

APO **AGRICULTURAL TRANSFORMATION FRAMEWORK**



The Asian Productivity Organization (APO) is an intergovernmental organization committed to improving productivity in the Asia-Pacific region. Established in 1961, the APO contributes to the sustainable socioeconomic development of the region through policy advisory services, acting as a think tank, and undertaking smart initiatives in the industry, agriculture, service, and public sectors. The APO is shaping the future of the region by assisting member economies in formulating national strategies for enhanced productivity and through a range of institutional capacity building efforts, including research and centers of excellence in member countries.

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APO Agricultural Transformation Framework

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ABBREVIATION

AI	Artificial Intelligence
APO	Asian Productivity Organization
ATF	Agricultural Transformation Framework
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute
NGO	Non-government Organization
SAT	Smart Agriculture Transformation
TPMU	Transformation Project Management Unit

FOREWORD

Food security and public health have a direct correlation and are important indicators of the quality of life in a country, while reflecting its economic development status. Economic access to a healthy diet is a key parameter indicating the overall status of a society, and the affordability of quality food, as well as other aspects of food safety and sufficiency, is an indicator of the status of the agriculture sector and its efficiency. Demand for food will continue to grow in the Asia-Pacific region, where more than 4.3 billion of the 7.7 billion world population resides. It is important to note that the global population is predicted to reach nine billion by 2050, with Asia continuing to be home to more than half of that.

All these mean that the world will need to produce at least 70% more food to sustain the growing population. Unfortunately, the availability of critical natural resources such as land and water for agricultural and food production has been declining at a steady pace in most APO member countries. This widening gap between food demand and the natural resources available to support agriculture, climate change and extreme weather conditions, and social issues like changing rural demographics and aging populations pose a serious threat to future food security.

While the industry and service sectors have grown rapidly and improved their productivity levels thanks to applications of digital technologies and the disruptions caused by them, the agricultural growth rate has been constrained by shrinking arable land and large-scale shifts of population and labor from rural to urban areas. This means that APO member countries must adopt new approaches to spur growth in their agriculture sectors, which is critical for overall economic health.

The Agricultural Transformation Framework (ATF) is an APO initiative to propel growth through a holistic approach to building the capacity of member countries to adopt modern technologies and best practices for farm-level transformation. It is also meant to encourage changes in food supply chains resulting in greater traceability and safety, higher value added, and more sustainable agriculture. The ATF also shows how policy-level changes can enable governments to modernize agricultural practices and increase productivity in the sector for more inclusive, comprehensive socioeconomic growth.

This document is a broad framework to help member countries identify food-related challenges, understand how to address them, and proceed to the next stage. It includes a simple checklist, potential risk factors, and dos and don'ts for assessing opportunities and determining the stage of readiness to undertake smart/digital agricultural transformation. The general ATF guidelines can also be utilized easily by stakeholders beyond the Asia-Pacific region.



Dr. Santhi Kanoktanaporn
Secretary-General
Tokyo
January 2019



1. BACKGROUND

The APO Agricultural Transformation Program is aimed at enhancing food security and meeting future food needs in the Asia-Pacific region through increased productivity, quality, and innovation in agricultural and food systems leading to improved rural livelihoods. While with rapid economic transformation, the share of agriculture in the GDP and employment of APO member countries has been steadily declining, the sector remains an important driver of rural transformation due to its key role in enhancing food security, improving nutrition, and reducing rural poverty.

Demand for food will continue to grow in the region where 60% of the world population resides. It is predicted that the global population will surpass nine billion by 2050, and Asia will continue to be home to more than half of that. The world as well as the region will need to produce at least 70% more additional food to feed nine billion individuals in 2050. The fast-growing middle-class population of developing Asian countries will add to the demand for healthy, safe, convenient, and exotic food. However, the availability of critical natural resources such as land and water for agricultural and food production is declining in many countries. The widening gap between food demand and natural resources available for agriculture poses a serious threat to future food security. Other important challenges to agricultural and food production are climate change and associated unpredictable extreme weather events such as droughts, floods, tropical storms, and heat waves. The situation is aggravated by changing rural demographics such as outmigration of youth to urban centers and rapid graying of rural populations. Agricultural transformation can address those challenges.

New approaches will be needed for the successful transformation of Asian agriculture. Many traditional approaches adopted for transformation in the past improved agricultural productivity but often at the cost of land and water quality and environmental degradation. Future agricultural transformation requires both inclusivity to create jobs and raise income and sustainability to protect the environment and provide healthy food. Innovative agricultural transformation is also important for achieving the UN Sustainable Development Goals of climate-smart sustainable economies, women's economic empowerment, and biodiversity.

Agriculture delegates from member countries met at the APO Workshop Meeting of Heads of NPOs in Yogyakarta, Indonesia, 2–4 October 2018. In the Strategic Planning Session of the Agricultural Committee, they agreed on the urgency of developing a Smart Agriculture Transformation (SAT) Framework to promote innovation and technology-led agricultural transformation.

This document was prepared as part of the project for Development of an Agricultural Transformation Framework (ATF) for APO Member Countries, as detailed in Project Implementation Plan 18-RP-01-GE-RES-C-09 dated 30 August 2018. An Expert Consultation Meeting was held for this in Tokyo, 29 October–1 November 2018.

2. THE NEW GENERATION OF MODERN TECHNOLOGY AND DRIVING FORCES

Digital technology and the disruptions led by it are drastically changing the way business is done in the manufacturing, service, and public sectors, from artificial intelligence (AI)-enabled ability to customize mass manufacturing production lines to near-human chatbots that can respond by contextualizing individual customers' needs. They are also changing the basic nature of governance and citizen service-delivery mechanisms.

Core agricultural activities, such as major food crops, livestock, fishery, forestry, and other primary areas, have been the slowest to respond to the multiple opportunities and challenges unleashed by the technology revolution and digital disruptions, the interconnected world, and the climate-change narrative. Applications of new-generation technologies like the Internet of Things, cloud computing, big data analytics, and AI are expected to revolutionize the global agricultural landscape, making it more resource efficient, productive, and sustainable.

Recognizing the unique needs of the agriculture sector, many private companies have started to develop technologies, platforms, and applications for crop yields, farming, resource and livestock management, and crop monitoring, including addressing issues that impact crop quality, productivity, and, most importantly, cost. This also requires a shift in approach from individual need-based agriculture to market-led technology-based commercial agriculture to increase productivity while addressing emerging challenges like degradation of the agricultural resource base, climate change, labor shortages, increasing proportion of aged farm workers, and lack of youth interest in farming.

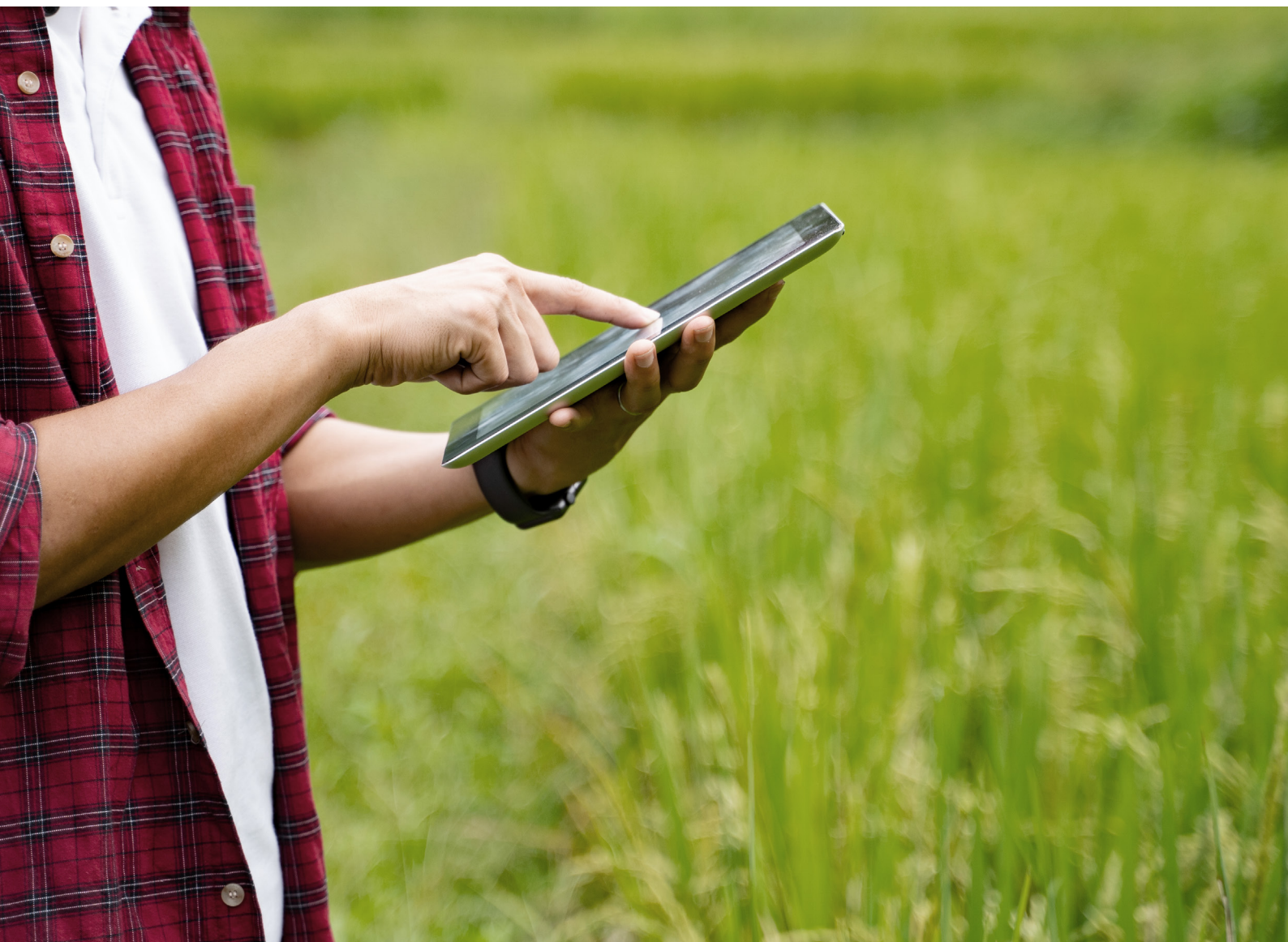
Hence it is imperative for policymakers and planners, farmers, and businesses to embrace modern technologies at all levels for smart agriculture processes and management. By using technology as a sustainable, scalable resource, agriculture can be transformed into a future-proof industry including productive, sustainable food value chains.

However, to achieve smart transformation of the agriculture sector, APO member countries will need to adopt multiple initiatives and changes. While transformation readiness at policy and institutional levels, government support, and political willingness are keys to driving these changes, APO member countries will also need to draft comprehensive national agricultural development plans and strategies, including those for increasing technology adoption and setting up sound delivery mechanisms to translate national plans into on-the-ground impact.

3. WHAT IS SMART AGRICULTURE?

Smart agriculture is the use of new, advanced technologies within the agrifood system to promote sustainable productivity by allowing farmers and other stakeholders to make more informed, appropriate decisions. Existing and emerging technologies like big data, online meteorological data, digital technologies, and analytics are important components of smart agriculture technologies.

However, smart agriculture technologies are context specific and their adoption is dependent on the stages of economic development, including per capita GDP, share of employment in the agriculture sector, and basic rural infrastructure required for the adoption of smart technologies.



4. OBJECTIVES OF THE SMART AGRICULTURE TRANSFORMATION PROGRAM

The overarching objective of the SAT Program of the APO is to assist member governments in meeting their sustainable agricultural productivity needs through smart transformation initiatives, including decision making, and optimization of farm operations, inputs, and outputs to improve food production, storage, and distribution processes.

SPECIFIC OBJECTIVES



Assess member economies' SAT readiness and their needs for digital transformation in agriculture



Assist member governments in developing comprehensive national SAT plans or strategies and sound delivery mechanisms



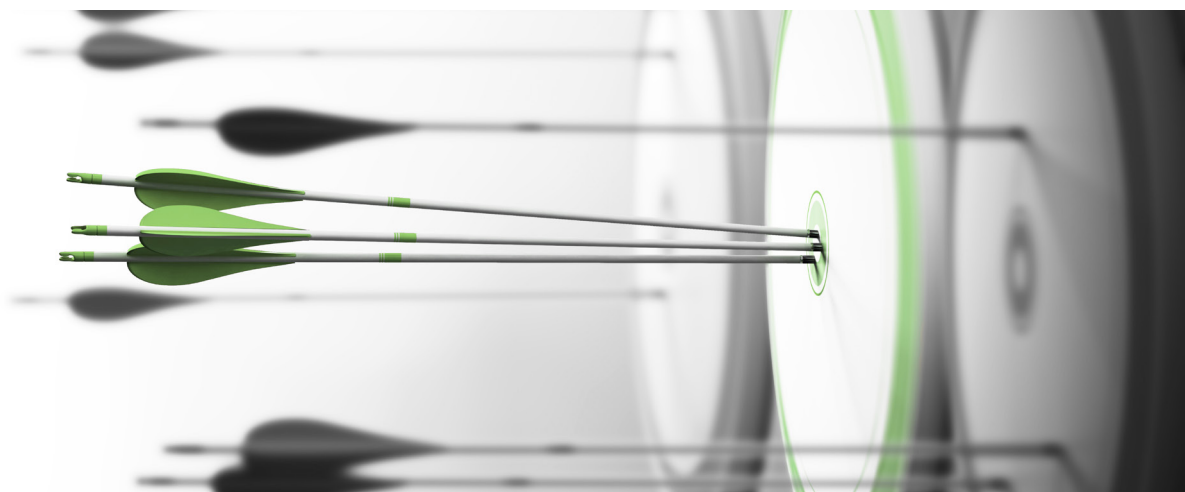
Build the capabilities of key stakeholders for accelerating SAT



Promote the application of smart technologies in agrifood chains in member countries



Establish networks of key stakeholders among countries to promote mutual learning on SAT

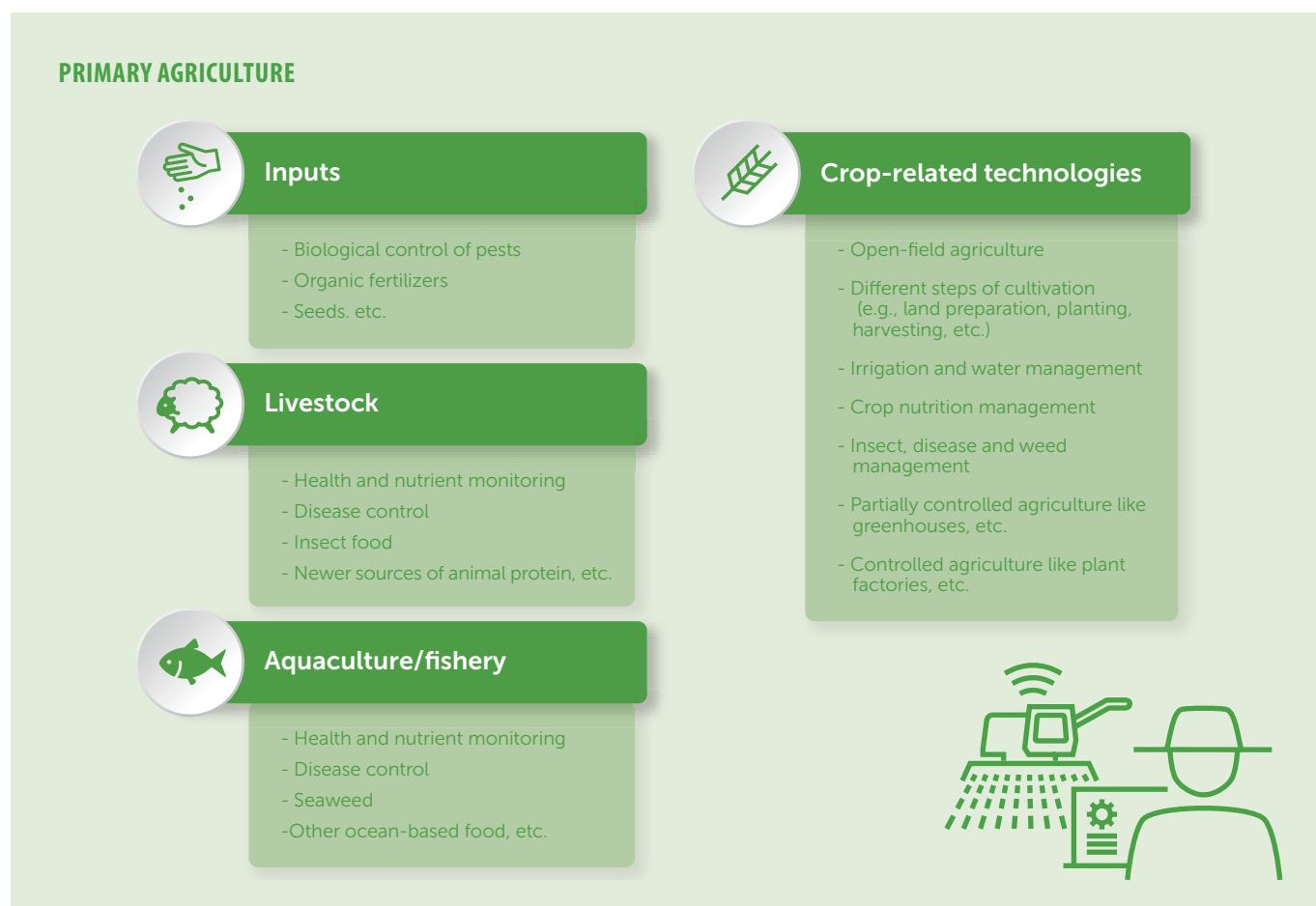


5. LIST OF ADOPTABLE SMART TECHNOLOGIES

Overall, the basic principle of using smart agricultural technologies is to transform the agrifood system, including the adoption of precision agriculture, increasing food safety through traceability, and optimization of agricultural system management to make it sustainable and efficient. This can be achieved using cutting-edge system-wide digital technologies in primary agricultural systems and processes.

However, postharvest technologies and management systems for processing and storage as well as a focus on marketing, distribution, and consumer protection also have a critical role in making transformation initiatives a success. While initiatives related to marketing and distribution will bring efficiency to the system and encourage the sector to focus more on improving food safety, APO member countries can explore the possibilities of learning from the producer–consumer interaction models of Tei-Kei in Japan and Tao Bao village of PR China, and the Hansanim model of the Republic of Korea.

The following is a list of technologies important for achieving agricultural transformation. This is not meant to be an exhaustive listing but rather indicative.



SYSTEM-WIDE TECHNOLOGIES



Big data platforms/data transmission/data analytics



Monitoring/forecasting/management (early-warning systems, etc.)



Adaptation/mitigation

POSTHARVEST TECHNOLOGIES AND MANAGEMENT



Grading, packaging, and labeling



Storage



Transportation



Processing

SUPPLY CHAIN AND CONSUMER PROTECTION



Collection



Wholesaling



e-Documentation



Logistics



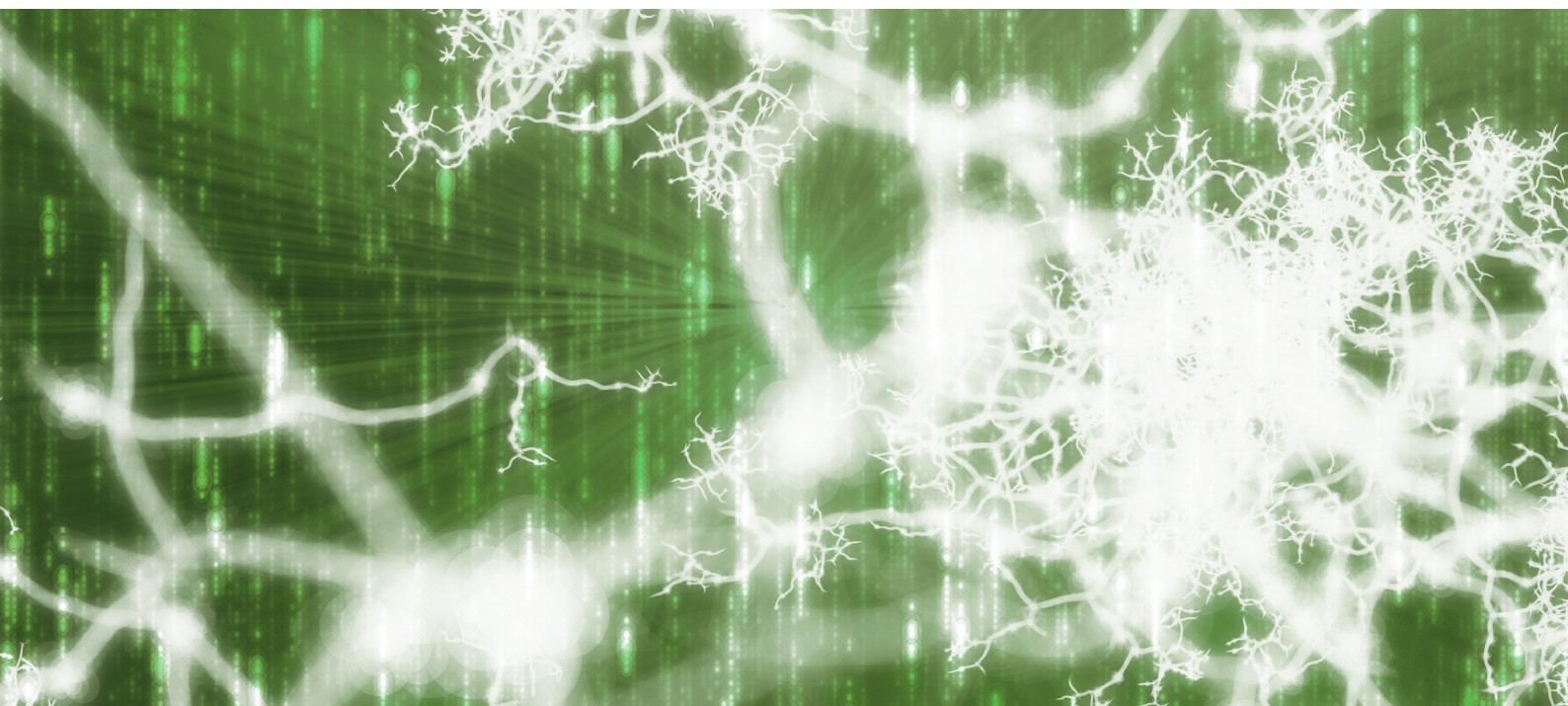
Retail

6. RELATIONSHIP BETWEEN SMART TECHNOLOGIES AND AGRICULTURAL TRANSFORMATION

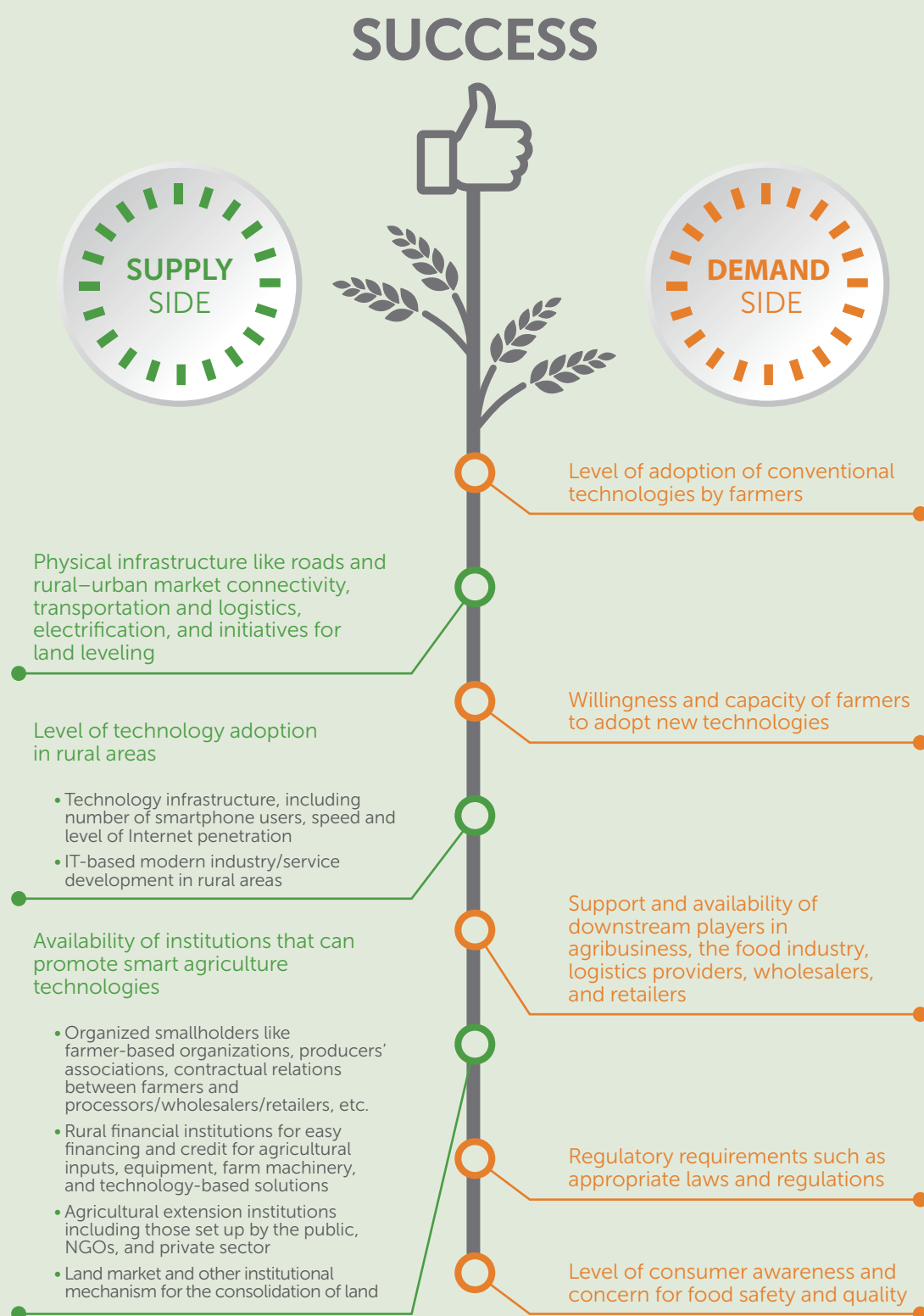
It is important to understand that agricultural transformation in today's context is very different from transformation initiatives over the past half-century which were supported by infrastructure development and the rice cropping revolution, particularly in the APO region. That transformation was primarily driven by the need to grow more food.

Today, rising income levels and technology-led awareness among the expanding middle class have led to increasing demand for healthy, safe, convenient, and exotic food and are changing agriculture. Agricultural transformation is needed mainly to deal with challenges like climate change, limited natural resources, aging farmers, population pressure, and changing dietary preferences. The availability of smart technologies for productivity growth and management, and their successful applications in other sectors, has created the case for more integrated agrifood systems.

To make transformation initiatives successful, it is important to consider the various stages of APO member economies, since they are at different levels of development. The rate of technology adoption across the Asia-Pacific region also varies markedly. Therefore, member countries will require context-specific smart agricultural technologies, depending on their readiness for transformation, government support and political commitment for the transformation, per capita GDP, rate of employment in agriculture, etc. Transformation initiatives must also be sustainable and sensitive to the local environment. Another important aspect is that initiatives must be more knowledge intensive and less input intensive.



ESSENTIALS FOR SUCCESSFUL SMART AGRICULTURE



7. HOW TO IDENTIFY OPPORTUNITIES WITHIN A COUNTRY

While technology can act as a great leveler, it is important for transformational efforts to follow the typical “think big, start small, scale fast” approach and focus on identifying areas of agricultural processes and locations that can give early success for proof of concept.

In less developed countries, farming operations are very diversified. Smart agricultural technologies can be adopted following location-specific, process- and operation-specific (like planting, harvesting, irrigation, postharvest management, transportation, storage, marketing, etc.), or product-specific (like horticulture and other high-value crops) models.

FOCUS ON FAVORABLE LOCATIONS AND CRITICAL AREAS OF AGRICULTURE



Peri-urban agricultural areas



Greenhouses for horticulture



Smallholders already integrated in value chains (contract farmers, etc.)



Irrigation management in water-scarce countries/areas (India, Pakistan, IR Iran, etc.)

IDENTIFY EARLY ADOPTERS/SUPPLIERS OF SMART AGRICULTURAL TECHNOLOGIES



Small number of innovative farmers



Industry

- Processors, wholesalers, logistics, supermarkets/retailers
- Suppliers of technologies

8. HOW TO ASSESS OPPORTUNITIES FOR PROMOTING SMART AGRICULTURE

AGRICULTURE SHOULD BE TREATED AS A BUSINESS WITH THE FOLLOWING OPPORTUNITIES AND SCOPES



Little difference exists between agriculture and urban businesses



Remote management of farming becomes possible



New technologies attract more educated youth and reduce drudgery for the elderly



Certain smart agricultural technologies become affordable for smaller farmers and SMEs and some low-cost technologies applied in other sectors can be adapted for agriculture

- SMEs: simple sensors, low-cost web/app services
- Some low-cost technologies: mobile payment, plant doctors, etc.

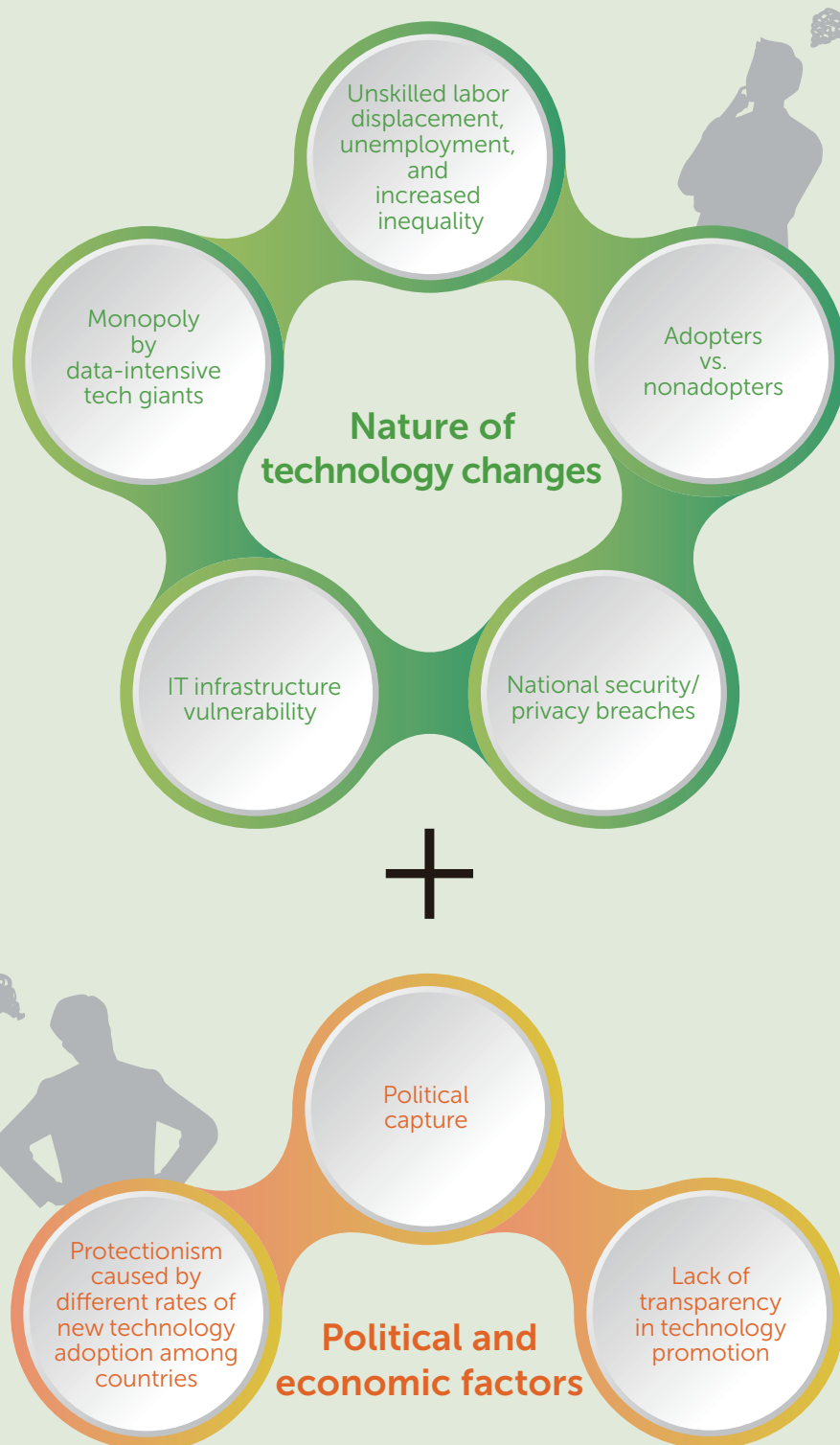
More integration can occur between agriculture, agribusiness, and the food industry because of urbanization, dietary transformation, and adoption of digital technologies from other sectors:

- Leverage more private-sector investment and promotion/adoption by farmers
- Form closer linkages between consumers and farmers/other players in the value chain through IT applications
- Meet the demand for traceability technologies

Government must have a strong commitment to invest in smart agriculture

- Build public-sector capacity to support R&D on smart agriculture

POTENTIAL RISK FACTORS AND THREATS



9. POLICY RECOMMENDATIONS

Governments should create public goods related to smart agricultural technologies that benefit the majority of players, especially smallholders

- Strategic, long-term investments that the private sector cannot make
- Data platforms
- Public support for certification and traceability systems
- Support and facilitate rural telecommunications infrastructure development
- Coordination role

Support public- and private-sector institutions in conducting R&D

- Encourage public–private partnerships
- Offer incentive mechanisms (e.g., royalties) to public research institutions to develop technologies

Encourage private investment in affordable, low-cost technologies and services

- Target small farmers and SMEs as clients for services with new business models such as
 - Fee-based services to cover investment costs
 - Service provision in exchange for data from users
 - Service provision through aggregators like farmers’ organizations, cooperatives, etc.
- Encourage the private sector to develop social benefit technologies in exchange for support from public research/funding
- Offer tax incentives and other financial support to the private sector for pilot testing and developing/promoting technologies
- Create other risk-sharing mechanisms in new technology development

Encourage information and data sharing, with adequate safeguards and protection of intellectual property rights

Experiment and launch pilot programs before scaling up

- Conduct field demonstrations and evaluations
- Undertake pilot programs and free trials for proof of concept and build use-cases for new technologies
- Provide financial support for piloting new technologies

Prioritize smart agriculture as part of national agricultural development strategies

- Assess the costs of technologies appropriately
- Address the most binding constraints like irrigation management in water-scarce areas
- Prioritize technologies with greater spillover and snowball effects like remote sensing
- Prioritize technologies with greater system-wide effects like traceability technologies

Formulate regulations and policies to support initiatives and encourage early adopters, as well as encourage cross-country collaboration and cooperation for knowledge, experience, best practice, and appropriate technology sharing (e.g., APO programs)

Other policies to overcome the potential risks/threats of smart agricultural technologies

- Social protection policies
- Reskilling programs to develop useful new abilities

WHAT NOT TO DO AND POLICIES TO AVOID



Highly subsidized interventions that benefit few stakeholders



Crowding out private investment with increased interest rates



Overregulation that discourages innovation
















Too much direct government intervention because of heterogeneity in agricultural systems

10. RECOMMENDATIONS FOR THE APO

- Develop country-specific ATFs
- Facilitate dissemination and exchange of information on modern digital technologies through programs like demonstration projects
- Set up a digital platform training center
- Develop the capacity for digital future-ready technology projects through the training of trainers
- Support national agricultural productivity efforts and priority areas through consultancy services under the Specific National Program
- Scenario assessment of alternative future agricultural transformation (global, regional) and implications for specific member countries
- Develop a Smart Agricultural Readiness Index guided by the master ATF
- Assess the transformation readiness of member countries using the index
- Assist in developing country-specific ATFs
 - Hold country-based consultation meetings on ATFs with different stakeholders
 - Develop detailed country-based manuals on ATFs
 - Arrange for expert and stakeholder validation
 - Offer advisory services to NPOs and related ministries in SAT
- Assist in developing country-specific action plans to implement ATFs
- Assist in setting up Transformation Project Management Units (TPMUs) under NPOs
- Assist in developing a performance index/measurement of SAT progress
- Build the capacity to monitor the progress of SAT by TPMUsStakeholders Recommended Activities

11. CHECKLIST

SELF-ASSESSMENT OF READINESS TO ADOPT SMART DIGITAL AGRICULTURAL APPLICATIONS FOR THE SAT

	Smartphone penetration	<input type="checkbox"/>
	Internet penetration and speed	<input type="checkbox"/>
	Electricity coverage and interruption rate	<input type="checkbox"/>
	Farmers' education level	<input type="checkbox"/>
	Access to nearest major market/sales point	<input type="checkbox"/>
	Availability of local financial support agencies	<input type="checkbox"/>
	Public–private partnership experience or opportunities in agriculture	<input type="checkbox"/>
	Private-sector investment opportunities	<input type="checkbox"/>
	Product storage facilities	<input type="checkbox"/>
	Roads and infrastructure	<input type="checkbox"/>
	Government policies on and priorities for digital agriculture	<input type="checkbox"/>
	Inclusion of digital agriculture in national agriculture policies	<input type="checkbox"/>
	Appropriate laws and regulations on digital agriculture	<input type="checkbox"/>

STAKEHOLDERS



Government policymakers	Staff of NPOs and related organizations	Food-processing industry enterprises	Representatives of associations of professionals
Consultants	Researchers	Producers	Agribusinesses
			Academics

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SUSTAINABLE PRODUCTIVITY

THE NEW FRONTIER FOR PRODUCTIVITY

Bangladesh
Cambodia
Republic of China
Fiji
Hong Kong
India
Indonesia
Islamic Republic of Iran
Japan
Republic of Korea
Lao PDR
Malaysia
Mongolia
Nepal
Pakistan
Philippines
Singapore
Sri Lanka
Thailand
Vietnam

