

# Chapter 1

## Introduction: Agricultural Development in Asia and Africa



Jonna P. Estudillo, Yoko Kijima, and Tetsushi Sonobe

### 1.1 Overview of This Book

Agriculture plays an important role in an economy. It supplies food, labor, and capital; serves as a domestic market for industrial commodities; and is a source of foreign exchange through exports. Many believe that Asia's take-off to rapid growth and development was propelled by productive agriculture and a dynamic rural economy. This book explores the multifaceted aspects of agricultural development and rural transformation in Asia and discusses the similarity of the Asian experience with that of contemporary Africa. In this book, Asia means tropical Asia, and Africa means Sub-Saharan Africa. Tropical Asia includes Southeast Asia and South Asia.

The most important finding presented in this book is that African agricultural development has evolved following the pathways of Asian agricultural development. The common pathways are borrowed technology from abroad and adaptive research exemplified by modern seeds, fertilizer, and mechanical technologies in rice farming; secured property rights on natural resources; adoption of ICTs; investments in human capital, including training; and launching of the high-value revolution (or high-value agriculture). In both continents, agricultural development started in the crop sector, which had a strong tendency to induce the dynamic development of other sectors in rural areas.

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This book is divided into four thematic parts: (1) the Green Revolution in Asia and Africa, (2) Land Tenure and Sustainable Natural Resource Management, (3) Transformation of the Rural Economy, and (4) Emerging Issues in Agriculture. In the following sections, we briefly present the findings in each part.

The term Green Revolution is intended to express an epochal change in which “Third World agriculture was embraced in the process of modern economic growth” (Hayami and Otsuka 1994, p. 15). The Asian Green Revolution was launched amid fear of famine due to high population growth, declining availability of farmland, and stagnant rice yield. It started with land-saving technology and improved seeds-inorganic fertilizer tandem intended to save land as a scarce factor. Later, the Asian Green Revolution moved to labor-saving mode as the nonfarm sector expanded, siphoning off labor away from agriculture. When Asian agriculture started experiencing labor scarcity and higher wages, mechanization started to accelerate. Land preparation and threshing were the first to get mechanized as these were the most labor-intensive activities in rice farming. Interestingly, Africa started to embark on the land-saving phase like the Asian Green Revolution, when the continent started experiencing population pressure on the closed land frontier. While the land-saving mode continues, there is evidence that Africa is now in the early stage of the labor-saving mode, as farm labor has started to become scarce and wages have started to go up.

Like Asia, Africa has also started embarking on management- and knowledge-intensive farm practices to increase input efficiency and save the environment. This volume shows that there has been technology transfer from Asia to Africa, as many of the technologies used in Africa are fairly similar to those in Asia. Current levels of rice yield in Africa are comparable to that in Asia. Overall, it is clear the Green Revolution in Asia is now being replicated in Africa, at least for the major rice-producing areas that are irrigated and favorably rainfed, suitable for rice production. Borrowed technology from abroad and adaptive research served as the main pillars of both the Asian and African Green Revolution.

Evidence in this volume shows that secured property right is the most important factor in increasing cropland productivity and enhancing the uptake of sustainable natural resource management (NRM) practices on both continents. Some policies, such as the household responsibility system in China, the land titling program in Thailand and Kenya, and low-cost registration certification in India and Vietnam, strengthened tenure security and enabled land rental market participation. Institution matters in forestland management. Communal property is far more superior to open access, but a mixed property system, which grants individualized property rights on timber on community forestlands, appears more superior to communal property in Ethiopia. To combat global climate change, cooperation among Asian countries could increase agriculture emission management efficiency to as high as 45%.

One aspect of rural development and transformation is the phenomenal spread of information and communication technologies (ICTs). Asia has quickly adopted ICTs, particularly computers, the internet, and mobile phones, and Africa is catching up rapidly. ICTs have a wide variety of uses, including electronic payment services or ‘mobile money’ in Africa and technology-assisted instruction in China. ICTs,

however, have created a digital divide as their adoption is affected by human capital, resource endowments, and ICT infrastructure.

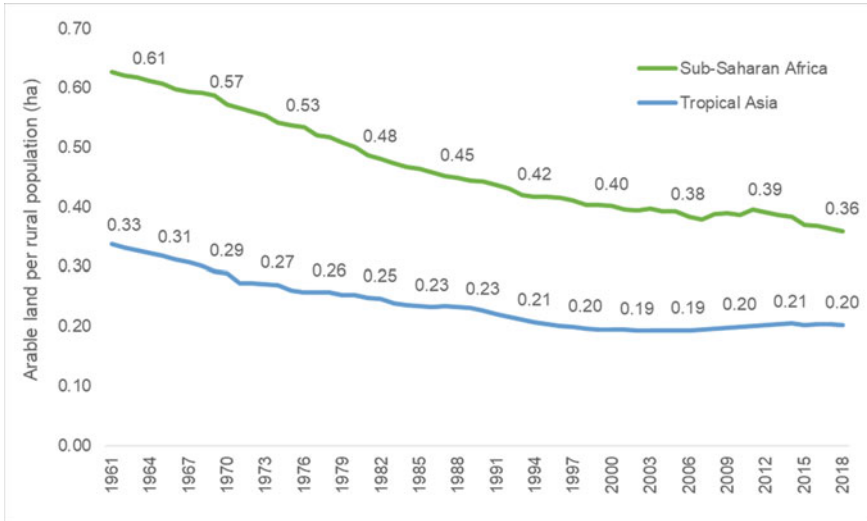
Nonetheless, ICTs have a clear transformative impact on urban and rural people's lives and livelihood, with positive distributional and welfare impacts. Rural transformation is also evident in the change in household strategies to earn a living away from the farm and into nonfarm, with an accompanying reduction in poverty. Farm mechanization facilitates the sectoral shift of labor from the farm to the nonfarm sector.

On emerging issues, high-value revolution is a developing component of 'new agriculture' on both continents. Evidence in this volume shows that this revolution is driven by rising income and global trade integration on the demand side and new technology, government and private sector assistance, and infrastructure on the supply side. Vietnam has become the largest exporter of shrimp, Thailand the largest exporter of cassava products, and Anding Province has emerged as one of the largest potato clusters in China because of improved seeds (in the case of cassava and potato) and improved farm practices (in the case of Vietnam). Government assistance played a significant role in China and Thailand in overcoming bottlenecks, such as developing new seeds, attracting buyers, and improving market access. In Nigeria, solar-powered cold storage that can overcome the lack of sustainable power supply can increase the consumption of perishable micronutrient-rich horticultural products, increase the incomes of market agents, and create employment.

## 1.2 Green Revolution in Asia and Africa

The Green Revolution in Asia started in the mid-1960s with increased investments in irrigation; the development of improved seed varieties; and the use of modern inputs, such as fertilizers and pesticides (Barker et al. 1985). This package was a land-saving technology that aimed to save on land as a scarce factor. Land has become scarce because of rapid population growth and closed land frontier. There were widespread fears of food shortages in the region; thus, the Green Revolution was focused on rice, wheat, and maize, which are the basic staples. The use of high-yielding seeds and modern inputs helped farmers increase yields. The per capita production of rice, wheat, and maize rose, and their prices declined leading to the deterioration of agricultural terms of trade (i.e., the decline in price of farm goods relative to nonfarm goods), which stimulates structural transformation.

In the mid-1980s, Asia started its structural transformation. Labor started to move out of agriculture and into industry and services. With farm labor scarcity, mechanization, such as the use of tractors and threshers, accelerated. Mechanization further contributed to agricultural modernization and productivity. Mechanization was partly triggered by rising wages as a result of the development of the nonfarm sector that siphoned off labor from agriculture, partly because of government subsidies to farmers in the purchase of machines and low oil prices before the 1972 oil crisis.



**Fig. 1.1** Arable land per rural population in Asia and Africa, 1961–2018. *Note* The figure was drawn using data from FAOSTAT

### 1.2.1 Population Pressure

Malthus predicted that food shortages will be inevitable because the population grows exponentially while food production grows only arithmetically. In this scenario, food production will not be able to catch up with population growth. However, serious famine has never taken place in Asia in the past 50 years because of rapid growth in food production. Malthus failed to predict the emergence of technological change induced by population pressure (Hayami and Ruttan 1985).

Two conditions propelled the Green Revolution in Asia: severe population pressure on limited farmland and technology transfer from abroad. Figure 1.1 shows arable land per rural population in Asia and Africa from 1961 to 2018. Arable land was 0.33 hectares (ha) per rural population on the verge of the Asian Green Revolution in 1961. In 2018, arable land was 0.36 ha per rural population in Africa, which is fairly the same as Asia's in 1961 before the Green Revolution took off. Before the Green Revolution, there were widespread fears of food shortages because of a burgeoning population, stagnant yield, and increasing scarcity of farmland.

Rice is the most important crop in Asia in terms of harvested area.<sup>1</sup> Here we focus on rice because Asia has accumulated mature technologies that could be easily transferred to Africa. Such technologies are suitable for smallholder farms common in both Asia and Africa. Figure 1.2 shows the yield trends of six important grains in Asia and Africa. The wheat yield in the two continents has been rising and has been fairly the same since the 1980s, which means the Green Revolution in wheat

<sup>1</sup> Maize is the most important grain in Africa.



**Fig. 1.2** Yields of selected crops in tropical Asia and Sub-Saharan Africa, 1961–2020. *Note* The figures were drawn using data from FAOStat

had already taken place in both continents. The yields of maize, millet, cassava, and sorghum are rising rapidly in Asia, but Africa is lagging, and yield is rising slowly. As a result, the yield gaps in these four crops have risen over time, indicating a widening technology gap between the two continents. In the case of rice, the yield has been rising rapidly in Asia, and the yield in Africa is also rising at a fairly moderate rate, which has led to a decline in the yield gap between the two continents. This means that the Green Revolution in rice could have started to evolve in Africa. While the rice area in Africa remains small, it is steadily increasing primarily due to the conversion of uncultivated marshy land to lowland paddy fields, indicating the rising importance of rice in African agriculture.

### 1.2.2 Technology Transfer from Abroad

Professor Keijiro Otsuka argues that technology transfer from abroad is the most decisive propelling force in the Asian Green Revolution. The Green Revolution in rice and wheat took place in Asia in the late 1960s when there was a huge technology

gap in agriculture between the temperate and tropical countries. The essence of the Asian Green Revolution in rice was the transfer of intensive rice farming systems from Japan to Taiwan and Korea and from Taiwan and Korea to tropical Asia. This new technology was characterized by the adoption of semidwarf fertilizer-responsive high-yielding rice varieties, intensified use of chemical fertilizer, and application of improved management practices.

The Asian Green Revolution started in 1966 when the International Rice Research Institute (IRRI) introduced IR8 (the first high-yielding variety of rice). IR8 had a yield potential five times that of traditional varieties. IR8 was a crossbreed between Peta, a tall variety from Indonesia, and Dee-Geowoo-Gen, a semidwarf variety from Taiwan. IR8 was modeled after the high-yielding Japanese varieties. After IR8, many rice varieties with better characteristics were released. Adaptive crop breeding research played the most important role in developing varieties that thrive in different environmental conditions, incorporate qualities that satisfy consumers' preferences, and are environment- and climate-friendly.

The Green Revolution has three technological pillars: (1) land-saving technology (modern seeds, inorganic fertilizer, and irrigation); (2) labor-saving technology (mechanical technologies); and (3) knowledge-intensive practices. Modern varieties (MVs) of rice could be broadly categorized into two: (1) first-generation MVs (MV1) are more high-yielding than the traditional varieties (TVs) but are susceptible to pests and diseases; and (2) second-generation MVs (MV2) are designed for yield stability because they incorporated improved resistance against multiple pests and diseases, have better grain quality, and shorter cropping period. Hybrid and genetically modified rices have been released more recently.

Knowledge-intensive crop management practices, such as timely fertilizer application and intensive-pest management, have replaced chemical inputs. The Green Revolution was initially focused on irrigated rice land, as it produces 70% of the world's rice supply. New rice technology is now spreading in unfavorable areas because later MVs were designed to withstand extreme weather, such as floods and drought.

### ***1.2.3 Transferability of the Asian Green Revolution to Africa***

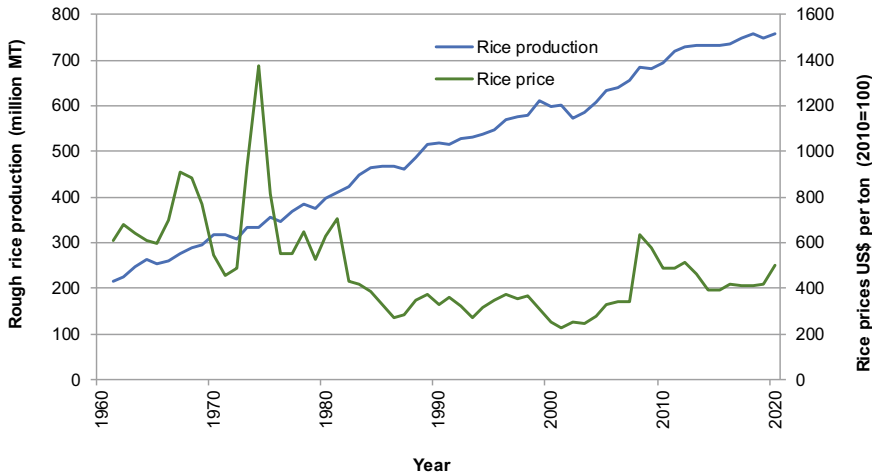
Here we argue that the Asian Green Revolution is transferable to Africa. First, through its long rice farming tradition, Asia has accumulated a huge stock of mature technology that can be transferred to Africa. Second, there is a huge technology gap in rice farming and in agriculture in general between Asia and Africa. This gap is similar to that between the temperate and tropical countries in the 1960s, which induced the establishment of national research centers for adaptive research and extension services to disseminate available new technologies to farmers. Third, in more recent years, population pressure has become so severe in Africa, fairly similar to Asia's on the eve of its Green Revolution. As shown in Fig. 1.1, Asia had 0.36 ha of arable land per rural population in 1961, while Africa had 0.33 in 2018. Fourth, agroclimatic

and soil conditions in some areas in Africa, such as those in Uganda and Tanzania, are favorable for lowland rice cultivation. While it cannot be generalized to all of Africa, the literature review by Balasubramanian et al. (2007) concludes that the rice yield potential in Africa is high. Professor Otsuka observed that many rainfed paddy fields are located in valley bottoms in Africa, which are moist and fertile, and hence, favorable for rice production.

In Asia, input and output markets were already in place when the Green Revolution took off. The Green Revolution was based on the high input and big harvest principle, and, for it to proceed in Africa, markets should be working. Otsuka and Larson (2016) note that markets for inputs and outputs have started to develop in Africa. For example, in Uganda, access to rice millers was greatly improved due to the rapid increase in the number of millers. Seeds have become increasingly available from seed suppliers and purchased from neighboring farmers, indicating the development of seed markets. Importantly, rice traders have emerged in Kenya offering tied-in-credit, a contract where rice traders advance credit to farmers for fertilizer purchases, with the farmer paying the trader in paddy after harvest (Njagi and Mano, in this volume). Overall, the conditions in Asia when the Green Revolution was launched were fairly similar to contemporary Africa, so there is great hope that it could also succeed in the latter.

### ***1.2.4 Trends in Rice Production and Prices***

The Asian Green Revolution was a phenomenal success in increasing rice production and decreasing world rice prices (Fig. 1.3). Rice prices declined in the late 1970s after reaching an all-time high in the early to mid-1970s due to political conflict between the US and the Soviet Union that led to chaos in the grain market. Except for another one-time hike in 1980/1981, this time due to oil price increase, rice prices were generally lower from 1980 to 2005 (hovering around USD 400 per ton in 2010 USD PPP) compared to the 1960s and 1970s. The world food crisis in 2006–2008 made rice prices rise again, but at a level that is substantially less than the highest peak in 1974 at USD 1,374 per ton. The sharp reduction in rice prices would mean that the sure ‘winners’ of the Green Revolution are rice consumers, most importantly, urban consumers, while rice farmers who failed to adopt new rice technology were clearly the ‘losers’ because of lower rice prices. Farmers who adopted new technology gained from yield increases but suffered from low rice prices, so the net benefits to them are unclear.



**Fig. 1.3** World rice production and rice prices, 1960–2020. *Note* Figure was drawn using data from FAOStat and World Bank Commodity Price Sheets

### 1.3 Land Tenure and Sustainable Natural Resource Management

Well-defined property rights strengthen the incentives of agents to sustainably manage natural resources, such as croplands and forestlands. With respect to cropland, land tenure defines individual rights over a piece of land. Holden (in this volume) reviews the impacts of contemporary land tenure policies in Asia and Africa. In China, establishing the household responsibility system created many benefits for family farms that were not present under the collective and state farms. Land-to-the-tiller reforms that aimed to enhance land access to land-poor and landless households but infringed on the workings of the land market, on the contrary, failed to achieve their objectives in Bangladesh, India, Nepal, Pakistan, and the Philippines. Landowners tried to evict tenants, and tenants were often converted to permanent laborers. This is not a land contract but a labor contract (Hayami and Otsuka 1993).<sup>2</sup> Land titling programs, such as those in Thailand and Kenya, provided documented land rights and enhanced the functioning of the credit markets by facilitating the use of land as collateral (Feder and Onchan 1987). In Ethiopia, land registration has strengthened land tenure, promoting investment in conservation and encouraging land market participation (Holden et al. 2009).

Secured land tenure enables households to deepen their engagement in the nonfarm economy. In the Philippines, for example, beneficiaries of land reform used their increased farm income to send their children to school, who, upon completing school, decide to work in the rural nonfarm economy or migrate to local towns, big

<sup>2</sup> In the Philippines, this is called the *porcientuhan* contract where the laborer receives 10% of the gross output at harvest time.



cities, and overseas, sending remittances back home (Estudillo and Otsuka 2016). In some cases, land reform beneficiaries pawn out their lands and use the pawning revenues as school funds for their children or as fixed costs for overseas work (Estudillo et al. 2009). Pawning is an arrangement whereby a creditor advances a loan to the farmer in return for cultivating the land until the loan is paid.<sup>3</sup> Pawning emerged because land market sales have been constrained by law for lands obtained through land reform.

Unlike croplands, in which tenure is largely under individual rights, forestlands may be open access or owned/rented/managed by the community or an individual. Stronger tenure rights in croplands could be why degradation in Africa is much less pervasive on croplands than in other land uses, including forestlands (Place, in this volume). Institutions in managing forestlands may prove important in preserving and rehabilitating forestlands. One such institution is the mixed management system (Takahashi, in this volume), whereby forestlands are owned by the community, but the trees are owned by individual members. Since decision-makers in this scheme are individuals, women and men may develop the same degree of propensity to adopt NRM practices since men have an interest in conserving forests for their commercial values, while women have interests in food, water, firewood, and medicinal products, which may be among their tasks to collect. While tenure is important, there could be other factors in the uptake of sustainable NRM practices, such as information and technical advantage, discount rate, low economic returns, and gender differences in constraints and benefits.

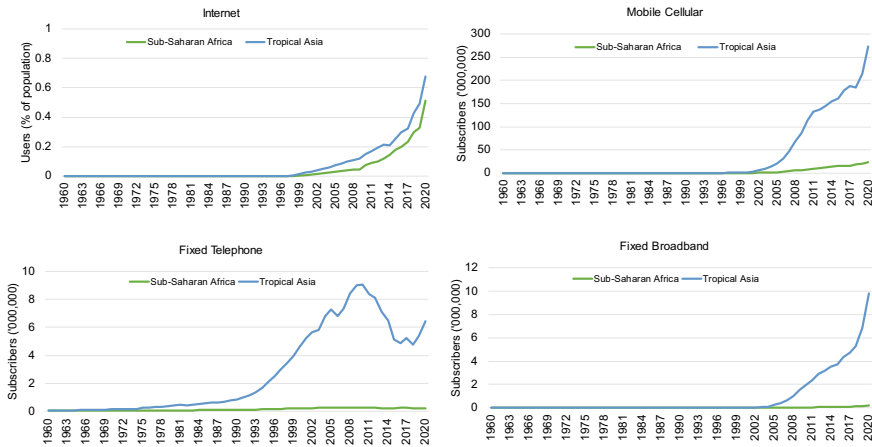
## 1.4 Transformation of the Rural Economy

There has been a phenomenal rise in the usage of ICTs in Asia. Africa is following suit more visibly in internet and mobile phones, but not so much in broadband and fixed phone subscriptions (Fig. 1.4). The spread of the internet and mobile phones started on both continents around the mid-1990s. The percentage of the population using the internet in Africa has been very close to Asia since the early 2000s. The number of fixed telephone subscriptions rose spectacularly in Asia in the mid-1980s. Its peak was in the mid-'00s, followed by a sharp drop when mobile phone subscriptions rose substantially.

The transformation of the rural economy is the shift of the locus of rural economic activity away from the farm to the nonfarm sector. The most important propelling force in rural transformation is the decline in the price of farm goods relative to

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<sup>3</sup> Pawning during the Hispanic colonial period was known as the *pacto de retrovenda*, in which a moneylender, usually a local Chinese trader (Chinese mestizo), secured the protection of his loan to a peasant by taking immediate control of the land. In the *pacto de retrovenda*, the indebted peasant remains in possession of the land but in the role of sharecropper to the Chinese trader. Land acquisition by the Chinese trader was inspired by the booming domestic trade in rice, corn, indigo, and fruits and vegetables.



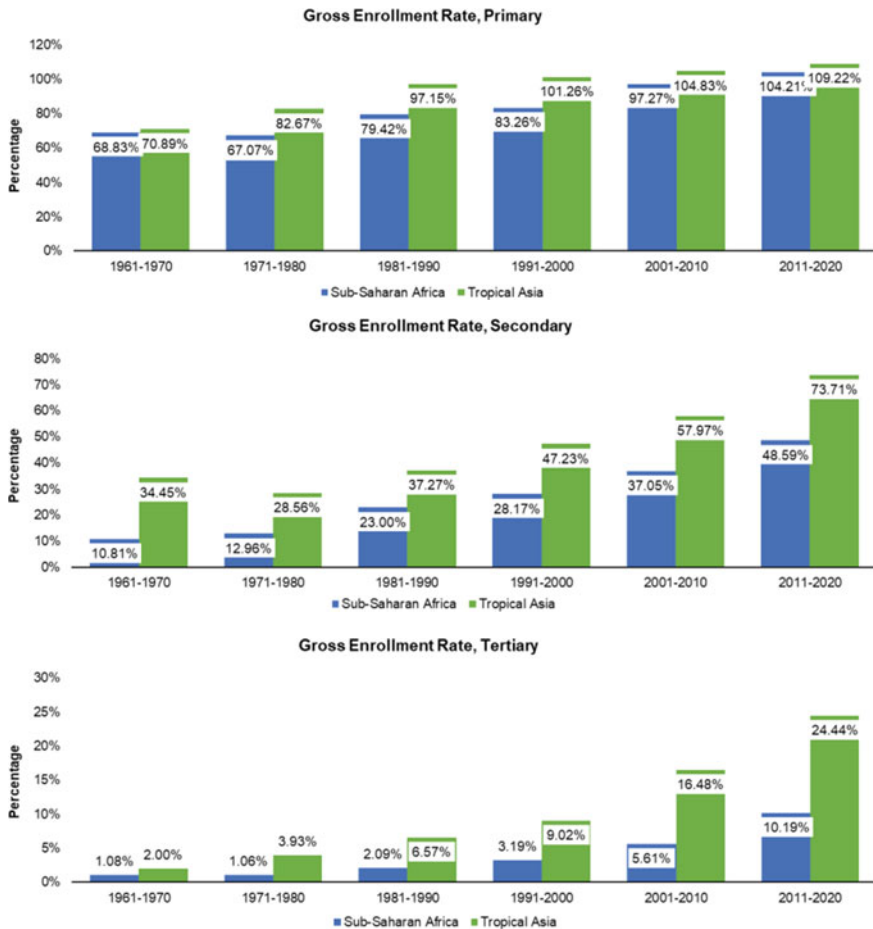
**Fig. 1.4** Adoption of ICTs in Asia and Africa, 1960–2020. *Note* The figures were drawn using data from World Development Indicators

nonfarm goods (i.e., deterioration in agricultural terms of trade) that stimulates the movement of resources away from the farm to nonfarm sectors. Rural transformation is often accompanied by (1) increasing productivity of agriculture (i.e., crop farming and high-value agricultural products); (2) more lucrative employment opportunities in rural nonfarm sectors; and (3) migration. The agricultural growth linkage hypothesis postulates that modern agricultural technology propels the development of the nonfarm economy through several production and consumption linkages (Haggblade et al. 2007). Production linkages come through backward linkages (e.g., the production of implements, agricultural machinery, and retail stores for fertilizer). It could also come through forward linkages (e.g., processing and agro-based industries). Consumption linkages come through increases in rural household income that stimulates consumer demand for locally-produced nonfarm goods and services. Consumption linkages are the more dominant.

There is no doubt that nonfarm income has been increasingly the major source of household income growth because of the decline in farm prices and increased profitability of nonfarm activities. Nonfarm income comes from wage income and remittances. The rise in nonfarm income is pro-poor as the landless and near landless households are engaged in nonfarm work. Remittances of migrant workers have transformative impacts on the rural economy. First, remittances can help increase the level of household consumption and reduce its volatility. Second, remittances can be used for productive investments, such as microenterprises, children's education, and housing. Finally, migration facilitates land consolidation and mechanization in rural areas. With the land rental market, migrants with land can rent or sell their land. Migration and rural wages going up induce farmers to mechanize to save on labor.

Economic transformation is the key driver of growth and development in Asia at the macro-level, accompanied by rapid income growth and poverty reduction (ADB 2020). Many believe that Asia's investments in primary and secondary education are

the main propelling force for economic transformation and rapid, sustained growth. Figure 1.5 shows that Asia’s gross enrollment in primary school has steadily increased since the 1960s, reaching more than 100% in the 1990s. It is higher than 100% because the gross enrollment rate includes overaged and underaged pupils and repeaters. The gross enrollment rate in secondary schooling is lower than in primary school but has risen fast since 1981. The tertiary enrollment rate in Asia is much lower than the secondary level, but there was a sharp rise beginning in 2001. From 2011 to 2020, the gross enrollment rate in tertiary schooling was nearly 25%. Africa has caught up with Asia at the primary level and is slowly catching up at the secondary and tertiary levels. If Africa were to follow the Asian path toward growth and development, investments in secondary and tertiary schools appear to be the right direction to go.



**Fig. 1.5** Gross enrollment in primary, secondary, and tertiary schooling in tropical Asia and Sub-Saharan Africa. *Note* The figures were drawn using data from the World Development Indicators

Sawada (this volume) argues that Asia's economic success was attributed to its rapid human capital accumulation that increased its capacity to absorb and adapt new technology from abroad, enabling rapid economic transformation. Because of investments in education, Asia improved to catalyze technological advances from abroad that drive sustained long-term growth ('innovation') in the nonfarm sector. Indeed, the major ingredient in the 'East Asian Miracle' was human capital investments in education and health, serving as the flagship in Asia's long-term rapid growth.

## 1.5 Emerging Issues in Agriculture

In the 'new agriculture,' high-value products tend to dominate, driven by supply and demand factors. On the supply side, the factors are new technology and improved farm management, support from trade guilds, and local government and infrastructure. On the demand side, higher income stimulates the demand for a more diversified diet and global trade integration. Case studies presented in this volume are the shrimp industry in Vietnam; cassava/tapioca in Thailand; fresh fruits and vegetables in Nigeria; and agricultural clusters in China (potato), Egypt (medicinal aromatic plants), and Tunisia (dates).

Emerging issues in agriculture go beyond the farm and into the social sphere. On women, a new metric, the Women's Empowerment in Agriculture Index (WEAI), was launched in 2012 and is being continuously upgraded to monitor women's inclusion in agricultural sector growth. The WEAI can help governments and civil society organizations design and implement gender-sensitive agricultural development programs in line with the adoption of SDG 5 on women's empowerment and gender equality. On governance, public choice considerations in Asia tend to exempt agriculture from competition law prohibitions, such as those involving exercise of market power by farmers' associations. Such a move serves as a countervailing force for the farmers' comparatively weak political influence in agricultural policy and their relative market power vis-à-vis the more concentrated wholesale-retail segments of the agri-food value chain.

## 1.6 Contributions of This Volume

This volume provides a comprehensive exploration of recent agricultural and rural development issues in Asia and Africa. This volume compiles the works of top scholars who provided analyses and evidence from household-level surveys collected over many years and, more recently, randomized controlled trials (RCT) in the two continents. The four themes in the volume represent the main research interests of Professor Keijiro Otsuka, with almost all authors having worked with him on a research project along these themes. This work will be of great value to development

economists, students, and researchers interested in rural economies and policymakers engaged in rural and agricultural development in Asia and Africa.

## 1.7 A Road Map to the Book

There are 27 chapters in this volume, including the Introduction and Summary and Conclusions. The remaining 25 chapters are divided into four thematic parts.

The first theme—*Green Revolution in Asia and Africa*—documents the evolution of the Green Revolution in Asia for more than six decades and evaluates to what extent the Asian Green Revolution has been replicated in contemporary Africa. We focus on the expansion of irrigation, development of high-yielding seeds, increased use of modern inputs, acceleration in mechanization, and improved farm management practices.

Part 1 has eight chapters. Chapter 2 (Pingali) synthesizes the lessons learned and spells out the policy redirections needed for a new version of the Green Revolution that addresses unresolved issues, such as food and nutrition security and economic development, while minimizing social, environmental, and health trade-offs. Chapter 3 (Kajisa et al.) reviews how rice farming practices in the lowland rainfed and irrigated ecosystems in Central Luzon have evolved for over half a century in terms of the adoption of new technology and rice yield. Chapter 4 (Yamano) reviews recent studies on the adoption and impacts of submergence-tolerant rice varieties in South Asia and found, in a study using DNA fingerprinting, that many farmers in Bangladesh wrongly identified varietal names, indicating that adoption studies may not accurately reflect farm-level adoption rates. Chapter 5 (Njagi and Mano) identifies factors and constraints in the spread of mechanization in the Mwea Irrigation Scheme in Kenya. Chapter 6 (Nakano and Magezi) summarizes four of their own studies in Tanzania that evaluate the effectiveness of irrigation, agricultural training, and microcredit in enhancing rice productivity. Chapter 7 (K. Takahashi) uncovers the impacts of the system of rice intensification (SRI) on enhancing rice productivity in Africa, with a particular focus on careful field management practices. Finally, Chapter 8 (Kijima and Tabetando) summarizes the findings and achievements of the Research on Poverty, Environment, and Agricultural Technology (RePEAT) conducted in East Africa for over 20 years.

The second theme—*Land Tenure and Natural Resource Management*—deals with the dynamics of land tenure, land market, property rights in agriculture, and the sustainability of current farming systems. Here we uncover the constraints and drivers of the uptake of sustainable NRM practices and identify which existing farming practices are sustainable. This section also assesses to what extent transboundary crop diseases affect global and African food security and spells out the prospective role of regional cooperation in attaining sustainable green growth by increasing emission-management efficiency.

Part 2 has six chapters. Chapter 9 (Holden) reviews the extant literature on land and tenure contracts in developing countries and presents an analysis of major land

tenure reforms in the twentieth century. Chapter 10 (R. Takahashi) presents the results of a randomized experiment in Ethiopia on the property rights regime and forest resource management. Chapter 11 (Place) reviews recent studies on the constraints and drivers of the degradation of agricultural resources in smallholder farms in Africa and spells out action agenda to redirect Africa's agricultural development pathways toward sustainability. Chapter 12 (Muraoka) investigates the possibilities and limitations of sustainable agricultural intensification and draws policy agenda on how to make it possible in the context of Africa. Chapter 13 (Mottaleb) quantifies the production loss caused by the spread of maize lethal necrosis in Kenya, DR Congo, and Tanzania. Finally, Chap. 14 (Zaman and Kalirajan) discusses the important role of regional cooperation in sustaining green growth in agriculture by increasing emission-management efficiency.

The third theme—*Transformation of the Rural Economy*—describes the strategic processes that underlie economic transformation, which is the shift of economic activities away from agriculture and into industry and services. One emerging aspect of rural development is the increasing use of ICTs, most importantly, the internet and mobile phones. If Asia is fast in this aspect, Africa is following suit. Evidence from long-term datasets at the macro- and household-level in Asia shows a fast sectoral movement away from agriculture and into services, putting into question whether there is an escalator leading directly to services without going through industrialization.

Part 3 includes six chapters. Chapter 15 (Huang et al.) documents the overall trends in the use of the internet, computers, and mobile phones in rural China and examines the enabling and constraining factors in farmers' adoption of major ICTs. Chapter 16 (Abbey et al.) assesses the potential of using educational technology to improve teaching quality in rural China. Chapter 17 (Matsumoto and Munyegera) summarizes the findings from research on the impact of the mobile revolution, focusing on the impacts of 'mobile money' on the lives and livelihood of rural residents in developing countries. Chapter 18 (Estudillo) describes the drivers of economic transformation in four villages in the Philippines, the so-called Kei's villages, and describes the strategic processes that accompany such transformation. Chapter 19 (Sawada) presents a case study of two pathways of economic transformation using long household panel data in Laguna in the Philippines. The first one followed the agricultural-manufacturing-services historical pathway (i.e., 'canonical industrialization') while the second skipped industrialization, moving straight to services (i.e., 'premature deindustrialization'). Finally, Chap. 20 (Larson) explores the relationships between sectoral migration, gaps in sectoral incomes, and mechanization using a cross-country panel spanning five decades.

The fourth theme—*Emerging Issues in Agriculture*—which are evolving in Asia and Africa, include the spread of high-value revolution and issues beyond the farm, such as the evolution of metrics to measure women's empowerment in agriculture and governance issues that exempt agriculture in competition laws. These themes show a high degree of commonality between Asia and Africa in their agricultural and rural development journeys.

Part 4 contains six chapters. Chapter 21 (Suzuki and Nam) illustrates how the shrimp culture industry has evolved in Vietnam by spelling out the factors that led to its evolution. Chapter 22 (Aida) describes the evolution of the cassava/tapioca industry in Thailand by identifying the motors of evolution. Chapter 23 (Zhang) compares agricultural clusters' performances in China and Africa using case studies on the potato cluster in China, the dates cluster in Tunisia, and the medicinal and aromatic cluster in Egypt, focusing on the important role of local government in providing the necessary public goods. Chapter 24 (Yamauchi and Takeshima) investigates the impacts on food loss, perishable horticultural commodities consumption, and livelihood outcomes of solar-powered cold storage systems in Nigeria. Chapter 25 (Quisumbing et al.) describes the development of new metrics that measure women's empowerment in agriculture. Chapter 26 (Balisacan) explores how exemption of agriculture from the competition laws has become beneficial to smallholder farmers in Asia in terms of the balance of political influence in agricultural policymaking and market power over the more concentrated wholesale-retail sector.

### **Recollections of Professor Keijiro Otsuka**

Among the non-Japanese researchers, I believe I have the longest association with Professor Otsuka, which spans well over two decades. I first met him at the International Rice Research Institute in 1988 when I was a masteral student. He then recommended me to the University of Hawaii, where I finished my Ph.D. in Economics. Our long research work started when I worked at the Tokyo Metropolitan University as a postdoc under his supervision. I then joined him at the Foundation for Advanced Studies on International Development and the National Graduate Institute for Policy Studies in Tokyo. We have produced three books (two written, one edited), 18 journal articles, and ten chapters on our joint research on poverty, economic mobility, gender and development, the nonfarm sector, agricultural productivity, and inclusive growth. It is my great pleasure and honor to be the chief editor of his *Festschrift*.—*Jonna P. Estudillo*.

I first met Professor Otsuka in 1995 when I decided to enter the master's program at Tokyo Metropolitan University. He was a visiting research fellow of IFPRI and traveled to Africa and Asia on projects related to land tenure and natural resource management. Luckily, he made me a part of the project, and we conducted research on tree management in community forests in Japan. This taught me the value of research and made me decide to be a researcher. After I obtained my Ph.D., he gave me an opportunity to work with him on the New Rice for Africa (NERICA) project in Uganda in 2004. Since then, I have been collaborating with him on studying the African rice Green Revolution. I am grateful to be his student and later colleague and collaborator and have learned from him how to conduct research in the development economics field. Curiosity, hard work, positive thinking, leadership, teamwork, and a warm and strong heart are what I learned from Professor Otsuka.—*Yoko Kijima*.

My Ph.D. dissertation supervisor, Professor TN Srinivasan, asked me, "Is this the university where Yujiro Hayami and Kei Otsuka work?" He encouraged me to accept the job offer I had just received from Tokyo Metropolitan University in 1992. Since

then, I have followed Kei and learned many important things from him. He and I were born in the Year of the Rat and raised in the same town. We are Taurus and share the same blood type. Our names share similar stroke-counts of Chinese characters. Do these coincidences mean that we resemble? Of course, no! But we share the same general values because we have discussed numerous things over thousands of beer and wine bottles.—*Tetsushi Sonobe*.

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