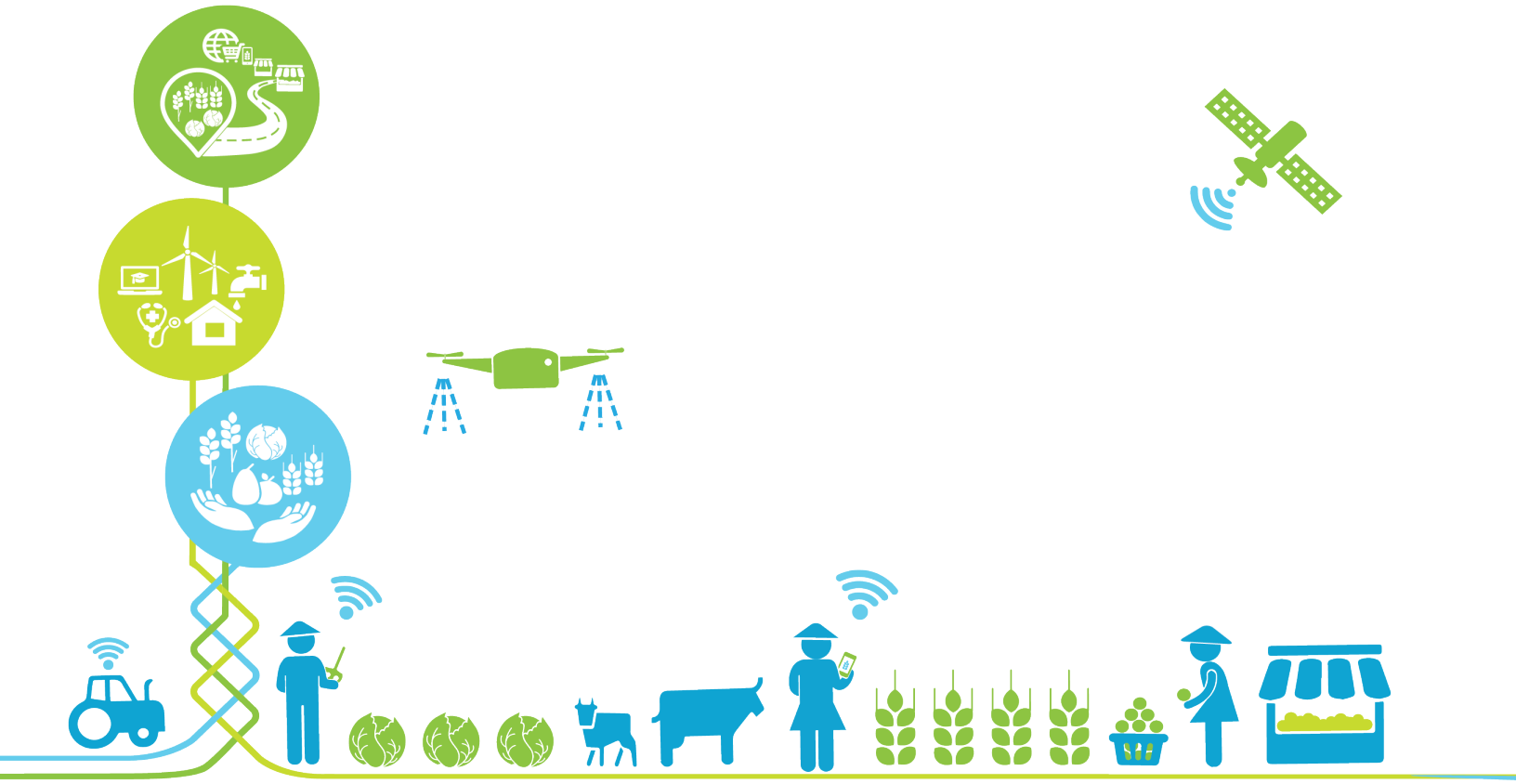

RURAL DEVELOPMENT AND FOOD SECURITY FORUM 2019 PROCEEDINGS

DECEMBER 2020

ASIAN DEVELOPMENT BANK

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Notes:
ADB President Takehiko Nakao stepped down as President on 16 January 2020.
In this publication, "$" refers to United States dollars.
ADB recognizes "China" as the People's Republic of China.
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Abbreviations

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
AWD	alternate wet and drying system
CIRAD	French Center for Research and Agricultural Development
CO_2	carbon dioxide
DMC	developing member country
DSR	directly seeded rice
EBRD	European Bank for Reconstruction and Development
EU	European Union
FAO	Food and Agriculture Organization
FDI	foreign direct investment
FPC	farmer-producer company
FPO	farmer-producer organization
GDP	gross domestic product
GIS	geographic information system
GMS	Greater Mekong Subregion
IAEA	International Atomic Energy Agency
ICT	information and communication technology
IFPRI	International Food Policy Research Institute
IRDP	Integrated rural development program

IRRI	International Rice Research Institute
IT	information technology
KMUTT	King Mongkut University of Technology, Thonburi
LAO PDR	Lao People's Democratic Republic
NATCO	National Confederation of Cooperatives in the Philippines
NGO	nongovernment organization
OECD	Organization for Economic Cooperation and Development
O&M	operation and maintenance
OTOP	One Tambon One Product
PGP	Carrageenan plant promoter
PNRI	Philippine Nuclear Research Institute
PRC	People's Republic of China
PPP	public–private partnership
PSOD	Private Sector Operations Department
RDFS	Rural Development and Food Security
R&D	research and development
SDG	Sustainable Development Goal
SME	small and medium-sized enterprises
STEAM	Science and Technology, Engineering, Arts and Mathematics
UK	United Kingdom
UNCDF	United Nations Capital Development Fund
US	United States
USAID	United States Agency for International Development
WHO	World Health Organization

Timely contributions to analyzing challenges. The knowledge products prepared in partnership with IFPRI, IRRI, and Mercasa will help stakeholders understand the issues facing the rural development and food security sector.

Publications Launch

Introduction

Akmal Siddiq, Chief of Rural Development and Food Security (Agriculture) Thematic Group, Sustainable Development and Climate Change Department, ADB

We would like to launch our knowledge products. We have had the privilege to work with two partners, IRRI in the Philippines, and IFPRI in Washington, DC.

Over the last year and half, we have worked with both institutions to carry out this research. With IRRI, we undertook field experiments to test their technologies for climate-smart agriculture in three countries—Bangladesh, Cambodia, and Nepal. With IFPRI we worked on long term policy for food security for the region as well as one particular study focusing on Indonesia. We also worked with them on a study to assess the potential of e-commerce in the PRC.

We are pleased to launch these four studies today. ADB also undertook studies in four countries to analyze agriculture value chains. We have discussed how agriculture markets have not performed well. These four policy briefs will also be launched, and we will share the results with you. The four countries we worked in were Bangladesh, Nepal, Pakistan, and Viet Nam.

I acknowledge the presence of our Vice-President Knowledge Management Bambang Susantono. After we hear from our Director General, Woochong Um about some of the salient features and lessons we have learned, we will request our vice-president to launch the studies.

I invite Director General Um to deliver the keynote address.

Holistic and cross-cutting approach for agriculture projects. Woochong Um, Director General, Sustainable Development and Climate Change Department, ADB, invited partners and stakeholders to work together in financing operations that adopt integrated approaches including gender equity, climate adaptation and mitigation, water resources management, natural resources management, and use of ICT and high-level technologies in agriculture.

Keynote Address

Woochong Um, Director General, Sustainable Development and Climate Change Department, ADB

Good morning everybody. I hope you had a good chance to enjoy some networking opportunity just before this session. Welcome to this launch event.

Mr. Oliver Frith representing Dr. Mathew Morrel, Director General of IRRI; Vice-President Bambang Susantono. Thank you very much for making it here because I know you arrived at 6.00 in the morning. Ladies and gentlemen, welcome.

I am honored to deliver this message at the launch of these four technical reports and four country briefs today during the Rural Development and Food Security Forum. These are:

i. *Climate-Smart Practices for Intensive Rice-Based Systems in Bangladesh, Cambodia, and Nepal;*
ii. *Ending Hunger in Asia and the Pacific by 2030: An Assessment of Investment Requirements in Agriculture;*
iii. *Policies to Support Investment Requirements of Indonesia's Food and Agriculture Development during 2020-2045;*
iv. *Application of Information and Communication Technology for Agriculture in the People's Republic of China; and*
v. *Country Briefs on Dysfunctional Horticultural Value Chains and the Need for Modern Marketing Infrastructure in Bangladesh, Nepal, Pakistan, and Viet Nam: Dysfunctional Horticultural Value Chains and the Need for Modern Marketing Infrastructure.*

These publications are the outputs from the joint research with our long-standing partners, IRRI and IFPRI for over 2 years. We also have a new partner, Mercasa, a public company based in Spain that specializes in horticulture value chain development and modern wholesale markets. The joint research was also done in close collaboration with national research organizations and think tanks in Bangladesh, Cambodia, the PRC, Indonesia, Nepal, Pakistan, and Viet Nam.

The launch of these publications and the forum itself are timely contributions to understanding and analyzing the challenges facing the rural development and food security sector.

Despite this great progress, there are still 822 million people who are still food insecure, 517 million of which are in Asia and the Pacific region. Basic services are limited especially in terms of access to sanitation and safe drinking water.

In the PRC, Philippines, and Thailand, for example, the average age range of farmers is 56–58 years old. At the same time, the youth, even the children of farming families,

are lured to urban areas for better opportunities resulting in the aging of farmers. This is a critical problem for sustainability of the sector.

The inefficient and ineffective markets and agricultural value chains, which result in high postharvest losses, are another area of concern. According to a United Nations study, around 42% of fruits and vegetables, and 30% of grains, are lost before reaching the consumers.

Based on a 2009 ADB-IFPRI study, climate change impacts the yields of primary commodities. Examples are the yields of irrigated rice, wheat, and soybeans, which could fall by 9% to 44% in 2050, thereby lifting commodity prices by up to 50%. Because of high prices, micronutrient intake of children decreases, which leads to 20% more malnourished children by 2050.

The publications are also timely because the ADB Board endorsed the action plan of the seven operational priorities for our corporate strategy, Strategy 2030, in October 2019. Rural development and food security are one of the seven priorities of Strategy 2030 that paves the way for ADB's efforts to eradicate extreme poverty while expanding its vision of a prosperous, inclusive, resilient, and sustainable Asia and the Pacific.

With Strategy 2030, ADB has committed to call for renewed focus of ADB operations in three areas:

i. **accelerated rural development** to focus on improving rural services, attracting private sector investments, and generating jobs in the rural areas;
ii. **efficient agricultural value chains** to distribute food efficiently from farmers to consumers, reduce postharvest losses, improve farmer profitability, and provide sufficient, safe, nutritious and affordable food; and
iii. **food security for all** to focus on building food systems to sustainably produce more with less resources while addressing malnutrition.

The findings of publications we are launching today will also help strengthen our operations in promoting rural development, improving agricultural value chains, and achieving food security.

I highlight three key insights based on the joint work with IFPRI, IRRI, and Mercasa:

First, there are investment opportunities that can address the challenges in agriculture. The publication on ***Ending Hunger in Asia and the Pacific by 2030: An Assessment of Investment Requirements in Agriculture***, quantifies the amount of investments needed by countries to reduce the number of food-insecure people below 5% of the total population by 2030. To achieve this goal, we must increase annual investments in agricultural research and development, water resource management, and infrastructure to reduce postharvest loss from the current level of $41 billion to $78 billion.

The report also identifies the priority areas for investments within the agriculture and natural resources sector. Additional annual investments in agricultural research and development can reduce the number of food-insecure people in ADB's developing members countries by 84 million by 2030. Although return on investments in irrigation will not be equally impressive, they will reduce the agricultural use of water by 7%, making more water available for alternative uses. Higher annual investments in rural infrastructure, such as rural roads, railways, and rural electricity by $16 billion can reduce the number of food insecure people by 67 million.

Second, agriculture can be made more productive and less resource intensive. Our agricultural resources are shrinking. The results of the joint research with IRRI in Bangladesh, Cambodia, and Nepal showed that climate-smart practices can increase profits from rice production and make it less resource intensive. These practices can result to lower water use, less greenhouse gas emissions, improved labor productivity, increased carbon sinks, and improved soil quality to enhance and sustain production. Depending on the country, climate-smart agriculture can reduce agricultural water use by 32%, labor by 79%, and emission of greenhouse gases by 41% without affecting rice yields.

However, to realize these benefits, we need supporting policies and an enabling environment for technology adoption, and affordable financing for farmers. The farmers' lack of access to knowledge and technology could create roadblocks in the successful promotion and adoption of climate-smart agriculture. ADB and key partners, including IRRI, will continue to work on developing the appropriate approach, mechanism, and institutions to deliver the knowledge and technology to farmers.

Third, we need to fix the value chain to minimize postharvest losses. The agricultural value chains, especially of fruits and vegetables, are most often dysfunctional and inefficient. These inefficiencies result in high postharvest losses and fail to generate fair profit for producers.

The conclusions of the four country briefs show that by reducing fruit and vegetable postharvest losses, countries like Bangladesh and Viet Nam can save up to almost $2 billion every year. This amount is far more than the cost of building modern wholesale market infrastructure, which can help preserve produce longer and reduce the losses.

The country briefs also tell us that market price fluctuations of fruits and vegetables in these countries are very high, which reflects inefficient value chains. For instance, in 2017, the price of tomatoes in Lahore, Pakistan, fluctuated by more than 800%. In the same year, the price fluctuation of fresh potatoes was about 177%. If these countries can regulate these fluctuations by reducing prices by 10%, the annual savings will be $815 million for Bangladesh, $145 million for Nepal, $825 million for Pakistan, and $581 million for Viet Nam, based on 2018 data.

We hope the joint finds of ADB, IFPRI, IRRI, and Mercasa will motivate us all to reflect and rethink our engagement in agriculture and food security. For example, how should we design our projects to achieve on-the-ground impact with optimal use of

resources? How can we effectively partner with other institutions to avoid duplication of effort and instead supplement and complement each other's efforts?

Moving forward, agriculture projects need to follow a holistic and cross-cutting approach. ADB is already financing operations that adopt integrated approaches encompassing gender equity, climate adaptation and mitigation, water resources management, natural resources management, and use of ICT and high-level technologies. The horticulture value chain projects in Pakistan and Uzbekistan; the use of Internet of Things to promote food safety and traceability in the PRC; the climate-friendly agribusiness value chains sector projects in Cambodia, Myanmar, and the Lao PDR; and the agriculture and rural development project in Mongolia that assists agro-processing enterprises, are a few good examples. You will hear more in Session 4 on ADB Knowledge Sharing and Experience on Climate Change, Gender Equity, High-Level Technology, and Natural Resources Management.

Under Strategy 2030, one of the cross-cutting themes is enhancing our partnership with everyone we work with because the task at hand is so vast and bigger than what we can do ourselves. Maximizing synergy from partnerships is also critical. We can only make a difference if we join forces with partners and relevant stakeholders to improve the lives of people in Asia and the Pacific region, and I am particularly grateful to our three knowledge partners.

Finally, let me, once again, express our appreciation for the cooperation and hard work of all our partners for the successful completion of this important knowledge sharing initiative.

The digital copies of the four reports and four country briefs, as well as the Strategy 2030 and the operational plan for Rural Development and Food Security, are available for download from ADB's website. We also invite you to read the ADB Blogs and feature articles in Development Asia on these publications.

Thank you very much.

Promoting more sustainable rice agri-food systems and practices. Oliver Frith, Head of Business Development, IRRI, shared that their field experimentation showed that alternate wetting and drying direct-seeded rice, when combined with climate-smart varieties, crop diversification, and mechanization practices can make rice production more profitable, sustainable, and resilient to climate change.

Messages

Oliver Frith, Head of Business Development, IRRI

Firstly, we would like to thank Director General Um and Vice-President Susantono for being here today for the launch and we also want to commend Dr. Akmal Siddiq and his team for the great work that they are doing in partnership with our national partners and IRRI over the last few years on the projects.

I am honored to speak on behalf of our Director General Morrell with the goal of sharing the joint progress and accomplishments that we have done with ADB to address the challenges of poverty, food security, and rural prosperity in Asia and the Pacific region.

IRRI's current research collaboration with ADB centers on fostering resilient agri-food systems in the face of a formidable challenge—climate change. Rice brings nutrition and income to millions of rice farmers in many Asian countries. It is also becoming a strategic crop for most of Africa. However, demographic and economic transformations, deteriorating soil, diminishing water resources, and climate change pose formidable challenges to the accomplishment of ending hunger and malnutrition by 2030 in line with SDG. Our deadline to meet this SDG 2 goal is fast approaching.

The reports we are launching today on climate-smart agricultural practices for intensive rice-based systems in Bangladesh, Cambodia, and Nepal offers some hope. There are consolidated efforts going into research for development supported by ADB and our partners in the region. This project was developed based on an ADB technical assistance project called *Investment Assessment and Application of High-Level Technology for Food Security in Asia and the Pacific*[14] The project uses participatory approaches and piloting of climate-smart agricultural practices for rice-based systems in Bangladesh, Cambodia, and Nepal.

The project aimed to do several things. Firstly, it aimed to identify strengths, policy and institutional support, and logistics needed to promote widespread adoption of research proven climate-smart practices and rice varieties. The project also aimed to demonstrate the use of alternate wetting and drying (AWD); direct seeded rice; on-farm mechanization; and climate-smart rice varieties in the rice-based systems in Nepal, Cambodia, and Bangladesh. The document shows findings and results of the field experimentation and policy recommendations that came out of the project. The results and initial outcome of the pilot project showed that AWD and direct-seeded rice, when combined with climate-smart varieties, crop diversification, and mechanization practices can make rice production more profitable and sustainable as well as more resilient to climate change. In the case of Nepal for example, we were able to see farmers having a significant decrease in the amount of inputs they required in their farming system, which heavily improved the sustainability of those systems. In Cambodia, we also saw very promising results with the application of drought tolerant varieties. In Bangladesh, we were able to show a good and strong adaptation and adoption among farmers for AWD technology.

I would like to thank and acknowledge our national partners that worked with us on this project. This includes the Bangladesh Rice Research Institute, the Cambodian Agriculture and Development Research Institute, and the Nepal Agricultural Research Council for their respective collaborations and the vital contributions they made to deliver the results we are representing here today.

Beyond the technologies and practices highlighted in the pilots, I urge you to learn more about the work that we are doing with our partners on promoting more sustainable rice agri-food systems and practices by speaking to the IRRI team that is here in the forum and also visiting our booth.

[14] ADB. 2016. Investment Assessment and Application of HighLevel Technology for Food Security in Asia and the Pacific.

We have been working with ADB for over 40 years. ADB has been a strong partner, working to address challenges to rural development, delivering prosperity and increased agricultural productivity in Asia. IRRI firmly believes in rural prosperity in Asia. IRRI supports the vision behind ADB's Strategy 2030 of increasing agricultural profitability and productivity, enhancing food safety, and improving climate and environmental resilience of smallholders in Asia. This aligns very closely with the IRRI mission of improving the health and welfare of rice farmers and consumers, promoting environmental sustainability in a world challenged by climate change, and supporting the empowerment of women and youth in the rice industry. IRRI is committed to continuing its partnership with ADB and we look forward and stand ready to build on results we have presented today. This will include helping ADB member countries prepare for climate change, competing uses of land due to increasing urbanization, shortage of labor, diminishing natural resources, and population and demographic changes.

In the future, our work will focus on supporting some of the key pillars of ADB in terms of farm mechanization and postharvest technologies as well as the application of ICT tools to support extension agents and farmers. We look forward to working with everyone here, mobilizing more resources to support revitalization of rural areas across Asia. In closing, I wish to laud all ADB partners whose projects have featured in this publication and other publications today.

Trends in ICT applications in rural PRC. Mark Rosengrant, Research Fellow Emeritus, IFPRI, said IFPRI's study showed that rural e-commerce and drone application in agriculture are growing fast.

Mark Rosegrant, IFPRI

Both the studies in Asia and the Pacific and Indonesia shared the objectives and methodology, which was to assess the investments and polices required in the agriculture and rural sector to meet food demand and end hunger in Asia and the Pacific region and Indonesia by 2030. In Indonesia, we took the analysis up to 2045 as requested by Bappenas in Indonesia. We used integrated agricultural and economy-wide modeling of the costs and impact of agricultural investments and policies on food security under climate change. In the PRC, we examined trends in applications of ICTs in rural PRC, the enabling factors and constraints to adopting ICTs, assess impacts, and generate policy implications for further development. For the PRC ICT, rural surveys and review of evidence to assess trends, constraints, and policies for development of rural e-commerce were conducted. We relied on our colleagues in the China Certification Center for Automotive Parts for this work. In Asia and the Pacific region and Indonesia studies, we looked at three types of investments:

i. agriculture research and development investments,
ii. irrigation investments (infrastructure and water use efficiency), and
iii. rural infrastructure investments.

Each of these scenarios has specific pathways to generate food security. Under agriculture research and development (R&D) investments, the primary pathway was through agricultural productivity growth, which tends to reduce food prices to consumers and increase food consumption. Higher agricultural productivity also boosts economy-wide growth in GDP and household income. Impacts in

agriculture have broad implications for the general economy. Under irrigation, pathways start with increase in crop area and yield through expansion of area or savings of water. This reduces food prices and increases food consumption, thus inducing economy-wide growth in GDP and household income. Under the rural infrastructure investments, the initial impact is to reduce marketing margins and postharvest losses. That in turn increases farm-level productivity and profitability, reducing prices to consumers, and increasing food consumption. The combined impacts drive economy-wide growth in GDP and household income. We have already heard some of the key results here—in Asia and the Pacific region, average annual public investments projected to 2030 of about $42 billion; incremental investments required for the combined, comprehensive scenario are about $37 billion. Some of the key impacts of the combined scenario of the three types of investments:

i. Ends hunger in Asia and the Pacific region by 2030 (reduces hunger share below 5% of population, the prudential threshold established by FAO/WHO for effectively achieving zero hunger);
ii. Generates GDP benefits of $1.1 trillion in Asia and the Pacific region in 2030 compared to baseline investments; and
iii. Agricultural R&D has highest rate of economic returns and hunger reduction, followed by rural infrastructure and irrigation.

In Indonesia we did a similar approach with specific models for Indonesia. We have three scenarios that focus on comprehensive investment impacts on agricultural production in 2045. In scenario III increases of about 19% are expected by 2045 compared to baseline for staple crops and livestock and over 7% for other crops and fisheries. Investment impacts on economy-wide welfare in 2045, based on a concept called absorption, the comprehensive investment scenario III projects the benefits compare to the Indonesia baseline are Rp1,834 trillion annually by 2045, which about $129 billion annually.

Based on the study, a number of policy recommendations were made. The most important ones are significant increases in investments in\

i. **Agricultural R&D** (crop and livestock breeding) both from government and private sector;
ii. **Infrastructure** (rural roads, electricity, cell phone towers, markets, cold chains, processing facilities) in partnership with private sector;
iii. **Irrigation** - expansion and improvement of existing systems with careful attention to cost-effectiveness;
iv. **Extension services and agricultural education** – need upgrading to support adoption of conventional and advanced agricultural technology (precision farming);
v. **Legal and regulatory reforms** – to reduce barriers to private investment and adoption of advanced agricultural technologies; and
vi. **Fertilizer subsidies** – should be phased-out; resources invested in increased agricultural R&D and targeted direct income support to small farmers.

Turning to ICT application in the PRC, the brief summary is drone application in agriculture is growing fast. The area of pesticide spraying by drones tripled in just 2 years up to now 2 million ha in 2017. It has important benefits. It improves speed and effectiveness of pest control—more responsive to pest outbreaks. Drones use less pesticides and a tenth of the water traditionally required by manual spraying, reducing ecological and economic costs. Rural e-commerce is also growing fast. It is still limited in remote areas but widespread in more advanced regions. Nearly 60% of surveyed rural households in Shandong and Zhejiang used e-commerce during 2016–2017. We also found that the use of rural e-commerce in the regions we studied increases farmer income. The prices obtained through online sales for apple and peach are significantly higher than what can be obtained through offline sales. There is substantial benefit for income increase to farmers. To boost e-commerce, we found that farmers' capacity should be built through training, investments provided in storage and transportation, scale of operational costs should be reduced cooperatives should be set up, financial and credit support to farmers provided, e-commerce market regulations strengthened, trust issues clarified, and development among regions and households should be inclusive.

New opportunities. Growing rice using the direct seeded rice system has opened more chances for farmers to use sound scientific data in rice propagation said Hans Bhardwaj, Rice Breeding Platform Lead, IRRI.

Hans Bhardwaj, IRRI

This project was titled *Climate-smart practices and varieties for intensive rice-based systems in Bangladesh, Cambodia, and Nepal*. The work was carried out from early 2016 to mid-2019. The principal investigator from IRRI was Arvind Kumar, who could not make it and sends his regrets; I am filling in for him.

I thank ADB for publishing the results of this study. This will be valuable information going forward for researchers and development experts in these countries. About 14 different partners were involved in this project in these three countries. I would also like to take this opportunity to thank all these partners who provided their support to the technologies that were researched, developed, demonstrated and deployed, depending on the need and country we are talking about. These include climate-smart varieties, water-saving mechanized cultivation such as alternate wet and drying system or directly seeded rice (DSR), mechanized direct seeding, and training and capacity building for distribution of quality seed of improved varieties. There was a total of nine sites in three different countries: two sites were in Bangladesh, two in Cambodia, and five in Nepal. Activities involved demonstration of AWD as well as DSR technologies, seed multiplication and distribution, and training of extension workers and farmers. Farmers also trained in mechanization and were linked to some of the service providers. To increase system productivity, the project introduced technologies to intensify and diversify rice-based agri-food system in these three countries. This included a combination of cropping—for example in Bangladesh it included cropping systems of rice-mustard-rice, rice-potato-rice, rice-pulses-rice; in Cambodia rice-mung bean, rice-vegetables, and even cassava in some cases. In Nepal it was primarily two seasons, so it was rice-wheat, rice-pulses, and rice-mustard as well as rice-maize were demonstrated.

The need for public sector action. ADB's study recommended the setting up of a production marketing architecture to reduce postharvest loss according to Md. Abul Basher, Natural Resources and Agricultural Specialist, ADB.

Some of the benefits of mechanized AWD and DSR are highlighted in the report. In some cases, yields increased up to 48% or stayed stable. The cost of seed used in some cases by 22% and up to 57%. The net profit to farmers following AWD or DSR practices increased from 30% to 47%. Similarly, labor cost was significantly reduced in almost all cases. Another important element, which we studied in this project, was greenhouse gas emissions (growing rice in flooded conditions leads to methane emissions). Methane emissions were reduced by over 40%. Some minor differences were observed from one variety to the other.

Both ADB and IRRI have tremendous new opportunities to work together and make an impact. The DSR is an emerging trend as increasingly, rice is being planted using the DSR system and that opens new opportunities for not only conducting research but also ensuring propagation of practices based on sound scientific data to rice farmers wherever possible. Even though the package of practices for DSR has been developed, there is no targeted effort to develop germplasm or breed varieties that adapt into the system. So far breeders, farmers, or researchers have been using varieties developed for conventional transplanting or flooded conditions and adapt them to DSR conditions. That is not the best use of those varieties as well as for that particular practice. IRRI has recently launched an initiative in developing and improving germplasm, which adapt to DSR conditions. I thank ADB again for providing this opportunity to IRRI to work together as well as inviting us to the forum to share our experience and learning.

Md. Abul Basher, ADB

We conducted four market studies in Bangladesh, Nepal, Pakistan, and Viet Nam. We used secondary data and information; visited wholesale markets in Dhaka (Bangladesh), Kathmandu and Pokhara (Nepal), Lahore (Pakistan), Ha Noi and Ho Cho Minh (Viet Nam); consulted with wholesalers, market management, and traders; and finally conducted consultative workshops in Dhaka, Kathmandu, Lahore, and Ha Noi. Some common facts about fruits and vegetables in the four countries are: (i) agriculture in these countries is still dominated by cereal production; (ii) the share of fruits and vegetable production on cultivated land is low, particularly in Bangladesh and Pakistan (estimated at less than 5%), while Nepal and Viet Nam have slightly higher shares; (iii) production is increasing but their yields are low compared to those of developed countries; and (iv) per capita consumption of fruits and vegetables is low, except for Viet Nam, where consumption is at par with the developed world.

There are four different transmission channels from producers to consumers, starting with Channel 1: Producers to Consumers (direct selling). The middlemen step in, then the supply chain gets longer.

i. Channel 1: Producers to Consumers (direct selling)
ii. Channel 2: Producers > Retailers > Consumers (middlemen introduced)
iii. Channel 3: Producers>Collectors > Local wholesaler > Retailers/Supermarket > Consumers
iv. Channel 4: Producers>Collectors>Local wholesalers>Regional wholesalers> Retailers / Supermarket > Consumers.

Channels 3 and 4 are significant. They account for the largest share of fruits and vegetable consumptions—for example, in Viet Nam the share is about 72% of fruits and vegetables consumed in that country. Channels 3 and 4 also require infrastructure and some logistics such as packaging facilities, cooling houses in the production areas, refrigerated transports, and cold storage in wholesale markets; these are either inadequate or missing in these four countries. The negative impacts of this inadequate or missing infrastructure are:

i. Postharvest loss is high: 30%–40% of fruits and vegetables lost in transition. Quality of produce is also affected for which retailers do not get expected price.
ii. Eventually the middlemen recover the economic costs of the postharvest loss of quantity and quality by paying less to the producers. The share of producer in retail price of fruits and vegetables is less than 30%. For perishables, this share is around 15%–20%.

One important point to note is that the cost of postharvest loss impacts the farmer. The profits of middlemen are not affected in the same manner as the losses of the farmer. The middlemen do not see an incentive for improving the transmission channel. There needs to be some public sector action. There are also high marketing costs as a result of long loading and unloading time, high transportation costs, and spoilage. Related to these factors is the price of produce, which fluctuates greatly in these four countries. The monthly price of tomatoes in 2017–2018 in Nepal varies from Rs30–Rs90 per kg within the same year. In addition, farmers suffer from the production cycle because of the nature of their production—every 4–5 years, there is crop failure. As shown in the Pakistan brief, potato farmers suffer both during crop failure and bumper harvests.

Based on these findings, we recommend the establishment of a production marketing architecture. Starting with production area, a collection center must be established with better agri-logistics, cooling houses, and packaging, grading, and sorting facilities so that products can be stored in the production area. Transmission from the production area to the local collection center must be improved as well as it is a source of postharvest loss. Transmission from the local collection center to the wholesale market (whether local or urban) must also be improved significantly. This is the poorest segment we have seen in these four countries. The wholesale markets need to be improved—those that we have visited in these countries are not in good shape. These wholesale markets are unable to deliver safe food and maintain supply. Transmission from wholesale markets to retailers to consumers require regulation in the form of food safety acts as well as monitoring, detecting, and preventing food contamination.

If we can improve the supply chain, postharvest loss will be reduced. Estimates done in these four countries show that cutting down postharvest loss by 10% from current highs of 40%–30% could result in savings of ranging between $1 billion–$2 billion depending on the size of the country. Similarly, if price fluctuations of produce could be reduced by 10% of the upper band, savings are estimated to be a $1 billion in countries like Bangladesh and Pakistan. The volume of savings alone provides us

A call to fix the markets. Akmal Siddiq, Chief of Rural Development and Food Security (Agriculture) Thematic Group, ADB, recommended that governments come up with the overall architecture of the marketing framework and to spend seed money in developing the wholesale market infrastructure.

a reason to think hard and improve the supply chain, transmission, and marketing of fruits and vegetables in these countries. If we can manage to improve the wholesale market infrastructure of Kalimati in Nepal and manage to reduce trading costs by 2 cents per kg, there will be savings of $1.3 million per year. Since the volume of trading in a wholesale market like Lahore, Pakistan is big, similar improvements will result in savings of $5.5 million a year. I hope these numbers are good enough to convince all of us that we need to do something about the supply chain and improve them.

Synthesis
Akmal Siddiq, Chief of Rural Development and Food Security Thematic Group, ADB

These reflect financial costs. In fact, the results of our studies in these countries do not yet reflect economic costs. For example, partly decomposed vegetables and fruits and those in the process of being decomposed, are bought by a lot of consumers. Consuming these produce has a detrimental effect on human health. We have not yet calculated the cost of detrimental health effects by consuming unsafe food. The other impacts are high and fluctuating prices and varying degrees of availability. Fruits and vegetables are not always available to low-income consumers, who spend between 50% and 60% of their household income on food.

One of the reasons for malnutrition is that low-income households cannot afford fruits and vegetables. If those costs were incorporated in the equation in these countries, the cost of dysfunctional markets would amount to billions of dollars. Therefore, our recommendation to governments is to seriously consider fixing the markets. These investments are worth every penny. Most of these investments will not come from the government. The role of government is to come up with the overall architecture of the marketing network. Within that investment framework, the government will spend seed money in developing the wholesale market infrastructure and some key infrastructure in the hinterland. We think government investment may be between 25% and 30% while the bulk of the investment will come from the private sector. This is the key message. But as David Dawe (FAO) said, we are all converts to the idea and the challenge is to convey the message to those who are not in the room. Hopefully, these studies will catch their attention as well.

Rural Development and Food Security Forum 2019 Proceedings

Smart rural development, effective agricultural policies, and efficient regulations are critical to ensure a sufficient, safe, nutritious, and affordable supply of food to Asia and the Pacific's growing population. Toward this end, the Asian Development Bank hosted the Rural Development and Food Security Forum 2019 to prompt governments in the region to provide the leadership and transformative change needed to generate rural prosperity and effective stewardship of land and water resources. Among the topics discussed were the farm income crisis, food insecurity and malnutrition, and rural distress and prosperity challenges. This report captures the stories and on-the-ground experiences of farmers, entrepreneurs and young agripreneurs to help prompt leaders to provide active leadership, effective resource stewardship, and promote transformative changes in rural development and food security.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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