DOA for national broadcast, namely *Govi Bimata Arunalu* (Agriculture Technology Programme), *Mihi Katha Dinuwo* (Farmer Success Story) and *Ketha Batha Kamatha* (Traditional Agriculture). The programmes are very popular among farmers and related groups. The videos have been uploaded to the YouTube and Vimeo, and shared through social media. The statistics show that this has significantly increased access to these videos by interested groups.

## Radio programmes on agriculture

In rural Sri Lanka, radio is the most popular mass media for accessing information. Many agriculture programmes have been produced by the DOA and broadcast through community radio stations and national radio channels. The programmes were produced in Sinhala and Tamil languages.

A web-based radio station, KrushiFM, hosted under the domain name of www.krushifm.lk started broadcasting in 2013 with the objective of establishing a dedicated national radio channel for agriculture (Figure 2). Further, an android-based mobile app has been introduced with the expectation of popularizing KrushiFM among smartphone users (Figure 3).

## Websites

### a. Official website of the Department of Agriculture

The DOA has also developed an official website, which provides institutional information to staff and the general public. Initially, the static website was developed using hyper text mark-up language (HTML). Then, along with the development of e-Government initiatives and the demand for agricultural technology transfer through the Internet, the website was revamped to include institutional and technical information for the stakeholders in the agriculture sector. Currently, the website is based on a content management system to ensure a user-friendly interface with a decentralized updating facility (Figure 4).

**Figure 2. KrushiFM mobile app**

**Figure 3. KrushiFM website: www.krushifm.lk**

### b. WikiGoviya website of the Department of Agriculture

Wikigoviya is a Web 2.0-based initiative that has established a discussion forum to facilitate progressive dialogues among agriculture stakeholders and developed a Wiki-based public agriculture knowledge repository (Agripedia). Further, it is supported by a multimedia-based e-learning system in agriculture. The IMM-CD-ROMs produced by the DOA on crops and other subjects have been uploaded for e-learning and an online agriculture classified advertising system has been developed to facilitate agricultural e-marketing (Figure 5).

## Agriculture Call Centre, 1920

The Agriculture Call Centre known as *Govi Sahana Sarana Sevaya* was established in 2006 to cater for the quick and timely information dissemination needs of the farmer. It is accessed via the short code, 1920. The call centre is the most popular initiative among farmers and is supported by recording the caller information from each call and video-calling facility. Initially, there were 4 call centre agents providing advice, but this has now increased to 20. They can handle more than 1,000 calls per day. However, the 1920 Agriculture Advisory Service currently receives only around 300 calls per day. The Agriculture Call Centre allowing information to be better tailored to farmers' needs.

## Management Information Systems

Real-time information is key for many decisions in agricultural ventures that are characterized by a high-risk environment. Agriculture-based Management Information Systems (MIS) can collect, process, manage and disseminate information to farmers in terms of timely and effective decision-making. The Decision Support System and the Market Information System are two different approaches of MIS applied to support decision-making by farmers, policymakers, extension workers and research officers. Some applications of the MIS system include: (i) Crop Forecasting Information System (CFIS); (ii) Good Agriculture Practices (GAP) Certification System; and (iii) Seed and Planting Material Information System.

## Agriculture mobile apps

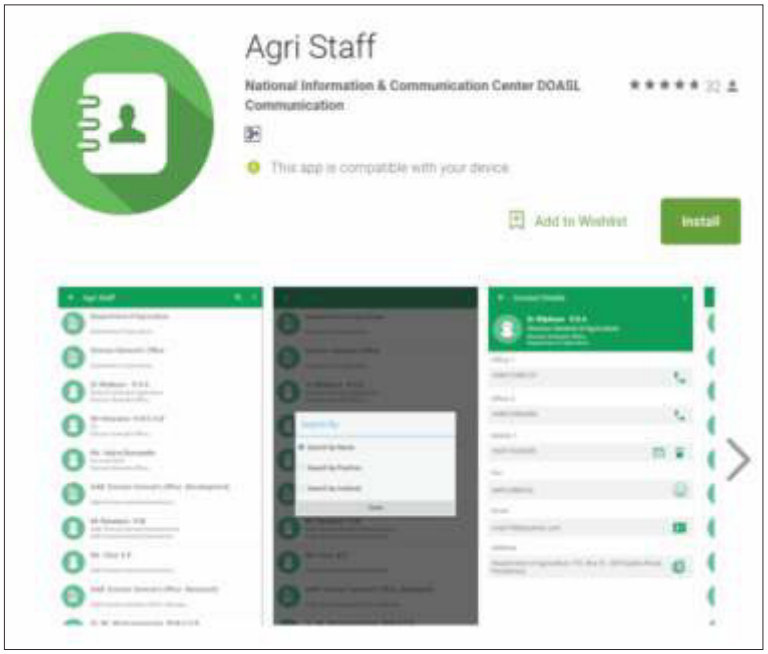
Smart phones are the most popular sources of information sharing among the local communities in Sri Lanka. Smart phones provide a variety of service platforms to share audio, video, text,

**Figure 4. Official website of the Department of Agriculture hosted under the domain name of www.doa.gov.lk**


**Figure 5. WikiGoviya website of the Department of Agriculture hosted under the domain name of www.goviya.lk**

images, animations, etc., in addition to the voice call and SMS services available on basic mobile phones. The DOA has started to develop mobile apps. For example, the mobile app Agri Staff is a simple and useful telephone directory, which provides quick access to the contact details of DOA staff and a one-touch dialling facility.

**Figure 6. Mobile app of Agri Staff Telephone Directory**




### Agriculture information dissemination through social media

Social media and smart phones allow content delivery at both a global and local level. The DOA has adopted a variety of strategies to utilize the popularity of social media for sharing information in order to deliver agricultural content. Facebook is the most popular social media in the country, with 5.4 million registered users. The e-Agriculture Working Group has recommended creating an official page for every institute under the DOA to collaborate with user groups. The official pages have initiated various discussions among agricultural interest groups, and this is the simplest way to disseminate agricultural information in an effective manner and allow feedback. Further, the DOA also utilizes the power of other social media such as YouTube, Twitter and Google+ in agricultural technology dissemination. This helps to raise awareness of new technological developments, latest trends, news, etc., among the public.

## National policy to support ICTs in agriculture: Sri Lanka e-agriculture strategy

The Government of Sri Lanka has the vision of building a digital economy to provide digital facilities, including e-agriculture, to every citizen in the country. The Sri Lanka e-agriculture strategy identifies the following priority objectives for the agriculture sector:

- Achieve self-sufficiency in food crops, which may grow locally and save foreign exchange on imports of those food items
- Increase availability of safe food by promoting eco-friendly practices and minimizing agrochemicals and pesticides in food crop production
- Ensure food security through appropriate management of buffer stocks
- Introduce and implement agroecological region-based food-crop cultivation programmes
- Increase the productivity of crop production through appropriate technologies
- Establish proper coordination among all agricultural stakeholders in the local food production process and connect all schools, civil organizations and general public to the programme
- Provide quality inputs for production and establish a proper marketing mechanism for products
- Build a healthy nation.

## Way forward for ICTs in agriculture

The establishment of the National Agriculture Information & Communication Centre of the DOA opened up enormous opportunities to streamline the process of adopting ICTs in agricultural development through coordinating the process of developing e-agriculture solutions. Further, the DOA has formed a high-level body known as the e-Agriculture Working Group to coordinate ICT initiatives and development of e-agriculture solutions. Based on the Sri Lanka e-agriculture strategy, the Working Group has prioritized activities to be addressed immediately and initiated the development process.

# Agriculture Technology Development to Enhance Resilience to Natural Disasters and Climate Change in Lao People's Democratic Republic (PDR)

SHORT ARTICLE

**By Chanseng Phongpachith**

## Background

The Lao People's Democratic Republic (PDR) is a landlocked country that is highly exposed and vulnerable to climate-related disasters, namely floods, droughts and storms. For example, a temperature anomaly occured on 25-27 January 2017 causing the northeast of the country to be hit by an extreme cold snap with temperatures as low as -2ºC, which resulted in the death of livestock. Since 1960, rainfall intensity has increased during the rainy season, followed by extended dry periods, more frequent flash-floods and a series of typhoons from the South Pacific. Floods and droughts occurr almost every year, sometimes twice a year, in the south and central parts of the country. The flood-prone areas are located along the Mekong River and its main tributaries, while the drought-prone areas are the upland northern areas and a few areas in southern provinces.

Climate-related disasters due to climate change have damaged public infrastructure, property, crops, productive agricultural land and other agricultural assets. Furthermore, they undermine farming systems, which increases farming household food insecurity as both floods and droughts severely damage rice, the main staple crop. In 1998 and 2003, drought events destroyed 29,202 ha and 23,770 ha of rice fields respectively, while in 2005, floods destroyed 54,640 ha of rain-fed rice fields and killed 14,941 livestock. Floods also damage agricultural infrastructure, such as irrigation systems or channels, roads and electricity infrastructure.

## Agriculture innovation and technology development

There are two main farming systems in Lao PDR: lowland and upland farming. They have high regional disparities. There are six agroecological zones based on the interdependence of the natural environment, agricultural production potential and rural poverty. About 80 per cent of livelihood is small-scale agriculture in the rural area. There is low adaptive capacity, exacerbating vulnerability to climate change.

Technological development priorities to enhance the resilience of agriculture to natural disaster and climate change include: (1) improving the climate change knowledge base; (2) strengthening agriculture and rural development policies; (3) developing institutional capacities for executing the climate change adaptation plan; (4) implementing appropriate and adaptive agricultural practices; (5) introducing alternative livelihoods for rural communities; and (6) building the capacity of farmers to support the government's green growth policy.

The following sections describe some important technology for enhancing agricultural resilience to natural disasters and climate change in Lao PDR.

**Rice seed development:** New rice varieties that are resistant to environmental stresses, namely TDK, VTE450 and Homsavan, have been produced. TDK is drought and flood resistant, VTE450 is specifically for lowland cultivation and Homsavan is a wet season, rain-fed lowland variety. In the last two decades, Lao has established several rice research centres, including a Rice Laboratory under Naphok Rice Research Center and Thasano's rice research centres under the National Agriculture and Forestry Research Institute.

**Water-use technology for agriculture:** The use of water from ponds and small reservoirs by using gravity canals allows rain-fed lowland rice-based farmers to capture rainfall and use it as a water supply for a short-term irrigation, conserving water from other sources.

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**Pumping the water into rice paddies from tributaries of the Mekong River**

Lowland farms often pump water from nearby tributaries or wetlands. The water level of these sources changes significantly between the wet and dry seasons, as backwater flows up from tributaries and some places along the Mekong. A floating pump or 'pontoon' method is used to cope with these changes. Some farmers also used drip irrigation systems.

**Agricultural mechanization:** Agricultural machines help to improve agricultural productivity and yield quality, and make land preparation, growth, harvest and post-harvest handling more time efficient.

**Greenhouses:** Greenhouse vegetables are now popular in Lao PDR, as greenhouse technology controls environment stresses, temperature and pest control.

In addition, they allow a more precise estimation of the effects, degree and timescale of climate change impact on agriculture. This information can then be used as the basis for climate change adaptation measures in agriculture; for example, crop modification.

**Solar energy:** In some rural areas, solar energy is being used for pumping water, light and to supply drinking water. However, the focus is on domestic needs. In the future, solar energy could be used to support farming practices, primarily by offering an alternative energy supply during the dry season.

**Integrated farming systems:** In the last century, the rural farmers in upland areas were encouraged to improve agriculture production by introducing new crops, growing horticulture crops instead of rice, diversifying crops and changing cropping systems; for example, changing from upland rice to maize, upland rice to Job's Tears plants, rubber trees, tea and coffee.

Currently, farmers are encouraged to use an integrated farming system, with cattle as livestock, as this is economically efficient. It has been estimated that 10,000 cattle and buffaloes were exported from Lao to Viet Nam in 2004, increasing to 40,000 animals in 2010 with an additional 20,000 cattle exported to China. However, issues in marketing, breeding programmes, artificial insemination, animal health, feed shortages, standard veterinary care and low fertility need to be addressed.

## National initiative and partnership

Several international organizations have worked in the agriculture sector with the Ministry of Agriculture, Forestry and Rural Development (MAF) and the Lao Government more generally. They include UNDP, ADB, WB, ACIAR, FAO, IFAD, CIAT, IRRI, JIRCAS, TABI, KOPIA, Care International and HEVITAS.

## Concluding remarks and ways forward

Recent climate change has already affected crops and animal production in Lao PDR. The core agriculture sector problems are low agricultural productivity, devastating natural disaster, and the unrealized potential of global market. The result is high rural poverty and low economic productivity.

As most of the country is still very much locked into the production of glutinous rice for subsistence purposes, there are opportunities to supply market-demand with products that are significantly different from those of larger regional competitors. Furthermore, Lao PDR is at the centre of a market, and many more consumers are increasingly demanding high-value and safe products, especially livestock products. In addition, the green growth policy will enforce environmentally friendly and sustainable farming practices to achieve fiscal stability while moving towards green growth.

The Planning of Agriculture Development Strategy to the year 2025 (ADS 2025) defines objectives and goals in developing the sector and agricultural production up to 2025. It will focus on the development of agricultural technology. The vision of the agriculture sector to the year 2030 is **"ensuring food security, producing comparative and competitive potential agricultural commodities, developing clean, safe and sustainable agriculture and shift[ing] gradually to the modernization of a resilient and productive agriculture economy, linking with rural development contributing to the national economic basis"**.

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**CAPSA NEWS**

# CAPSA to Evolve as an Independent Inter-governmental Organization

The fourteenth session of CAPSA Governing Council marked a critical change in CAPSA's institutional future. The session held in Bangkok, Thailand, on 13 December 2017 concluded with a decision by the member countries to transition into an independent intergovernmental organization outside of the UN system.

Read the Communiqué.

CASE STUDY

# Smart Farm as an ICT Application for Resilient Agriculture: A case in the Republic of Korea

**By Sanghun Lee**

## Introduction

Smart Farm involves the use of new agricultural facilities and information and communications technology (ICT) to accurately maintain and manage the crop or livestock growth environment remotely and automatically. Smart Farm is optimized according to crop growth data and environmental information to improve the quality and quantity of products, with less labour, energy and nutrients than previously.

Smart Farm enables precision agriculture by automatically monitoring environmental and crop-growth information to measure the duration and quantity of nutrient supply required precisely. Therefore, water and fertilizer use can be reduced as the dripper irrigation system accurately provides the needed nutrition. This ultimately improves farmers' income, producing a consistent quality product by avoiding environmental stresses caused by climate change and natural disasters.

Smart Farm can also contribute to reducing greenhouse gas production and livestock mortality rates by utilizing an automatic separation system for livestock waste. Studies on adopting renewable energy (e.g. geothermal and solar power) in Smart Farm based on energy storage and energy management systems are ongoing. By using geothermal and solar power, greenhouses gas emissions and production costs can be reduced.

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## Smart Farm implementation for resilience agriculture

Smart Farm in the Republic of Korea is mainly applied to horticulture, orchard and livestock farming.

### Horticulture

The temperature, humidity and $CO_2$ levels of the greenhouse are monitored through a PC or mobile device to provide the optimum environment for vegetables and flowers (including tomatoes, paprika, mushrooms, ginseng, medicinal plants, etc.). Environmental controls include remotely opening and closing windows. ICT is used to collect environmental information and mobile devices are used to manage growth and environmental parameters, such as the heating system.

### Orchard

Fruit plantations (e.g. apples, pears, tangerines) use PCs and mobile devices to monitor sensors for temperature, humidity, wind speed and other weather conditions in the open fields, and operate automatic irrigation and pest control. Growth, pest control, prevention of cold-weather damage, optimal irrigation, protection from thefts, etc., are monitored and controlled using mobile devices.

### Livestock farming

Smart Farm in livestock farming refers to the smart barn, which can monitor growth environment parameters, such as temperature and humidity, and also remotely control the time and amount of feed and water using PCs or mobile devices. ICT technology is used to collect environmental information from the barn; for example, temperature, humidity, power outages and fires. Remote monitoring from outside the barn uses CCTV and mobile devices. Mobile devices also can control feeding and breeding management, such as automatic feeding systems, drinking water management systems, etc.

**Smart Farm for horticulture (left), outdoor (middle) and intensive pig farming (right)**



## Evaluation of Smart Farm implementation

Seoul National University R&DB Foundation, 2016)[1] evaluated Smart Farm implementation. The study revealed that the production per unit area was increased by 27.9 per cent, along with a decrease in labour needed. The self-employed hours reduced by 15.8 per cent from 278 hours/year to 234 hours/year. The average cost of hiring labour was reduced by 15.9 per cent. Additionally, after the adoption of the Smart Farm system, the number of pest and disease incidents decreased by an average of 53.7 per cent, and the cost due to damage was reduced by 57.3 per cent, reducing the business risk of farms as a result.

Smart Farm is not immediately applicable to every environment. A report by Education, Promotion and Information Service in Food, Agriculture, Forestry and Fisheries (EPIS) through Korea Agri ICT-ODA stated that 'to apply Smart Farms successfully in low developing countries, the local environment and practice of crop cultivation should be well analysed formerly, according to each country's condition, especially, considering the economic condition of the countries'. Investment costs are the primary factor for consideration. Rather than applying high-tech technology unconditionally, we should consider implementing Smart Farms using optimal technology for the local environment to reduce operating costs and maximize profits.

The initial investment cost for Smart Farms is high. Establishing public-private partnerships is a realistic approach for developing countries. Public funds could suport pilot project stages, while the private sector could supply capital for expansion and investment in technology creating a win-win strategy for the development of Smart Agriculture.

[1] Productivity analysis on Smart Farm implementation (SNU R&DB Foundation, 2016)

**PUBLICATION INFO**

# ICT In Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions

(updated edition)

World Bank, 2017

Information and communication have always mattered in agriculture. Agriculture is facing new and severe challenges, including population growth, increased disaster events, climate change and environmental degradation. With rising food prices that have pushed over 40 million people into poverty since 2010, more effective interventions are essential in agriculture. Given these challenges, the arrival of information and communication technology (ICT) in the agriculture sector is well timed.

This publication is an updated edition which is designed to support practitioners and policymakers in taking maximum advantage of ICT's potential to improve agricultural productivity and smallholder incomes, strengthen agricultural markets and institutions, improve agricultural services and build developing-country linkages to regional and global agricultural value chains. It focuses primarily on how ICT can assist small-scale producers and the intermediate institutions that serve them, yet it also looks at how to link smallholders to ICT-enabled improvements in larger-scale farming, markets and agribusiness to stimulate the broader rural economy.

The Sourcebook provides users with a comprehensive overview of current and upcoming ICT-in-agriculture applications and how they might improve agricultural interventions or strategies. It is not a primary research product; nor does it claim to be the definitive treatment of a sector that is evolving so rapidly. Its modules are intended to serve as a practical resource for development professionals seeking a better understanding of the opportunities and existing applications offered by ICT as tools for agricultural development.

To facilitate learning, the Sourcebook is split into an introduction plus 14 modules focusing on specific aspects of the agricultural sector in relation to ICT. A module box briefly describes the content, an overview, topic notes and innovative practice summaries. The innovative practice summaries are bulleted underneath the description of the topic note, and can be viewed directly by clicking on the title. Many of the tools, examples and projects discussed also include links to websites and other useful resources.

For more information, please visit:
http://documents.worldbank.org/curated/en/522141499680975973/ICT-in-agriculture-connecting-smallholders-to-knowledge-networks-and-institutions

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