



Food and Agriculture  
Organization of the  
United Nations



# LEVERAGING INNOVATION AND TECHNOLOGY FOR FOOD AND AGRICULTURE IN ASIA AND THE PACIFIC





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# INTRODUCTION

The Asia-Pacific region is home to the world's fastest growing economies and is the “growth engine” of the global economy. At the same time, it has the largest number of malnourished people (nearly 500 million). Asia and the Pacific also has the largest number (more than 100 million) of family and smallholder food producers in the world. These farmers, fishers and herders produce more than 80 percent of the food consumed in the region. Yet they face unprecedented challenges that affect the sustainability of our food and agriculture systems. An increasing and fast urbanizing world population, deteriorating natural resources, loss of biodiversity, and the impacts of climate change are converging into a “perfect storm” which threatens the livelihoods of smallholders. Moreover, these challenges hugely impact women who are the principal drivers of change towards more sustainable food production systems and more varied and healthier diets.

While efforts in the past centred on boosting agriculture to produce more food, today's focus is on addressing the root causes of hunger and malnutrition through transformative changes to

our food systems. The way food is produced, processed, distributed and consumed needs to be re-thought and re-engineered. Concomitantly, greenhouse gas emissions from agriculture need to be dramatically reduced and agriculture itself needs to utilize fewer natural resources while keeping pace with population growth. The Asia-Pacific region is particularly vulnerable to extreme weather and other natural disasters, and building resilience to such shocks is vital.

Agriculture needs to be profitable for smallholders, and access to online and physical markets and the incorporation of good practices, standards and infrastructure are critical for regional and international trade. Innovation, therefore, is central to achieving this multi-dimensional change.

However, innovation is often grouped with science and technology. While the impact of digital and other technologies is obvious in multiple aspects of development, the impact of novel changes to processes, policies and programming should not be underestimated.

**In the words of the Secretary-General of the United Nations,  
Antonio Gutierrez:**

We can do things differently, and we can do different things...innovation is not only (about developing) the most sophisticated technology, sometimes it's the simplest of things. Be bold, be revolutionary [...] because without innovation, there is no way we can overcome the challenges of our time.

Food and Agriculture Organization of the United Nations (FAO) defines agricultural innovation as the process whereby new or existing products, processes or ways of organization are used for the first time in a specific context in order to increase their effectiveness, competitiveness and resilience with the goal of contributing towards food security and nutrition, economic development, and sustainable natural resource management.



# INNOVATION STORIES FROM ASIA AND THE PACIFIC



The region is at the forefront of innovation, and is renowned for its diversity and ingenuity, especially with regard to food and agriculture. Governments and development agencies are leveraging the presence of a large young population and fostering an enabling environment for the digital economy, which is attracting investors and entrepreneurial talent. The Asia and Pacific region can potentially lead the global economy in the future, not only through economic growth, but also through its ability and actions to embrace innovation and change. In this fast-paced environment, the FAO Regional Office for Asia and the Pacific (RAP) and its country offices, over the last few years, have increasingly put into practice innovations in partnerships and business development. These efforts aim to explore the responsible

application and adoption of existing and frontier technologies, and to design and increase new services, tools and approaches to empower rural households, and inspire youth entrepreneurship in food and agriculture.

The stories of innovation presented here were assembled by FAO country offices. They are the fruit of collaborative work of countries, FAO and other partners, and revolve around the use of innovations for improved agriculture policy-making, planning and incorporating technologies and new ways of working along the entire food chain. The vision of FAO's director-general is to leverage the collaborative platforms that are being established, and disseminate innovation throughout the region and beyond.

## Making agriculture productive and sustainable

The knowledge and expertise of FAO stemming from its experience of 75 years is being combined with new ideas and technologies to enhance productivity with controlled natural resource use in agriculture.

### Revamping technologies

In many countries of the Asia-Pacific region, poor soils, salt-water intrusion, limited access to technology and issues of land ownership hinder agricultural production. Product quality and safety, therefore, cannot be controlled as is needed to meet market demands and standards.

Controlled crop production in greenhouses, combined with drip irrigation, has been globally successful as a means for intensifying cropping and increasing water-use efficiency in water-scarce environments.

Greenhouses, however, are not yet common throughout the region. In Cox's Bazar in Bangladesh, where nearly one million refugees from Myanmar are housed, local farmer groups have constructed low-cost greenhouses and installed drip irrigation technology designed by FAO experts for high-quality vegetable production. This has helped these farmers to extend the growing season, thereby increasing their yields and incomes. Additionally, the farmers are supplying vegetables to World Food Programme (WFP) outlets, which can then be made available to the refugees.

Drip irrigation in Bangladesh





In Bhutan, conventional subsistence farming is a continuing challenge given the country's mountainous topography and cold weather, and this also discourages youth from remaining in rural areas. In collaboration with FAO, Bhutan is investing in protected farming with inexpensive materials. Polysheets are being used for areas larger than conventional greenhouses. The sheets not only provide the sides and roofs of the greenhouse structure but also serve to suppress weeds and maintain soil moisture when placed on the ground. To upgrade the technology package, drip irrigation is being introduced with an automated schedule of irrigation through a mobile application, and supported by solar-powered pumps thereby replacing labour for irrigation. The result is minimal post-harvest loss and crops are protected from wildlife. This innovation allows farming to become commercial and market driven, and assures income to farmers. Technologies that increase labour efficiency and capital are recognized by the government as the future of farming in the country.

### Information and communications technology for agriculture planning

Improving access to valuable information helps agricultural stakeholders make better decisions regarding the use of available resources in the most productive and sustainable manner. FAO has been supporting its member countries in setting up national

### Hydroponic farming in Bhutan



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e-agriculture strategies that provide an effective roadmap for the agriculture of the future. These strategies are characterized by a holistic and multi-stakeholder approach as information and communications technology is also driving other sectors closely linked to agriculture, such as banking, weather monitoring, insurance, logistics and e-governance.



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## Digital data collection in Cambodia

In 2020, Cambodia will release its first annual survey of agriculture. Data collection, processing and validation are the result of a joint collaboration started in 2018 between the Royal Government of Cambodia, the United States Agency for International Development, and FAO. The survey involved approximately 16 000 households in all provinces across Cambodia, and used a computer-assisted personal interviewing system to streamline data collection and management. This vital dataset will contribute to Cambodia's ability to report on the agricultural productivity and income of small-scale producers under the Sustainable Development Goals through a new platform. The data, when made more widely available and in a timely manner, will contribute to better understanding the situation of

Cambodia's agricultural sector and to better policies and decision-making.

Crowdsourcing is the gathering of information, ideas or funding from a large group of people, and is usually done through remote data collection. In partnership with the Philippines Statistics Authority (PSA), FAO assessed the effectiveness of short message service (SMS)-based crowdsourcing as a tool in forecasting palay (unmilled rice) production and analysing the crop situation in the Philippines. It provides a valuable supplement to traditional macroeconomic forecasts by improving the accuracy, speed of generation, and reliability of circulated data. The study was able to produce yield statistics and assess palay production on a monthly

basis from the information directly given by the farmers. Additional funds will enable PSA, with support from FAO, to expand and institutionalize crowdsourcing and SMS in its data collection for crop forecasting.

In Lao People's Democratic Republic, the village public announcement system remains a critical public communication and information dissemination tool in rural and remote communities. This mode of communication has inspired a partnership with Lao National Radio to train local farmers in broadcasting skills to inform farming households about climate and geospatial information in local languages via this established community channel. The aim is to boost sustainable production by optimizing farmers' and smallholders' resilience against climate change. The partnership led to increased local capabilities and understanding of agroclimatic monitoring, and the efficient use of existing community assets (e.g. human and material resources).

## Policies for innovations in the digital age

Digitalization in agriculture is transforming innovation and already provoking a shift in farming and food production. As a result, market dynamics, structure and distribution are also changing. In view of this transformation, changes to innovation policy are required in the digital age. Data handling, open

## A smart farm in Republic of Korea



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science, fair access, intellectual property, and the promotion of e-literacy and digital skills in rural areas are all aspects that should be addressed to create an enabling regulatory environment for agricultural innovation.

The Republic of Korea is recognized as a leader in information and communication technology (ICT) development. Growth engines in the agricultural sector, however, are weakening due to an aging population, lack of entry of new farmers, and the expansion of the sector in neighbouring countries. To reverse the trend, the government is working to transform the country's agricultural structure – from traditional to smart farm-oriented and technology-intensive. In 2018, the government enacted a

pivotal policy to spread smart farms in the future through the smart farm spread plan. The Farmland Act was also revised to enable smart farms to be established in agricultural promotion zones, in addition to preferential leasing of agricultural land to young farmers who wish to operate smart farms. Four 'Smart Farm Innovation Valleys' have been established to expand the infrastructure and include tech start-ups and education programmes. FAO aims to cooperate with the government to export the model of smart farms to other countries in the region, while taking into consideration the context and infrastructure of those countries.

Thailand, too, has accumulated significant technical know-how and experience in promoting smart farming

and digital agriculture. From support to start-ups and agrotech entrepreneurs, to investment and special taxation system, and smart farm education programmes, Thailand is committed to providing an enabling environment for agricultural innovation to thrive. As a leading supplier of rice to the world, Thailand has invested in precision agriculture to reduce production costs and increase the productivity of rice paddies. The demonstration paddy field in Suphanburi Province, for instance, uses digital technologies in soil and water management, temperature and pest control among others. Cutting-edge technologies have been applied to this demonstration field in soil analysis to develop fertility maps, monitor moisture to determine sowing time, prepare seeds and manage pesticide applications.

## Pest control by drones in Thailand





Advanced agriculture machines are used for seed drilling, weeding, measuring nutrient requirements of plants, watering, distributing fertilizer, and harvesting. Drones are also used to monitor the fields, including for developmental stages for input applications and control of pest populations.

In Japan, 64 percent of farmers (1.33 million in 2015) were older than 65. To increase production per farmer and expand business, the government has accelerated agricultural reform by promoting smart agriculture. The heart of this programme lies in the creation of an enabling environment, including the establishment of consultation systems for farmers who may be interested in introducing such technologies. Farmers are encouraged to introduce advanced technologies (e.g. big data, Internet of Things, robotics, drones) to their practices, and collaborate with machinery-makers to increase agricultural productivity. Japan's national policies support research and development of advanced technologies based on the needs of farmers, verification and dissemination of success stories, and environmental improvement. Ongoing examples include the automated tractors introduced by the Japanese company Yanmar that are helping to expand farming areas, or the scale of agriculture per farmer, within a limited cropping season; advanced water management systems through the use of smart phones; and ICT technologies

for improved precision in predicting the growth and diseases of farm crops.

## Climate action and disaster risk reduction

Climate change hugely impacts rural communities. Natural disasters and extreme weather events make it more difficult to grow crops, raise animals and earn steady incomes. Agricultural innovations, however, can provide solutions to mitigate the effects of climate change and assure sustainable and resilient livelihoods for the most vulnerable. The challenge of climate change is fuelling a comeback and renewal of traditional, mechanical and conservation practices that are backed with digitalization for precision delivery and monitoring.

### What adaptation really means

Domestic innovations and adaptive research are often employed in countries where access to technology is limited. In the Democratic People's Republic of Korea, due to constraints on international collaboration in technology and research, experimental practices and farmer-led innovations are generating benefits and mitigating environmental challenges. The country is promoting advanced farming methods and focusing on developing biological and organic methods for controlling pests and weeds through research and innovation. Cooperative farmers in



Yomju County, North Pyongan Province, for instance, introduced an innovation in weed control by growing mud snails in rice fields. The mud snail is a tropical mollusc that feeds on grass in water. The results of the experiment proved that in addition to eliminating the weed, the use of the mud snail improved soil moisture retention and fertility, making rice cultivation more profitable and environmentally sustainable. In Timor-Leste, the long-term use of slash and burn cultivation, which burns all organic matter in the top layer of the soil, has left soils with low levels of organics and nutrients. As a result, the soil surface seals with the first rains, thereby increasing runoff and erosion, and reducing the soil's water-holding capacity. The Government of Timor-Leste and FAO, in the context of promoting climate-smart practices, have emphasized conservation agriculture, agroforestry and off-farm water harvesting. The three principles that were validated in collaboration with local authorities and farmers groups were: no burning, no ploughing and growing a cover crop. When these principles were applied, soil fertility increased, the requirement for fertilizers decreased, and the recommended package of practices eliminated the need to burn forests for food production.

Along similar lines, FAO worked with the Government of Indonesia at the national and local level to promote a locally adapted approach to conservation

agriculture in the country's driest provinces. The approach used was based on three main principles: minimum soil disturbance, soil surface cover with crop residues, and crop rotation and/or intercropping with leguminous crops. After four years of implementation, conservation agriculture methods have improved soil health, increased the organic carbon content of soils by 29 percent, increased soil nitrogen content by 51 percent, improved soil density, and increased soil moisture and soil water-holding capacity. This improved soil health and increased maize productivity by 63 percent on average, from 2.7 to 4.5 tonnes per hectare. Food availability for farmers increased from four to five months per year, on average, to around ten months.

## Transformative change

India is taking major steps to holistically transform its agricultural system so as to conserve critical biodiversity and forest landscapes. To attain harmony between conservation and development efforts, FAO is working with the Indian government to develop innovative strategies and sustainable business models to mainstream environmental considerations into agriculture, and to pilot and replicate sustainable management practices and the eco-restoration of priority biodiversity landscapes. The innovative landscape approach focuses on protecting areas of significant global



importance in terms of biodiversity that, at the same time, offer key ecosystem services and has value for addressing land degradation, climate change mitigation, and sustainable forest management. India has called for scientific research to focus on achieving greener landscapes along with efficient and effective resource use, and is enhancing the capacity of farmers to adopt and maintain ecologically friendly agriculture and land-use practices. The diversification in farming systems will ensure that species and genetic resources are optimized across time and space within food systems so that they can ensure food security and nutrition while also conserving, protecting and enhancing natural resources. This approach is being implemented in five states with a combined population of almost 210 million.

## Precision monitoring

Agriculture in Myanmar is the most affected sector in terms of impacts from disasters, accounting for half of all economic losses with rural livelihoods significantly impacted. The country is vulnerable to increased risks that in turn are increasing the impacts of biotic and abiotic stresses. Coastal regions are at high risk for cyclones, storm surges and tsunamis, while most of the country is exposed to flooding and landslides during the rainy season, in addition to drought and fire during the dry season. These challenges call for more comprehensive approaches based on an integrated analysis of hazards, risks linked with land use, livelihoods planning, and natural resource management. The timely collection of reliable information is of utmost importance to support disaster risk reduction. FAO has partnered with national counterparts to use drones for data collection. The information collected by the drones is then fed into a modelling system with analytical capabilities that provide valuable insights into problems and possible solutions. Thus, information collected in this way can provide rural communities with high-quality reliable advice and can assist the government to better plan disaster relief and response services. A drone-mapping unit has subsequently been established within the Ministry of Agriculture.

## Using RFID tag for traceability of pigs in Papua New Guinea



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## From farm to fork

The steps involved in getting agricultural products from the farm to the table are complex and include production, post-harvesting, processing, distribution, marketing and retail. The sharing economy business model is being adapted to agriculture, and is being taken up by many countries in the region. Efficient new systems and technologies can now ensure that food quality and safety standards are met through the incorporation of good practices across the supply chain.

### At the farm

India, Philippines and Indonesia all have fertile terrain for agricultural innovations, including producing better agri-products, creating platforms to provide capital to farmers through crowdsourcing, and creating e-commerce platforms for more efficient and transparent distribution chains. In Myanmar, smallholder farmers are overcoming the issue of affordability of machinery thanks to a harvester and tractor machine booking app, Tun Yat. Many smallholder farmers cannot afford to hire workers during the high season. Mechanization eases and relieves labour shortages, improves productivity and timeliness of agricultural operations, improves the efficient use of resources, enhances market access, and contributes to mitigating climate-related hazards. A similar service, Tringo, is active in India.

Consumer concerns about food safety and compliance with international standards have driven the adoption of business practices that help participants in the supply chain to track and trace a product throughout the supply network. Traceability is defined as the ability to discern, identify and follow the movement of a food or substance intended to be, or expected to be, incorporated into a food, through all stages of production, processing and distribution. Countries are promoting the development of information and communication technology solutions in the field. In Papua New Guinea, a pilot project on pigs is using distributed ledger technologies, or blockchain, to create a database. Pigs are linked to a database via RFID (radio frequency identification)-enabled tags. Performance data are uploaded via a mobile application (PNG Pigs), to track the quality of pigs and facilitate engagement with key stakeholders across the value chain over time.

Mongolia is testing the feasibility of using GPS (global positioning system)-tracking technology in the nomadic country context to characterize herd movements and the patterns of interaction between herds throughout the year. Information regarding key management and husbandry practices during seasonal mobility is collected. The GPS data could also assist in better understanding pasture and water usage and information-sharing mechanisms between neighbouring herds.

## GPS livestock tracking system in Mongolia



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### Food loss and food waste

Reducing food loss and waste is critical to creating a “zero hunger” world. Since 2011, when FAO presented the estimate that around one-third of the world’s food was lost or wasted each year, much has changed in the global perception of the problem. There is now a greater understanding that everyone has a part to play, and FAO is working with a broad spectrum of stakeholders and partners to address the problem.

Private sector companies in China have created several models to reduce food loss and waste. Meicai, a start-up that helps farmers sell vegetables to restaurants, established the “SOS Precision Poverty Alleviation Program”, which procures under-marketed vegetables in China’s poverty-stricken areas to reduce food loss and waste in the production phase and, hence, reduce poverty. Alibaba, a high-tech giant, has established pilot projects with industries in urban areas to



reduce food loss and waste in the food delivery process, such as serving smaller portions of dishes, using recyclable food packages and edible chopsticks and spoons, and recycling food residuals, all of which also create more employment opportunities for immigrant workers in the process. With the support of another private company, Messe Dusseldorf, and Tsinghua University, FAO organized the Agriculture Innovation Lab and facilitated a “hackathon”, which brought together teams of skilled computer experts, to come up with an ICT solution to food loss and waste. The winning team, Food for Life, designed an app

to help supermarkets and restaurants sell still fresh but soon-to-be-expired food at discounted prices to consumers and, therefore, reduce food waste in the supply chain.

### Healthier fast food

A unique partnership is shaping up in Samoa between the government, FAO and fast food stall owners. The aim is to improve the nutritional value of fast food in Apia, Samoa’s capital. This initiative targets the major food stall outlets in the center of Apia which largely provides food (unhealthy choices) to the youth most, if not all of

Fast food made healthier for consumers in Samoa



them, of whom commute through this main transport hub. It is estimated that at least 1 500 individuals, purchase their food from this location. The owners of these outlets are being convinced to make their recipes healthier and thus influence the choices being made by the young customers. A field trial has been conducted and the results of healthy fast food adoption by youth are very promising. This is, therefore, an innovative pilot effort with the potential to be scaled up to reach thousands of more consumers.

Fast processed food in Apia, like many places on Earth, is easier to access than fresh food, particularly for urban dwellers. Fast food tends to lack micronutrients, and is high in fat, sugar and salt. As such, there are a series of associated health problems and social drawbacks and concerns, including psychosomatic dependency and malnutrition. The consumption of fast food contributes to increased obesity, a risk factor for non-communicable diseases (NCDs) such as diabetes and heart diseases. This is particularly the case in the Pacific Island countries, which have some of the world's highest rates of obesity and NCDs. The innovative partnership will enhance the capacity of selected fast food vendors to produce healthier fast food, promote readily available local ingredients, and increase consumers' awareness of the available healthy fast food options and their nutritional value.

The Government of Pakistan, FAO and academic institutions collaborated to formulate the first-ever comprehensive and country-specific dietary guidelines – “Pakistan Dietary Guidelines for Better Nutrition” – through a series of consultations promoting healthy diets and food-based approaches to improve the nutrition and overall health of the population. Awareness raising on nutrition issues, and identifying cost-effective and innovative solutions, are critical in addressing malnutrition. Keeping pace with the global trend on massive open online courses, an engaging, interesting and user-friendly e-learning course on Pakistan's dietary guidelines has been developed in order to capture the basic concepts of food and nutrition, promote of healthy diet and stress on the importance of physical activity and a healthy lifestyle.

# THE WAY FORWARD – BUILDING ON THE MOMENTUM

Success hinges on connecting the drivers that influence innovation uptake. Governments and other key stakeholders – including civil society, farmer organizations, research institutions and the private sector – all have a role to play in fostering an environment that enables innovation in agriculture to flourish and generate solutions.

FAO plays a key role in advocating and promoting the importance of agricultural innovation to increase food security, sustainable development and promote rural development.

## FAO aims to continue engaging stakeholders in innovation and creative thinking processes to:

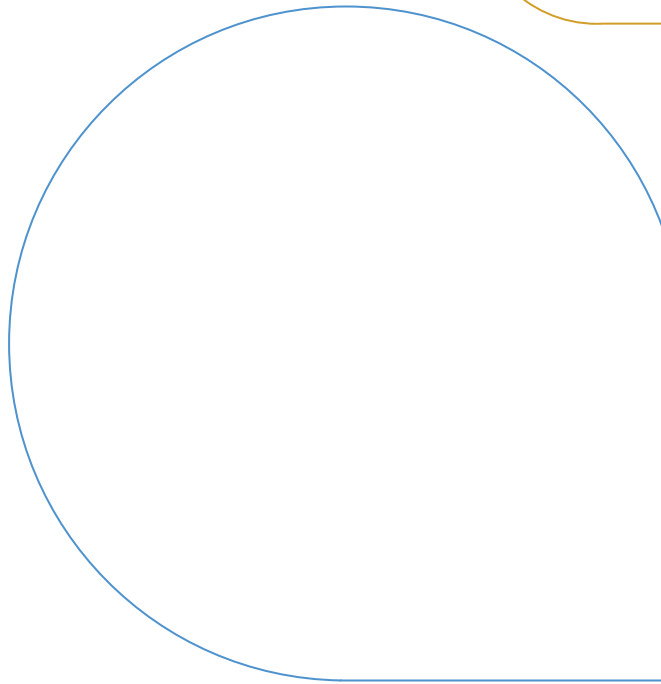
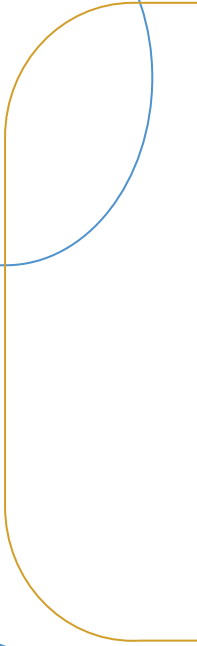
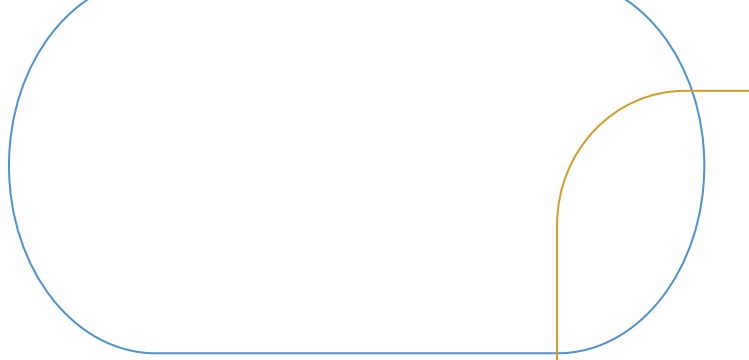
- further develop policy options for strengthening inclusive agricultural innovation systems; understand that smallholder farmers and producers are protagonists of innovation processes and, therefore;
- unlock their innovation potential and foster their capacity; and
- develop a better understanding of impact pathways, new partnerships and business models involving the public and private sectors, civil society and farmer organizations.

FAO has recently set up an Innovation Programme that has four major areas of work and is supported by a Corporate Working Group and an Innovation Board. This structure is an important step forward, providing a new mechanism to address FAO's priorities for innovation and achieving the Sustainable Development Goals. FAO's Regional Office for Asia and the Pacific (RAP) has been at the forefront of innovation discussions and initiatives during the last three years, and recognizes the central importance of the organization's renewed focus on innovation for achieving a world that is free from hunger and malnutrition. The Regional Innovation Lab for Partnerships and Development that was held in July 2019 helped reach a wider understanding of innovation: in approach, through technology, via an enabling environment, and by fostering a pro-innovation mindset. In the spirit of the Innovation Programme, RAP initiated the establishment of an FAO accelerator, entitled "FAO i-Connect AgCelerator".

The FAO RAP innovation accelerator will reinforce existing initiatives and connect them across regions and countries, while providing an environment that will encourage new innovation possibilities. Innovation will cover new technologies for sustainable agriculture, new mechanisms of work or knowledge transfer and extension, and new forms of exchange and trade

in markets. Innovation labs at the country level will enable open, flexible and inclusive spaces for catalysing experimentation, prototyping and the development of innovative projects. These labs will be supported by the i-Connect AgCelerator hub at the regional level, which will facilitate the active transfer of knowledge and information sharing, and connect innovation actors and practices across the region and beyond.

The FAO RAP innovation accelerator will offer new methodologies, facilitate the learning of new skills, and promote the development of new business models at the country level, and all benefiting from the strategic guidance provided at corporate level. Innovation will be fully mainstreamed in FAO's programming to support countries in Asia and the Pacific to achieve the momentous challenges of the 2030 Agenda for Sustainable Development and beyond.







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