



Food and Agriculture
Organization of the
United Nations

Agricultural transformation in Asia

Policy and institutional experiences



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Foreword

The Sustainable Development Goals (SDGs) committed the world to eradicating the scourges of poverty and hunger in all their manifestations by 2030, and represented a clear expression of collective moral imperative. Yet the latest estimates suggest that nearly 690 million people, nearly nine percent of the global population, remain undernourished – a figure that should shock and shame us all. And while the clock keeps ticking, and access to nutritious and sufficient food remains out of reach for so many, recent data suggest the COVID-19 pandemic will swell the ranks of those living in extreme poverty by an additional 124 million people.

Asia is home to over 350 million undernourished people, more than half the global total. Nearly 1.9 billion people in the region cannot afford to access a healthy diet, while South Asia accounts for 29 percent of the world's extreme poor. Some 400 million people in Asia continue to live in extreme poverty, using the US\$1.9 a day benchmark, and that number would rise to 1.2 billion people if the higher threshold of US\$3.2 a day was used. While urban poverty is significant, the great majority of the poor live in rural areas. The latest assessments indicate that COVID-19 will likely further undercut efforts aimed at addressing malnutrition and eradicating pockets of extreme poverty in Asia.

Recent literature confirms that growth in agriculture is two-to-three times more effective in reducing poverty and malnutrition, compared to similar growth in non-agricultural sectors. However, experiences in some countries suggest that not all agricultural growth alleviates poverty or improves nutrition. Nevertheless, many countries in Asia have been successful in addressing poverty and malnutrition by transforming their agricultural sectors. The question is: What did the public sector in these countries do to facilitate successful transformation and effectively address poverty and malnutrition?

FAO strives to support member nations in their quest to facilitate inclusive and sustainable agricultural transformation. This study explores the role of the public sector in the agricultural transformation process. The enquiry is not whether transformation has happened, but rather how has it been facilitated in terms of public policies, institutional innovations, legislation and investment. The hope is that taking stock of experiences in some countries in Asia will help others both inside and outside this region build on those experiences to facilitate the desired transformation. The study highlights some key factors that have contributed to agricultural transformation in selected countries, including details on prioritization, processes and capacities that are helpful for implementing and adapting successful policies and initiatives.

FAO has the mandate and capacity to facilitate the exchange of technical knowhow, policy and institutional experiences across countries. I hope this publication will positively contribute to inclusive agricultural transformation, and by extension, to a region and world without hunger and malnutrition.

A handwritten signature in black ink, appearing to read 'JJ Kim', with a stylized, cursive script.

Jong-Jin Kim

Assistant Director-General and FAO Regional
Representative for Asia and the Pacific

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Chapter 1

Agricultural transformation

Introduction and summary of experiences from Asia.

Arya A,

Food and Agriculture Organization of the United Nations



I. Introduction

Recent studies confirm that agriculture remains relevant to growth and poverty alleviation. They demonstrate that growth in agriculture is two to three times more effective in reducing poverty than equivalent growth in non-agriculture sectors (Christiaensen and Martin, 2018). Growth in agriculture disproportionately benefits the poorest, particularly in countries at the lower levels of economic development (Ligon and Sadoulet, 2018). Heady (2013) suggests that growth in agriculture is more effective than growth in other sectors in addressing malnutrition. However, not all agriculture alleviates poverty or improves nutrition. Context, source and inclusivity of agriculture growth are important to assess the efficacy of agriculture in poverty alleviation and nutrition impact (Kirk, Kilic and Carletto, 2018).

Over the past few decades, some countries in Asia have been more successful than others in addressing poverty and malnutrition. The key question is what policies, strategies, legislation and institutional arrangements have led to a transformed agricultural sector, effectively contributing to poverty alleviation and addressing malnutrition. The great majority of national policymakers within and outside the Asia-Pacific region are keen to understand the causes of agricultural development and transformation in successful countries in Asia. A large number of studies have been conducted and some of them link specific public policies and interventions to successful agricultural transformation. However, there seems to be lack of focus on the policy, legislative and institutional environments that have enabled or impeded Agricultural transformation in Asia. National policymakers are likely to benefit significantly from adequate and convincing information on successful and relevant experiences in successful transformation. Countries are interested in what their neighbours and peers have done, and why some have achieved impressive results. The main purpose of this study is to take stock of public sector experiences in facilitating and enabling agricultural transformation in selected countries in Asia. The study focuses on key public sector interventions, in particular policies, legislation and institutional innovations, because these areas have so far not been adequately researched.

The study is organized into six chapters, including this introduction. This chapter provides a literature review of the latest developments in agricultural transformation, key aspects of agricultural transformation and a summary of findings from selected country studies. Chapter 2 provides a general overview of the processes and experiences of agricultural transformation in Asia, with a focus on South and Southeast Asia. Chapters 3 through 6 present agricultural transformation and key policy, legislation and institutional innovation experiences in the Republic of Korea, the Kingdom of Thailand, Viet Nam and Bangladesh, respectively.

I.1. What is agricultural transformation?

Agricultural transformation may be broadly defined as the process over time by which the agrifood system evolves from subsistence oriented and farm centred into more commercialised, productive and off-farm centred (Laborde *et al.*, 2018). Transformation is said to be inclusive if the results lead to food security and poverty alleviation and reach the socially and economically disadvantaged, in particular women, minorities, the disabled and the elderly. Agricultural transformation is a key component of structural transformation, and the linkages between the two are such that isolating one from the other is either problematic or not feasible. Timmer (2012) posits that structural transformation historically follows a remarkably uniform pattern, namely:

- (i). A decline in the [relative] share of agriculture in GDP and a decline in the labour/land ratio in agriculture. Misinterpreting this paradox and ignoring the agricultural sector in some countries may have caused stagnation, relative decline and enhanced poverty (Timmer, 1988, 2002; Vos, 2018).
- (ii). A commensurate rise in non-agriculture sectors, in particular urban/industrial/modern service activities. A number of scholars have pointed out that the non-farm sectors grow much faster, causing income disparity between farm and non-farm sectors, which has at times caused pockets of persistent poverty (Otsuka, 2012). Johnson (1991) and Timmer (2012) argue that policies to reduce the income gap between the farm and non-farm sectors have usually derailed the process of transformation by artificially keeping an inflated labour force in the farm sector, which likely would have migrated to other sectors in the absence of such interventions.
- (iii). Rural to urban migration of labour – this directly relates to the preceding point.
- (iv). A demographic transition defined by falling mortality rates, gradual decline in fertility rates and a subsequent period of rapid population growth.

Rising labour productivity is the basic feature of agricultural transformation, which can be achieved in three key ways (Timmer, 2012): (i) New and improved technology for a given amount of labour; (ii) More labour absorbed in other sectors away from agriculture, ensuring the same or higher output with fewer workers in agriculture; (iii) Improved agriculture terms of trade – higher real income for farmers. One could add (iv) agricultural livelihood diversification from mono-cropping staple crops to diversified, intensive and high-value crops, as well as value chain development and (v) secure and inclusive land tenure to give farmers more incentives to invest.

Agricultural transformation evolves through at least four distinct phases, and the role of public policies, strategies and investments vary accordingly (Timmer, 1988). The stylized stages, though not always clearly distinguishable, are very useful to analyse public interventions at different stages of agricultural development. The defined stages would also help policymakers determine the relevance of certain policy measures to specific settings/countries. The transformation stages and some of the key associated policy instruments may be roughly defined as:

- (i) *'Getting agriculture moving'* – Typically an early phase of agricultural development, when productivity per worker begins to increase, improved technologies are adopted and some labour force is released from agriculture. Key policy options during this phase typically are institutional change, new technologies, market structures, incentives, and significant investments in rural infrastructure.
- (ii) *'Agriculture as a contributor to growth'* – The surplus generated in the first phase is tapped and invested in non-agricultural sectors, hence increasing their labour-absorption capacity and facilitating labour exit from agriculture. During this stage, the agricultural sector continues to adopt productivity-enhancing technologies, and enhance enabling environment, including innovative institutional change and inclusive legislations. Key policy options may include establishing agriculture-industry market linkages, as well as technology and incentives that support the creation of a sustainable agriculture sector.
- (iii) *'Integrating agriculture into the macroeconomy'* – Progressive investment in rural infrastructure, market linkages and integration of factor and product markets between agriculture and other sectors facilitate the integration of agriculture into the macroeconomy. Factor productivity and income differentials between agriculture and non-agriculture sectors diminish, and market signals are transmitted to rural areas with relative ease. Managing trade, shocks in commodity markets and market interventions continue to be focus areas for policy in agriculture.
- (iv) *'Agriculture in industrialized economies'* – During this stage agriculture is a much smaller sector of the economy and food expenditures occupy a small share in consumer budgets. The policy focus include rural employment generation, income support to farmers, environmental protection and the supply of verifiable healthy diets. In addition, some of the issues in phase iii, in particular agricultural protectionism, managing commodity market shocks and environmental impacts continue to be relevant and the focus of policy agendas.

Laborde *et al.*, IFPRI 2018, suggest two additional phases to the four mentioned by Timmer (1988). These are (i) subsistence agriculture and (ii) moving labour out of agriculture. In the Timmer formulation, the first one is ignored and the second is present throughout the transformation process. Nevertheless, the countries in this study do not seem to have had any significant pockets of subsistence agriculture during the period under consideration, and including this phase may not be relevant (Country Reports, EIU, WB-country at a glance).

I.2. Agricultural transformation key factors

Although similarities may exist, each country has followed a distinct path to agricultural transformation. Key factors contributing to agricultural transformation tend to vary across countries, and that should be taken into consideration when analysing individual countries or a group of countries. A literature review, by no means exhaustive, suggests the following key factors that typically contribute to agricultural transformation. These may be relevant to the country/countries of interest to various degrees.

I.2.1 Farm mechanization

Farm mechanization has been taking place in Asia, but accurate estimates of its pace are often difficult due to lack of adequate data (Dawe, 2015). Pingali (2007) found that developing regions, except for sub-Saharan Africa, have adopted labour-saving technologies relatively rapidly. Pingali determined this, using a categorisation of operations according to the task's power and control intensities (table 1), based on a methodology by Pingali and Binswanger (1987). A number of other studies have concluded that mechanisation in Asia has accelerated over the recent past, though there are significant variations across countries and regions (Soni P and Ou Y, 2010; IFPRI, 2014 among others). Otsuka (2012) suggests that farm mechanization and improved technology use accelerated with the green revolution, but has been somewhat impeded due to declining farm sizes in Asia.

Despite some data shortcomings, the consensus is that mechanization in Asia accelerated during earlier phases of agricultural transformation and continued at a slower but positive rate during later phases. It is important to understand the contributions of policy, legislation and institutions to the process of mechanization and, hence, productivity. Many countries in Asia have promoted agriculture mechanisation through subsidies, incentives and enabling environment for private initiatives. Due to small farm sizes, some countries in Asia have supported the supply of agriculture machinery to groups of farmers, promoted hire-purchase schemes, machinery hiring services and farm machinery parks. The initial heavily subsidised agricultural machinery in most Asian countries have gradually been withdrawn as farmers become more familiar with the benefits of mechanisation during the subsequent stages of agricultural transformation.

Table 1: Nature of agricultural operations, operational control and power intensities.

Nature of operations	Operational Control and Power Intensity Requirements		
	Low control, High power	Medium Control & Power	High control, low power
Stationary operations	Grinding, milling, crushing, water lifting, threshing, wood cutting	Cold storage/cold chain, Sorting and Labelling ¹	Sifting, winnowing
Mobile operations	Transportation, primary tillage (land preparation, harrowing, levelling)	Harvesting root crops, harvesting grain crops, Secondary tillage and inter-culture	Weeding and harvesting tea, coffee and perennial orchards, Seeding and transplanting

Source: Based on Pingali and Binswanger, 1987.

¹ Cold storage/cold chain, sorting and labelling have been added to the original framework for their importance in the agriculture mechanisation.

1.2.2 Labour absorption in non-agriculture sectors

Evidence suggests that prior to structural transformation, in most developed countries agriculture usually accounts for much of GDP and the labour force. The share of agriculture in total GDP, however, falls short of its share in the total labour force because of higher productivity in the non-agriculture sectors. Labour productivity in the industrial sector rises more quickly relative to the agricultural sector, further widening the inter-sectoral differential in labour productivity and hence income (Timmer, 2009; Binswanger, 2012). During structural transformation, labour is pulled out of agriculture at a speed that depends on the labour intensity of industry, skills compatibility, wage differentials and growth in the non-agricultural sector. Without labour absorption in the non-agricultural sector, including through migration, labour productivity in agriculture is unlikely to improve, and under- and unemployment are likely to rise. In Asia, labour exits from agriculture have been closely linked with growth in the non-agriculture sector over the past six decades (Vos, 2018). The speed and rate of labour exits from agriculture have varied across countries in Asia (Briones and Felipe, 2013).

Experiences in Asia in managing an inclusive transformation process have shown that ensuring a smooth transition from agriculture to other-sector jobs requiring new sets of skills while being careful not to undermine the transformation process is very important. Countries in Asia have had varying experiences with the shifts in employment, in particular regarding the public-sector role in ensuring a smooth transition. Some countries in Asia have been highly successful in promoting skills development to increase the likelihood of off-farm employment, supporting start-up businesses and providing conditional support to the non-agriculture sector to promote employment. Experiences from Vietnam, China and Thailand are highly instructive in this regard.

I.2.3 Improved productivity

Technical efficiency refers to improved input-output ratios - that is, the amount of outputs obtained for a given amount of inputs on average and at the margins, corresponding to the average and marginal rates of productivity. Technology-based agricultural growth tends to increase income for farmers, through improved productivity for a given level of resources, and for consumers by making more food available at lower prices (Mellor and Ahmed, 1988; Timmer 2015). This simultaneity of increased income for farmers and decreased prices for consumers, cannot be achieved through pricing policy, where a choice needs to be made between farmers and consumers.

I.2.4 Agricultural commodity prices

Farmers' incomes are affected by a myriad of factors, including technology, weather, pests and diseases, as well as prices. The latter have a more immediate effect and are subject to control by the political system (Mellor, 2017). Public policies related to productivity-enhancing investments and pricing policies can influence supply-demand balances. In this context, agricultural prices serve as important signals for farmer decisions on farm investments, choice of crops and related livelihoods. Such policies may impede or facilitate agricultural transformation. Agricultural prices, in particular for staple cereals, are usually important as a political tool and can affect the real income of low-income households, much of whose income is spent on staples. Political expediency has in a number of countries proven to take the better of policymakers, and they have adopted policies with short-term gains at the expense of long-term agricultural transformation and economic growth.

Laborde *et al.* (2018) found that in almost all cases the speed of agricultural transformation significantly improved when anti-agriculture bias in price policies was removed. The anti-agriculture bias refers to the situation when farmers receive unfavourable prices for their outputs relative to other sectors in the economy. Mellor (2017) asserts the political importance of agricultural prices affecting the real income of all households, in particular those living below or near the poverty line. Pricing policies in developing countries at earlier stages of agricultural transformation have tended towards keeping food prices down for the urban masses, as they may be more adept at organizing and demonstrating. The large number of small farmers present a good political base but they are less likely to organise and demand favourable changes (Mellor, 2017). In high-income countries, agriculture subsidies, insurance subsidies, protectionist trade policies and price support policies are more common. These are mainly considered to be income transfers from a very large non-agricultural sector to the very small agriculture sector (Mellor, 2017). In less-developed countries the concern is more about keeping food prices down and affordable for the majority of the urban and rural non-agriculture population.

I.2.5 Farm and crop diversification

Farm diversification is the most important element of agricultural transformation and poverty alleviation, particularly among smallholders in Asia (World Bank and FAO, 2001). Farm diversification here refers to diversifying from crops to livestock, fisheries, from annual to perennial crops and others. Economic growth, urbanization,

globalization and rapid growth in middle-income households are causing significant shifts in diets, with consequent changes in farming systems (Pingali, 2004; Dorjee *et al.*, 2003). Policies in much of Asia seem to have favoured cereal self-sufficiency, which may have blunted the response for opportunities afforded by rapid economic growth and urbanization. Some countries have successfully managed the process of diversification and, therefore, transformation, while others continue to grapple with the inertia in the system. South Asia and some countries in Southeast Asia may fall into the latter group. Nevertheless, it is important to take stock of specific policies and strategies that have facilitated or inhibited the processes of farm diversification and transformation.

I.2.6 Agrifood value chains

A value chain refers to the stages and set of actors and activities that deliver a basic agricultural product from production in the field to final consumption, adding value in each stage to the basic product (FAO, 2005). Similarly, Devaux *et al.* (2018) define the value chain as “the sequence of interlinked agents and markets that transforms inputs and services into products with attributes that consumers are prepared to purchase.” The agrifood value-chain development approach gives equal attention to production/productivity, and value addition through processing and marketing in a holistic manner. The value-chain development approach overcomes a key impediment to agrifood development and transformation, namely the piecemeal and unsynchronized approach to input supply, production, processing, finance and marketing. The value-chain development approach holistically addresses challenges and opportunities along the value chain. Successful value chains tend to create employment, integrate smallholders into markets and attract services such as capacity development, input supply, technology, finance, insurance and transportation.

In Asia, shifting demographics, urbanization and changing diets have had significant implications for agrifood systems (FAO, 2018; Vos, 2018). The changes in agrifood systems and value chains have created new income and employment opportunities in wholesale, retail, processing, insurance and the logistics of supplying food to increasingly urbanized populations (Reardon and Timmer, 2014; Vos, 2018). The additional labour absorption capacity in agri-business further fuels agricultural transformation. Experience with agrifood value-chain development has varied across Asia. This study will examine specific policies, legislations and institutional innovations that have led to successful agrifood system transformation in Asia.

I.2.7 Agricultural research and extension

Agricultural research has evolved from a narrow focus on crop yields and production to a collection of activities aimed at improving resilience, sustainable natural resource management, nutrition and food security. Sustainable productivity growth, plant, animal and human health, irrigation, storage, farm mechanization, efficient marketing and resource management are part of agricultural research objectives (Binswanger-Mkhize, 2012). Mellor (2017) asserts the centrality of research to agriculture and the economic transformation of countries, with the public sector playing a key role in producing a steady flow of improved technology.

Agricultural extension is essentially a bridge between research and farmers who will need to translate innovative technologies and good practices into increased yields, sustainable natural resource management and food security (Singh, 2002). Agricultural extension systems have to contend with challenges like: appropriate technological options, optimal use of inputs, producing for market demand, quality specifications for produce, verification of food safety, sourcing reputable input suppliers, market information, access to financial services, coping with climate change, sustainable natural resource management, off-farm income-generation options and accessing the digital highway. The efficacy of extension services is directly related to the rural development policy framework (Swanson *et al.*, 1997). Continuous two-way linkages are necessary to introduce new technologies to farmers and ensure that farmers' requirements are fed back to researchers (Mellor, 2017). The research agenda is also influenced by feedback on changing tastes and demands from markets. As a result, research, extension and market intelligence must be tightly integrated in support of agricultural transformation.

I.2.8. Land tenure security

Land-tenure security plays a key role in agricultural transformation and economic growth in a number of ways (Deininger, 2003). These are: (i) it provides incentives to invest and improve land productivity as the risk of appropriation is minimized; (ii) it is the basis for efficient land markets, because tenure security facilitates land to be transferred to the most productive and efficient farmers; and (iii) it facilitates access to credit as well as input and output markets. Asia's experiences have, by and large, followed this pattern where relatively secure land tenure has led to efficient land markets, provided more incentives to invest in land and facilitated access to financial services (Jayne *et al.*, 2016).

The Voluntary Guidelines on the Responsible Governance of Tenure (VGGT – FAO/CFS, 2012) suggest that economic growth, food security and eradication of hunger are dependent on secure and equitable access to land. The system of tenure determines how communities, institutions and individuals gain access to land, fisheries and forestry. The tenure system, whether enshrined in social capital or sanctioned by the state, determines who can use which resources, for how long and under what conditions. The tenure systems in Asia are highly diverse and dynamic, changing with economic progress and agricultural transformation.

I.2.9. Rural finance

Rural finance is concerned with a plethora of services, including loans for agricultural investment, non-agricultural rural firms, consumption, social expenditures and services for rural savings and insurance. In many developing countries, two types of rural financial service suppliers are common: formal and informal. Informal financial service suppliers are comprised of private individuals, such as professional moneylenders, traders, commission agents, landlords, friends and relatives. Civil society organizations, such as the Grameen Bank in Bangladesh, have increasingly occupied this space over the past few decades. The formal sector is comprised of commercial banks and other financial intermediaries that fall under the country's banking regulations and supervision (FAO, 2001).

Informal lenders have key information advantage compared with formal financial intermediaries. Their loans are less often for productive activities and more for dealing with crises of relatively resource-poor households such as weddings, deaths, illnesses, crop failures and animal diseases. The effective interest rates are usually exorbitant and loan defaults result in dispossessing farmers of their land and other productive assets. Mellor (2017) suggests that loans to small commercial farmers increases their investment and significantly contributes to agricultural growth. Both the formal and informal rural financial intermediaries have important roles to play, but the former will be a key source of credit for small commercial farmers with increasing agricultural transformation (Mellor, 2017). The same author also suggests creating a specialized lending agency to meet the specific needs of small commercial farmers. The paradigm shift with regard to rural finance in the late 1990s emphasized the necessity for a decentralized system of rural finance (FAO, 2001; Mellor, 2017).

I.2.10. Policies outside agriculture

Policies, institutional innovations, governance and public investment in the rest of the economy are important factors contributing to agricultural transformation. Growth, stability and an inclusive enabling environment in the rest of the economy is critical for absorbing excess labour from the agricultural sector, as well as for generating demand for diverse agricultural produce. Apart from the policies mentioned in the preceding sections, which directly target the agricultural sector, non-agricultural policies and enabling environments are also important for the agricultural transformation process. These include good governance, macro policies such as exchange rate policies, taxation, trade and trade facilitation, social protection and investment in services such as education and health, among others. Public investment in infrastructure to facilitate rural and urban connectivity, improved communication and access to information technology, and measures to leave no one behind are essential to agricultural transformation.

II. Objectives, hypothesis and methodology

II.1 Objectives

The main objective of this study is to examine and analyse key lessons in policies, legislation and institutional innovations that have led to successful and inclusive transformation in the agricultural sector. The study is intended to support policymakers and practitioners in less developed countries in Asia and elsewhere to build on successful experiences while attempting to facilitate and navigate agricultural and rural transformation.

II.2 Hypothesis

The key hypothesis is that the public sector plays an important role in facilitating or impeding transformation in agriculture by adopting enabling policies, legislation and institutional arrangements. Moreover, the role of the public sector varies during the different phases of agricultural transformation process as specified by Timmer (1988).

II.3 Methodology

The Food and Agriculture Organization of the United Nations (FAO) teamed up with research institutions to review and analyse agricultural transformation experiences in selected countries in Asia. The findings of this study are entirely based on desk review and analysis of key elements of agricultural transformation as discussed in section I of this chapter.

Vos *et al.* (chapter 2) conducted a cross-country review of experiences that may have led to Agricultural transformation in Asia. This chapter reviews the process of agricultural transformation, with a focus on South and Southeast Asia, adopting the agricultural transformation framework developed by Laborde *et al.* (2018). The framework, based on Timmer's approach, considers six phases of agricultural transformation. The phases of transformation range from low-productivity subsistence agriculture, where most people directly depend on agriculture, to industrialized economies where negligible numbers of people are employed in primary food production.

Chapter 2 reviews policies and institutional development experiences among four clusters of countries: (i) the early, successful transformers – Japan, Iran, Republic of Korea and Malaysia; (ii) the late, successful transformers – China, Indonesia and Thailand; (iii) the very late transforming countries – Afghanistan, Bangladesh, Cambodia, India, Myanmar, Pakistan, the Philippines and Viet Nam; and (iv) the lagging countries – Lao PDR and Nepal. The methodology adopted in the cross-country study (chapter 2) adds an inclusivity dimension to agricultural transformation, highlighting the impact on food insecurity and hunger. The original Timmer framework focused more on agricultural productivity and less on inclusiveness.

Chapters 3 through 6 closely follow the Timmer framework, focussing on stages of agricultural transformation in four countries, namely the Republic of Korea, the Kingdom of Thailand, the Socialist Republic of Viet Nam and the People's Republic of Bangladesh. Key characteristics of each transformation phase are defined, and public interventions in the form of policies, institutional innovations and investments are highlighted.

III. Summary of key findings

This section summarizes key findings from the five studies that make up chapters 2 through 6. These are only highlights, and readers are encouraged to read specific sections of the publication for further analysis and elaboration. The findings are organized under each of the five chapters as follows.

III.A. Agricultural transformation in Asia: an overview of recent experiences (Chapter 2)

- Declining shares of agriculture in GDP and employment are the main characteristics of economic development. While Asia has closely followed this pattern, the speed and timing vary among countries. By the 1980s, agriculture's share in GDP and employment had significantly declined in Japan, Korea and Malaysia. Other Asian countries remained agrarian well into the 1980s, with agriculture employing a significant share of the total labour force. Even today, agriculture in India employs one-third of the labour force. South Asia, in comparison with Southeast Asia, has been slow in starting the process of reducing the shares of agriculture in GDP and total employment. The employment share in South Asia fell from 56 percent in 1991 to 41 percent in 2017. In the same period agriculture's share of GDP in South Asia dropped from 27 percent to 16 percent. This points to the relative importance of the agricultural sector in South Asia, but also low productivity in agriculture and an inability of the non-agriculture sectors to absorb labour.
- Total factor productivity (TFP), sometimes called multifactor productivity, is a measure of efficiency in the use of all inputs to produce a unit of output. It has been the main driver of agricultural output growth in Asia. Southeast Asia and South Asia initially lagged behind the early transformers, but accelerated output growth during the 1970s and the 1990s, respectively. Over the past two decades, agricultural diversification, associated with productivity gains and value addition, has accelerated in Asia, with a shift from basic grains to more fruits, vegetables and animal-source foods. Agriculture commercialization has underpinned agricultural productivity growth in Asia in the recent past. The development of machinery rental markets and off-farm employment opportunities over the past couple of decades has significantly influenced the capital intensity of Asian agriculture. Improved rural infrastructure – roads, electricity, irrigation and communications – has also contributed to TFP growth in agriculture.
- In general, high undernutrition is associated with early phases of agricultural transformation, while rising rates of overweight and obesity are associated with later phases. Asia has, by and large, followed this pattern with some outliers. Success in lowering the prevalence of undernutrition is a significant indicator of inclusive agricultural transformation.
- The share in employment and GDP of the agrifood system beyond the farm-gate increases with agricultural transformation. The agrifood system includes agricultural production, agriculture-related input provision, processing, distribution, trade and related transportation and food services – restaurants,

hotels and street vendors. Urbanization, changes in types of employment and housing, as well as other characteristics of demographic and structural changes in the economy affect food habits and types of food consumption. This in turn attracts investment and employment in the agrifood system outside the farm gate. In Asia, the relative share of the agrifood system in GDP and total employment has declined with increasing incomes per capita, but less than that of primary agriculture alone. Significant potential exists to generate employment through agrifood business development, especially around small urban areas in Asia, where food demand is concentrated.

- The emergence of large-scale wholesale and retail distribution systems – the supermarket revolution – is another source of the recent transformation experiences in Asia. Investment in rural roads, improved connectivity and liberalization of food marketing helped bring producers closer to processors, wholesalers and retailers, progressively eliminating the role of rural intermediaries. On the other hand, large-scale businesses in the agrifood system are displacing many smaller businesses without creating sufficient new jobs for the displaced workers.

A.1 Policies and institutional reform

The degree of coherence and complementarity among key policies has been critical in determining the rate of success of agricultural transformation across developing countries since 1970. Essential policies and public interventions include price incentives, public spending on agricultural research and development (R&D), rural infrastructure, education and health, and reform of rural institutions that deal with land tenure security, credit and savings. Agricultural institutions play a crucial role in agricultural transformation; their effective and timely reforms create a dynamic environment that is critical to successful transformation. Chapter 2 has adopted a cluster approach to facilitate analysis across countries that have followed similar patterns of agricultural transformation. The cluster classifications are based on the timing and efficacy of policy and institutional reform experiences, and include: (i) early successful transformers (Japan, Korea and Malaysia); (ii) the late but successful transformers (China, Indonesia, Mongolia, Sri Lanka and Thailand); (3) the very late transformers (Afghanistan, Bangladesh, Cambodia, India, Myanmar, Pakistan, the Philippines and Viet Nam); and (4) the lagging countries (Lao PDR and Nepal).

Land reform has underpinned agricultural transformation in some countries with unequal land distribution in Asia. Land reform has been more effective when coupled with other incentives for farmers. The Korea land reform in 1949 aimed to achieve equitable land distribution, and support to the new land owners was very important for agricultural development. The reform set an upper limit of 3 hectares for each landowner. As a result, land owners increased from 14 percent of the population in 1945 to 70 percent in 1965. Similarly, Japan's land reforms in 1945 set an upper limit of 4 hectares per landowner. Those land reforms, coupled with incentives to introduce improved farming, helped increase real incomes in rural Japan and Korea. The land reform efforts in India during the 1970s were less successful, and the land reform in Afghanistan was short-lived and immediately followed by a devastating civil war.

Direct *price interventions* in many Asian countries initially had an anti-agriculture bias. However, more favourable price incentive policies were subsequently adopted to promote agriculture and reduce the urban-rural income gap. Until 1971, agriculture in Korea was taxed and food prices kept low as part of its push for export-led industrialization. This led to low agricultural growth and further widened rural-urban income inequality. Consequently, agriculture was given high priority through policies such as import restrictions (quotas) for agricultural products, higher public purchase prices for outputs and subsidies for agriculture inputs such as mineral fertilizers, pesticides and farm machinery. In response to the widening rural-urban income gap, Japan reversed net agriculture taxation and provided more support to agriculture through import restrictions and price support.

In China the anti-agriculture price bias was reversed in 1979, when purchase prices for important agriculture commodities were raised. In the 1990s, subsidies for several crops in China were introduced, turning the negative rate of assistance to agriculture to positive for the first time. Indonesia, in the 1960s, established a food procurement agency, responsible for international trade and for setting minimum and maximum prices for essential commodities, in particular rice. Price and trade policies in South Asia have historically been characterised by significant anti-agriculture bias. The net relative rate of assistance to agriculture in India remains negative despite some subsidies and trade liberalization since the late 1990s. The anti-agriculture policy bias is still present in Pakistan, though at a much lower level today than in the 1960s.

A.2 Public expenditure and investment in agriculture

High public expenditure in agriculture has been associated with early stages of Agricultural transformation in Asia. This usually focussed on infrastructure (irrigation, rural roads and electrification), agricultural mechanisation, subsidies to modern inputs (seeds and fertilisers). Rice self-sufficiency has been the focus of public policy and investment in almost all countries in Asia, and in some countries it continues to this day. Investment in agricultural R&D, extension and education has helped propel agricultural transformation and poverty alleviation in almost all countries. Average annual public expenditure in agriculture in China increased by 240 percent during 1996–2010. In Indonesia, public investment in agriculture increased by about 10 percent in the 1970s, which propelled agricultural transformation from the 1980s onward. Investment in primary education and vocational training in Vietnam, Thailand, the Philippines, China and Korea have played a critical role in inclusive agricultural transformation.

South Asia has made significant investments in rural roads, electrification and irrigation. In India, public expenditure in agriculture increased but consistently remained below the levels of support per farmer in successful early and late transformers in East and Southeast Asia. The main focus of public expenditure in agriculture in South Asia has been on irrigation and subsidies for fertilizers with less focus on rural roads and electrification. In Bangladesh, public investments in agricultural research and technology, rural infrastructure such as irrigation and rural roads have contributed to productivity growth. A focus on research to develop new and high-yielding varieties, in particular for rice has, been instrumental in ensuring food security and improved well-being. Public expenditure in irrigation, agriculture research and extension has been

modest but facilitated the adaptation of the Green Revolution technologies. However, the irrigation investments have entailed significant environmental consequences and have mostly favoured large landowners.

Public expenditure in agriculture is lowest in Nepal and Laos, which is reflected in low productivity and in still being in the early phases of agricultural transformation. In Nepal, investment in agriculture research, rural infrastructure, electrification and rural education is the lowest in Asia, and the differences with more successful countries are stark. Public investment in agriculture per farmer is three times lower in Nepal compared with Lao PDR, and the latter's is 10 times lower than that of Malaysia.

III.B. Key takeaways from country studies

B.1 Agricultural transformation in the Republic of Korea (Chapter 3)

The awe-inspiring economic development in the Republic of Korea (ROK) has been considered one of the great success stories of the 20th century. A number of studies have examined contributing factors and attempted to draw lessons. However, consensus has been relatively elusive (Quibria M. G, 2002).¹ One of the few areas most observers seem to agree on is the fact that the ROK economy grew at an unprecedented pace. Real annual GDP per capita rose from US\$8 620 in 1961 to US\$31 836 in 2018. In 1961, nearly 66 percent of the population lived in absolute poverty, compared to about 5 percent in 2015.

B.1.1 Characteristics of agricultural transformation in Korea

Using the Timmer terminology, the “*getting agriculture moving*” phase corresponds with the period 1958–1967, which followed the end of colonial occupation and the Korean War. In 1965, agriculture accounted for nearly 43 percent of GDP and employed 63 percent of the labour force. Over 85 percent of farming households were tenants, with few households owning large tracts of land. Poverty in 1955 was nearly 66 percent, but dropped to just over 40 percent in 1965. The post-war reconstruction efforts and food aid from the United States played a major role in reducing poverty in this period. Agricultural land and labour productivity in this period remained relatively stagnant. The most significant public policy in this stage of agricultural transformation was the Farmland Reform Act, which aimed to redistribute agricultural land. The state would purchase land from large landowners and distribute it to landless tenants.

“*Agriculture contributing to growth*” 1968–1977 was a remarkable period with a 10 percent average annual economic growth rate. The agriculture sector provided a stable food supply and labour to the rising industrial sector. Significant numbers of rural youth migrated to urban areas during this period, to newly created higher paid jobs and a new lifestyle. Between 1965 and 1975, agriculture's share in GDP fell from 43

¹ For more on the Asian Miracle please refer to: The World Bank (WB). 1993. *The East Asian Miracle: Economic Growth and Public Policy*. Washington, D.C Stiglitz J and Yusuf S, eds. 2001. *Rethinking the East Asian Miracle*. Oxford, U.K: Oxford University Press Westphal, L. 1990. *Industrial Policy in an Export-Propelled Economy: Lessons from South Korea's Experience*. *Journal of Economic Perspectives* 4(3): 41-59 Fishlow A, Gwin C, Haggard S, and Rodrik D, eds. 1994. *Miracle or Design? Lessons from the East Asian Experience*. Washington, D.C.: Overseas Development Council. Danny Leipziger, ed. 1997. *Lessons from East Asia*. Ann Arbor, Michigan: University of Michigan Press. *The Korean Story: Secrets of an Economic Miracle* - <https://sdgacademy.org/course/the-korean-story/>.

percent to 24.5 percent and agriculture's share in employment fell from 63 percent to 45.7 percent, respectively. Over the same period, poverty fell from more than 40 percent to just over 15 percent. Labour and land productivity in 1977 compared with 1968 increased by 114 percent and 78 percent, respectively.

The subsequent phase of transformation, *Integrating agriculture into the macro-economy* 1978–1985, was characterized by market liberalization, agricultural commercialization, and crop and rural livelihood diversification. It coincided with the country's fourth five-year plan, aiming to consolidate and sustain economic growth. This was to be achieved by crowding out the public sector and allowing the private sector to take the lead in economic management. Agriculture in this period grew by an average of 4 percent per year, and the overall economy grew by 7.7 percent. Land and labour productivity in 1985 increased by 31 percent, respectively, compared with 1977.

From 1985 until now, Korea has been in the *agriculture in industrialized economies* phase of transformation. By 1996, the Korean economy had sufficiently industrialized to join the Organisation of Economic Cooperation and Development (OECD) and the OECD Development Assistance Committee (DAC). The agriculture and rural policies during this phase have been mainly concerned with bridging the rural-urban income gap, environmental concerns, trade competitiveness, and food safety among other issues. The agricultural sector has been increasingly liberalized, in line with international trade agreements, which opened the sector to global competition. By 2018, the share of agriculture in GDP declined to 2 percent and its share in employment to 1.5 percent.

B.1.2 The main contributing factors to agricultural transformation by phase

(i) Getting agriculture moving, 1958–1967

The state provided **agricultural machinery** to farmers, initially focussing on small power tillers and then water pumps, threshers, sprayers and cultivators. The state supported the manufacturing of agricultural machinery to meet the increasing demand and build the country's industrial base. Aiming to become self-sufficient in rice, the government established a **rice seed variety** development system.

The Rural Development Administration (RDA) was established in 1962 to promote agriculture development through **research**, capacity development, **extension** and international cooperation in agricultural development. The RDA service coverage in rural areas continuously expanded and provided much needed training and access to improved technologies. National universities also provided training to extension workers, further building the knowledge base for agricultural research and extension. The National Agricultural Cooperative Federation (NACF) was established in 1961 by merging the Agricultural Bank and the Agricultural Cooperatives organization. The NACF was responsible for facilitating farmers' access to loans and subsidies throughout the country.

Prior to the 1950s, the great majority of agricultural land was owned by a small number of large landlords, and that was considered as a key contributor to the high levels of rural poverty. The Land Reform Act of 1950 aimed to limit the total amount of land owned by individual farmers to a maximum of 3 hectares and ensure most tenant farmers access to land. The government purchased land from large landowners and distributed it to tenant farmers. In addition, the reform disallowed the use of farmland for alternative purposes. The state also expanded agricultural land through a reclamation programme in the 1960s. The key focus of government policy in this phase of agricultural transformation was to ensure food availability in the country.

Agriculture as a contributor to growth, 1968–77

The state adopted the 1st Farm Mechanization 5-Year Plan (1972–1976), which foresaw the provision of domestically manufactured **agricultural machinery**, long-term low-interest loans and the building of an extensive farm machinery training network throughout the country. The Department of Agricultural Mechanization was established in the Ministry of Agriculture and Fisheries. Korea established close cooperation with the International Rice Research Institute (IRRI) and other seed research organizations in more developed countries. These collaborations enabled Korea to introduce several high yield seed varieties and establish a **seed production and supply** system, the Korea Seed and Variety Service (KSVP). By 1997, Korea achieved its goal of rice self-sufficiency.

During this stage, the government increased resources to reform and increase the capacity of the RDA in support of agricultural **research, extension** and education. A crop protection department was added to the RDA with adequate outreach to most farmers. Every winter, farmers received agricultural training for four months, which is credited with accelerating technology adaptation and leading to significant gains in land and labour productivity. The NACF expanded financial services to rural areas, which increased saving deposits from farming and fishing communities. The state created the Agricultural Mechanization Fund in 1974 and the Livestock Promotion Fund in 1977 to promote these two sectors.

The Saemaul Undong Movement, or the New Community Movement, aiming to transform rural areas was launched in 1970, with the aim of improving rural living conditions. Initially, it provided cement and steel to households to improve their homes and local infrastructure. Subsequently it provided hands-on training in livelihood development and rural transformation. Villages were categorized as underdeveloped, developing and developed to target appropriate support under a large number of state-sponsored village development projects. Though highly successful in its goal of transforming rural livelihoods and living conditions, the New Community Movement was also a political project and a means to control rural communities. During this phase the state's open-market interventions entailed lower grain purchasing prices compared with the sale price to cover the increasing budget deficit, thus reducing support to farmers.

(ii) Agriculture integrated into the macroeconomy, 1978–85

Rural-urban migration accelerated in this phase, which caused labour shortages in agriculture. In response, the Farm Mechanization Act was adopted in 1978 to promote **farm mechanization**. Policies included continuous support to farmers to purchase machinery, the establishment of the Farm Mechanization Research Institute as part of the Rural Development Administration (RDA), piloting new technologies and promoting agricultural machinery service and rental systems, and training in the use and maintenance of machinery. Trade liberalization also meant opening the **seed market**, which saw many seed companies in Korea acquired by foreign companies. Imports of seeds increased. As a result, in the mid-1980s, Korea experienced seed shortages and vulnerability to access appropriate seeds.

The state policy during this period focused on improving incomes and living standards of rural households. The RDA was restructured to concentrate more on rural development and enhanced capacity development in the adaptation and use of agricultural machinery. Farmer indebtedness rapidly rose. In response, the government increased the NACF soft loans, underwrote significant farmer debts and rescheduled debt payments. Korea eliminated the dual price system for grains, where farmers were paid lower prices for outputs compared with market prices, and increased targeted support to farmers and other rural households. In order to further bridge the rural-urban income divide and reduce the rate of migration, the government provided significant support for rural industrialization. The policy encouraged the establishment of industrial parks in rural areas with financial incentives provided to companies to relocate. As a result, in the 1980s 122 rural industrial parks were created and 1 335 companies relocated or were newly established in rural areas. Other key government investments included rural roads, waterways, highways, education, health and other social protection instruments.

(iii) Agriculture in industrialized economies, 1986 to present

Farm mechanization was further promoted by offering a 50 percent subsidy and an additional 40 percent in soft loans during 1993–1997. Local government institutions also provided agricultural machinery rental and leasing services. From 2008, agricultural cooperatives also began to purchase farm machinery and rent to farmers at low prices. Seed insecurity² during the early to mid-1980s prompted the government to adopt the Seed Industry Act promoting the production, access and adaptation of appropriate **seed varieties** in a sustainable manner. The Seed Bank, subsequently named the Gene Bank Information Centre was established by the RDA to preserve and promote the genetic base of local and appropriate imported varieties.

Agriculture in this phase has become highly specialized. Its focus has shifted to cost reduction and provision of healthy food to more health- and environment-conscious consumers. Specialization in farming required more specialized training, which was provided by the newly established Korea National Agriculture College. Farmers also organized themselves to help each other resolve specific technical issues, with extension workers remaining as an additional technical resource. The government

² FAO, 2015, defines seed security as a situation when farmers have sufficient access to adequate quantities of good quality seed and planting materials of preferred crop varieties at all times following both good and bad cropping seasons.

promoted agrifood value chains by creating the Agriculture Product Processing Centres (APC) in the main production areas and logistic hubs. The APC's functions include sorting/grading, packaging and storage, shipping and related services. By 2013, the National Agricultural Cooperative Federation (NACF) operated 70 percent of the APCs, and farmer organizations operated the remaining 30 percent. Food quality, safety and origin have been key government policies over the recent past. Addressing farmer indebtedness remains a key policy especially after the 1997 Asian financial crisis. Important policies included underwriting some government loans, rescheduling loan payments and reducing interest on overdue loans to alleviate financial difficulties among farmers.

The main policy concerns in this phase were the increased conversion of farmland for non-agricultural purposes the need to maintain a financially viable agriculture sector. Demand for non-agricultural uses of farmland pushed land prices up and landholding became an important store of value. The Farmland Rent and Lease Act in 1994 allowed farmers to hold up to 10 hectares, up from the previous limit of 3 hectares per farmer. The government also began direct payments to farmers to guarantee them a minimum income. This policy also supported early retirement of farmers, encouraging environmentally friendly practices, and rural landscape conservation among others.

III.B.2 Agricultural transformation in the Kingdom of Thailand (Chapter 4)

This chapter defines the various phases of agricultural transformation in Thailand and explains the transformation process and key contributing factors in each phase. It highlights some significant features and drivers of agricultural transformation in Thailand. The agricultural transformation phases correspond only roughly to the stated dates, with significant overlap across phases.

B.2.1 Characteristics of agricultural transformation in Thailand

For the purpose of this study, the first half of last century (1910–1960) is labelled **getting agriculture moving**. By 1951, agriculture employed 85 percent of the labour force and accounted for nearly 38 percent of GDP. Large-scale production and exports soared for rice, mung beans, maize, rubber and teak. During this phase, land and labour productivity and crop diversification increased, and agricultural land encroached on forests. Economic and food supply growth mostly outpaced population growth, indicating improved nutrition and economic well-being. Poverty in 1960 was estimated at 57.5 percent.

Rapid economic growth with significant contributions from agriculture ushered in the second phase of agricultural transformation – **agriculture as a contributor to growth, 1961–1985**. Agriculture's share in GDP fell from 36.4 percent in 1960 to 15.8 percent in 1985. Labour exodus from agriculture was relatively less rapid. Agriculture employed 67.6 percent of the labour force in 1985, compared to 82.3 percent in 1960. During 1977–1985, agricultural labour productivity and agricultural GDP had negative growth of -0.01 percent and -2.68 percent, respectively. Agricultural labour productivity in the same period contributed negatively (-13.3 percent) to overall labour productivity. Poverty declined from nearly 58 percent in 1960 to about 34 percent in 1981. There

are no reliable estimates of malnutrition from this time period. Deforestation and encroachment on marginal lands continued unabated, compromising sustainability.

The surge in labour demand in the non-agriculture sector propelled a massive rural-urban migration of young workers (15 to 34 year olds). Contrary to the norm, Thailand's stage of **labour moving out of agriculture, 1986–1996**, followed the stage of **agriculture as a contributor to growth**. Agriculture's share of GDP declined from nearly 16 percent in 1985 to just over 9 percent in 1995. Agriculture continued to employ 52 percent of the labour force in 1995, compared with nearly 68 percent a decade earlier. Characteristically, rural-urban labour migration was seasonal and limited to younger family members. Productivity growth in agriculture slowed, as did growth, which attributed to depressed agriculture commodity prices and limits to extensive agriculture. Agricultural labour productivity growth between 1985 and 2000 was about 2.5 percent per year, compared to -2.7 percent during the preceding phase. Poverty, using the pre-1990 methodology,³ declined to 31.4 percent in 1995, compared to 45 percent a decade earlier.

Agriculture integrated into macroeconomy, 1996 to the present, is distinguished from the preceding phase by significant advances in food processing and the value chain revolution. Throughout this period agriculture accounted for 8–10 percent of GDP. Agricultural employment, however, remained high at 32 percent in 2018. Poverty declined significantly, reaching just over 7 percent in 2015 compared to 58 percent in 1995, using comparable poverty line estimates.

Agricultural production became closely linked with processing, related services, tourism and trade (both domestic and international). The gap between rural and urban incomes continuously narrowed. The exodus of young workers from rural areas left agriculture to increasingly older farmers.

B.2.2 The main contributing factors to agricultural transformation by phase

(i) Getting agriculture moving, 1910–1960

During the early part of the 20th century, a series of coherent labour and land reform policies, as well as foreign trade agreements, propelled agricultural production and trade, in particular of rice. Between 1925 and 1929, nearly 40 percent of the rice produced was exported under trade agreements reached with several countries, especially Britain, Japan and the Netherlands. Property rights security, labour laws and declining costs of sea transportation helped increase the production and trade of rice, rubber and teak. Public investment during the first half of the last century focused on irrigation, rural roads and railways. During this phase, reduction of taxes on agricultural land and labour, establishment of an agricultural research system and higher education for a number of Thai students abroad had significant impact on agricultural development.

³ The methodology to estimate poverty was modified in 1990, which cannot be compared with previously reported figures.

(ii) Agriculture as a contributor to growth, 1961–1985

This stage of agricultural transformation began with the first National Development Plan, which further emphasised investment in rural infrastructure including rural roads, irrigation and electrification, as well as compulsory primary education. The public sector invested heavily in agricultural research and extension, with a prominent role for universities in research and development. As part of the government's efforts to ensure a stable economy, it adopted prudent monetary and fiscal policies in the 1960s, which provided the necessary enabling environment for private investment. The agricultural research and extension system successfully developed and introduced high yielding rice varieties, which boosted productivity and met domestic and export market demand. Cooperation with a number of international organizations played a key role in agricultural research, and prominent among them were the International Rice Research Institute (IRRI), USAID and FAO.

The government in 1966 established the Bank for Agriculture and Agriculture Cooperatives (BAAC) to provide affordable short- and medium-term credit to individual and groups of farmers. Most farmers had access to affordable credit, which enabled increased production, mechanization and conversion of marginal lands to productive agricultural lands. The introduction of two land policies, namely the Land Allocation for Living Act (LALA) in 1961 and the Land Reform Act (LRF) in 1975, had the overall objective of alleviating rural poverty. Under the LALA, public land was allocated to the rural poor for farming, and could be inherited and sold. Under the LRF, public and large privately owned lands were allocated to the poor for farming, but farmers only had user rights, which could be inherited but not sold.

The government taxed heavily and introduced quotas on some agriculture exports, in particular rice and maize, while industrial products were subsidized and protected from competition. In addition, the Thai baht (currency) appreciation further reduced earnings on agricultural exports and increased farmer expenditures on protected agriculture machinery. These policies effectively lowered returns on farming and increased poverty in rural areas. Sugar and sugarcane, however, enjoyed significant support and protection, which resulted in a production and export glut at the expense of other crops. Market functioning in this stage was frequently disrupted by ad hoc government interventions through agricultural input and output price controls, at the expense of stakeholders in the agriculture value chains.

(iii) Labour moving out of agriculture, 1986–1996

The beginning of this stage was characterized by stalled agricultural transformation, high rural poverty rates, depressed world agricultural commodity prices and the El Niño weather phenomenon. Serious policies were needed to address these daunting problems. The government progressively devalued the Thai currency, export quotas and tariffs were eliminated, and the government proactively participated in the Uruguay Round of trade negotiations, with a particular focus on agricultural trade liberalization. These measures were intended to improve agricultural incomes and promote exports, and were relatively successful in both objectives. The government provided incentives to farmers to switch from low-value crops with depressed international prices to high-value crops with good potential for marketing. However, this policy was less successful

as international prices changed while farmers had already invested heavily in crop and farm diversification, leaving many farmers heavily indebted. The policy was based on an assumption that international commodity prices would remain static. Addressing malnutrition as a development challenge was included for the first time in the Fifth National Development Plan (1982–1986). The Poverty Alleviation Plan (PAP) and school meal and school farms⁴ initiatives were launched to address malnutrition. As a result, malnutrition among children declined to levels comparable to industrialized countries.

International trade and concerns over food safety and origins necessitated policy and institutional innovations to meet international standards. The public sector partially liberalized foreign direct investment in supermarkets, which accelerated the development of food value chains (FVCs). The development of FVCs began with the introduction of contract farming to meet the increasing domestic and international demand for agricultural commodities. Spearheaded by Charoen Pokphand (CP), an agribusiness conglomerate, many companies engaged in contract farming, initially for poultry and sugarcane and later for other products. Processors, traders and exporters were providing credit or agricultural inputs to finance production and eliminate the need for trade and financial intermediaries. The government also promoted biotechnology by providing a large number of scholarships for students and investing in national universities to promote biotechnology. This revolutionized breeding and the development of new crop varieties in a short period.

During the mid-1980s, Thailand switched from import substitution to export promoting industrialization. The policy emphasized labour-intensive and export-oriented industrialization. The government established the Eastern Seaboard Industrial Zone, which attracted significant investments from Japan. The appreciation of the yen, following the 1986 Plaza Accord, encouraged Japanese investors to relocate labour-intensive industries outside the country, and Thailand was ready to reap the benefits. This generated significant demand for unskilled labour, which the agriculture sector could well afford to supply. This led to a net increase in rural wages and prompted labour-saving mechanization in the agriculture sector.

(iv) Agriculture integrated into the macroeconomy, 1996 to present

The 1997/98 economic crisis and ensuing political tensions paved the way for populist and unsustainable policies. These are key factors why agricultural transformation stalled. The government in 2001 introduced a debt moratorium for farmers and a price support scheme for rice. Under the price support scheme, the government pledged to buy paddy from farmers at above market price levels and would subsequently sell it at a loss. The financial burden was unsustainable, and soon the government found itself unable to pay farmers the promised high price or to sell the paddy stockpiles. Subsequent governments have introduced an income guarantee scheme, making direct payments to rice farmers, calculated as the difference between the market price and the farm-gate, price to ensure a minimum income. The income guarantee scheme

⁴ School farms initiative enabled rural schools to grow food in the school premises to provide food for students under the school meal programme.

was not considered a direct price intervention and did not have an immediate effect on market prices. However, the scheme targeting only rice farmers may have contributed to the stalled agricultural transformation.

The government has established a series of institutions to ensure food safety and other standards. This was propelled by the need to adhere to export standards for food and other agricultural commodities as well as a rising food safety-conscious middle class. These institutions include the National Bureau of Agricultural Commodity and Food Standards (2004) and agencies responsible for the certification of Good Agriculture Practice (GAP), organic agriculture, Sanitary and Phytosanitary (PSP), biosafety, product traceability and food labelling. Urbanization, along with changing demographics and diets have spawned demand for new types of food and are a pull factor for new and improved food value chains. Supermarkets have adapted to the changing situation by operating at three scales – express markets (small/medium size convenience stores), large supermarkets and superstores. Digital technology and the rising health-conscious consumers are increasingly attracting a new breed of young entrepreneurs, who are more dynamic and technology savvy to tap into emerging domestic and international markets. The government, the Chamber of Commerce, and a number of civil society organizations are supporting this trend through infrastructure, and institutional and capacity development investments.

III.B.3 Agricultural transformation in Viet Nam (Chapter 5)

The agricultural transformation process in Viet Nam has been tumultuous. The country has had to grapple with a devastated post-war economy and experimentation with centrally planned economic management. This chapter analyses the process of agricultural transformation from the period immediately after the war in the mid-1970s. Although, the exact circumstances in Viet Nam may not apply to many countries, some of the policy and institutional experiences may provide valuable lessons.

B.3.1 Characteristics of agricultural transformation in Viet Nam

The post-war reunification efforts were coupled with a state-controlled agriculture collectivization drive throughout the country. The **central planning phase** lasted from 1975 to 1985, which is perhaps unique to the conditions of Viet Nam. Collectivization debilitated individual incentives and resource allocation, which resulted in drastic reductions in agriculture output. This compelled Viet Nam to import much of its food. Labour productivity in this period was negative at the margins and rice yields were only 2.2 tonnes per hectare. Agriculture contributed around 40 percent of GDP and employed over 70 percent of the labour force. Over 70 percent of the population was living below the poverty line and one in three Vietnamese were malnourished during this period. Based on state-provided rations figures, most Vietnamese were suffering from hunger and malnutrition. Farm mechanization was very low, with much of the heavy agricultural work carried out by animal power. In 1976 there were only 18 000 tractors and an equal number of rice threshers, which increased to 31 000 and 40 000, respectively, in 1985. The state owned all land, and the cooperatives/collectives managed agricultural land with no space for private land holding in any form.

A series of policy reforms named *Doi Moi* (renovation/restoration) initiated in 1986 marked the beginning of the second phase of agricultural transformation, **getting agriculture moving**, 1986–2000. Agriculture productivity during this period grew by 2.2 percent per year and the share of agriculture in GDP dropped from just over 38 percent in 1986 to 24.5 percent in 2000. Agriculture employed 68.6 percent of the labour force in 1986 and 65.3 percent in 2000. During the 1990s, Viet Nam’s net rice exports amounted to about 360 000 tonnes per year. The average annual GDP growth rate in this period was 6.8 percent, reaching as high as 9 percent during 1992–1997. Poverty remained high at 40 percent but significantly lower than in the preceding phase. In 1994, the number of tractors, mostly small, had increased three times compared to 1985, and mechanized farming covered nearly 34 percent of the total cropland. Post-harvest mechanization concentrated on rice mills and threshers, which numbered 100 000 by 1994. Growth in total factor productivity during the second half of the 1990s contributed significantly to the 4.5 percent agricultural annual growth rate.

Doi Moi policies began to usher in the phase **moving labour out of agriculture**, 2001–2010. Agriculture began to release labour to other sectors by an average of 3 percent per year. By 2010, agriculture employed 24.5 percent of the labour force compared with 64 percent in 2001. Agriculture’s share of GDP declined to about 18 percent in 2010, compared with 24.5 percent a decade earlier. Rural poverty dropped to about 17 percent in 2010, compared with 40 percent a decade earlier. Agriculture mechanization progressed at a very fast pace and the total number of tractors, large and small, reached 314 386, nearly three times more than in the preceding phase. The number of more sophisticated and large-size agricultural machinery also increased, enabling more food processing and mechanized operations. Labour productivity growth reached nearly 4 percent, compared to 2.2 percent during the previous phase. Agricultural GDP grew at 3.5 percent compared, with 7.65 percent in the non-agriculture sector.

The stage **agriculture as a contributor to economic growth** began in 2011 when labour productivity further increased and the share of agriculture in GDP and employment continued to decline. Between 2011 and 2018, agricultural productivity grew by 5.4 percent per year and the share of agriculture in total GDP dropped to 14.7 percent. In 2018, the share of agriculture in total employment was nearly 40 percent, down only by 9 percent compared to 2010. Farm mechanization proceeded at an unprecedented pace at all levels in pre and post-harvest operations. More sophisticated and complex machinery have been widely used. Rural poverty decreased to 9.6 percent in 2018 compared to nearly 45 percent in 1998, while urban poverty in the same period decreased to 1.5 percent from 9 percent.

B.3.2 The main contributing factors to agricultural transformation by phase

(i) Central planning (1975–1985)

The key policy in this phase was the centralization of all production, provision of rations to the population and limiting/prohibiting market functions. Collectivization of agriculture inhibited individual initiative and efficient resource allocation. During this period, Viet Nam also had to struggle with rehabilitating a post-war economy and devastated infrastructure. In addition, several large-scale floods and typhoons, as well as wars with two neighbouring countries, further complicated rehabilitation efforts.

Some of these policies were somewhat relaxed in 1981 by allowing some private economic activities and control over a small portion of own production. These had some positive but limited impacts on reviving the rural economy and ameliorating hunger.

(ii) **Getting agriculture moving (1986–2000)**

Two five-year plans, 1986–1990 and 1991–1995, considered agriculture essential to industrialization and socio-economic well-being. The policies limited the role of cooperatives (collectives) to providing extension and marketing services. The government removed the dual-price system, which penalized producers, providing further incentives to farmers. The stated policy directions in this period included: (i) commercialization of agriculture and increased processing; (ii) increasing production for domestic consumption and export; (iii) improved natural resource management and environmental protection. The private sector was gradually allowed to play increasingly significant roles in agriculture and the non-agriculture sectors of the economy.

In 1990, the state adopted a coherent legal framework for private business and promoted private banking. It pegged the exchange rate, providing some stability in the foreign exchange market. Legislation included the Labour Code, which specified the rights and obligations of employees and employers as well as contract regulation. In 1995, Viet Nam joined the Association of Southeast Asian Nations (ASEAN) and its Free Trade Area (AFTA). In the same year, the United States lifted its embargo and Vietnam joined the Asia-Pacific Economic Cooperation (APEC). All of these significantly facilitated Viet Nam's access to the world market. Viet Nam introduced a value added tax (VAT) and Corporate Income Tax (CIT). In 1990–1991, the state slashed taxes by half for all agricultural units, which further encouraged production and improved incomes among farmers. A series of land tenure laws in 1988 and 1993 secured land tenure and property rights for farmers. Initially, farmers were not allowed to sell or inherit land, but those restrictions were loosened in 1993. The amended land law allowed land titleholders to inherit, lease, transfer, exchange and use as collateral for loans.

Universal education and the elimination of illiteracy have been top priorities of the government since 1945. By 2000, literacy rate among 15-year-olds and above reached 90 percent. In 1994, 99.8 percent of the communes had primary schools and 76.6 percent had junior high schools. The educated population allowed Viet Nam to benefit from the *Doi Moi* policies and trade liberalization. Investment in agricultural R&D was 0.1 percent of GDP in 1996 and 0.2 percent in 2000, but has been lower than Cambodia, Malaysia and Thailand. However, the achievements in crop breeding, intensive agriculture and irrigation have been significant. Extension services primarily focused on improved crop varieties, crop protection, land preparation and harvesting. Other areas, such as crop production techniques, animal husbandry, on-farm crop processing, marketing, and climate change adaptation, have not received as much emphasis.

The agricultural sector in this period mostly focused on rice cultivation. Rice fields covered nearly 70 percent of cultivated areas. Coffee and pepper also became strategic

crops. The state promoted specific crops based on their importance in the domestic market and their export potential. However, the drive to become one of the top three rice exporters in the world and an important coffee exporter may have compromised natural resources and product quality. In 1993, the state established a price stabilization fund for agricultural inputs, which ended up only focussing on mineral fertilizer. During the 1980s, the state provided heavily subsidized loans, which were mostly unsustainable and caused a state-banking collapse. Semi-private, and later private, banks were established to provide financial services. Some of these concentrated on agriculture and poverty alleviation. In addition, People's Cooperative Funds (PCF), a form of savings and credit unions, were established to provide rural financial services with significant success.

Public investment accounted for 26 percent of total investment in agriculture in 1985. Between 1986 and 2000, public investment in agriculture was on average more than 15 percent of total public investment in the country. In 1994, nearly 88 percent of the country had all-weather motorable roads, but inter-village connections were poor, making communication relatively difficult. In the same year, 60.4 percent of communes had access to electricity, which was relatively unreliable, necessitating the use of generators. Public investment in irrigation infrastructure was 3.4 times higher than during the preceding phase.

(iii) **Moving labour out of agriculture (2001–2010)**

By the time this phase began, Viet Nam had achieved most of its stated goals, even if poverty remained unacceptably high at 17.4 percent. The country was consistently among the top four rice exporters, and many processed and semi-processed agriculture products were reaching international markets, both established and emerging. Policies in this phase focused on social and environmental objectives. The government began privatizing state enterprises and adopted a coherent set of company and enterprise laws and regulations. The state also launched a massive vocational training programme to facilitate the transition from less skilled to more skilled labour and a diversified job market.

In 2008, the government adopted a series of comprehensive policies in an effort to transform agriculture and the rural economy. Called *Tam Nong*, they were built on the foundation of *Doi Moi*. The *Tam Nong* policies included:

- Modernization of agriculture by facilitating research, access to technology and application of science and technology in agricultural production, and improving human resources.
- Facilitating the establishment and relocation of industry and services in rural areas.
- Bridging the gap between rural and urban investment in socio-economic infrastructure.
- Improving living conditions in rural areas, with a particular focus on disadvantaged areas.

- Improving sustainable and efficient use of resources in rural areas with a view to improving living standards among farmers.
- Promoting the strength of socio-political organizations in rural areas, especially the farmers' union.

The state provided interest-free loans for agricultural machinery purchases with a maximum period of two years. The State Bank of Vietnam/Central Bank determined interest rates for credit, leaving little space for commercial banks to set rates. Since 2000, the interest ceiling-rate has been replaced with a base rate, which is sufficiently high to function as a ceiling. Contract farming and consolidated land management by enterprises were increasing at a fast pace and, many key crops were produced under contract farming between agriculture enterprises, cooperatives or individual landholders. Land consolidation and the creation of a coherent land market were facilitated by the 2003 Land Law, which allowed households to lease, rent, inherit, mortgage and receive compensation if land is taken for public use. The nascent land market, support to mechanization, and access to finance as well as international markets facilitated crop diversification and large-scale cultivation of high-value crops, such as cashew nuts, tea, coffee and other perennial crops. The state also supported aquaculture for domestic as well as international markets.

Public investment in agriculture was 15 percent of total public investment in 2006. The state heavily invested in rural electrification, reaching nearly 90 percent of all communes and 79 percent of households throughout the country. Electricity was more reliable with minimum load-shedding periods. The government made rural roads a priority, aiming to connect all villages across the country. Over 87 percent of communes had inter-village all-weather roads in 2011, compared with 33 percent in 2001. The state continued emphasizing rural education and by 2011 over 93 percent of communes had kindergartens, primary and secondary schools. Irrigation and drainage were prioritized in this phase of transformation and irrigated land, land with drainage, and prevention of salt intrusion significantly increased. The irrigation system of the country is managed by 100 agencies (22 569 employees) and 12 000 cooperatives.

(iv) Agriculture as a contributor to growth (2011 to present)

Viet Nam continued to expand its external trade and investment partnerships through a number of bilateral and multilateral trade agreements. The most important of these included the Eurasian Economic Union, the comprehensive and Progressive Agreement for Trans-Pacific Partnership, and the EU-Vietnam Free Trade Agreement among others. By 2017, total export value reached US\$36.4 billion, over 14 times higher than in 1995, when the country joined ASEAN. Viet Nam is currently among the top 20 agricultural exporters in the world. However, primary agricultural commodities still dominate, leaving untapped potential for further value addition. A stable macroeconomic environment, a highly educated population and consistent investment in agriculture and rural development have been foundational to Viet Nam's success.

The government has gradually exempted all agricultural land from taxation to reduce the gap between urban and rural incomes. The goal of the New Rural Development 2010–2020 (NRD) programme is to transform rural areas by investing in socio-economic infrastructure. The NRD stipulates institutional reform in agricultural production and service-providing entities, associating rural development with urban planning. Environmental protection, improved natural resource management and improved well-being of the rural population are essential to achieving the NRD goals. In 2012, the Agriculture Master Plan was launched to modernize the agricultural sector, promote sustainable agricultural practices, promote strategic and high-value crops with comparative advantage and ensure improved living standards for rural households. Efficient use of land, water, labour, forests and fisheries are areas of focus. Under the NRD, the state has increased its support of R&D for crop diversification, livestock production and health, aquaculture and biotechnology.

The NRD also addresses value chain development, encouraging and facilitating production-consumption integration, and adopting a food-system approach to agriculture. The NRD and the Agriculture Restructuring Action Plan (2017) targets three product categories.

- i. National strategic products (products with export turnover of more than US\$1 million): Support includes strategies, plans and facilitation of large-scale production, and development of efficient value chains through institutional reforms and improved technologies.
- ii. Provincial products: Identifies and supports products that are of regional/national importance. Interventions include policies and technical solutions to improve sustainable production and productivity building on regional/provincial competitive advantages in the selected crops.
- iii. Local specialty products: Product differentiation, including, geographic indication, are key to the development of locally specific products under the One Commune, One Product programme. Such product specialization will also be linked to rural development efforts.

The government is also attempting to increase value-addition to exports and export markets by promoting processing and marketing elements in the value chain. Despite some efforts to consolidate land management units, fragmentation continues to hamper the benefits from economies of scale in the use of technologies and access to markets. The Employment Law was revised in 2013 to include vocational training, free career consultation and free job placement for those intending to change jobs. Furthermore, small and medium enterprises that create rural employment are entitled to borrow capital from the National Fund for Employment and receive information on product development and markets, in addition to being exempt from taxes. The strengthened vocational training programme provides free training, lodging and loans for establishing businesses. Rural infrastructure over the last 20 years has consistently improved. Almost all households in rural areas have access to reliable electricity and all-weather roads. Educational institutions have been modernized in line with new developments in technology. All-weather rural roads have further improved, and most villages are connected with each and to the national network.

III.B.4 Agricultural transformation in Bangladesh (Chapter 6)

Agricultural transformation in Bangladesh has been remarkable. In 1971, when Bangladesh achieved independence, it was a country with severe food deficits, frequent threats of food shortages, and hunger among a population of 75 million. Today Bangladesh produces sufficient and diverse food to feed a population of 116 million. The focus of this study is the post-independence period, from 1971 onwards. The war of independence devastated many aspects of the economy, and Bangladesh needed to heal its social fabric while also mending its broken economy and feeding a fast-growing population. This chapter explores the country's agricultural transformation and highlights some potential contributing factors such as policies, investments and institutions.

B.4.1 Characteristics of agricultural transformation in Bangladesh

In 1971, Bangladesh gained its independence and with it a broken economy and infrastructure. The years immediately after independence are considered the start of *getting agriculture moving* (1971–1989) when its per capita income of US\$120 was among the lowest in the world. In 1972, agriculture accounted for almost 60 percent of GDP and employed around 79 percent of the labour force. By the end of this phase in 1989, agriculture's share of GDP had fallen to about 30.5 percent. During the 1970s, over 71 percent of the population was living below the poverty line, a share which decreased to 39 percent in the 1980s (Hossain, 2014). Malnutrition was very high throughout this phase of transformation. During the 1980s, nearly 69 percent of children were stunted and nearly 72 percent were underweight. Wasting among children remained constant at about 14.8 percent throughout this period (Hossain *et al.*, 2005).

The end of political turmoil in 1990 marked the beginning of the second phase of agricultural transformation, *labour moving out of agriculture* (1990–2010). Per capita GDP rose from US\$286 in 1989 to US\$781 in 2010. The average contribution of agriculture to GDP declined from 42 percent in the preceding phase to 23 percent during this phase. Agriculture remained the main source of employment, providing jobs for 59.4 percent of the labour force. The average crop production index (CPI), a measure of land productivity, rose from about 55 in the preceding phase (1971-89) to 91 during this phase, with 2004/5 as the base period. Similarly, labour productivity, in terms of kg rice equivalent per labourer per year, rose from 2 500 in the preceding phase to 3 346 during this phase. Poverty remained high throughout the 1990s at over 50 percent of the total population until 2000. By 2010, the poverty incidence, using the upper poverty line, declined to about 30 percent (Hossain, 2014). In 1992, over 64 percent of children were stunted, 17 percent wasted and more than 68 percent underweight, a share which declined to just below 49 percent, 12 percent and 51 percent, respectively, by 2000 (Hossain *et al.*, 2005).

The third phase of agricultural transformation, *agriculture as contributor to growth*, (2011 to now) began with a sharp rise in per capita annual income, which reached nearly US\$2 000 in 2020, compared to US\$781 a decade earlier. The average contribution of agriculture to GDP dropped to about 15 percent, from a high of 23 percent in the

preceding phase. However, agriculture continues to employ about 43 percent of the labour force and remains a dominant source of employment in the country. The national poverty rate in 2016 was estimated at 26.4 percent, using the upper poverty line. Rural poverty has consistently been higher by a large margin compared with urban poverty. In 2000, rural poverty stood at 52 percent of the population, while urban poverty was 35 percent. The poverty rates for 2016 were 26 percent and 19 percent, respectively. The prevalence of undernourishment from 2000 to 2018 has remained relatively unchanged at between 16 percent and 14 percent of the population. Child stunting and wasting further dropped in 2018 to 31 and 8 percent, respectively. Similarly, anaemia among children and pregnant women in 1990 fell from 73 percent and 55 percent to 40 percent and 46 percent in 2016, respectively.

Farm sizes have been declining over time, compromising economies of scale in production and marketing. During phase 1, *getting agriculture moving*, 70.7 percent of the farms were small (0.02 to 1 hectare) and by phase three the small-size farms had increased to nearly 91 percent of total farms. In phase 1, the medium-size farms (1 to 3 hectares) were estimated at 24.7 percent of total farms, a share which dropped to just over 8 percent in phase 3. In 2019, just over 63 percent of rural households were considered farming families, compared with about 73 percent in 1983/84.

Yields per unit of land have been increasing significantly for almost all crops except pulses, which had minimal increases. In 1972, the processed rice yield was a mere 1 tonne per hectare, which tripled by 2017. Rice is the main staple and remains essential to ensuring food security and social stability in the country. In 1972, the rice deficit was estimated at 4.6 million tonnes, which was brought to zero in 2008.

B.4.2 The main contributing factors to agricultural transformation in Bangladesh

(i) **Getting agriculture moving (1971–1989)**

This was a tumultuous period for Bangladesh. It was a time of building state institutions, massive rehabilitation efforts after a devastating war of independence, and political turmoil in subsequent years. During the 1970s, the state focused on rice and other agriculture commodities as strategic crops necessary for food security and social security. The Bangladesh Rice Research Institute (BRRI) was strengthened, building close collaboration with the International Rice Research Institute (IRRI). The state also established the Bangladesh Institute of Nuclear Agriculture (BINA), the Cotton Development Board (CDB), the Bangladesh Agricultural Research Institute (BRRI), Bangladesh Fisheries Research Institute (BFRI) and the Bangladesh Livestock Research Institute (BLRI).

Throughout the 1970s, the government was the main supplier of **agricultural machinery**, with a focus on irrigation and tillage machinery for rice cultivation. The government managed most of the machinery, and the subsidy for machinery rent was as much as 70 percent. The rising fiscal deficit and operational demands of such a large programme compelled the government to abandon the policy in 1978. The private sector was encouraged through favourable credits and reduced tariffs to import and

distribute agricultural machinery, in particular shallow tube wells. Concerned with ground water depletion, the government restricted the use of deep tube wells and some diesel engines during the second half of the 1980s. These restrictions were later lifted, but throughout this stage agricultural machinery was mainly comprised of irrigation pumps and a limited number of tractors and threshers.

During this stage, **seed** multiplication and supply was firmly in the public sector supported by the Bangladesh Agricultural Development Corporation (BADC) and the Department of Agricultural Extension (DAE). In 1977, the Seeds Ordinance was enacted to define the national seeds system and all aspects of seed governance, with heavy involvement from the public sector. Fertilizer use was first popularized with the advent of the Green Revolution in the 1950s and 1960s when fertilizers were distributed to farmers free of charge. During the first stage of agricultural transformation (1971-89), the BADC imported and distributed fertilizers at highly subsidised rates. The average fertilizer use was only 48 kg per hectare.

Rice dominated the agricultural sector with very few alternative crops and little fisheries, poultry and livestock production. The government policies focused on rice self-sufficiency. **Crop and farm diversification** was not a key objective of public policy. Support to **rural credit** was promoted through the establishment of two state-owned banks and a cooperative bank. The agricultural sector was the main beneficiary of these banks, as they supported investments in crop production, fisheries, livestock, irrigation and agricultural machinery. However, the amount of credit to the agriculture sector remained relatively low throughout this stage. The private sector and civil society organizations were not active in this stage of agricultural transformation.

(ii) **Labour moving out of agriculture (1990–2010)**

Bangladesh entered the ‘labour moving out of agriculture’ phase with the end of socio-political turmoil and the establishment of representative government. The state continued its support for agricultural research, strengthening capacities of the established institutes and facilitating linkages with international research institutions. Extension services were bolstered and the agricultural input markets liberalized, with increased private sector engagement.

The removal of tariff and non-tariff barriers to **agriculture machinery** imports significantly increased the number of irrigation pumps. In 1995, small power tillers were imported duty free and credit was provided to farmers to purchase such machinery. From 2009, the government provided a 25 percent subsidy for the purchase and use of power tillers, tractors, threshers and combine harvesters. The number and variety of agriculture machinery increased by a large margin. For instance, threshers increased from a total of 2 400 in stage 1 to 95 000 in stage 2, and power tillers increased from 1 900 to 300 000 during the same period.

The 1993 National **Seed** Policy marked the beginning of the seed system liberalization process and removed many restrictions on private sector engagement. By 1998 restrictions on the import and sale of seeds for strategic and other crops were removed in a significant amendment of the Seeds Ordinance of 1977. In 1997/98, the

Bangladesh Chemical Industries Corporation (BCIC) was established with a monopoly on importing and marketing **fertilizers**. With increases in irrigation, familiarization with the benefits of fertilizers, increased crop intensity and hefty subsidies, fertilizer use increased to an average of 175 kg per hectare, nearly 3.5 times higher than in the preceding stage. The research institutes established in stage 1 began to develop and release a number of improved rice, vegetable and fruit varieties, as well as improved fish, animal and bird species, under a results-based planning process. The 1996 New Agriculture Extension Policy (NAEP) was highly instrumental in introducing improved agricultural technologies and reaching out to farmers throughout the country.

The Crop Diversification Programme was launched in 1989, with the aim of improving nutrition and income. In 2008, the National Poultry Development Policy was adopted to promote sustainable poultry production and diversify sources of nutrition and income. As the economy steadily grew, demand for fish and aquaculture rose significantly. The government supported the development of aquaculture for the domestic market and for exports. The objectives of the 1998 Fisheries Policy included diversifying sources of nutrition, income generation, poverty alleviation and foreign exchange earnings through exports. Policies to increase maize production and liberalize feed imports facilitated a tremendous boom in the lucrative aquaculture sector.

Non-governmental organizations (NGOs) and private sector microcredit institutions have been the driving force behind the surge in rural microfinance. The government established the Microcredit Regulatory Authority (MRA) to supervise and improve transparency of the increasing number of microfinance institutions. Mamun *et al.* (2013) find a strong correlation between microfinance and poverty alleviation in Bangladesh.

(iii) **Agriculture as a contributor to growth (2011 to present)**

Crop diversification was a key policy during this phase. The state promoted the cultivation of more high-value horticultural crops through a seven-year plan. To promote wheat and maize cultivation, the state established the Bangladesh Wheat and Maize Research Institute (BWMRI) in 2017. Subsidies for **agricultural mechanization** continued from the preceding stage and rose to 70 percent of the total price in 2017. Vocational training and provision of credit propelled maintenance capacity and local production of some agricultural machinery. Agricultural machinery use continued to increase and now includes very high numbers in land preparation, seeding/transplanting, fertilizer application, irrigation, harvesting and post-harvest.

The public sector continues to be a major supplier of subsidized seeds for strategic crops – rice, wheat, maize and jute. The formal seed sector, composed of both private and public companies, supply just over 26 percent of the annual seed needs. The figure for rice is about 61 percent, over 51 percent of which is supplied by the public sector. The private sector supplies nearly 81 percent of vegetable seeds and 90 percent of the rice hybrid seeds.

Public sector investment and support for irrigation infrastructure has been prominent since independence. In stage 1, only 1.1 million hectares of land were under irrigation.

This rose to 3.9 million hectares in stage 2 and 7.3 million hectares in stage 3. In 1993, only 0.3 percent of the rural population had access to electricity, a share which rose to about 78.3 percent in 2018 (World Bank, Data Bank). Rural electrification facilitated the further expansion of electric pumps for irrigation and hence the continuous expansion of irrigated areas. Since independence, a strong correlation can be observed between irrigation and fertilizer use. Despite continuous reductions in subsidies, which nevertheless remain high, fertilizer use increased to an average of 275 kg per hectare, 1.5 times higher than the preceding stage of agricultural transformation. Urea fertilizer has been mostly produced domestically since the mid-1990s, whereas phosphate and potassium-based fertilizers are imported. Domestic prices of urea and other fertilizers are still controlled but prices of non-urea fertilizers have recently been adjusted to international price movements (Bayes, 2020).

Banking on the success of previous policies with regard to crop and farm diversification, the National Food Policy Plan of Action (2008–2015) was adopted to increase the production of high-value crops, fisheries and livestock. Promoting dietary diversity, increasing farm-based incomes, strengthening value chains and ensuring food safety are key policy concerns in this phase. The extension services were further decentralized and streamlined to the needs of farmers, according to agro-ecological zones and farming systems. Under the revised extension system, farmers have been organized into common interest groups (CIGs) and farmer producer groups (FPGs). Extension services specific to their needs are provided to CIGs and FPGs on demand and in a timely manner in decentralized locations.

The dominance of NGOs and private-sector microfinance institutions continued to strengthen. By mid-2017, over 783 **microfinance** institutions were operating. The top four microfinance institutions include Grameen Bank, the Bangladesh Rural Advancement Committee (BRAC), the Association for Social Advancement (ASA) and Proshika (Bhuiya *et al.*, 2016). Traders and other value chain actors also provide short-term credit to farmers. The central bank, Bangladesh Bank, has also facilitated access to rural finance through a series of policies. Group-lending to CIGs or FPGs have particularly been successful.

IV. Summary and conclusions

Agricultural transformation in Asia has followed a remarkably uniform pattern but with significant overlaps between the defining stages as described by Timmer (1988) and Laborde *et al.* (2018). Each stage of agricultural transformation has presented policy-makers with a diverse set of challenges and opportunities. Policy makers in different countries have grappled with similar issues with various degrees of success at different times, and the associated costs of policy failure have been significant. However, mechanisms and processes to share experiences across countries in order to avoid costly experiments with policy choices have been rare and inadequate.

The review of experiences in Asia confirms the critical role played by the public sector in facilitating and guiding agricultural transformation. The public sector has also been responsible for misguided policies and interventions, which inhibited agricultural transformation. The role of the public sector during earlier stages of transformation was more prominent and heavily interventionist. In later stages, the state's role has diminished and has been limited to facilitating an enabling environment, including the efficient functioning of markets and trade, and promoting inclusive development. The private sector has tended to increasingly crowd-out the public sector in various functions, with successful transformation from one stage to the next.

A high share of agriculture in GDP and employment are associated with earlier stages of agricultural transformation. The share of agriculture in GDP and employment declined over time with successive stages of transformation. However, in Thailand and South Asia, despite some success in agricultural transformation, agriculture continues to be an important source of employment. This points to the inability of other sectors to attract rural labour as well as the inability of the agriculture sector to shed excess labour. Employment in agrifood systems beyond the farm-gate has increased with successive stages of agricultural transformation. New production, processing and marketing technologies, including digital agriculture and product differentiation for more health- and environmentally conscience consumers, are slowly attracting dynamic and young groups of entrepreneurs to the agrifood system.

Growth in total factor productivity (TFP) has underpinned agricultural transformation in Asia. The early and successful transformers, Japan, Korea and Malaysia, were able to significantly increase TFP in agriculture while other countries, particularly in South and Southeast Asia, lagged until the 1970s. Over the past decade, TFP growth in agriculture and the industrial sector in Thailand have been very low or negative, which are considered key factors in stalled agricultural transformation. South Asia and some countries in Southeast Asia are showing similar signs of low TFP growth, which has hindered agricultural transformation. The Green Revolution, despite some criticism, facilitated productivity growth throughout Asia. The emergence of the supermarket revolution and, increasingly, digital agriculture have underpinned current and recent transformations in agriculture.

High levels of undernutrition are generally associated with earlier stages of agricultural transformation. However, a skewed and non-inclusive agricultural transformation, even if successful, leaves large pockets of malnourished people even in the later stages. Overweight and obesity at later stages of transformation have been a key concern for policy-makers in the region.

The Asian experience confirms that institutions capable of adapting, guiding and facilitating change in a fluid environment are key to successful transformation. In countries with unequal land distribution, land reforms and facilitating access to land for the landless have been critical to transformation. Japan, the Republic of Korea, Thailand, India and Afghanistan have all implemented land reforms with various degrees of success. Japan, Korea and Thailand - the latter, however, only during the first three stages of transformation - were successful in reducing rural poverty and facilitating agricultural transformation. The land reforms in these countries were coupled with incentives and policies to support capabilities to improve production and marketing among the new landowners. The unsuccessful land reform in India in the 1970s was attributed to a lack of incentives and support to the new landowners. Land fragmentation and financially unviable farm sizes are the new challenges facing policy makers throughout Asia.

Almost all countries in Asia have, at some point, adopted trade and price policies with anti-agriculture bias in support of affordable food supplies for the benefit of urban consumers and the non-agricultural sector. Faced with rising rural poverty, declining investments and faltering TFP growth in agriculture, as well as unreliable and declining food supplies, most governments have reversed the bias. Rice, as the main staple in the region, is protected, and farmers in some countries, including Japan, Korea, Malaysia and Thailand, receive heavy subsidies. Input subsidies, in particular for fertilizers, and trade management policies – quantitative measures, tariffs and duties – are policy instruments used to support some agricultural commodities. In general, such price and trade policies have distorted market signals, reduced incentives to invest efficiently and stalled agricultural transformation.

Public investment in rural infrastructure has been, without exception, beneficial to agriculture and rural transformation. This includes rural roads, irrigation, rural electrification, agriculture research, extension and education. The public sector has also had a significant role in farm mechanization and provision of affordable and farm-specific credit, especially during the early stages of agricultural transformation.

Today's agriculture presents a new set of challenges and opportunities. The agriculture sector is threatened by climate change, soil erosion and degradation, water pollution, the projected rise in temperatures and sea levels, increasing threats from animal and plant diseases, and increasing demand for land and other natural resources. The agriculture sector is also expected to supply more nutritious and diversified food for a rising population. Urbanization in Asia is accelerating, generating demand for more diversified and processed food. At the same time, agricultural labour in Asia is

increasingly greying while decreasing numbers of youths are attracted to agriculture. New and improved technologies in the agrifood systems present new opportunities where labour productivity is on par with or exceeds that in other sectors. Digital agriculture, improved production technologies, such as hydroponics and protected agriculture, as well as product differentiation and digital marketing, are opportunities with significant potential to meet the current and emerging challenges.

While not all policy and institutional experiences of the past are relevant to the challenges and opportunities of today, lessons from the past are still key to meeting emerging challenges. Communications technology and increasing interconnectedness allow policy-makers and international partners to share policy experiences and innovative approaches to address specific impediments to transformation. Similarly to the situation until the 1970s, when farm mechanization, new agricultural inputs (fertilizers, seeds, plant protection and farming techniques), trade and agricultural finance required state intervention and new institutions, the emerging challenges and technologies may require a set of interventions and institutions. It is the hope that this study can shed some light on important policy and institutional experiences with a view to supporting the next stage of agricultural transformation.

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Chapter 2

Agricultural transformation in Asia

An overview of recent experiences.

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Abstract

Structural change is a cornerstone of long-term economic development, according to economic theory and as borne out by international experience. Urbanization and industrial growth are key features of structural change. Urbanization and industrialization helped fuel the remarkable acceleration of economic growth in East Asia and parts of Southeast Asia over the past half-century. However, strong agricultural productivity growth and agrarian change were also essential ingredients of these economic ‘miracles,’ particularly during the initial stages of rapid economic acceleration, or “take-off”. The Green Revolution, reforms of agricultural and rural institutions, and public investment in rural infrastructure have been critical factors in the economic take-off of early and late successful transformers. In subsequent stages, the industrial sector, and later the service sector became the dominant drivers of overall growth. But, economic acceleration also pushed agriculture and rural economies to deeper transformative change. The expansion of cities, rising incomes and other factors led to major changes in diets that require a more industrial organization of food systems. These processes have also been taking place in South Asia and less developed parts of Southeast Asia, although they began later and are moving at a slower pace. In India and other South Asian countries, structural impediments to development including land scarcity, water stress, and weak institutions, initially constrained agricultural growth and broader economic development. As some of these impediments were lifted faster growth was unleashed.

Some of the lessons from East Asia may not apply to India and South Asia. However, certain patterns will likely remain the same. In all countries, agricultural employment will decline in importance, while that of non-farm segments of the agrifood system will rise along with urbanization, income growth and dietary change. Farm efficiency and rural employment opportunities are already increasingly influenced by what happens beyond the farmgate and by the relative strength of rural–urban linkages. However, countries in the early to intermediate stages of agricultural transformation face additional challenges. Land scarcity combined with continued population pressures have led to further fragmentation of landholdings and increasing stress on already degraded land and water resources. Countries that follow past development pathways will eventually run into environmental constraints. Likewise, while structural change has dramatically reduced poverty and undernourishment in Asia, dietary and food-system changes have created new malnutrition challenges: overweight and obesity are on the rise. Policies have been critical in determining the speed of agricultural transformations in Asia. Moving forward, the focus on promoting agricultural productivity growth will have to change. Policymakers must strike a balance. They must improve farm efficiency and food value-chain development. Yet, they must also reduce food insecurity and all forms of malnutrition, while preserving environmental sustainability.

1. Introduction

Economic development has historically been characterized by sustained structural change. This typically begins with a shift of labour from agriculture to the ‘modern’ industrial sector. The result of this process is an increased share of non-agricultural sectors in gross domestic product (GDP) and total employment. The Lewis dual-economy model provided an early theoretical formulation of this process (Lewis 1954). Investment in modern-sector capital would drive economic growth inducing excess labour in agriculture (whose marginal product was assumed to be zero) to move to a modern industrial sector. In reality, at least in its initial stages, it has been agricultural productivity growth that was critical in facilitating the reallocation of labour and capital to underpin industrial growth (Timmer, 1988, 2014). Over the past sixty years, countries in Asia managed to accelerate their economic development. However, they showed marked differences in the speed and nature of their development depending to considerable extent on the timing and shape of the agricultural transformation process (Vos 2019).

In much of East Asia and parts of Southeast Asia, the Green Revolution of the 1960s and 1970s brought a quantum leap in yields and output of rice and wheat, boosting farm productivity and profits. Farms became more commercial and agricultural value added per worker rose significantly. Through the late 1990s, public investment and strong support for smallholder agriculture and agrarian reforms paved the way for manufacturing industries to develop. Gradually, aggregate economic growth increasingly depended on the dynamics in the industrial and service sectors.

While the Green Revolution also played an important role in South Asia, the processes of agricultural transformation and structural change have lagged those taking place in East Asia. The service sector has become predominant in much of South Asia, especially in India, and a mature manufacturing sector has yet to develop (Ashan and Mitra, 2016). Institutional reforms and public support for rural infrastructure have been less pervasive than in East Asia. As a result, South Asia has been slow in making the shift from low- to high-productivity employment, despite the decline in agriculture’s share in GDP.

This paper re-examines Asia’s agricultural and rural transformations in the context of economy-wide structural change. In section 2, it will identify the different pathways Asian societies have taken in terms of agricultural transitions; transformation of food systems in tandem with rising incomes and urbanization; infrastructure development to forge rural–urban linkages, and the implications of broader structural economic transformations. Section 3 investigates the role of policies and institutions in driving agricultural transformation processes in Asia. In section 4, based on the review of evidence, lessons will be drawn for how to address today’s challenges for the development of Asia’s agriculture and food systems, and possible pathways for more inclusive and sustainable rural transformations in the coming decades.

2. Asia's process of agricultural transformation

2.1 Review of approaches to measuring agricultural transformation

Improvements in food security can be associated with different stages of transformation of agriculture and economies at large. This was the conclusion by Timmer (1988, 2014) from extensive reviews of literature and evidence. Timmer's work highlights the vital and precarious period of structural transformation when agriculture represents a declining share of the economy and labour moves to the cities. Historically, successful structural transformation has been the only sustainable pathway out of poverty, as labour productivity in the agricultural and non-agricultural sectors converge. Timmer warns, however, that policymakers should be wary of other possible outcomes. Much of Asia, he argues, could fall into an inequality trap in which the income gap between the two sectors widens, leaving many in rural areas suffering from food insecurity and undernutrition. In Sub-Saharan Africa, ever smaller-sized farms are dominating agriculture, reducing the prospects for further increases in productivity. In these trying environments, targeted interventions by governments to improve access to food by poor households will not be enough. They must, at the same time, manage to improve the functioning of markets to generate more investment in agriculture and more efficient use and allocation of resources in food systems.

Timmer (1988, 2014) and Laborde *et al.* (2018) identify six phases of agricultural transformation. This study follows a similar approach. The six phases begin with an initial predominance of low-productivity subsistence agriculture with most people in society directly dependent on agriculture. They culminate with industrialized economies characterised by high productivity agriculture and very few workers active in primary food production (Box 1). Laborde *et al.* show that countries have taken different pathways of agricultural transformations as part of efforts to reach higher levels of economic development. Different pathways produced different outcomes in income growth, food security and inequality.

While Timmer's approach has a strong productivity focus, Laborde *et al.* (2018) add a dimension indicative of the degree of "inclusiveness" of the agricultural transformation process, that is, the extent to which agricultural transformation is contributing to food security and ending hunger. Adding to this literature, the analysis presented in sections 2.2.3 and 2.2.5 will consider three complementary dimensions:

- The combination of Timmer's productivity focus with the "inclusiveness/food security" dimension along the lines of Laborde *et al.* (2018).
- The introduction of urbanization among the drivers of agricultural transformation. This reflects changes in food consumption demand associated with higher incomes and urban lifestyles, and the growing and modernizing non-farm component of agrifood systems (transport and distribution systems, distribution, processing, retail, food services), both of which strongly influence the transformation of agriculture itself.

- The inclusion of environmental factors (such as water stress) as a structural driver of, or constraint on agricultural transformation.

Prior to delving into these transformation dynamics, the paper describes the main differences in the extent and nature of the agricultural transformation process in Asia.

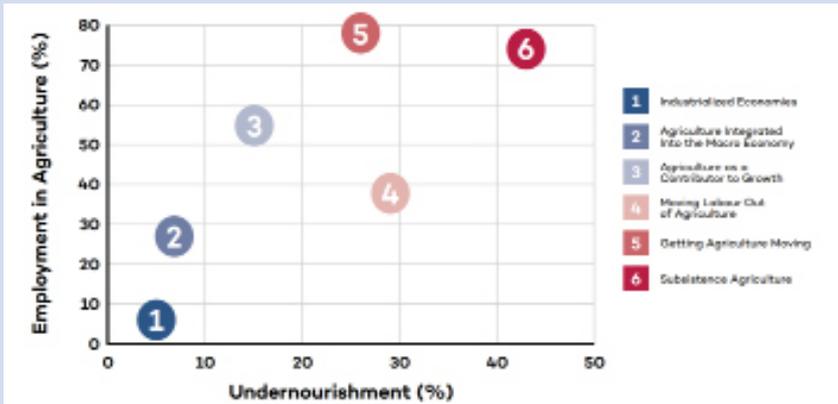
Box 1: Stages of agricultural transformation

The agricultural transformation framework was developed by Peter Timmer (1988). It assesses the level of inclusive agricultural transformation by using data on the prevalence of under-nourishment and the share of agricultural employment. Laborde et al. (2018) test this framework empirically with updated data and identify six non-linear phases of agricultural transformation, moving mostly from stage 6 to stage 1:

- (6) **Subsistence agriculture:** Stage 6 is the least advanced stage. Farmers consume most of what they produce, agricultural productivity is low, and agriculture is by far the main source of employment in the economy;
- (5) **Getting agriculture moving:** Stage 5 is characterized by agrarian economies where agriculture remains the dominant source of employment, but agricultural productivity is rising, allowing for broader economic growth, poverty reduction and improvements in nutritional status of the population;
- (4) **Labour moving out of agriculture:** Stage 4 represents non-inclusive structural transformation where labour is shifting into higher productivity sectors, while agricultural productivity is lagging and, hence, (rural-urban) inequality is increasing;
- (3) **Agriculture as a contributor to growth:** Stage 3 is characterized by more dynamic agriculture and expanding non-farm rural employment, which in turn are providing a basis for economy-wide, non-agricultural growth, poverty reduction and reductions in hunger and undernutrition;
- (2) **Agriculture integrated in the macro economy:** Stage 2 represents those countries that have achieved large agricultural productivity gains, whose agricultural sectors have strong linkages with industrial and service sectors and still absorb a significant but not the dominant share of employment. These countries typically have reduced undernourishment to low levels;

(1) **Industrialized economies:** Stage 1 is where countries have reached high-levels of per capita in-come, agriculture is highly productive but only represents very low shares in GDP and employ-ment, most of the population lives in cities, poverty and hunger are by-and-large eradicated (though other forms of malnutrition, such as obesity, may be on the rise).

Laborde *et al.* confirm that countries have tended to solve their problems of undernour-ishment as they managed to make agriculture more productive and move labour into non-agricultural employment, as shown graphically in the figure below.



Source: Laborde et al. (2018)

2.2 Patterns of agricultural transformation in Asia

2.2.1 Differences in timing and speed of agricultural transformation

The declining share of agriculture in GDP and of agricultural employment in total employment is a stylized fact of economic development. Between 1991 and 2017, the share of agriculture in world GDP decreased from 8.0 percent to 3.5 percent, and the share of agricultural labour in total employment fell from 43.8 percent to 28.0 percent.¹ This pattern is a key characteristic of agricultural transformation, which Laborde et al. (2018) define as:

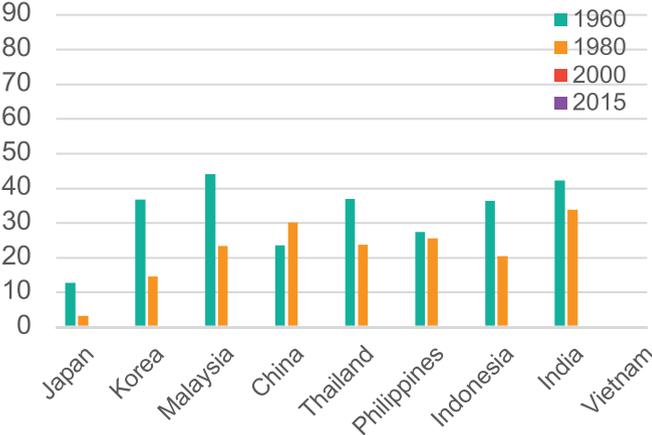
“The process by which an agrifood system transforms over time from being subsistence-oriented and farm-centred into one that is more commercialized, productive and off-farm centred. As labour and other resources move from traditional into more modern economic activities, overall productivity rises, and incomes expand. Agricultural transformation is considered inclusive when the results lead to poverty reduction, increased food security, and improvements in gender equality and women’s empowerment.”

¹ Estimates based on World Bank, World Development Indicators (<https://databank.worldbank.org/source/world-development-indicators>)

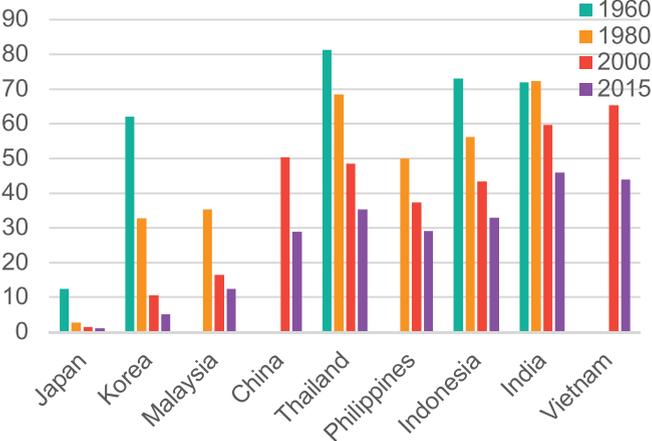
In Asia, as illustrated by Figures 1a and 1b, both shares have declined continuously since the 1960s. However, the timing and speed of the process of structural change differs markedly between countries in the region.

Figure 1: Declining shares of agriculture in GDP and employment, 1960–2015

Agriculture’s share in GDP



Agriculture’s share in employment



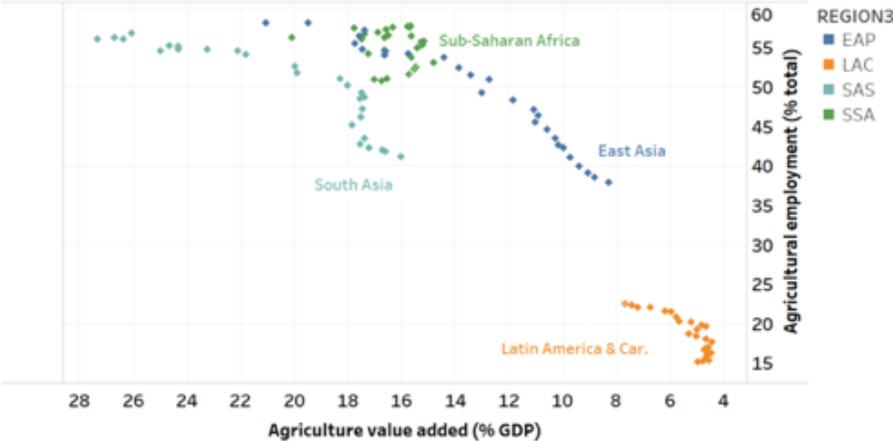
Source: Updated from Vos (2018), using data from World Bank Development Indicators.

In one group of countries composed of Japan, the Republic of Korea and Malaysia, agriculture’s share in GDP and employment had already fallen to low levels by 1980 or earlier. While the sector continued to grow in absolute terms, the growth of modern industry and services easily outpaced it. By 2015, agriculture represented less than 6 percent of GDP and less than 15 percent of total employment in the three countries. In Asia, Japanese and Korean agriculture have the lowest shares in both GDP (1.5 percent and 3.3 percent, respectively) and total employment (4 percent and 5.2 percent

respectively). Most other countries in the region were still predominantly agrarian in 1980. Labour exit from agriculture became significant no earlier than three to four decades ago and is still ongoing today. In India, for instance, agriculture continues to employ at least one-third of the labour force and provides a livelihood for almost half of the population.

In a broader inter-regional comparison, South Asia was also lagging most other developing regions, including Sub-Saharan Africa, until recently (Figure 2). This changed in the early 1990s, when structural transformation in South Asia accelerated while remaining lacklustre in Sub-Saharan Africa. In South Asia, agriculture’s share in GDP dropped from 27 percent to 16 percent in the same period, while its share in employment fell from 56 percent to 41 percent. Despite this substantial labour exit from agriculture, the sector still provides employment to over 40 percent of South Asia’s labour force.

Figure 2: Agriculture and structural change by developing region, 1990–2017



Source: Updated from Vos (2018), using data from World Bank Development Indicators. In the graph, each dot represents a year, starting 1990. Declining shares of agricultural value added and employment are interpreted as structural change toward higher income, modernizing economies.

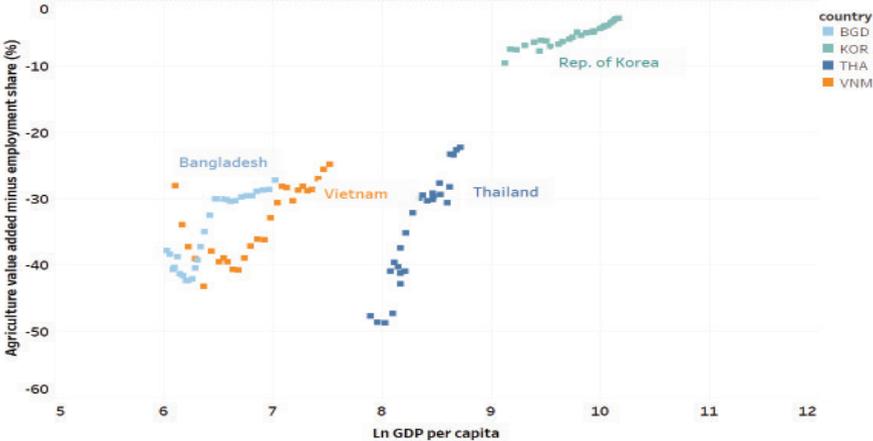
The association between the speed of transformation and overall economic development can be assessed by looking at the trend in the gap between the share of agriculture in GDP and total employment, on the one hand, and per capita income growth, on the other. Declining agricultural shares in GDP and converging agricultural value added and employment shares reflect a transformation process in which agricultural productivity growth drives structural change. Figures 3a-d illustrate these patterns in the four countries in East Asia, Southeast Asia and South Asia for which case studies are contained in this book.

They confirm the findings by Vos (2018, 2019) that Japan, the Republic of Korea, and Malaysia already reached high levels of per capita income on the back of higher agricultural productivity levels and rapid exit of labour from agriculture. In these countries, the process of structural change had already progressed substantially prior

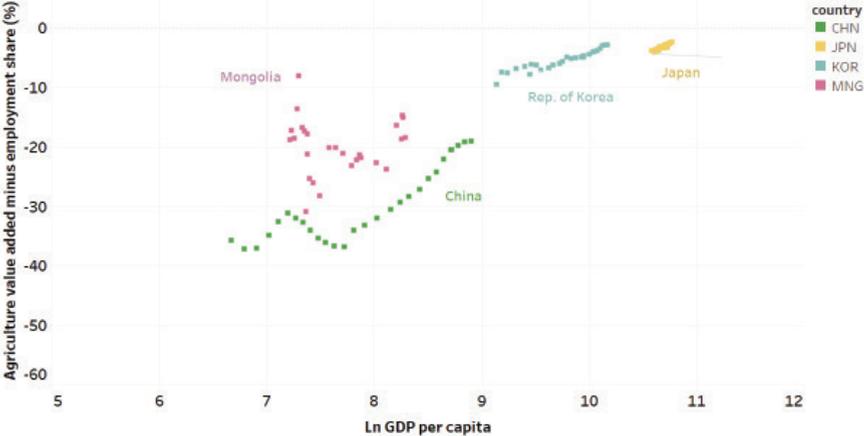
to the 1990s. Since the 1990s, the convergence also accelerated in countries like Indonesia, the Philippines, Thailand and Viet Nam. Even so, these countries still have relatively high shares of agricultural employment. Notably, in China, the convergence of agricultural GDP and employment shares set in as late as the early 2000s, more than two decades after the country's institutional agrarian reform and the beginning of its overall economic take off.

Figure 3: Convergence of declining agricultural value added and employment shares with rising income per capita in Asia

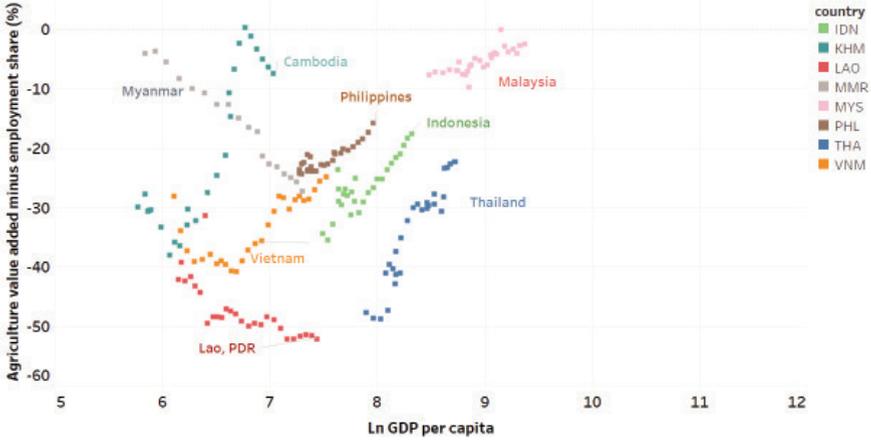
a. Bangladesh, Rep. of Korea, Thailand, and Viet Nam, 1990–2017



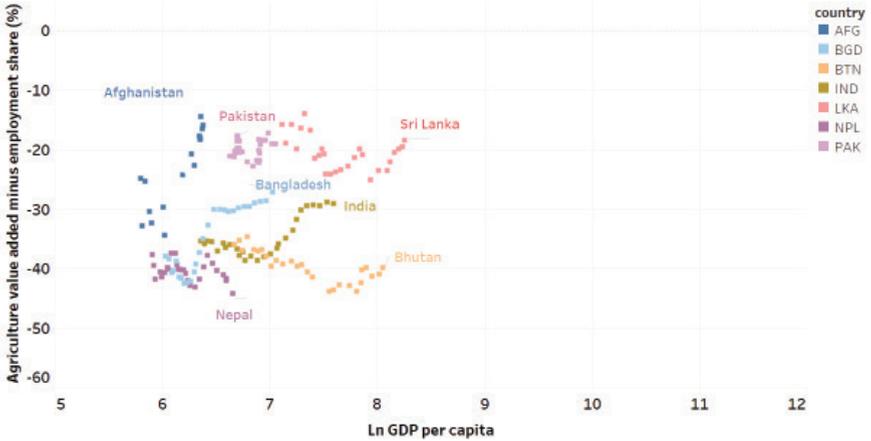
b. East Asian countries, 1990–2017



c. Southeast Asian countries, 1990–2017



d. South Asian countries, 1990–2017



Source: FAOSTAT and World Development Indicators. In the graphs, each dot represents a year, starting 1990.

In South Asia, the agricultural transformation process has been much slower (Figure 3d). All countries still show very high shares of agricultural employment. During the 1990s, the share of agriculture in India’s GDP began to decline, but labour exit from agriculture was slow, as reflected in the downward trend in the convergence line. The trend reversed during the mid-2000s. The share of agriculture in employment remains high, however, as the agricultural transformation process slowed in the 2010s. Overall, the slow decline in agriculture’s share in employment is reflected in the country’s low agricultural labour productivity growth, as discussed further below.² Trends in Bangladesh have been broadly similar, but with convergence accelerating from 2000, then stagnating during the second half of that decade (Figure 3a and 3d).

² See also FAO (2018) for the intersectoral productivity gap between agriculture and the rest of the economy reflected in the difference between the share of agriculture in GDP and the share of agriculture in total employment in South Asia.

Bhutan, Lao PDR, Myanmar, and Nepal still show a widening gap between agriculture's GDP and employment shares. This is evidence of very low agricultural labour productivity growth and weak agricultural transformation. With the exception of Bhutan, where recent growth has been driven by a rapidly expanding hydropower energy sector, these trends are associated with lacklustre per capita income growth in these countries. Conflict-ridden Afghanistan has also experienced slow average overall income growth during the three decades since 1990. The country had high, but erratic GDP growth during the 2000s supported by massive foreign aid inflows, which during 2008–2012 propelled growth in the service sector. Service-sector growth pulled labour out of agriculture and its share in total employment plunged from 60 percent to 40 percent in that short period of time. The agricultural employment share stabilized at that level after aid flows fell and overall economic growth slowed.

The process of structural transformation in the cases of Bangladesh, Republic of Korea, Thailand and Viet Nam, discussed at greater length in other chapters, was already highlighted earlier (Figure 3a). However, Table 1 shows clear differences in the timing, nature and speed of structural transformation among the four countries.

- As indicated, the Republic of Korea belongs among the early and rapid transformers. Income per capita has increased 25-fold since 1965 on the back of strong agricultural productivity growth to underpin the country's successful industrialization strategy. Agriculture's share in both total GDP and employment has been declining rapidly since the 1960s.
- Thailand's transformation process was much slower. While agriculture's share in GDP was down to similar levels as Korea's by the mid-1980s, labour exit from agriculture has been much slower. In 1985, almost 70 percent of the labour force was employed in agriculture. The exit of labour from the sector accelerated from the 1990s. Yet by 2015, one-third of Thailand's labour force was still working in agriculture. This reflects much slower labour productivity growth in agriculture than other sectors of Thailand's economy. It also indicates that agricultural productivity growth in Thailand has lagged that observed in the Republic of Korea, explaining in part why income growth in Thailand has also been slower.
- Both Bangladesh and Viet Nam remained essentially agrarian economies until the 1990s, with two-thirds or more of the labour force still employed in agriculture at that time. In Bangladesh, agriculture's share in GDP declined sharply in the 1980s, but the process of agricultural labour exit started later and at a slower pace. In Viet Nam's case, non-agricultural growth takes off in the 1990s, absorbing rural labour. By 2015, however, well over 40 percent of the labour force was still working in agriculture. Both countries have had a five-fold increase in per capita income since 1985. Income levels in Korea and Thailand also increased by a factor of five between 1985 and 2015. However, Bangladesh and Viet Nam started at much lower levels of economic welfare. Per capita income levels between the two richer and the two poorer nations have diverged further during the past three decades.

Table 1: Structural change and development in the four selected countries, 1965-2015

	1965	1975	1985	1995	2005	2015
Republic of Korea						
GDP pc (constant US\$)	1,156	2,636	5,398	12,163	19,225	26,064
Share agriculture in GDP	38%	24%	12%	5%	3%	2%
Share agriculture in employment	57%	44%	24%	12%	8%	5%
Difference in shares	-20%	-20%	-12%	-6%	-5%	-3%
Thailand						
GDP pc (constant US\$)	695	1,071	1,667	3,532	4,338	5,741
Share agriculture in GDP	32%	27%	16%	9%	9%	9%
Share agriculture in employment	80%	73%	68%	52%	39%	32%
Difference in shares	-48%	-46%	-52%	-43%	-29%	-23%
Viet Nam						
GDP pc (constant US\$)			396	607	1,036	1,685
Share agriculture in GDP		43%	43%	27%	19%	17%
Share agriculture in employment				70%	56%	44%
Difference in shares				-43%	-36%	-27%
Bangladesh						
GDP pc (constant US\$)	405	333	383	583	1,018	1,667
Share agriculture in GDP	53%	62%	33%	27%	19%	15%
Share agriculture in employment				66%	51%	43%
Difference in shares				-39%	-33%	-29%

Source: World Bank, World Development Indicators.

2.2.2 Technological change and agricultural productivity growth

Agricultural output growth has been robust over the past half century, especially in East Asia, and China, in particular. Output growth in Southeast Asia and South Asia lagged initially, but accelerated from the 1970s and the 1980s, respectively. Total factor productivity growth, or efficiency improvement, has been the main driver of agricultural output growth since the 1990s (Table 2, based on Fuglie, 2012, 2015). This is part of a worldwide pattern, as corroborated by many other studies (e.g. Alexandratos and Bruinsma 2012; FAO 2017; Vos and Bellù, 2019).³ Before the 1990s, agricultural output growth relied mainly on increased use of inputs, such as land, labour and fertilizers.

³ Estimates based on growth accounting have been criticized for potentially overstating total factor productivity growth (e.g., Dawe, 2015). While this may be the case, the corroborating evidence suggest that the magnitudes expressed in Table 2 could be in doubt, but not the overall pattern.

Important changes in farming systems in most of Asia have underpinned agricultural productivity growth and efficiency gains over the past four or five decades. Reardon and Timmer (2014) showed that farms have become commercial: Agricultural production has diversified from predominantly cultivating basic grains towards greater production of fruits, vegetables, and animal-sourced foods. This phenomenon mirrors the dietary change associated with higher incomes and increased urbanization (Vos, 2019). Diversification is happening even as individual farms have become more specialized, focusing on cropping, livestock, poultry or aquaculture. Farmers have shifted from non-purchased to purchased inputs. This includes switching from human to animal to machine power, and from manure, by-products, and residues to chemical fertilizers, and to greater use of pesticides and herbicides.⁴

Table 2: Agricultural output and TFP growth in Asia, 1961–2012

(Annual growth rates in percent)

	1961–70		1971–80		1981–90		1991–2000		2001–2012	
	Output	TFP	Output	TFP	Output	TFP	Output	TFP	Output	TFP
East Asia (mainly China)	4.8	0.9	3.3	0.7	4.5	1.8	5.0	3.9	3.5	3.1
Southeast Asia	2.6	0.5	3.9	1.9	3.3	0.4	3.0	1.4	4.0	2.5
South Asia	2.5	0.6	2.7	0.8	3.3	1.2	2.7	1.0	3.6	2.0

Source: Fuglie (2015).

The degree and speed of these changes have varied across locations. They occurred earliest and fastest in the “classical Green Revolution” zones, particularly lowland rice systems and irrigated wheat areas. During the 2000s, a second wave of intensification and commercialization swept across areas that were “catching up” with the first Green Revolution zones, such as in Uttar Pradesh in India, northern Bangladesh, and northeast China in rice, potato, and horticulture (Reardon *et al.*, 2012a). Joshi *et al.* (2014) document the diversification of agricultural production in parts of India with the development of horticulture in the 1990s and 2000s.

More recently, the capital intensity of Asian agriculture has increased, significantly reflected in greater use of mechanization and less reliance on labour among both small and large farms (Dawe, 2015; Vos 2018, 2019). The development of rental markets for agricultural machinery has facilitated this process. This type of change has not happened across the board. In many parts of South Asia and some parts of Southeast Asia (Cambodia, Lao PDR, Myanmar) the process of commercialization, involving —intensification, diversification and mechanization, has been slower. This slow pace has delayed structural transformation.

Rising rural wages and growing off-farm employment have substantially influenced farm system change, accelerating the mechanization of agriculture (Reardon and

⁴ These changes have also been documented earlier in, for instance, Pingali and Rosegrant (1995), Cassman and Pingali (1995), and Dawe (2015).

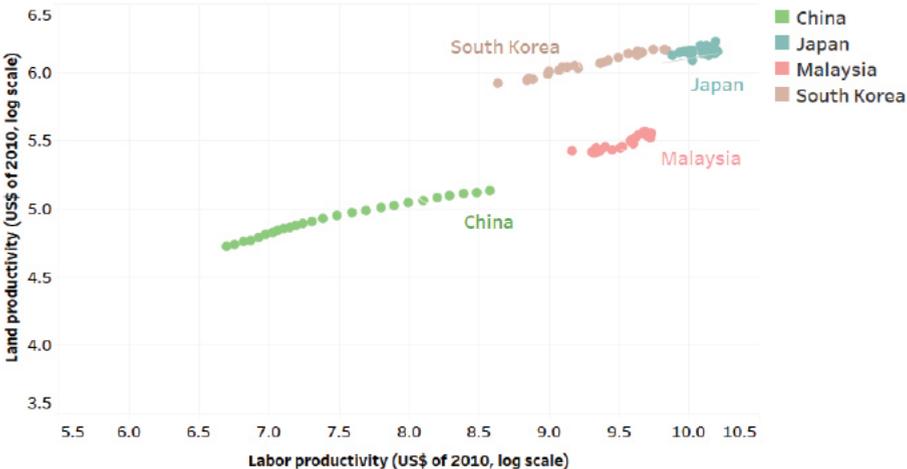
Timmer 2014; also see further below). Greater income from off-farm activity allowed farmers to buy or rent machinery, as Takahashi and Otsuka (2009) illustrate in the case of Central Luzon in the Philippines from 1979 to 2003. Yang *et al.* (2013) provide evidence of the development of rental markets and service providers of large harvesting machines in China. Renting machinery has enabled smaller producers to overcome their lack of economies of scale. Conversely, mechanization frees labour for both migration to cities and rural non-farm activities.

Improved infrastructure – such as rural roads, electricity, irrigation, and communications – has also been critical to total factor productivity growth in agriculture in China and other parts of Asia over the past three decades (Fan, 2008; Fan *et al.*, 2004). Production areas served by rural roads, and those closer to urban areas, have lower transaction costs for obtaining inputs, and higher use rates.

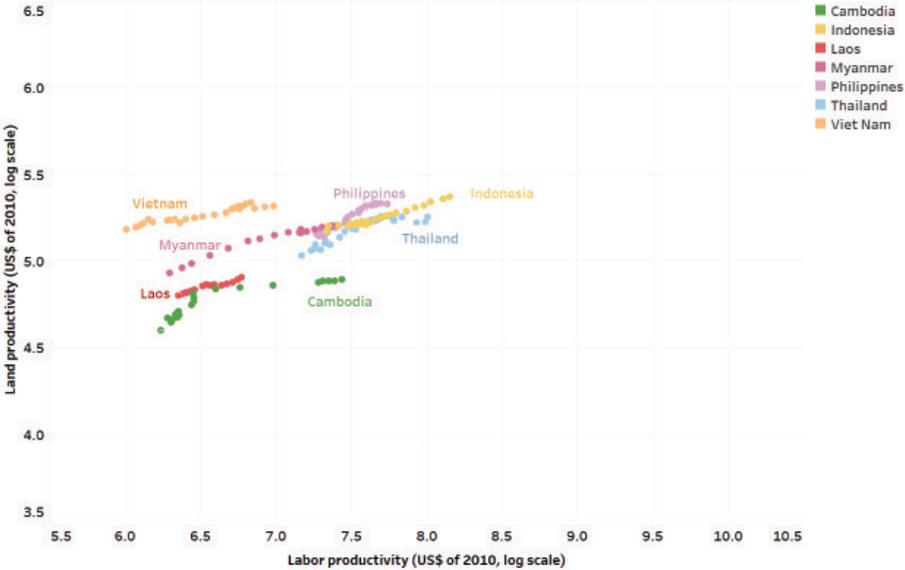
Changes including commercialization, modern inputs use, mechanization, improved infrastructure have helped raise both land and total factor productivity. Growth in labour productivity has been relatively slow in South Asia, as visible from the rather steep upward-sloping land-labour productivity curves (Figure 4c) compared with those in most countries in East and Southeast Asia (Figures 4a and 4b).

Figure 4: Land versus agricultural labour productivity in Asia, 1990–2017

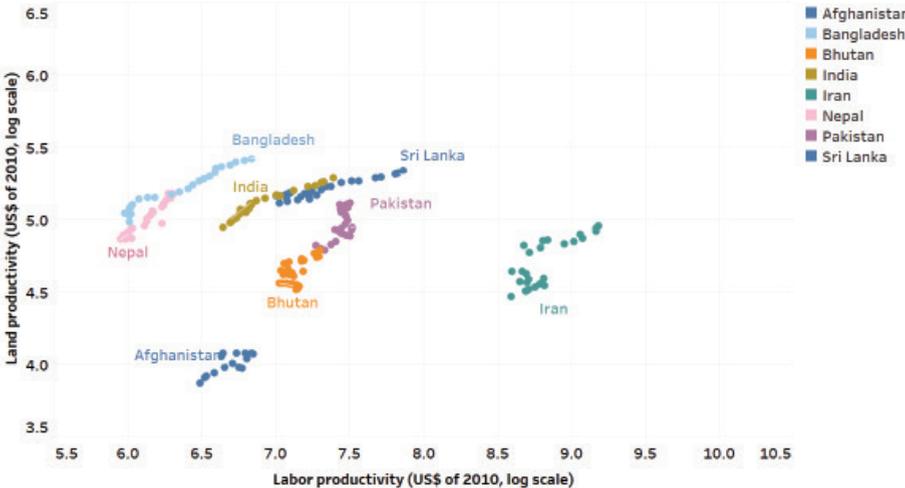
a. East Asian countries, 1990–2017



b. South-East Asian countries, 1990–2017



c. South Asian countries, 1990–2017



Source: FAOSTAT and World Development Indicators. In the graphs, each dot represents a year, starting 1990.

Relatively steep upward sloping curves mark the trends in Bangladesh, India, Pakistan, and Nepal. Land and labour productivity in Indonesia, Thailand and the Philippines (Figure 4b) initially also followed similar paths until giving way for faster agricultural labour productivity and wage growth from the mid-1990s once their industrialization processes matured. In China, land and labour productivity growth have moved in tandem since 1980 (Figure 4a). The institutional reforms that allowed individual farmers to sell marketable surpluses and labour to move into non-agriculture jobs were instrumental to this development (Section 3). In contrast, the curves are virtually flat for Japan and the Republic of Korea, which had already reached a stage of deep structural change by the beginning of the 1980s. In Malaysia, plantation-based agriculture is extensive, an important economic sector, and its export-orientation provided a push for labour-saving productivity improvements.

These findings are consistent with those of Mikecz and Vos (2016) that both the level and the pace of growth in labour productivity in low-income countries have lagged those in high-income countries over the past three decades. Slow agricultural labour productivity growth is also associated with insufficient expansion of employment opportunities outside agriculture in low-income countries, including those in South Asia. Despite the impacts of mechanization on parts of agriculture, on average, labour inputs per unit of land have continued to increase in South Asia, which has contributed to higher land productivity while holding back rural wage and labour productivity growth.

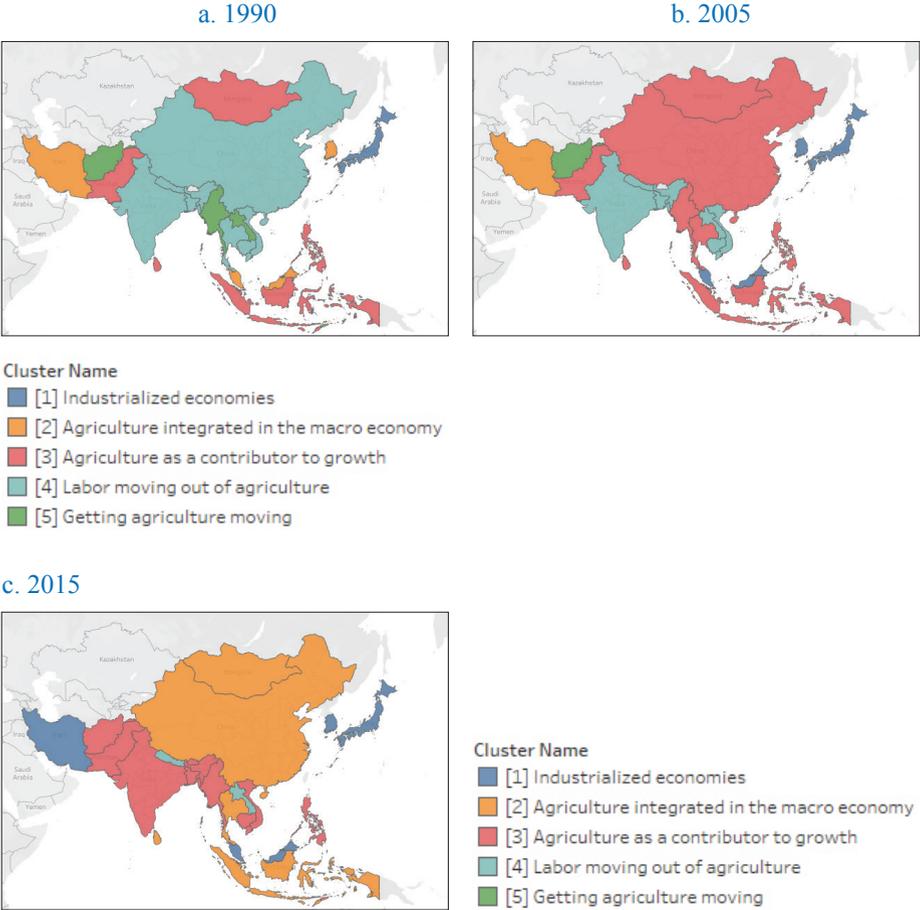
2.2.3 Agricultural transformation pathways in Asia, 1990–2015

To paint a more structured picture, we deployed a cluster analysis to arrive at a typology of the stage of agricultural transformation countries in Asia have gone through in recent decades. The cluster analysis is based on a worldwide cross-country assessment (Appendix A for methodology). In this section we present what stage of agricultural transformation Asian countries find themselves in today and how their agricultural systems have changed, according to the Timmer-typology (Box 1). As indicated in section 2.1, we enhance earlier work by undertaking the cluster analysis combining two dimensions: the degree of inclusiveness of the transformation process (i.e. does it achieve food security), as proposed by Laborde *et al.* (2018), and progress in terms of agricultural productivity improvements, as per Timmer's approach (Timmer, 1998).

The cluster analysis of Asia's agricultural transformation over time suggests countries in the region can be classified in four groups (Figures 5a-c). The first group consists of countries that all have reached advanced stages of the transformation process and started their structural change relatively early: Japan, Iran, Malaysia, the Republic of Korea and Singapore. These countries were already at an advanced stage of agricultural transformation in the seventies, with Japan and Singapore classified as industrialized (cluster 1) before 1990, followed by the Republic of Korea and Malaysia during the 1990s, and by Iran in the 2010s. The second group represents countries where the transformation process started as late as 1990, but have made significant progress since: China, Indonesia, Mongolia, Sri Lanka and Thailand. By 2015 or earlier, all countries in this group reached stage 2, in which agriculture is integrated into the macroeconomy. The third group consists of slow or late transformers: Afghanistan,

Bangladesh, Bhutan, India, and Pakistan, Cambodia, Myanmar, the Philippines, and Viet Nam, which by 2015 had reached stage 3 in which agriculture is a contributor to growth. Of these, Pakistan and the Philippines were already in that category by 1990, but subsequent progress was not enough to move up the agricultural-transformation ladder. Lastly, the fourth group of countries consists of only Nepal and Lao PDR, both of which are landlocked. These countries did not move beyond the early stage of getting agriculture going, which they had already reached by 1990, reflecting stagnant transformation dynamics.

Figure 5: Stages of “inclusive and productive” agricultural transformation in Asia, 1990–2015



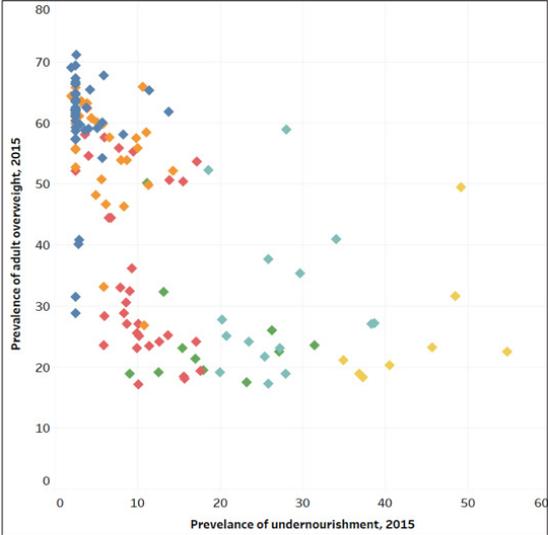
Source: Authors' elaboration.

The agricultural transformation pathways can be broadly associated with the global pattern of nutritional transition: high undernutrition in early stages and rising rates of overweight and obesity in later stages (Figure 6). In countries at an advanced stage of agricultural transformation (stage 1), one would expect that hunger has essentially been eradicated, while the prevalence of overweight and obesity has risen to worrisome levels (Figure 6a). With few exceptions, the prevalence of overweight in those countries has already surpassed an alarming 50 percent of the adult population. At the other end of the spectrum, hunger is the main nutritional challenge in countries where subsistence farming is still significant (stage 6). Haiti is a notable exception. Its undernourishment and overweight prevalences are both higher than 50 percent. Most countries with maturing agricultural sectors (stage 2) have managed to reduce undernourishment to 15 percent or lower, but already face rising ‘over-nourishment.’ Countries in the intermediated stages of agricultural transformation (3, 4, and 5) also show intermediate levels of undernourishment and over-nourishment.

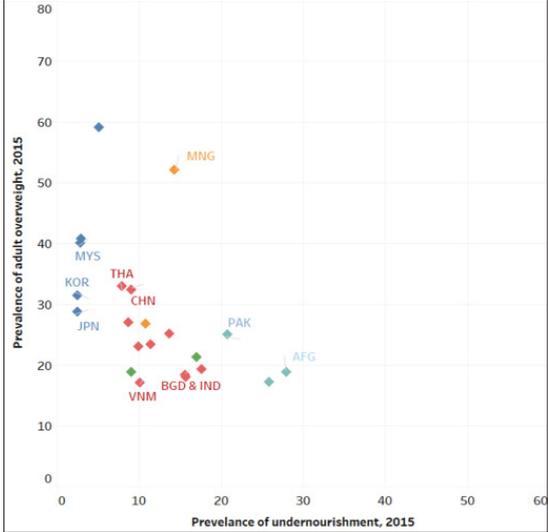
Countries in Asia broadly fit these patterns (Figure 6b). Japan (stage 1) is among the very few countries in the world with near zero rates of undernourishment but moderate to low rates of overweight (less than 30 percent of the adult population). Korea and Malaysia (stage 1 in 2015), as well as China and Thailand (stage 3) have managed to bring the prevalence of undernourishment down to less than 10 percent but are seeing significant increases in rates of overweight and obesity, exceeding 30 percent of the adult population. In the case of Mongolia (stage 2), overweight is already becoming a major challenge at over 50 percent, while undernourishment is still significant at over 15 percent. By contrast, Viet Nam, Bangladesh and India (stage 3 in 2015) managed to bring down their rates of undernourishment to levels similar or slightly higher than those of China and Thailand but show still much lower prevalence of overweight among their adult populations (below 20 percent). Nepal and Lao PDR are outliers in this pattern: Despite being largely rural economies at an early stage of agricultural transformation (stage 5), they had significantly reduced undernourishment to 9 percent and 17 percent, respectively, by 2015. Pakistan, Timor-Leste, and Afghanistan (stage 4) still face significant hunger challenges with undernourishment over 20 percent.

Figure 6: Nutrition outcomes and stages of “inclusive and productive” agricultural transformation in Asia and the world, 2015

a. World



b. Asia



- Agricultural Transformation Cluster in 2015
- [1] Industrialized economies
 - [2] Agriculture integrated in the macro economy
 - [3] Agriculture as a contributor to growth
 - [4] Labor moving out of agriculture
 - [5] Getting agriculture moving
 - [6] Subsistence agriculture

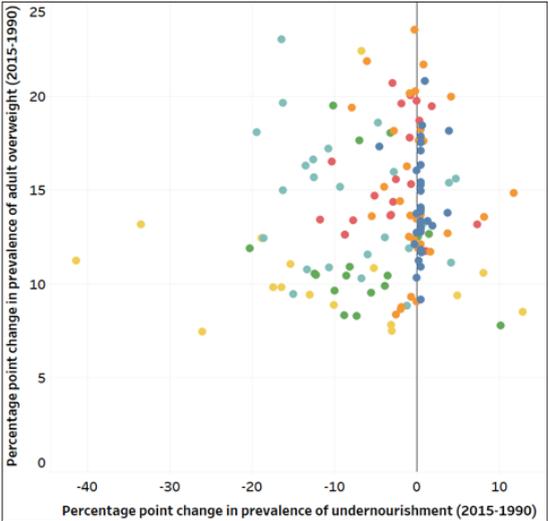
Source: Authors’ elaboration.

Figure 7 tracks the changes in key nutritional indicators between 1990 and 2015. Colours reflect the stage of agricultural transformation of countries in 1990. It shows that relatively few countries experienced increases in the prevalence of undernourishment during this period, but that all countries had increases in rates of overweight and obesity in the adult population. In Asia, not a single country for which data is available showed a rise in undernourishment. As expected, those in the early stages of agricultural transformation, when initial rates of undernutrition were still high, made the most progress in reducing hunger, most notably, Myanmar, Mongolia, Lao PDR and Afghanistan. While significant progress now has been made in reducing hunger, Figure 7b shows that rising overweight and obesity is now becoming a major concern. The prevalence of overweight increased by between 9 percent in Japan and almost 22 percent in Malaysia. Increases were also significant (>15 points) in Brunei, China, Indonesia, Iran, Maldives, Mongolia and Thailand.

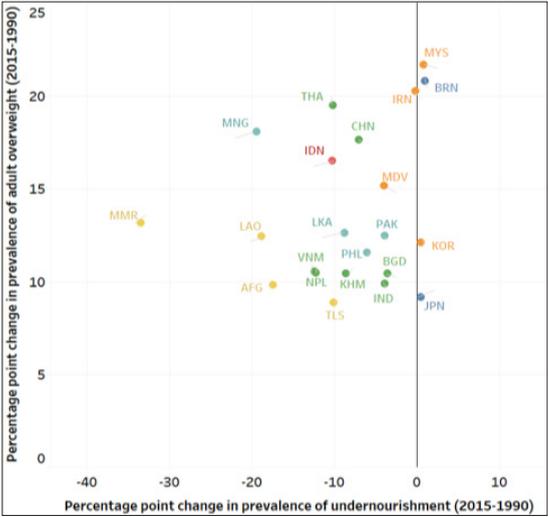
Figure 7: Changes in nutrition outcomes and stages of agricultural transformation in Asia and the world, 1990–2015

(Changes in percentage points)

a. World



b. Asia



- Agricultural Transformation Cluster in 2015
- [1] Industrialized economies
 - [2] Agriculture integrated in the macro economy
 - [3] Agriculture as a contributor to growth
 - [4] Labor moving out of agriculture
 - [5] Getting agriculture moving
 - [6] Subsistence agriculture

Source: Authors' elaboration.

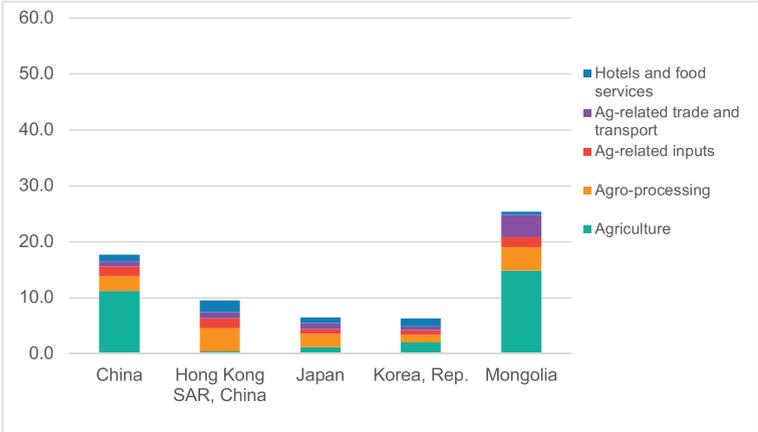
2.2.4 Agricultural transformation beyond agriculture

Food sectors are changing rapidly in developing countries. Transformations of the farming sector are just one element of this change. Activities beyond the farmgate tend to expand with the transformation of agriculture and as economies become more urbanized and industrialised. Changes in supply and demand for food products are driving growth in off-farm segments of agrifood systems (Reardon and Timmer, 2012; Barrett *et al.* 2019). First, the share of home consumption in rural food production has gradually fallen. This has been accompanied by a shift to marketed production of more profitable vegetables and animal-sourced foods, which has led to a rise in marketing and logistics services. Second, the urban share of the food market has risen rapidly, increasing demand for more diverse foods. As cities grow, so must supply chains, particularly the transportation and wholesale segments. Third, people are consuming more processed food. As a result, more local food processing companies are emerging, and both regional and global companies are entering national markets. Finally, retailing has evolved over the past several decades, from the marked increase in consumption of food away from home to the rapid spread of fast food chains, restaurants, and supermarkets in Asia.

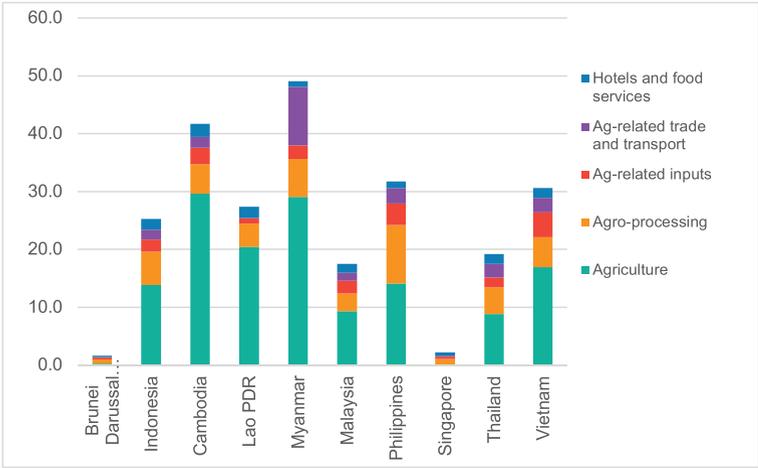
Figure 8: The size of the agrifood sector in Asia, 2015

(Share of total GDP)

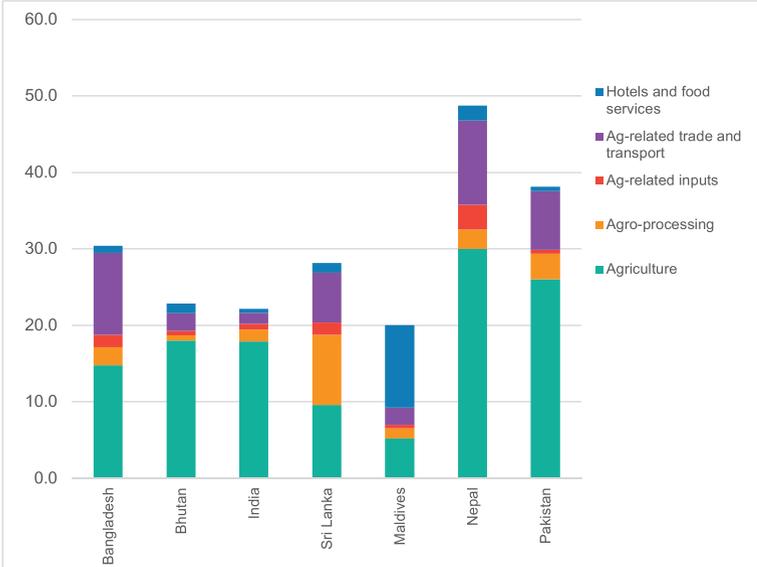
a. East Asia



b. Southeast Asia



c. South Asia



Source: Authors’ estimates based on AGGDP+ database provided by James Thurlow (IFPRI).

Estimates vary of the share of the agrifood system in countries’ GDP, based on the limited data available. The share is between 30 and 50 percent of total GDP in lower-middle income countries that are still at early stages of agricultural transformation, which includes Cambodia, Myanmar, Nepal, Pakistan, and the Philippines. In countries at more advanced stages of agricultural transformation, it ranges between 20 and 30 percent of GDP. Those countries include Bangladesh, Bhutan, Indonesia, India, Lao PDR, Mongolia, Sri Lanka, Thailand and Viet Nam. In the more industrialized economies the shares of non-farm food activities in total GDP are much lower. Among those countries are China, Hong Kong SAR, Japan, the Republic of Korea and Singapore (Figures 8a-c).

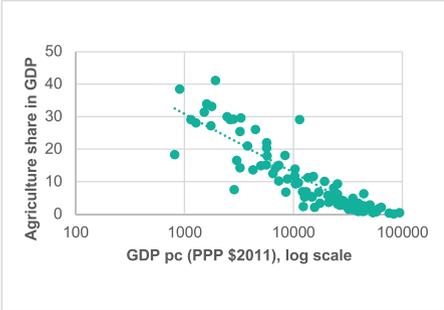
The total agrifood system is defined here as including agricultural production, agriculture-related input provisioning, agrifood processing and distribution, agrifood related trade and transportation, and food services provided through restaurants, hotels, street vendors or otherwise. Notably, the before- (inputs) and beyond-the-farmgate activities tend to expand with structural change and for the reasons mentioned above. In Asia, the share of the non-agricultural part of the agrifood system varies widely. In Bangladesh, Myanmar, Sri Lanka, and the Philippines it is 15 percent to 20 percent of total GDP. In Brunei, Singapore and, notably India, it is less than 5 percent of total GDP. In India the relative size of food the processing sector is much smaller than that in Bangladesh, Pakistan, Sri Lanka or Indonesia, Myanmar and the Philippines, which have sizeable food-manufacturing capacity.

The agricultural sector not only tends to shrink as a share of GDP when economic development progresses, it also becomes less important in size relative to other segments of agrifood supply chains. Figures 9a-d show this pattern for a global sample

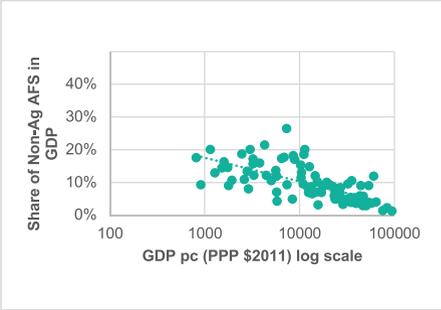
of 97 developed and developing countries, as well as for the sub-sample of Asian countries for which such data is available. The declining trend line is much flatter for the share of the non-agriculture agrifood system (AFS), suggesting that with economic development downstream agrifood system activities increase in importance. This is further confirmed in Figures 10a and b, which show that the share of the downstream segments in the total agrifood system increases in an upward non-linear trend with income per capita. Asian countries mimic the global pattern.

Figure 9: Share of agriculture and non-agriculture AFS in GDP and income per capita, 2015

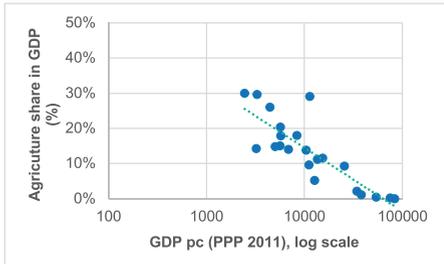
a. Agriculture share in GDP, all countries



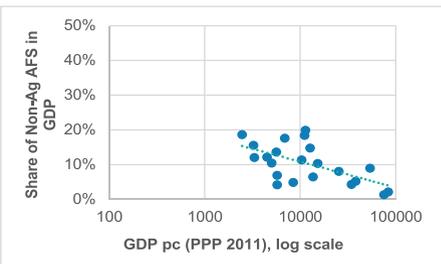
b. Non-Ag. AFS share in GDP, all countries



c. Agriculture share in GDP, Asia only



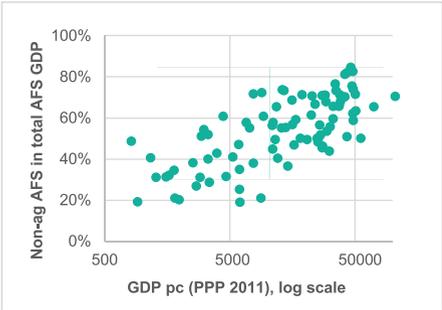
d. Non-Ag. AFS share in GDP, Asia only



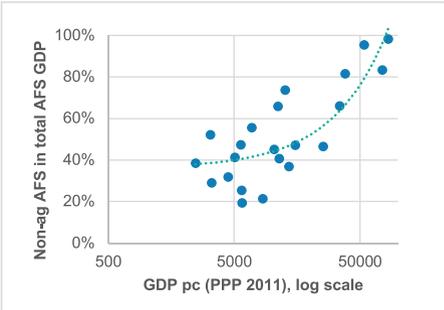
Source: Authors' estimates based on AGGDP+ database provided by James Thurlow (IFPRI) and World Development Indicators for GDP per capita data.

Figure 10: The GDP share of the non-ag. AFS rises with income per capita, 2015

a. All countries (97)



b. Asia only

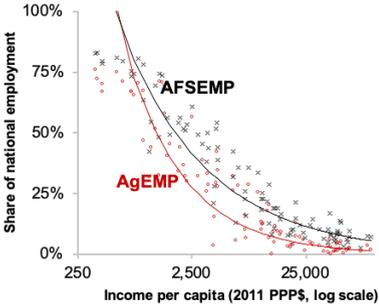


Source: Authors' estimates based on AGGDP+ database provided by James Thurlow (IFPRI) and World Development Indicators for GDP per capita data.

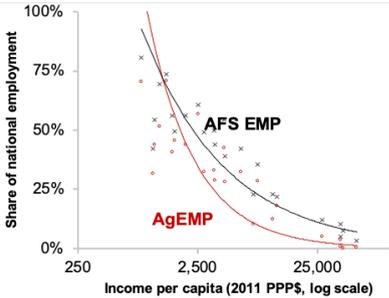
Employment growth in the agrifood sector follows similar patterns as that of GDP. Figures 11a-b illustrate that both the shares of on- and off-farm agrifood sector employment tend to decline with per capita income. However, the decline of the off-farm employment share is less marked. This is consistent with the notion that the non-agricultural share of the agrifood system increases with income (Figures 12a-b). Countries in Asia follow this worldwide pattern.

Figure 11: Share of employment in agriculture and non-ag AFS in total employment and income per capita, 2015

a. All countries (97)



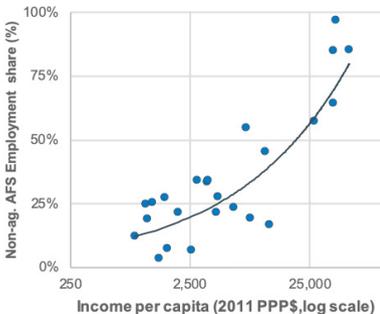
b. Asia only



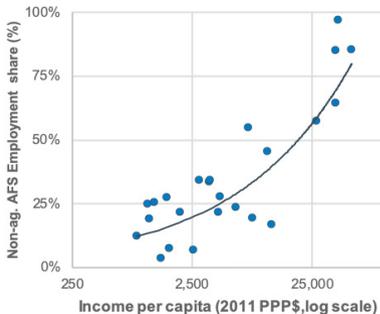
Source: Authors' estimates based on AGGDP+ database provided by James Thurlow (IFPRI) and World Development Indicators for GDP per capita data.

Figure 12: The employment share of the non-ag. AFS rises with income per capita, 2015

a. All countries (97)



b. Asia only



Source: Authors’ estimates based on AGGDP+ database provided by James Thurlow (IFPRI) and World Development Indicators for GDP per capita data.

More specifically, the transformation of the post-farmgate segments of food supply chains (wholesale, brokerage, logistics, cold chain, processing, retail and food services) has important implications. Their evolution impacts employment, income diversification and poverty reduction among rural households. Together, they also have implications for the transformation of farm systems. As mentioned, these agrifood system changes are closely related to urbanization processes, as much of Asia’s food supply is already moving from rural to urban areas. This is creating new income and employment opportunities in wholesale, retail, processing and the logistics of providing food to growing urban populations. Such opportunities can be critical pathways to climb out of poverty for those exiting agriculture or seeking to diversify incomes during agricultural transformation and structural change.

Much of rural off-farm employment tends to be generated in the proximity of cities and towns. Recent studies suggest that dynamic structural change through agrifood system development (characterized by both rapid agricultural productivity growth and rural non-farm wage and employment growth) is more likely to occur when taking place close to smaller towns and intermediate cities (e.g. FAO, 2017; IFPRI, 2017). Based on evidence for Bangladesh, Deichman *et al.* (2009) similarly find that high-potential agricultural production areas close to cities tend to generate more and higher-return rural non-farm employment both for wage earners and the self-employed. Where the high-potential farm area is far from the city, low-return rural non-farm employment predominates, mostly in informal services. Moreover, most urban food demand in Asia is concentrated in smaller urban areas: about 60 per cent, according to FAO estimates (FAO, 2017), suggesting there is a large potential for dynamic rural non-farm employment creation through agrifood business development. In fact, during rapid structural transformation in Indonesia, Malaysia and Viet Nam, food-processing industries have played an important role in pulling labour into off-farm activity and accounted for about one-sixth of total manufacturing employment around 2010 (FAO,

2017). In Viet Nam, employment in agrifood processing more than doubled between 1999 and 2009. Small household-based enterprises in rural areas and small towns generated about 53 percent of the employment growth, but employment growth in modern private enterprises was higher in relative terms (McGaig and Pavcnik, 2016). This reflects broader changes in agrifood systems taking place in Viet Nam, as much as elsewhere in Asia.

The modernization of the midstream of food supply chains has driven these transformations. This includes the emergence of large-scale wholesale and retail food distributors (the ‘supermarket revolution’), vertically integrated food-processing companies, and reduced roles for state-operated food distribution networks (Reardon and Timmer, 2014). In much of Southeast Asia (outside Viet Nam, Cambodia, Lao PDR, and Myanmar), the wholesale sector’s transformation started in the 1970s, while processing transformation took off in the 1980s. Retail transformation (the ‘supermarket revolution’) did not start until the mid-to-late 1990s. China, India and Viet Nam had their growth and urbanization spurts mainly in the 1990s and 2000s and also did not open up their food industries to foreign investment until the 1990s.

The massive proliferation of wholesale markets, the extension and improvement of rural roads, and the regulatory liberalization of their operations in most countries opened the door to for what Reardon and Timmer (2014) label ‘progressive disintermediation’ in the rural areas and in supply chains. Two main factors propelled this trend. Regulatory changes, the first factor, have freed up wholesale markets and provided incentives to large-scale traders, distributors, and food companies to establish direct links to farmers through contract farming, supermarket-led collection centres and other methods. These changes have taken place in some states in India and also in Viet Nam through the privatization of state-owned businesses. The second factor is the diffusion of wholesale markets in towns near or in rural areas, and the improvement of road systems connecting rural areas to urban wholesale markets. In many locations, however, this has undercut small-scale village traders in diverse settings and further stimulated direct purchases from farmers by wholesale market traders who previously procured through village traders.

The agrifood system changes are also providing sources of income diversification for farmers, bringing extra cash for investing in farm productivity and mechanization. Greater rural non-farm income has also helped farmers overcome lack of access to credit and provided a source for funding the purchase of agricultural inputs and land (FAO, 2018; Reardon *et al.*, 2014; Vos, 2018). Where rural–urban linkages have remained weak, however, rural livelihoods have failed to improve significantly. Large-scale urban manufacturers catering to mass markets have also displaced, and are displacing, small-scale businesses in food processing and distribution in rural areas and near or in cities. That trend is diminishing non-farm rural employment without generating sufficient new jobs for the displaced workers. This problem is particularly pressing in areas with low agricultural potential and where poor connectivity to urban markets is holding back poverty reduction.

2.2.5 Structural drivers of agricultural transformations in Asia

Following the approach taken in Laborde *et al.* (2019), we further investigate structural factors that may promote or impede the process of agricultural transformation. From a review of evidence for all developed and developing countries on possible drivers of transformation, we selected an initial set of 24 structural indicators across four socio-economic domains: agricultural development potential, demographic pressure, urbanization, and institutional capacity.

Upon further examination, we narrowed the list of indicators to six to identify four types of drivers/constraints:

- 1) **Agricultural potential and environmental constraints.** In most developing countries, agriculture is a key source of income for the poor (food access) and the origin of food production (food availability). Hence, we identify two related structural conditions for the potential of agricultural development at the extensive margin (available agricultural land per capita) and the intensive margin (land quality as measured by potential land productivity). In addition, we look at related natural resource constraints that may limit realizing the agricultural potential proxied through the degree of water stress [3 indicators].
- 2) **The degree of urbanization** is captured through the share of the population living in urban areas. Urbanization is in part an expression of agricultural transformation, as it is facilitated by higher agricultural productivity. For the present analysis, however, we consider urbanization also as a structural driver, because it is one of the drivers of changing diets and of agrifood value-chain development, which in turn requires the transformation of agricultural systems [1 indicator].
- 3) **Institutional capacity and quality** tend to correlate with the capacity to contain corruption. The strength of institutions underpins the likelihood that policies are credible and the ability of government to establish the enabling environment needed for the promotion of economic development and food security. While not undisputed, the best available indicators for making cross-country comparisons relate to the World Bank [Worldwide Governance Indicators](#) that measure, inter alia, a country's capacity to contain corruption and the degree of political stability [1 indicator].
- 4) **Demographic pressures** are captured by the birth rate as an indicator of both population growth and demographic transition [1 indicator].

Appendix A.2 provides the list of definitions of these variables.

Applying the cluster analysis methodology across these five dimensions for all countries over the period 1990–2015 yields the following typology of structural conditions:

- **Type A: *urbanized economy, strong institutions, no land or water constraint.*** Type A describes an advanced economic structure, characterized by low population growth and a high degree of urbanization. Despite relative land scarcity, it has high agricultural potential and low water stress. Institutions are strong.
- **Type B: *urbanized economy, strong institutions, land scarce and somewhat water stressed.*** Type B consists of countries similar to Type A, were land scarce (very low availability of agricultural land per capita) and showed moderate water stress from initial stages of their agricultural transformation.
- **Type C: *urbanizing, land scarce with high agricultural potential, weak institutions, low water stress.*** Type C consists of countries facing land scarcity, though with high land fertility and low water stress, and, hence, significant agricultural potential. By 1990, the urban share of the population had already increased to around a median of 50 percent, but their institutional capacity tends to be weak.
- **Type D: *urbanizing, land abundant with low agricultural potential, weak institutions, moderate water stress.*** Type D is largely composed of low-income, land abundant countries, but where agricultural development is constrained by low land fertility and a certain degree of water stress. Institutional quality is poor.
- **Type E: *rural economy, land abundant with high agricultural potential, high demographic pressure, very weak institutions.*** Type E consists of countries with still large rural populations, relative land abundance and high agricultural potential. Strong population growth and very weak institutions are holding back agricultural productivity growth.
- **Type F: *arid and land scarce, very low agricultural potential, urbanized, moderate to good institutions.*** Type F consists of countries with extremely low agricultural potential, because of an arid climate and severe water stress. They are already urbanized on the back of non-agricultural sectors (including mineral resource exports), though still have moderate to high population growth.

Table 3: Structural drivers of agricultural transformations: descriptive statistics (median value for 1990–2015) for key indicators across five clusters

Code	Description	<i>[A] Urbanized economy, strong institutions, no land or water constraints</i>	<i>[B] Urbanized economy, strong institutions, land scarce and somewhat water stressed</i>	<i>[C] Getting urbanized, land scarce with high agricultural potential, weak institutions, low water stress</i>	<i>[D] Getting urbanized, land abundant with low agricultural potential, weak institutions, moderate water stress</i>	<i>[E] Rural economy, land abundant with high agricultural potential; high demographic pressure, very weak institutions</i>	<i>[F] Arid and land scarce, very low agricultural potential, urbanized, good institutions</i>
LNCAP	Agricultural land per capita	0.59	0.05	0.38	2.17	0.81	0.14
SUITAB	Potential land productivity (US\$ per ha)	836	1,276	1,084	230	1,630	1
WATSR	Water stress (fresh water withdrawal as % of total water resources)	4.77	31.03	8.43	31.91	1.44	1,425.00
URPOP	Share of urban population in total (%)	73.90	82.53	53.84	57.59	30.87	82.72
CCORP	Control of corruption (index, 0–100)	81.09	84.04	29.97	28.65	22.10	62.70
PGRWT	Population growth (birth rate)	12.18	12.56	20.59	28.07	40.11	21.49

Source: Authors' elaboration.

According to this typology, by 1990, no Asian countries belonged to the advanced kind of land-abundant economic structure of type A. However, Japan, the Republic of Korea, and Singapore already possessed the conditions of advanced but land-scarce economic structures of type B (Figure 13a-b). By 2015, in all three type B countries structural conditions were still the same as in 1990, so there was no change in their position within this typology. Malaysia, however, moved from type C to type A, following the country's rapid urbanization and drop in the birth rate between 1990 and 2015. While similar shifts also occurred in China, Indonesia, Thailand and Viet Nam during that period, but these were less pronounced and so their structural conditions still fit those of type C.

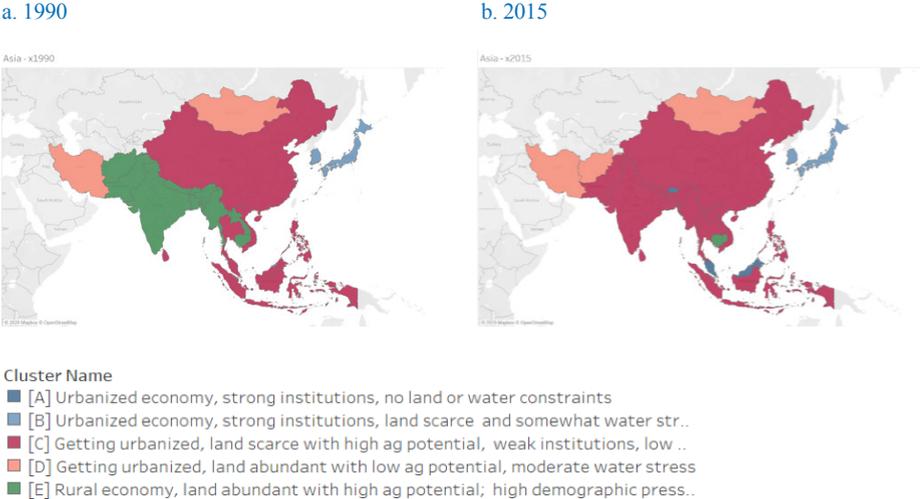
The cluster analysis suggests that Iran and Mongolia both fit type D in 1990 and retained those characteristics in 2015. Mongolia's relative land abundance has not been a real advantage because it combines with very low agricultural potential (\$200

per hectare), still high birth rates (25 per 1 000 population) and weak institutions. Labour exit from agriculture was not pushed by agricultural productivity growth, but rather by non-agricultural activity and rapid urbanization (68 percent in 2015). The first set of the mentioned structural conditions still prevails today and keeps Mongolia a type D country. The case of Iran is somewhat different. While Iran is also a land-abundant country, it has additional natural-resource richness, possessing major oil reserves. Furthermore, Iran has a long history of engaging in modern agriculture. It is the world’s twelfth largest producer of wheat, but also a major exporter of high value crops such as pistachios, apples, and medicinal herbs. As a result, average agricultural productivity, measured in value added per hectare, is high and nowadays similar to those of Japan and Korea (as noted above).

Bangladesh, India, Lao PDR, Myanmar, Nepal and Pakistan, in contrast, all moved from type E to type C, mainly because they became more urbanized, birth rates fell and they gradually tapped into their relatively high agricultural potential.

Bangladesh, India, Lao PDR, Myanmar, Nepal and Pakistan, in contrast, all moved from type E to type C, mainly because they became more urbanized, birth rates fell and they gradually tapped into their relatively high agricultural potential.

Figure 13: Structural drivers of agricultural transformations in Asia: cluster typology



Source: Authors’ elaboration.

Cambodia and Afghanistan deviated from this pattern for different reasons. Cambodia remains by and large a type E rural economy with weak institutional capacity. While Cambodia’s birth rate has fallen from 41 to 24 per 1 000 population between 1990 and 2015, its pace of urbanization is still lagging. Afghanistan, by contrast, was on the border of types E and D. While it shifted to type D, its structural features remain that of an essentially rural economy with a very low urbanization rate of 25 percent and low agricultural potential well below the median for type E.

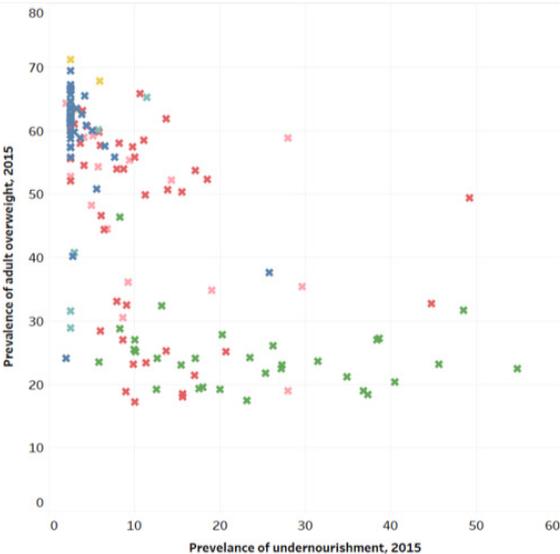
No Asian country fits type F, which is more typical of structural conditions of many countries in the Middle East.

Nutritional outcomes in terms of both the prevalence of undernourishment and that of overweight and obesity sustain a broad association with the structural conditions as defined here through the cluster analysis (Figure 14). Looking across all countries (Figure 14a), as one would expect, hunger has by and large been eradicated in countries with the more advanced economic structures of types A and B, while overweight and obesity are on the rise. In rural economies, type E, hunger is still the main nutritional challenge, while most type C and D countries undergoing urbanization face a double malnutrition burden in most cases, with still significant hunger rates and rising prevalence of overweight.

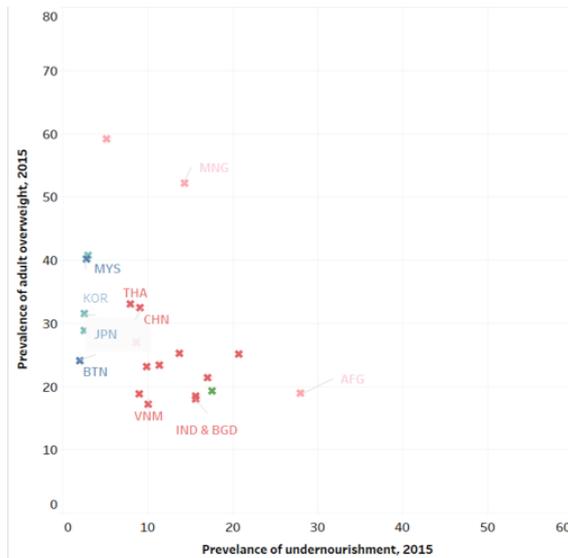
Countries in Asia (Figure 14b) broadly fit this pattern. Japan is one of very few countries, if not the only one, with near zero rates of undernourishment, while overweight is affecting less than 30 percent of the adult population. The Republic of Korea, a type B country, and Malaysia, type A in 2015, as well as China and Thailand, both type C, managed to reduce the prevalence of undernourishment to under 10 percent. However, they have seen their rates of overweight and obesity rise above 30 percent of the adult population. As observed before, in Mongolia, type D, overweight has already emerged as a major challenge at over 50 percent of the adult population, while the prevalence of undernourishment is still significant at over 15 percent. While type C countries Viet Nam, Bangladesh and India have managed to bring down their rates of undernourishment to levels similar or slightly above to those of China and Thailand, they have also kept the prevalence of overweight under 20 percent.

Figure 14: Nutritional outcomes by structural clusters in Asia and the world, 2015

a. World



b. Asia



Structural clusters in Asia in 2015

- [A] Urbanized economy, strong institutions, no land or water constraints
- [B] Urbanized economy, strong institutions, land scarce and somewhat water str..
- [C] Getting urbanized, land scarce with high ag potential, weak institutions, low ..
- [D] Getting urbanized, land abundant with low ag potential, moderate water stress
- [E] Rural economy, land abundant with high ag potential; high demographic press..

Source: Authors' elaboration.

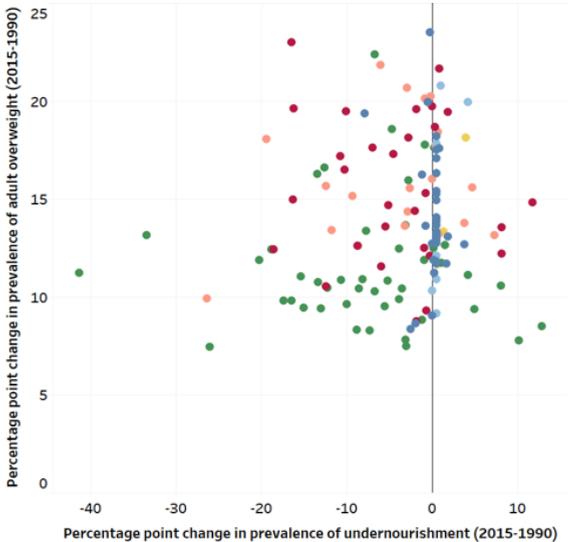
Figure 15 shows the percentage change in the prevalence of undernourishment and adult overweight between 1990 and 2015 by countries, and their structural cluster position in 1990. As expected, it shows that the more advanced urbanized economies (types A and B) tend to show increases in the prevalence of adult overweight, while maintaining low to zero rates of hunger and undernutrition. For the other structural clusters (types C, D, and E), the figure shows a rather dispersed pattern of rates of reduction in undernutrition and increase in adult overweight, which could suggest that the impact of structural conditions is strongly mediated through policy.

Findings for Asia are similar to those discussed in section 2.2.3: no country showed a rise in undernourishment during 1990 and 2015. Countries with less favourable structural conditions (types D and E) did manage to make significant progress in reducing hunger, despite the weak quality of their institutions, notably, Myanmar, Mongolia, Lao PDR and Afghanistan. This suggests further that looking at single factors (initial structure or quality of institutions) will not be enough to explain differences in progress towards reducing hunger, nor differences in the degree of the rise in overweight. Policies seem to matter a good deal in explaining those outcomes.

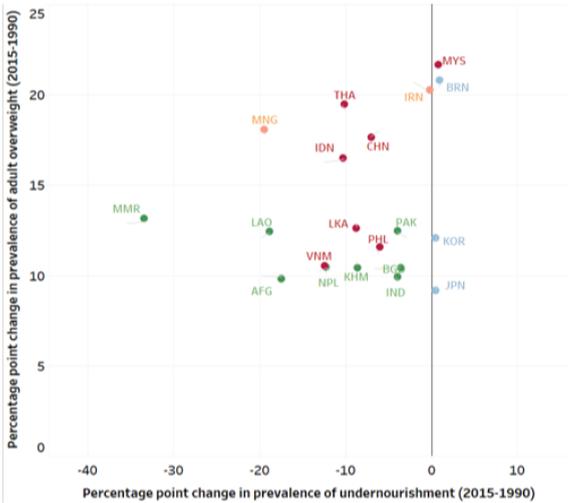
Figure 15: Changes in nutritional outcomes between 1990 and 2015 by structural cluster position in 1990, Asia and the world

(Changes in percentage points)

a. World



b. Asia



Structural Clusters in 1990

- [A] Urbanized economy, strong institutions, no land or water constraints
- [B] Urbanized economy, strong institutions, land scarce and somewhat water str..
- [C] Getting urbanized, land scarce with high ag potential, weak institutions, low ..
- [D] Getting urbanized, land abundant with low ag potential, moderate water stress
- [E] Rural economy, land abundant with high ag potential; high demographic press..
- [F] Arid and land scarce, very low ag. potential, urbanized, good institutions

Source: Authors' elaboration.

3. Policies and institutional reforms

In the 1960s, most of developing Asia faced some similarity in the initial conditions of the early stages of their economic advancement. These early stages were characterized by high birth rates and relatively fertile but scarce agricultural land. The Green Revolution brought new high-yielding varieties of staple crops, facilitating substantial farm productivity increases, even for smallholders, to jumpstart agricultural transformations and structural change. While broadly adopted across the region, the speed of the new technologies and the success in ‘pushing’ broader economic development through agricultural productivity growth has varied depending on policies and institutional reforms.

The nature and timing of institutional and agricultural policy reforms have differed greatly across the countries in the region. A common feature of reforms in recent decades has been a much smaller direct role of governments in food systems. A parallel development has been the growth of off-farm, private sector small and medium-sized agrifood businesses and services, which have stepped into the void left by parastatals. Generally, the policy reforms enabled the entry of large-scale domestic and foreign firms such as processors, supermarkets and fast-food chains. Many governments supported transformative change, including through large infrastructure programmes that helped strengthen rural–urban linkages and integrate food supply chains.

Laborde *et al.* (2018) and Vos (2018, 2019) explain different rates of success with agricultural transformations by key differences across developing-country regions and different periods of time since 1970. The differences included agricultural price incentives, public spending priorities for investing in agricultural research and development (R&D), rural infrastructure, education and health, and reforms of rural institutions including land reform and credit schemes. According to the review of evidence in Laborde *et al.* (2018), the more critical factor appears to be the degree of coherence and complementarity across these areas of intervention to promote sufficient agricultural productivity growth to facilitate a take-off of non-agricultural sectors by freeing up labour and savings, and by overcoming population pressures on food security. Vos (2018, 2019) adds a second key finding: effective and timely reform of agricultural institutions has been critical in explaining successful transformations in Asia.

The remainder of this section discusses some of the salient features of policy and institutional change that have shaped agricultural transformations in several of the main Asian economies. These broad conclusions, however, do not pretend to provide full proof of the precise impact of policies on agricultural and rural transformation processes.

In reviewing the role of policies, we group Asia’s country experiences into the four categories identified in sub-section 2.2.3: (1) the early successful transformers (Japan, Korea and Malaysia); (2) the late but successful transformers (China, Indonesia,

Mongolia, Sri Lanka and Thailand); (3) *the very late transformers* (Afghanistan, Bangladesh, Cambodia, India, Myanmar, Pakistan, the Philippines and Viet Nam); and (4) the lagging countries (Lao PDR and Nepal). The four selected countries – Korea, Thailand, Bangladesh and Viet Nam – are spread across the first three categories. The timing of agricultural transformation processes is closely linked to country-specific policies and institutional reforms, as discussed below. Table 4 shows how the timing is associated with the stages and structural drivers of agricultural transformation as identified through the cluster analysis presented in the previous section. The early transformers had already reached stage 1 (industrialized economies) by 1990 or shortly after, while the late transformers had reached stage 2 (agriculture integrated in the macro economy) only recently. The very late transformers of stage 3 either got agricultural development going as late as the 2010s, or saw stagnation after earlier pushes for transformation, as in the cases of Pakistan and the Philippines. Lao PDR and Nepal are still ‘stuck’ in stage 4, where labour exit from agriculture is ongoing but the economic structure has remained largely rural and agrarian. The next sub-sections discuss the types of policies and institutional reform that have been most relevant in explaining the speed and degree of success in achieving more modern agrarian structures underpinning economic development.

Table 4: Classification of countries in Asia by timing, stage and structural cluster of agricultural transformation

		Stage of agricultural transformation			Cluster of structural drivers		
		in 1990	in 2005	in 2015	in 1990	in 2005	in 2015
Early successful transformers	Japan	1	1	1	B	B	B
	Korea, Rep. of	2	1	1	B	B	B
	Malaysia	2	1	1	C	A	A
Late, successful transformers	China	4	3	2	C	C	C
	Indonesia	3	3	2	C	C	C
	Mongolia	3	3	2	D	D	D
	Sri Lanka	3	3	2	C	C	C
	Thailand	4	3	2	C	C	C
Very late transformers	Afghanistan	5	5	3	E	E	D
	Bangladesh	4	4	3	E	C	C
	Cambodia	4	4	3	E	E	E
	India	4	4	3	E	C	C
	Myanmar	5	3	3	E	C	C
	Pakistan	3	3	3	E	C	C
	Philippines	3	3	3	C	C	C
	Viet Nam	4	4	3	C	C	C
Lagging transformers	Lao PDR	5	4	4	E	E	C
	Nepal	4	4	4	E	E	C

Source: Authors’ compilation based on analysis in Section 2.

Note: In this table we have left out a number of cases either because of insufficient data (Bhutan), or they represent special cases of agricultural and/or non-agricultural resource abundance and other factors (Brunei and Iran) or being essentially city economies (Singapore).

Legend:

Stages of agricultural transformation

- Cluster Name
- [1] Industrialized economies
- [2] Agriculture integrated in the macro economy
- [3] Agriculture as a contributor to growth
- [4] Labor moving out of agriculture
- [5] Getting agriculture moving

Clusters of structural drivers/constraints

- Cluster Name
- [A] Urbanized economy, strong institutions, no land or water constraints
- [B] Urbanized economy, strong institutions, land scarce and somewhat water str...
- [C] Getting urbanized, land scarce with high ag potential, weak institutions, low ...
- [D] Getting urbanized, land abundant with low ag potential, moderate water stress
- [E] Rural economy, land abundant with high ag potential; high demographic press...

3.1 Early, successful transformers: the role of policies and institutional reform

The first group of countries we consider are those that were at a very advanced stage of their structural transformation process in the 1970s. Japan, Malaysia and the Republic of Korea are in that category. They managed to substantially reduce poverty, helped in good part by high agricultural productivity growth. While Japan had already achieved stage 1 of structural transformation in 1970, the Republic of Korea and Malaysia moved from stage 2 to stage 1 during the 1990s.

In Japan, agricultural transformation started in the Meiji period (1868–1912). In 1928, the share of agriculture in GDP had already fallen to 18 percent (Minami, 1994). Agricultural production and productivity increased strongly during the Meiji period and after World War II. Two-thirds of production increases during 1880–1935 were induced by the introduction of high-yield crop varieties, improved techniques of fertilization and freedom of movement that facilitated adoption. Both Japan and Korea have high population density and low per-capita agricultural land availability. Unequal land distribution was an additional constraint on agricultural transformation. The land reforms introduced in both countries after WW II gave a big push to agricultural productivity growth facilitating fast labour exit from agriculture and underpinning export-led industrialization strategies. In Malaysia, the transition has also occurred very rapidly. At independence in 1957, agriculture was still the dominant activity, with the natural rubber sector alone accounting for 25 percent of GDP (Meerman, 1979). Land availability was less of a constraint in Malaysia and there has been less pressure for land reforms and other changes in agricultural institutions. The government's agro-based industrialization strategy (relying on plantation agriculture including rubber, palm oil and coconuts) has been more critical in driving the country's agricultural transformation process.

3.1.1 Institutional reforms

Land reform was key in countries with unequal land distribution, particularly in the Republic of Korea and in Japan. The redistribution of land was a key element in successful transformation.

The land reform undertaken by the Korean government and the United States in 1949 to achieve equitable land distribution to support smallholder agriculture was very important for agricultural development. The percentage of landowners rose from 14 percent in 1945 to 70 percent in 1965 with an upper limit for each landowner of about 3 hectares (Tsakok, 2011).

In Japan, unequal land distribution was considered to be a main driver of income inequality. At the end of World War II, with the economic reforms imposed by the United States, land reform was undertaken in 1952 resulting in a much more egalitarian distribution. Land was redistributed to tenants, who made up 45 percent of farmers. The maximum land size was fixed at 4 hectares. The reform helped improve real rural incomes as the new landowners no longer had to pay high land rents and obtained incentives for introducing improved farming practices (Tsakok, 2011).

In Malaysia, major reforms of agrarian institutions were less crucial than the government's support promoting investment in the vertical integration of plantations with processing industries, and support to smallholder agriculture through price support schemes, input subsidies, and low-interest rate credits, as discussed further below. The country's New Agricultural Policy of 1984 provided a coherent agro-industrial development strategy that drove agricultural income growth, commercialization of farming, and overall economic transformation through agricultural market development, R&D, and incentives for diversification from rice to agro-industrial crops, including rubber and palm oil (Tsakok 2011).

3.1.2 Price incentives

Direct price interventions played the key role in catalysing the agricultural transformation process in the three countries. In Korea and Malaysia, price policies initially had a strong anti-agricultural bias, but once reversed towards net support to the sector, helped boost agricultural productivity growth and accelerate the transformation process.

In the Republic of Korea, the price policy shifted from net taxation of agriculture in the 1960s as part of its push for export-led industrialization towards net subsidization in the 1970s. Initially, the government's main objective was to keep food prices low and real wages of industrial workers low, as part of the industrial promotion policies (Honma and Hayami, 2009).⁵ The policy held back agricultural growth, and income gaps between rural and urban populations widened. A major policy shift followed the 1971 presidential elections (Eberstadt, 1996) and much greater priority was given to agriculture in the third five-year plan (1972–1976), including through agricultural import restrictions (quotas), higher public purchase prices, and input subsidies on chemical fertilizers, pesticides and farm equipment. The producer subsidy equivalent (PSE), measured as a share of the value of agricultural production, increased to over 100 percent from the late 1970s, with transfers to the rice sector accounting for 75 percent of total PSE (OECD, 1999). Market price support for agriculture has remained strong since that time (Figure 16).

In Japan, supportive agricultural price policies were already important during the Meiji period. The land tax reform of 1873–76 provided incentives to farm investment, raising productivity and the rate of commercialization.⁶ Production growth was strong enough to allow for agricultural exports, which generated foreign exchange that could cover the import cost of capital goods required for

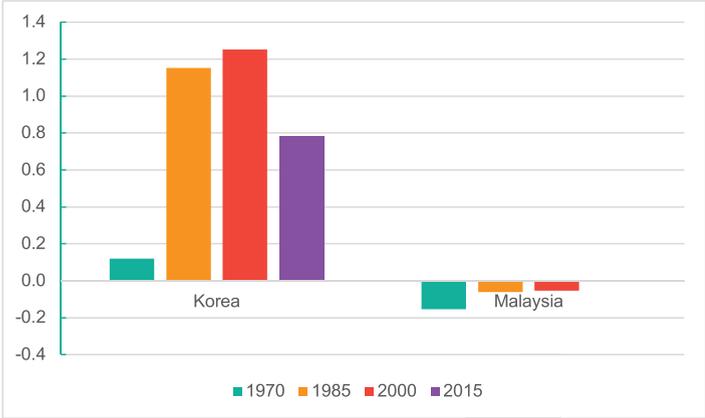
the modernization of the industrial sector. Initially, the agricultural sector was more heavily taxed than non-agricultural activity. In the 1960s, recognizing the widening income differentials between farm and non-farm households, Japan started to protect agriculture through restrictions and price support policies (Agricultural Basic Law of 1961). Since then, Japan has continued to subsidize agriculture.

⁵ The Grain Management Law of 1950 allowed the government to regulate agricultural prices. During the 1950s and 1960s, the Korean Government purchased agricultural products below market prices thereby keeping food prices low for urban consumers.

⁶ With the reform, taxes were levied on individual parcels of land instead of on villages as entities (Tsakok, 2011). The overall tax burden dropped as a result (Yamamura, 1986).

In Malaysia, the government maintained an open trade policy regime for a prolonged period and avoided use of non-tariff barriers, quantitative restrictions and marketing boards, and maintained low tariffs for both agriculture and manufactured goods. The average tariff rate in 1965 was estimated at 13 percent (Power, 1971). Rubber and palm oil, however, were subject to export duties, providing a major source of government revenue until the late 1980s (Athukorala and Loke, 2009). However, since the 2000s, the government cut export taxes on rubber and palm oil because it could rely on revenue from petroleum exports. The only crop it has protected has been rice, an import competing product. The rice sector has been protected since independence but was strengthened with the 1970 New Economic Policy (*Dasar Ekonomi Baru*), as part of an affirmative-action policy package favouring Malay ethnic groups. Since the early 1970s, the government has supported rice producers through a guaranteed minimum price and a fertilizer subsidy. The government also provided targeted price support to smallholder agriculture through output and input subsidies, and subsidized credits. Overall, however, despite such crop-specific support, protection of agriculture relative to other sectors has been either slightly negative or neutral (Figure 16). The greater impetus for agricultural transformation came from non-price support measures (see below).

Figure 16: Relative rate of assistance to agriculture in the Republic of Korea and Malaysia



Source: Laborde et al., (2018) and Vos (2018)

3.1.3 Public spending for agricultural development, education and infrastructure

The countries that successfully transformed sustained a high level of public expenditure for several decades (Figures 17a and 17b). The Republic of Korea and Malaysia, in particular, invested heavily in research and development, extension services, and rural infrastructure, particularly in irrigation.

In Japan, public education policies that began in the Meiji period were a good complement to rural infrastructure development, investment programmes and agricultural innovation. According to Minami (1994), Japan's high literacy levels at the beginning of the 20th century are the legacy of the compulsory education measures introduced in the early 1870s, particularly the focus on technical education.

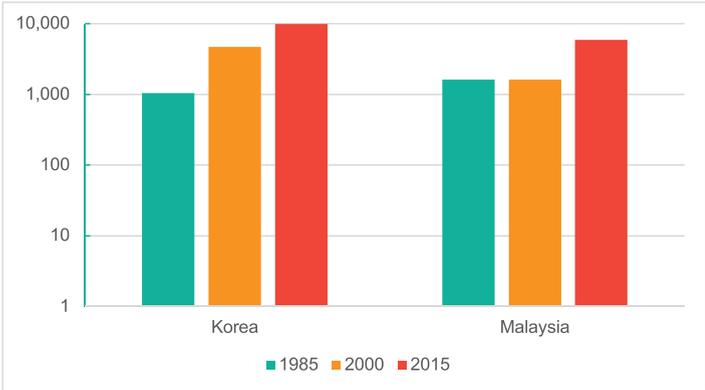
In the Republic of Korea, the expansion of public investment in support of agriculture started during the Japanese colonial period. From 1910 to 1945, government provided significant investment support, particularly for the rice sector, in order to ensure the food self-sufficiency of the country's colonizer, Japan. Public spending for agriculture prioritized research and extension services and supported the introduction of new crop varieties and chemical fertilizers. The government also invested heavily in irrigation in the years before industrialization. From 1954 to 1970, land under irrigation increased by 85 percent (Tsakok, 2011). This substantially enhanced the impact of land reform on agricultural productivity.

In Malaysia, tree-crop agriculture (rubber, palm oil, coconut) has been a crucial ingredient of natural-resource-led growth and structural transformation. Government policies have underpinned productivity growth on large-scale plantations through significant R&D spending, land development, and infrastructure investment promoting vertical integration with processing industries. In parallel, the Government of Malaysia also invested heavily in smallholder agriculture through output price support, input subsidies, and low interest-rate credits. Between 1971 and 1995, the share of public expenditures allocated to agriculture and rural development averaged 17 per cent. The New Agricultural Policy of 1984 helped propel agricultural income growth, commercialization of farming, and overall economic transformation through agricultural market development, R&D, and incentives for diversification from rice to agro-industrial crops, including rubber and palm oil (Tsakok, 2011).

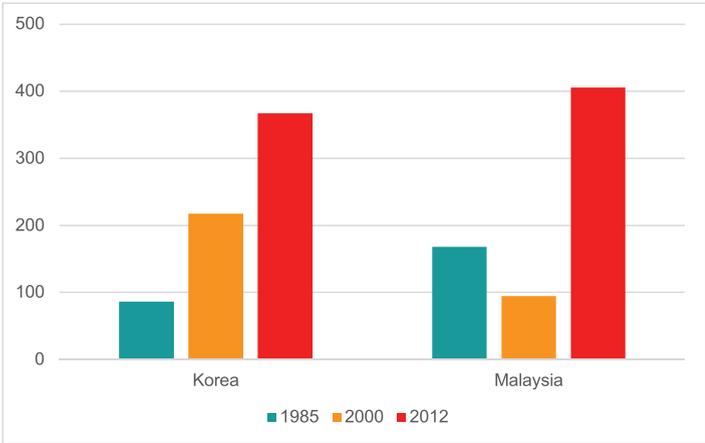
In addition, sustained public spending to expand basic social services coverage provided support for the agricultural transformations process in both Korea and Malaysia. Access to electrification is now universal in both countries, and was already high in 1990 (Figure 18). Likewise, net primary school enrolment rates are near 100 percent in both countries (Figure 19). In fact, access to education was already high with rates well over 80 percent by 1970, enabling the modernization of agriculture.

Figure 17: Public expenditures per farmer and per capita (PPP\$) in Korea and Malaysia

a. Spending per farmer (log scale)



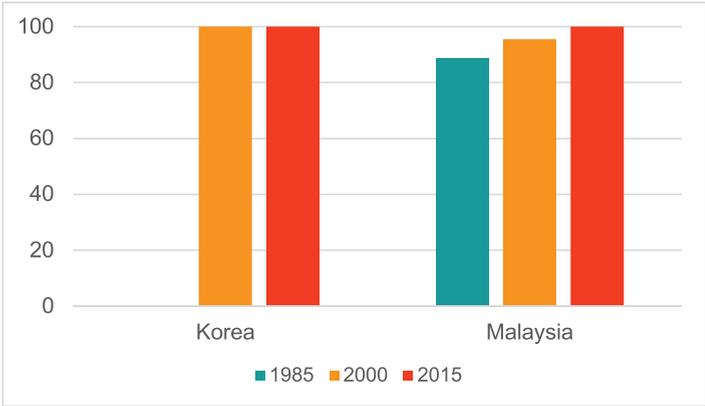
b. Spending per capita



Source: Updated from Laborde et al., (2018) and Vos (2018)

Figure 18: Rural electrification in Korea and Malaysia

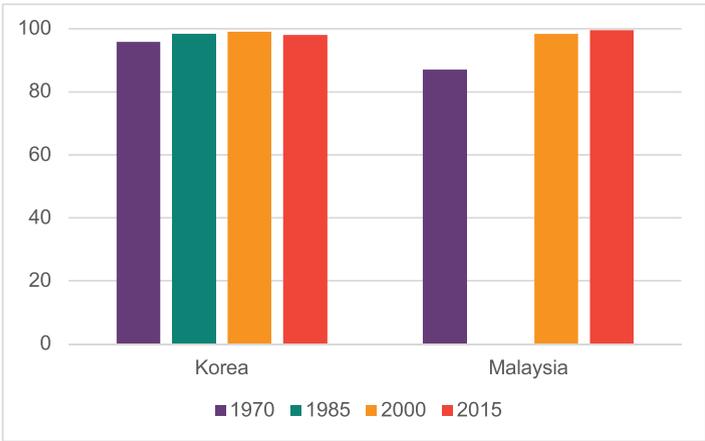
(% of rural population with access)



Source: Laborde et al., (2018) and Vos (2018)

Figure 19: Net primary school enrolment rate in Korea and Malaysia

(% of children in primary school age)



Source: Laborde et al., (2018) and Vos (2018)

3.2 Late, successful transformers: the role of policies and institutional reform

Several countries have made significant transformative progress since the 1980s. By 2015, China, Indonesia, Mongolia, Sri Lanka and Thailand had reached stage 2 of the Timmer-Laborde typology of the agricultural transformation process in which agriculture is integrated into the macroeconomy (Table 4). Several of these, such as China, are likely to reach the advanced stage 1 in the coming decade. Agricultural productivity has increased significantly in all of these countries and rural poverty has decreased, although significant rural-urban disparities remain. In the discussion that follows, we focus on the cases of China, Indonesia and Thailand.

3.2.1 Institutional reforms

Institutional reforms were crucial in jumpstarting the structural transformation process in China. The adoption of the Household Responsibility System (HRS) amplified the agricultural transformation process. This reform allowed farm households to become responsible for their production and entitled to the profits. Before that, only ten percent of land was available for private use. The collective nature of the farming system had been holding back productivity growth. The reform also allowed the private establishment of Town and Village Enterprises (TVEs) and the liberalization of rural labour markets, enabling farmers to connect with markets and strengthen rural-urban economic linkages (Ho, 1994). The HRS and TVEs unleashed massive private initiative. According to one study, the two reforms were responsible for 60 percent of China's impressive agricultural growth during 1978–1990, much more than public expenditure (EIU, 2008).

In Thailand, regulations introduced in the 1990s to facilitate improved access to credit gave a major boost to agricultural productivity growth. The Bank for Agriculture and Agricultural Cooperatives (BAAC) was the main vehicle extending credit to small-scale farmers. The BAAC expanded to more than 657 branches by the late 1990s. It initiated a group liability programme that allowed farmers to access credit without the use of land titles as collateral. The BAAC eventually reached 90 percent of farm households and became self-financing, ensuring future sustainability (Leturque and Wiggins, 2011).

In Indonesia, financial sector reform in the 1960s improved access to agricultural credit. Complemented by other supportive policies, this helped accelerate agricultural productivity growth. As part of the reform, the Bank Rakyat Indonesia was encouraged to provide credit to the agricultural sector and the government subsidized the bank's loans through the BIMAS programme. The subsidized loans contributed to agricultural growth through access to capital (EIU, 2008).

3.2.2 Price interventions

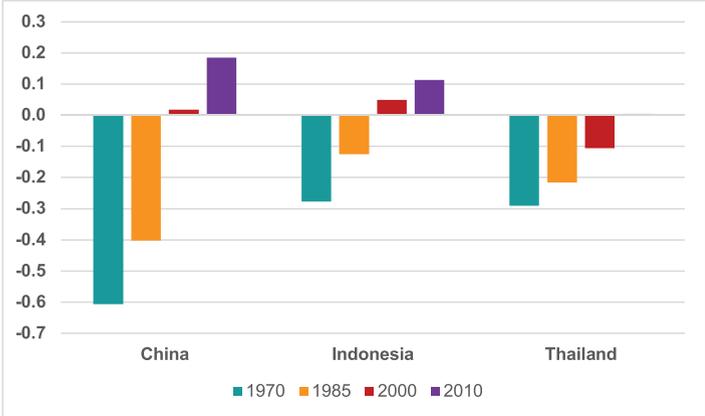
Direct price interventions played a key role in the agricultural transformation process in all of the countries. Most started the 1970s with a strong anti-agricultural bias that diminished significantly over time. China and Indonesia shifted completely to positive

support for agriculture. The change from, or significant reduction of anti-agricultural bias boosted the transformation process.

For decades, price incentives in China were strongly biased against agriculture. From 1958 until 1979, agricultural incomes were squeezed by taxes and administered prices, while farmers were not allowed to market their production surpluses. The anti-agricultural bias fomented the import-substitution industrialization strategy, but held back agricultural production and productivity growth (Tsakok, 2011). After 1979, with the HRS, several restrictions on farming were lifted and farmers were provided with further incentives as the anti-agriculture bias in price incentives was gradually reversed. Purchase prices for most agricultural products were lifted and in-quota and above-quota prices for grains, oil crops, cotton, sugar, and pork were raised (EIU, 2008). In the 1990s, subsidies for various crops, including soybeans, were introduced. As a result, the net or relative rate of assistance to agriculture (RRA) moved out of negative territory, turning positive in the 2000s (Figure 20).

Indonesia established a food procurement agency in the 1960s with monopoly control on international trade. Floor and ceiling prices were also established for key commodities such as rice. The negative consequences of these policies led the country to adopt reforms more favourable to agriculture with some success. Market-oriented policies were implemented, but some government intervention to support the agricultural sector still took place. Removing ceiling prices and the anti-agricultural bias (high tariffs, output taxes and export restrictions), combined with targeted subsidies to facilitate the use of fertilizer and high-yield crop varieties helped boost agricultural productivity growth (Tsakok, 2011; EIU, 2008). More support came in 1969 with the start of successive five-year national development plans that pursued the triple objectives of growth, equity and stability. The plans helped achieve relative macroeconomic stability, as they required fiscal discipline that helped dampen inflation. Macroeconomic policies included periodic currency devaluations that helped mitigate pressures for the rupiah to appreciate during the oil price booms of the 1970s and early 1980s. A cheaper rupiah kept agricultural production competitive and facilitated the introduction of Green-Revolution technologies (Timmer, 2005; Tsakok, 2011).

Figure 20: Relative rate of assistance to agriculture in China, Indonesia and Thailand



Source: Laborde et al., (2018) and Vos (2018)

Thailand historically has generated large agricultural surpluses, especially for rice. Price policies have focused on maintaining food-price stability for consumers. Until the 1980s, agriculture activities, especially rice exports, were taxed, providing an important source of government revenue. Thereafter, taxes on the sector have been gradually reduced. Export taxes on rice were eliminated in the mid-1980s, while those on rubber were removed after 1990. Taxes on fertilizers, a major input, were also cut after 1990. Import restrictions have been maintained on a number of commodities, including soybeans, palm oil, rubber, rice and sugar. Policies still in use include non-tariff instruments such as import prohibitions, licensing arrangements, and local content rules (Warr and Kohpaiboon, 2009). In more recent years, the government has facilitated growth in production of high-value food commodities, such as fish products, through food safety and certification programmes, strengthening of related value chains and international marketing efforts (Upali Wickramasinghe, 2017).

3.2.3 Public spending for agricultural development, education and infrastructure

Similar to the case of the early transformers, the impact of agricultural price incentives and institutional reforms in China, Indonesia and Thailand were greatly enhanced by complementary public investments in agricultural R&D, extension services, and rural infrastructure such as irrigation, electricity, and roads. Investments in primary education were also important.

In China, public expenditure for agricultural development expanded over a prolonged period. The expansion began during the 1980s, was stepped up during the 1990s and increased even more significantly during the 2000s (Figure 21). Average annual spending more than tripled (increasing by 240 percent) during 1996–2010. As a result, public spending on agriculture increased from 5.9 percent to 10.8 percent of agricultural GDP during that period. Towards the end of that time, most of the spending was for rural education (33 percent), irrigation (30 percent) and other infrastructure such as energy and roads (20 percent). The share of agricultural R&D reached 2.2 percent of

total public spending for agriculture. Fan *et al.* (2004) found a significant impact of public investment on agricultural growth and rural poverty in China, either by directly stimulating agricultural production or indirectly through the creation of employment in the non-farm sector. However, in the early stages, the main stimulus came from the institutional reforms, accounting for 60 percent of the agricultural production growth during 1978–1990, which would leave 40 percent attributable to the public expenditure policies (EIU, 2008).

Indonesia, significantly stepped up public funding for agricultural research, increasing it by 9.5 percent per year during the 1970s. The expansion came with the creation of the Agency for Agricultural Research and Development. Spending on extension services and rural education also increased during this period and decades after, thereby helping accelerate agricultural transformation in Indonesia from the 1980s onwards (Tsakok, 2011). In addition, increases in public investments in irrigation infrastructure, rural roads and electrification were equally important. According to EIU (2008), those infrastructure investments could explain as much as 48 percent of the poverty reduction achieved between 1976 and 1993. When also adding spending for R&D, extension services and input subsidies, public expenditures for agricultural development might explain as much as 82 percent of agricultural growth and 68 percent of poverty reduction during 1976–1993 (EIU, 2008). This progress slowed considerably, however, following the Asian economic crisis of the late 1990s. The budget for public investment was cut back drastically, agricultural growth slowed markedly and the result was a resurgence in the rural poverty rate from 20 percent in 1996 to 25 percent in 1998 (Timmer, 2005). In the 2000s, after the economic crisis receded, public spending recovered, growing by 11 percent on average between 2001 and 2009 (Siregar *et al.*, 2012). Most of the increase went to spending on poorly targeted subsidies. As a consequence, the rural poverty incidence was brought down to 19 percent in 2010, barely below the levels already reached in the years before the crisis (Ibid, 2012).

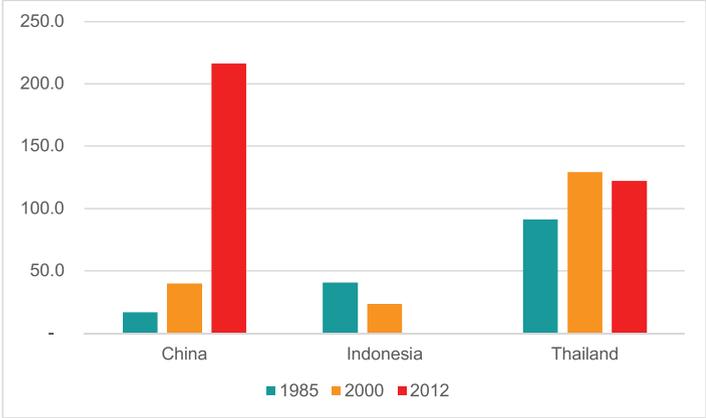
Public expenditures for agricultural development traditionally have been high in Thailand. Funding of agricultural R&D has been an important factor in driving agricultural productivity growth. Public research was formally organized in the 1950s and 1960s, as public research organizations were established within the Ministry of Agriculture. Universities also played a role in publicly funded agricultural research. The research helped the development and local adoption of high-yielding varieties, especially for rice and sugar cane. In the fisheries sector, new varieties of fish, reproduction and cultivation methods have also been important for growth. The development and adoption of farm equipment has also helped the agricultural sector advance, with land preparation and harvesting becoming mechanized in the 1990s (Poapongsakorn, 2011). Foundations were laid in preceding decades for the adoption of new varieties and modern farming practices. During the 1960s and 1970s, agricultural production growth was mainly driven by land expansion. During this period, the government supported land expansion by granting tenure rights to farmers who cleared forests and paid taxes tenure. As forest land was cleared, rural infrastructure expanded, including irrigation, transportation and electrification (Upali Wickramasinghe, 2017). Productivity was raised with the expansion of land under irrigation, which more than

doubled from 1.7 million ha to 4.4 million ha between 1970 and the late 1990s. The central plain was the primary focus of large-scale irrigation projects in the 1970s and 1980s. Since the mid-1980s, irrigation investment has shifted away from large-scale projects to smaller-scale systems (Leturque and Wiggins, 2011).

Public spending helped expand rural electrification in all three countries. They reached near-full coverage by 2015, though they started from much lower levels in the 1980s, as in Korea and Malaysia (Figure 22). In the 1970s, Indonesia and Thailand still had much lower net primary school enrolment rates than Korean and Malaysia, and this may have been a factor in the slower process of agricultural transformation (Figure 23). China, however, already had high primary school enrolment rates at the start of its economic take off in the early 1980s.

Figure 21: Per capita public expenditures for agriculture In China, Indonesia and Thailand

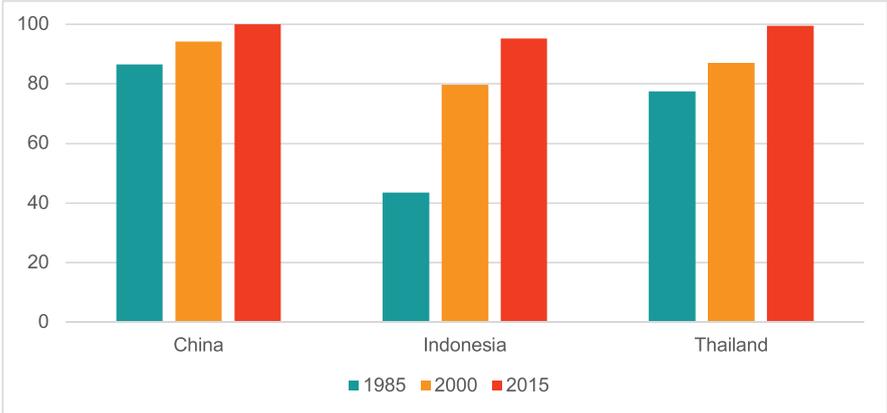
(Expenditures in 2011 PPP\$)



Source: Laborde et al., (2018) and Vos (2018)

Figure 22: Rural electrification in China, Indonesia and Thailand

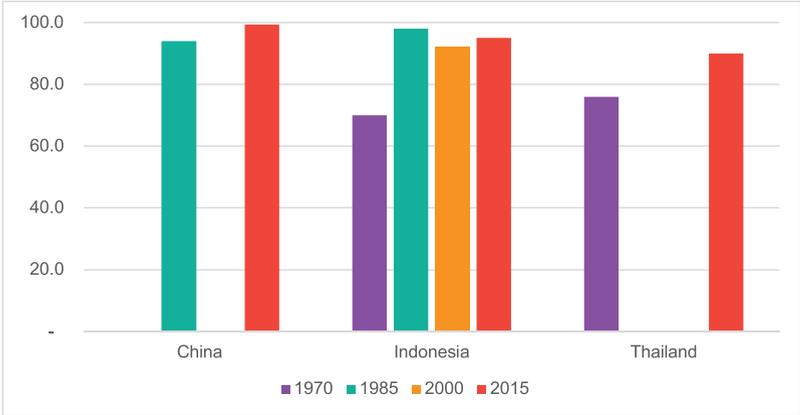
(% of rural population with access)



Source: Laborde et al., (2018) and Vos (2018)

Figure 23: Net primary school enrolment rate in China, Indonesia, and Thailand

(% of children in primary school age)



Source: Laborde et al., (2018) and Vos (2018)

3.3 Very late transforming countries: the role of policies and institutional reform

Afghanistan, Bangladesh, Cambodia, India, Myanmar, Pakistan, the Philippines and Viet Nam have all made progress with agricultural transformations more recently, albeit in varying degrees. All moved from stage 4 to stage 3 between 1990 and 2015, that is, they moved from the stage where labour starts exiting agriculture to where agriculture becomes a contributor to the growth of the economy at large (Table 4). Afghanistan and Myanmar even advanced two stages (from 5 to 3). Pakistan and the Philippines had already reached stage 3 by 1990. They belong to the slow or stagnant very late transformers within this group of countries. In the section that follows, we describe policy and institutional reforms in Bangladesh, India, Pakistan and Viet Nam.

3.3.1 Institutional reforms

India engaged in land reform not long after independence. In contrast to the early successful transformers, India's land reform of 1955 was too limited to make a significant impact on agricultural development at that point in time. In essence, it consisted of a stricter enforcement of the existing tenancy law. The 1955 law and its successive amendments have guaranteed to sharecroppers permanent and inheritable incumbency rights to land that is registered, if they would pay the legally stipulated share. Because of loopholes in the law and little administrative support for poor and often illiterate sharecroppers, very few of them actually registered their landholding. This, combined with low levels of public investment in infrastructure and rural development, was probably a key factor in holding back agricultural productivity growth and rural transformation in most of India until at least the 1990s. This changed when such investments were stepped up in subsequent decades (United Nations, 2006: 136-137, and further below). Where tenancy laws were more effectively enforced, such as in the state of West Bengal, agricultural growth accelerated earlier. In West Bengal, Operation Barga proved more effective in that respect, providing security of tenure to sharecroppers during the 1970s (Banerjee *et al.*, 2002). Helped further by rural infrastructure improvements, West Bengal experienced a significant jump in the annual growth rate of rice production, its major food crop: from 1.8 percent during 1960–1976 to 4.7 percent during 1977–1994 (Raychaudhuri, 2004).

Agricultural development in Bangladesh has been constrained by land scarcity. Per inhabitant an average of just 0.09 ha of agricultural land is available. Smallholder farms account for most of the sector. Since the country was founded in 1971, no government has attempted to reform the land tenure system. According to FAO (2010), this lack of institutional reform is mainly the result of a failure to sufficiently appreciate the country's land constraints. Instead, successive governments have prioritized farmers' access to finance. Large-scale subsidized credit programmes operated by state-owned banks, such as Bangladesh Krishi Bank (BKB) and Rajshahi Krishi Unnayan Bank (RAKUB), have provided support for agricultural growth since the 1970s. More recently, government has promoted microfinancing mechanisms, starting with the Grameen Bank Ordinance in 1983, and in 2006, the establishment of the Microcredit Regulatory Authority (MRA). Microfinance institutions now provide about 30 percent of formal bank lending to rural areas. Microfinance has served to improve smallholder

access to input supplies and storage, and has also helped fund the start of small-scale food processing activities. In the 1990s, the liberalization of the market for agricultural machinery was an important regulatory change. Private-sector companies emerged selling and renting machinery. A sub-sector of agricultural machinery manufacturers has also been growing alongside imports and after-sale service providers., Improved access to finance, while providing a boost to agricultural development, has not solved the problem of fragmented landholdings caused by the overall land constraint. Land constraints also explain the slow uptake of mechanization. More recently, uptake seems to be accelerating in areas where labour exit from agriculture has been outpacing agricultural productivity growth, leading to labour shortages in the sector (Alam, 2019).

In Viet Nam, family farming replaced collective farming during *Doi Moi*, or the policies of economic reform that began in 1986. Under the new system, the government allowed farmers to lease parcels of state-owned land for up to 15 years, and were given the freedom to sell what they produced as they wished. As in the case of China, other reforms favourable to agricultural productivity growth were implemented in parallel, including domestic-market and trade liberalization. These reforms allowed for the introduction of market-based transactions in agricultural and non-agricultural products and the entry of foreign direct investment. As a result, Viet Nam has moved toward a more open economy. Several reforms also led to changes in domestic price-support policies. In 1979–80, the government lifted restrictions on individual farming households, permitting them to keep or sell surplus above that contracted by collective farms on the market. In addition, the rationing system was abolished in 1987. A result of that measure was that official prices were raised to near market prices. Also, in 1990, the government ended its procuring of agricultural goods, allowing farmers to sell all produce at market prices (Athukorala, Huon and Thanh, 2009). Along with domestic price liberalization, the trade regime was opened up. The average import tariff on agricultural commodities fell from 22 percent to 13.6 percent between 1999 and 2004. Quantitative import restrictions were largely eliminated, aside from those related to sugar and petroleum products. Restrictions on foreign direct investment were eased, and private companies were allowed to participate in foreign trade (Athukorala, Huong, and Thanh, 2009).

Many countries in South and Southeast Asia enacted regulatory changes and liberalization of agrifood markets in different stages (Timmer and Reardon, 2014). These changes facilitated the transformative change of agriculture and rural economies. They helped modernize and open up wholesale distribution and food processing during the 1960s through the 1980s. India and Viet Nam, however, did not allow the entry of foreign companies in their food industries until the 1990s. The bigger changes in most other parts of the region took place from the mid-1980s to today on the wave of economic liberalization and globalization. During these phases, agrifood systems modernized, and supply chains began to include large-scale operators in retail ('supermarket revolution'), wholesale, food processing, and greater vertical integration of food-market value chains (Section 2.2.4).

3.3.2 Price incentives

Domestic price and trade policies conducted by the very late transformer governments were characterized by a significant anti-agricultural bias for a prolonged period of time. India, especially, has sustained an anti-agriculture bias until today. In Bangladesh and Pakistan, the relative rate of assistance has been negative ever since the 1970s. More recently, however, agricultural price policies have moved gradually towards a more 'neutral' (zero) stance in both countries. Viet Nam also gradually removed its initially strong anti-agricultural bias during 1985–2005.

India traditionally has provided significant subsidies for agricultural inputs. Fertilizer subsidies increased from 2.6 billion Indian rupees in 1976 to 80 billion rupees in 2000. Irrigation subsidies increased by 7.6 percent on average per year between 1966 and 1999, though during the 1990s the rate of growth slowed to 1 percent per year. Electricity use in agriculture was also heavily subsidized during that period, which led to the agriculture sector consuming 29 percent of the total electricity use in 1999, but farmers only paid 3.4 percent of the cost (Fan, Gulati, and Thorat, 2007). Trade policy was likewise interventionist, favouring protection of the manufacturing and service sectors over agriculture.

In the late 1990s, however, policies shifted towards trade liberalization. Export controls, and quantitative and tariff restrictions on imports were reduced (EIU, 2008). However, the liberalization measures and a more flexible exchange rate policy did not offset the overall anti-agricultural bias (Figure 24a). A closer look at India's price interventions reveals that the anti-agricultural bias (negative relative rate of assistance) is strongly driven by taxes on agricultural exports as import-competing products are protected (Pursell, Gulati and Gupta, 2007). The most heavily taxed food products (negative nominal rate of assistance) are rice, fruits and vegetables, while the most protected ones (positive NRA) are milk, wheat and sugar. High input subsidies on fertilizers and other agricultural inputs have not been able to overcome the overall anti-agricultural bias in India's price policies. Public procurement of staple crop purchases for food reserve holdings and food distribution programmes have tilted agricultural support in favour of consumers.

Starting in the 1960s, Pakistan's⁷ agricultural markets were characterized by significant price interventions. These came to an end following the economic liberalization programme of the mid-1980s to the early 1990s. Tariffs, taxes and other direct government interventions in agricultural markets were drastically reduced. The government also put an end to its import-substituting industrialization strategy. The measures also helped substantially reduce the anti-agriculture bias in trade and price policies, but without eliminating it entirely. This is visible in the relative rate of assistance (RRA) for Pakistan, which remained negative during 1962–2005, although it fell from negative 69 percent in 1962 to negative 14.7 percent in 2005 (Dorosh and Salam, 2007). The anti-agricultural bias is still present but has been reduced compared to the 1970s (Figure 24b). Agricultural exports (rice and cotton) have been taxed, while many import-competing products (wheat, maize, sugar and milk) were protected.

⁷ Including Bangladesh until 1971.

Before the reforms of the 1990s, public monopolies managed the rice and cotton sectors with a significant level of implicit taxation and export taxes for cotton, amplified by the dual exchange rate system. During 1962–2005, sugar and milk benefited from high levels of protection, with a positive nominal rate of assistance (NRA) of over 120 percent. On the input side, chemical fertilizers were heavily subsidized until the early 1990s, which pushed up the NRA for wheat in particular (Dorosh and Salam, 2009).

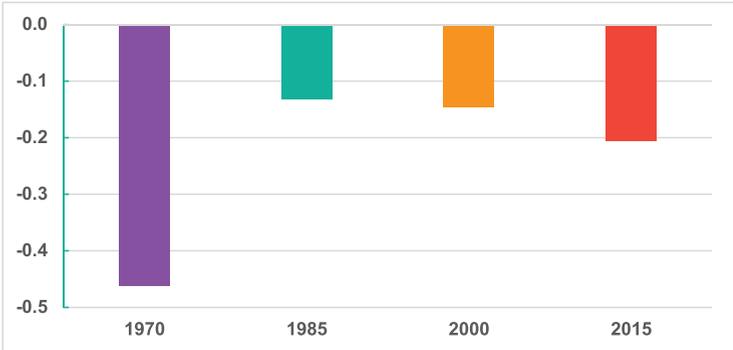
In Bangladesh, the government has pursued an economic liberalization process since the late 1970s. Upon independence, Bangladesh inherited the very restrictive trade and agricultural policies from when it was part of Pakistan. The main goal of these restrictive policies was to secure adequate domestic food supplies. During the 1980s and 1990s, however, the government started a process of gradual removal of high import tariffs, export taxes, quantitative restrictions and government monopolies in agriculture and food distribution. From 1981 through 1986, under pressure from foreign lenders and aid donors, including the Asian Development Bank, World Bank and USAID, export duties on raw jute and tea were removed. Subsequently, the duties on exports of dried fruit, fresh fruit, oil cakes, coriander seed, dry chillies, dry ginger, black pepper, turmeric, tobacco, vegetables, and potatoes were eliminated. The remaining export restrictions, mainly on rice, wheat bran, and molasses, were removed in the mid-1990s (Ahmed et al., 2009). The early reforms in the late 1970's concerned also the input sector when the monopoly of the Bangladesh Agricultural Development Corporation over the procurement and distribution of fertilizers, seeds, pesticides, and small irrigation equipment was eliminated and agricultural input markets were liberalized (though partially reversed in 1995). In addition, input subsidies, mainly for fertilizers, were introduced in the early 1980s, though support fluctuated as subsidies of and on inputs have been retracted and reintroduced during 1983–2005. Although overall agricultural price distortions were significantly reduced in the mid-1990s (Rahman, 1994; Ahmed et al., 2009), fertilizer subsidies have remained substantial with the government subsidizing 55 percent of the cost of publicly procured 50 kg bags of fertilizer.

On balance, the RRA for Bangladesh has remained negative, though the bias has diminished over time (Figure 24b). The total agricultural NRA has fluctuated around zero starting in the late-1980s and has shifted from negative to positive between 1995–1999 and 2000–2004 (Ahmed *et al.*, 2007). Exportables (jute and tea) have been relatively taxed, while import competing products (rice, wheat and sugar) and non-tradables were subsidized.

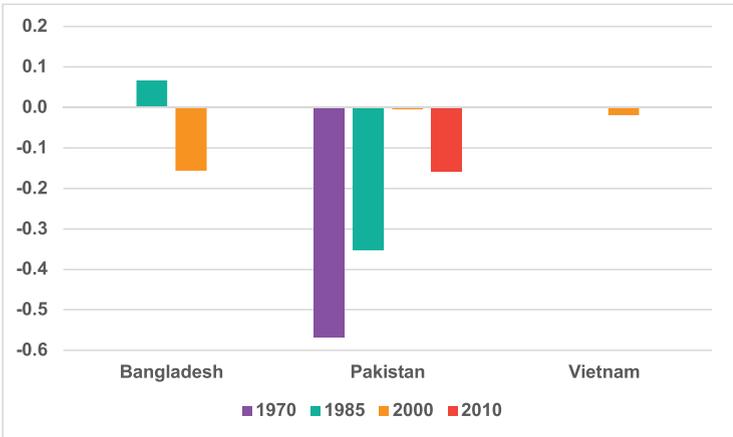
Viet Nam swiftly eliminated its anti-agricultural bias with the *Doi Moi* reforms of the 1980s, turning to a neutral stance between incentives for agriculture vis-à-vis non-agricultural sectors (see Figure 24b).

Figure 24: Relative rate of assistance to agriculture in Bangladesh, India, Pakistan and Viet Nam

a. India



b. Pakistan, Bangladesh and Viet Nam



Source: Laborde et al., (2018), Vos (2018), and Anderson and Martin (2009)

3.3.3 Public spending for agricultural development, education and infrastructure

Public spending for agricultural and rural development in the very late transformers has been well below that of the early successful transformers (Figures 25a-b). India and Pakistan did make significant investments in rural infrastructure, including for roads, irrigation and electrification, but these were insufficient to offset the feeble price incentives to induce an earlier take-off of agricultural transformation and productivity growth.

In India, public spending per farmer also increased more recently, but to levels no higher than those in Viet Nam and well below those of faster agricultural transformers in Asia. Spending was stepped up well after the land reform of the 1970s, and the lack of complementary support through improved rural infrastructure may have contributed

to that reform's failure to spur agricultural productivity growth. Traditionally, most public support to agriculture has been for input subsidies for fertilizers and irrigation water with less priority for investments in rural infrastructure. More recently, such investments have been stepped up, leading to increased rural road density and access to electricity, helping to accelerate agricultural growth. Yet, India's roughly 60-percent rural electrification coverage remains well below that of other parts of Asia where agricultural and rural transformations have progressed earlier and at a faster pace (Figure 26).

Viet Nam's institutional reforms were complemented with significant, and timely, public investment in rural infrastructure, such as roads and electrification. The government also invested in basic social services, including primary education, vocational training, and healthcare. These investments paid off by the 1980s, with accelerated agricultural productivity growth and the rapid growth of non-agricultural sectors (Van Arkadie and Duc Dinh, 2004). The pay-off came in part thanks to a relatively well-educated labour force. The country invested substantially in both primary education, and technical and professional training. According to Van Arkadie and Duc Dinh (2004), these investments in education laid the groundwork for the growth of non-agricultural sectors that was paramount for Viet Nam's transformation process.

In Bangladesh, public investments in agricultural research and technology, and rural infrastructure, have contributed to productivity growth. Particularly crucial was the increase in irrigation in the area under rice cultivation (Ahmed *et al.*, 2009). However, about 75 percent of cultivated land is irrigated with groundwater, which is putting stress on available water reserves and the environment (Ghani, 2016). Also, the Bangladesh Rice Research Institute (BRRI), in collaboration with International Rice Research Institute (IRRI), has invested heavily in the development of hybrid and high-yielding varieties (HYV) of rice (IRRI, 2020). With three rice-cultivation seasons each year, Bangladesh now also produces hybrid and HYV rice during its dry irrigated season. Introduction of such varieties, along with multiple cropping and use of increased inputs per hectare, has contributed to higher rice production, a decrease in food insecurity and increased welfare (Shew *et al.*, 2019).

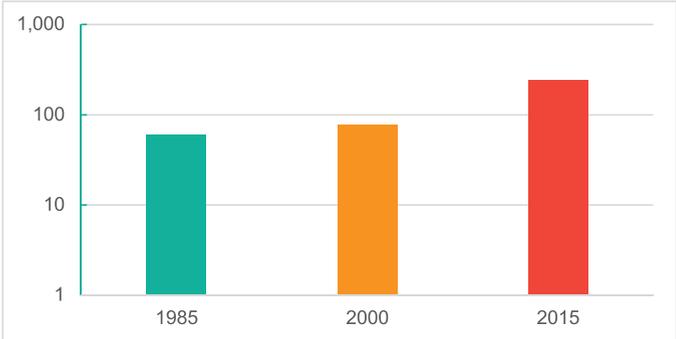
In Pakistan, public spending on irrigation and agricultural research and extension, although modest compared to other countries, helped diffuse the adoption of Green Revolution technologies, such as improved seeds, fertilizers, and irrigation through private tube wells. Productivity increased significantly for rice and wheat. Wheat production doubled between the early 1970s and late 1990s (Ali and Byerlee, 2002). Between 1960 and 2005, the total land area under irrigation expanded from 10 million to 19 million hectares. By 2005, major investments resulted in 80 percent of total cropped area being irrigated (Dorosh and Salam, 2009). Nonetheless, growth of agricultural GDP has been erratic, fluctuating between 0.8 percent and 4.5 percent per year during 1970–1995. Given the country's high rate of population growth, food production should have increased by at least 5 percent per year to significantly improve food security and achieve inclusive agricultural transformation (Naqvi *et al.*, 1992). In practice, most of the growth that was achieved benefited large-scale farmers

controlling most of the irrigated land and able to deploy mechanized production methods (Chaudhry and Chaudhry, 1997).

In all four countries, rural electrification coverage started at lower levels than in the earlier transforming economies. While rapidly catching up, coverage is still relatively low in Bangladesh. Coverage has become universal in Viet Nam (Figure 26). The net primary school enrolment rate in Pakistan remains rather low, with levels similar to those achieved by India in 1970 (Figure 27). Until recently, this was also the case in Bangladesh, but school attendance has significantly increased. Viet Nam achieved near universal primary school access in 1970.

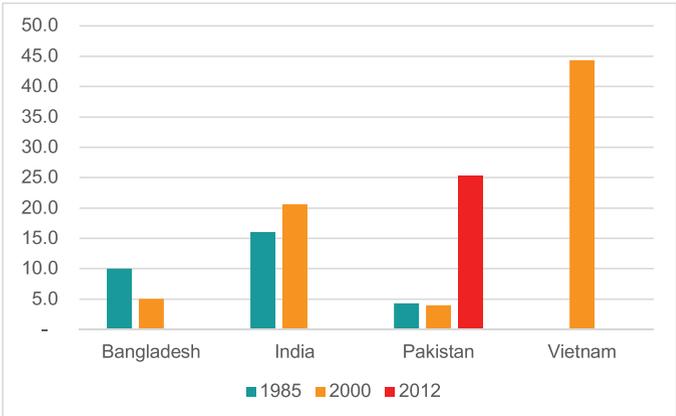
Figure 25: Public expenditures per farmer and per capita in Bangladesh, India, Pakistan and Viet Nam

a. Public expenditures per farmer in India (2011 PPP dollars; log scale)



Source: Laborde et al., (2018) and Vos (2018)

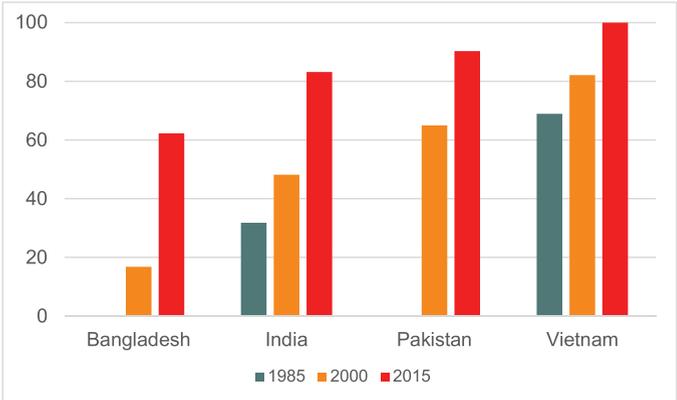
b. Public expenditures in agriculture per capita in Bangladesh, India, Pakistan, and Viet Nam (PPP dollars)



Source: Laborde et al., (2018), Vos (2018), and Anderson and Martin (2009)

Figure 26: Rural electrification in Bangladesh, India, Pakistan, and Viet Nam

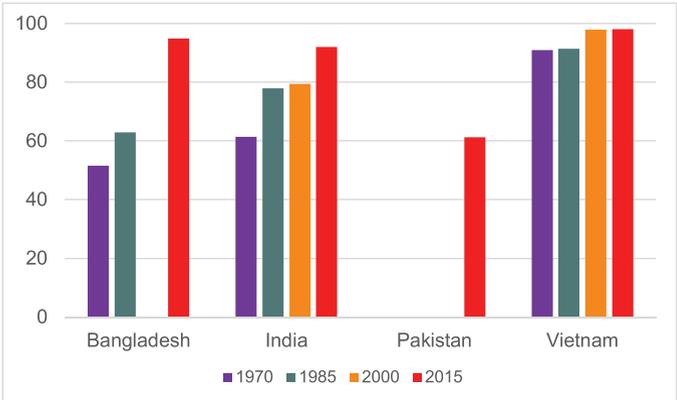
(% of rural population with access)



Source: Laborde et al., (2018) and Vos (2018)

Figure 27: Net primary school enrolment rate in Bangladesh, India, Pakistan, and Viet Nam

(% of population in primary school age)



Source: Laborde et al., (2018) and Vos (2018)

3.4 Lagging countries: the role of policies and institutional reform

The last group of countries, composed of Lao PDR and Nepal, has not made progress since the 1990s and is still lagging at the early stages of the agricultural transformation process.

3.4.1 Institutional reforms

In 1975, the Government of Lao PDR introduced new institutional arrangements promoting two types of collectivization: state farms and farmers cooperatives. In the early period, it introduced the strategy of collectivization through discourses given by the government at different levels, called *hian kan meuang*, or learning politics. It created more than 4 000 cooperatives in the country within 10 years (Bourget, 1993). However, government officers often lacked the capacity to efficiently plan and transmit the centralization policies to the grass roots level. This also applied to the system of price controls, introduced in the 1970s. The system failed to achieve its main target of food self-sufficiency, and was subsequently abandoned (Section 3.4.2). From the late 1980s, with the introduction of the New Economic Mechanism (NEM), the government embarked on a far-reaching liberalization process, including the elimination of many of the agricultural price controls and the abandonment of the collectivist farming system. It introduced a wide range of new legislation, including laws to facilitate foreign direct investment and provide protection of private property rights (Ivarsson, 1995).

Agricultural productivity growth in Nepal has lagged that of other South Asian countries⁸ over the last three decades. The poor performance was caused in part by protracted armed conflict, civil strife and political instability. These conditions have eroded already low institutional capabilities. As a result, the process of structural change and agricultural transformation has been slow and economic growth has been stagnant (Paudel and Wagle, 2019). Farmers, especially smallholders, have poor access to modern inputs, technology and credit. In 2015, only 22 percent of farmers had access to agricultural credit with only 37 percent among them borrowing from institutional sources (*ibid.*). More recently, however, the government and the Bank of Lao PDR (central bank) have embarked on a subsidized credit scheme channelled through the Small Farmer Development Bank, and introduced mandatory directives requiring the formal banking system to increase agricultural credit. The Bank of Lao PDR is underwriting the directive through a refinancing facility for banks providing credit to the agricultural sector.

3.4.2 Price incentives

After a protracted armed conflict, Lao PDR was founded in 1975, and its leaders opted for a centrally planned economy with the aim of unifying the population and developing social solidarity. The government introduced direct price controls that fixed the price of food staples, such as rice and other essentials. The stringent controls led to the development of parallel black markets for commodities and foreign

⁸ The total factor productivity growth rate was 0.06% per year during 1981–2013, the lowest in South Asia (Anick et al, 2017)

exchange. The government nationalized most industry, transport, and commerce. It set up state-owned trading companies to manage the imports of most commodities (Khouangvichit, 2010). In addition, it levied taxes on agricultural production, sparking discontent among peasants (Brown and Joseph, 1977). The centralized control of the economy held back modern agricultural transformation and failed to achieve most of its intended goals, especially achieving food self-sufficiency. Many of the control mechanisms were abandoned in the late 1980s, following the introduction of the New Economic Mechanism (NEM) adopted during the Fourth Party Congress. The NEM was a shift to a more liberalized economy. The shift was accelerated by the collapse of the USSR. The government labelled the reforms *chintana kan mai* (new thinking). They aimed to make public enterprises more accountable, deregulate price controls and remove trade barriers. Internal trade between provinces was deregulated and the exchange rate system was unified with the establishment of a single exchange rate. The reforms had only a limited impact on the agricultural sector and benefited mainly the mining sector, which contributed to rapid economic growth during the 1990s and 2000s.

In the 1960s, Nepal introduced strict agricultural price controls. The control mechanisms involved all stages of agrifood supply chains but were most stringent for inputs. In 1966, the Agriculture Input Corporation (AIC) was brought under the then Ministry of Agriculture, though it continued to operate as a public enterprise. The AIC controlled all imports and distribution of chemical fertilizers. To promote uptake, the government introduced subsidies on fertilizers in 1973, consisting of a subsidy on both the purchase price of fertilizers and the cost of transportation to selected districts. However, when fertilizer prices increased significantly in international markets in the mid-1990s, the AIC began operating at a loss and no longer had the funds to meet import demand for fertilizers. The high fiscal burden and poor results of the agricultural controls led the government to liberalize the sector in the mid-1990s. In 1997, it launched the Agricultural Perspective Plan (APP) that among other things deregulated the fertilizer market (Pokharel, 2019). Subsidies were removed, and the private sector was allowed to enter the market for both imports and distribution. The seed sector followed the same steps.⁹ Subsidies were eliminated for pump sets and tube wells. The removal of the subsidies for fertilizers and irrigation caused a decline in fertilizer use and coverage of irrigated land. The government reintroduced subsidies on these inputs in 2009. In addition, the government also introduced tax exemptions for purchases of small-size machinery, such as pump sets, threshers, tillers and small harvesters. The Nepalese government continues to influence final agricultural output prices through public purchases and sales operated by the Nepal Food Corporation and Dairy Development Corporation. This mostly affects milk, other dairy products and food grains, mainly rice. In collaboration with the corresponding commodity boards, the government also sets consumer prices for sugar, coffee and tea, but these only serve as benchmark prices and do not constitute mandatory minimum price levels. Producers may not be able to sell at these prices if the market conditions push actual prices above or below the benchmark prices.

⁹ More precisely, AIC was split into two companies: Agriculture Inputs Company Limited, responsible for the fertilizer business, and the National Seed Company Limited, responsible for the crop seed business.

Agricultural price incentives are strongly influenced by exchange rates. The huge amount of remittance incomes (about 30 percent of GDP), means there is strong pressure for the real exchange rate to appreciate. This structural feature of the economy has created a lasting bias against tradable agricultural production, eroding the competitiveness of export crops, which become more expensive, and import-competing crops for domestic markets as imports become cheaper.

3.4.3 Public expenditures for agricultural development

Public expenditure in Lao PDR and Nepal are far below the levels of successful early transforming economies. The scarce data available (Figure 28) shows total public spending for agricultural development per 100 000 farmers. Average spending in Nepal is three times less than that in Lao PDR, while the latter's is already well below that of other countries in Asia. In comparison, spending per farmer in Malaysia is tenfold that in Lao PDR. Public spending on research and development is particularly low. In Nepal, the current investment in agricultural research is less than 0.3 percent of agricultural GDP (Gaucham, 2019).

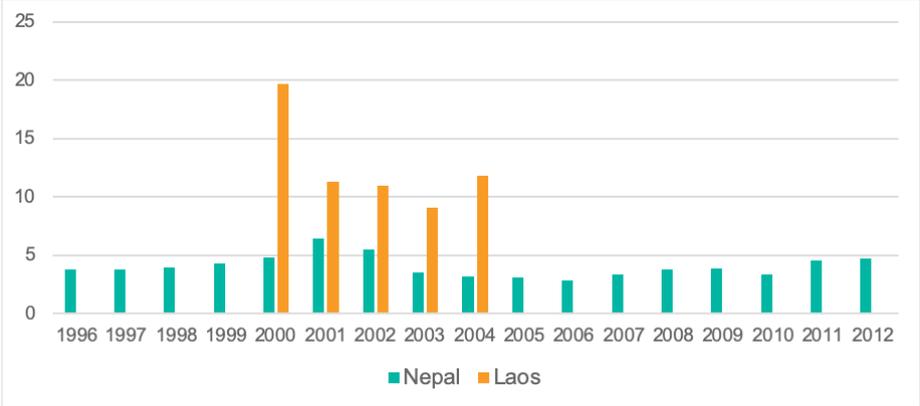
In terms of infrastructure, rural electrification coverage is still very low in both countries. The electrification levels are half of India's in 2000 and four times lower than those of the early transforming countries. There have been significant efforts during 2000–2015 when the connectivity increased at least threefold in the two countries (Figure 29). Public investment in rural infrastructure is of the essence, especially for Nepal given its land-locked position and the difficult topography of the country, making transport and other forms of connectivity costly and challenging. The doubling of public capital expenditure for infrastructure, such as rural roads and electricity), between 2001 and 2016¹⁰ was encouraging, though the degree of connectivity reached remains far from sufficient for adequate market access for farmers and for a thriving commercialization of agricultural production.

The contrast with successful countries in educational performance is significant, though not as stark as that for rural infrastructure (Figure 30). Primary school enrolment rates in both Nepal and Lao PDR had reached similar levels as those for India in 2000, but the gap with successful countries was 26 percentage points for Nepal and 23 points for Lao PDR at that point in time. However, between 2000 and 2015, important progress was made, reducing the difference to only 4 percentage points for Lao PDR and practically zero for Nepal.

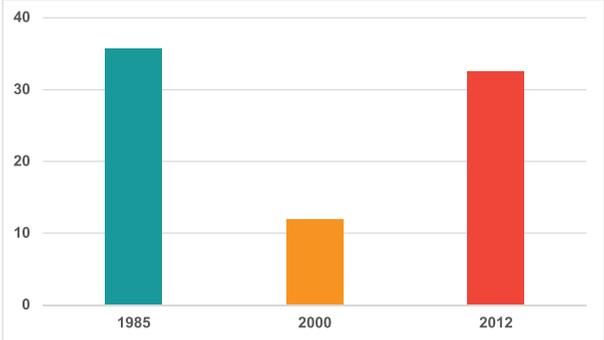
¹⁰ Because of low initial levels this should be interpreted with caution.

Figure 28: Total public spending for agriculture per farmer and per capita in Lao PDR and Nepal

a. Spending per farmer (2011 PPP\$)



b. Spending per capita in Nepal (2011 PPP\$)



Source: Gaucham (2019) for Nepal.

Figure 29: Rural electrification in Lao PDR and Nepal

(% of rural population with access)

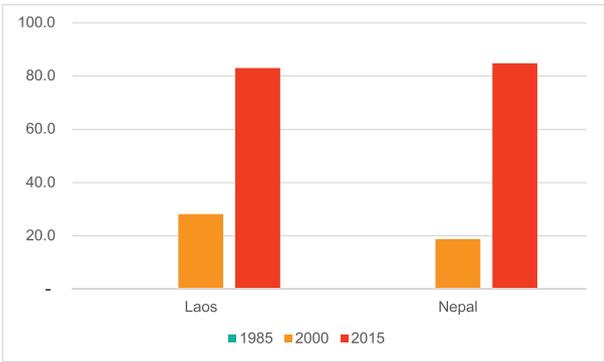
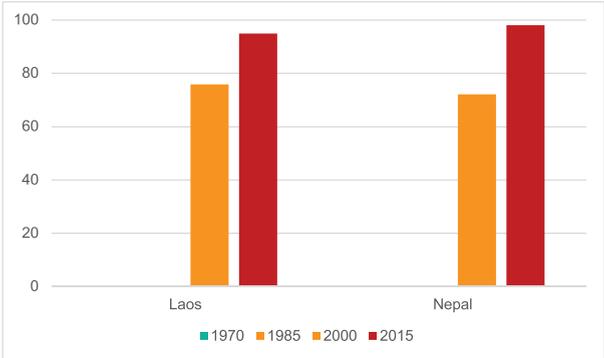


Figure 30: Primary enrolment rate in Lao PDR and Nepal

(% of population in primary school age)



Source: World Development Indicators.

4. Conclusions

4.1 Key findings

Both international experience and economic theory show that structural change is an essential component of long-term economic development. Urbanization and industrial growth are key features of this structural change. Along the way, rural labour and savings are being pulled into higher productivity sectors to underpin broader economic growth. With some variation across countries, this process was key to the remarkable acceleration of economic growth in East Asia and parts of Southeast Asia over the past half century or more, belying pessimistic views about Asia's development potential that were predominant until the early 1970s.¹¹ However, this 'miracle' could not have come about without strong agricultural productivity growth and agrarian change in initial stages of economic take-off. The Green Revolution, reforms of agricultural and rural institutions, and public investment in rural infrastructure have been critical factors in the take-off of the early and late successful transformers. In subsequent stages, industrial and other modern-sector development took over as the main drivers of economy-wide growth, while at the same time pushing agriculture and rural economies to deeper transformative change, as urbanization, income growth and other factors have caused major dietary change and led to a more industrial organization of food systems at large.

This process is also taking place in South Asia and less developed parts of Southeast Asia, albeit at a slower and delayed pace. Initial concerns with structural impediments to development in India, Bangladesh and other South Asian countries, held back agricultural growth and broader economic development in cumulative causation, certainly in comparison with other parts of Asia. These include land scarcity, historical traditions of production activity, weak institutions, and a 'soft state.' The lifting of these constraints, even partially, unleashed faster growth. However, moving forward, fewer of the lessons from East Asia may be relevant for India and the rest of South Asia.

Some patterns will likely remain the same. All countries will see agricultural employment diminish in importance. This decline is consistent with agricultural productivity growth, wider spread of mechanization, and with agrifood transformations and dietary change with increased demand for processed food and the importance of off-farm activity related to food chains. But the pace of these changes has been different and will be different among countries in the region.

Structural transformation is already most advanced in the countries of developing Asia, but pathways have starkly differed. In Malaysia, agricultural export growth and extensive farming have driven rapid labour exit from agriculture, leading to a faster declining share for agriculture in employment than the sector's share in GDP. Elsewhere, as in India and Bangladesh, and to a lesser extent in Indonesia, Thailand, Viet Nam and the Philippines, the decline of agriculture's share in employment has lagged behind

¹¹ Gunnar Myrdal's notion of an Asian drama (Myrdal, 1968) was one rather dramatic expression of that pessimism, referring in particular to the institutional, cultural and structural weaknesses he saw as impediments to economic development in South Asia and Indonesia.

the drop in agriculture's share in GDP. These contexts are further characterized by increased fragmentation of landholdings. Agricultural labour productivity growth has been slower in consequence and could slow down poverty reduction if not offset by other drivers. Employment growth in non-farm (agri-food and other manufacturing) activities and agricultural exports have been important other drivers of poverty reduction in Southeast Asian countries. Such factors have been less dynamic in recent decades in the countries of South Asia, warranting the expectation that poverty among their populations will be far from eradicated in the coming decades.

The ability of small farms to become efficient, the capacity of midstream agrifood supply chain segments to develop, and the requirements for a dynamic and inclusive food system development have been strongly conditioned by public investments and policy choices (Section 3).

Ongoing urbanization and modernization of agrifood systems are changing the nature of rural transformations (Section 2.2.4). Farm efficiency and rural employment opportunities are increasingly influenced by what happens beyond the farm gate and the strength of rural-urban linkages. However, many challenges remain in countries in the early to medium stages of agricultural transformation. Land scarcity combined with continued population pressure has led to further fragmentation of landholdings and to added pressure on already degraded land, and scarcity of water resources (Vos and Bellù, 2018). These factors imply that continuing along past development pathways will eventually collide with environmental constraints. Likewise, while structural change has dramatically brought down poverty and undernourishment in Asia, dietary and food-system changes have produced new malnutrition challenges. Overweight and obesity are on the rise (Section 2.2.3).

4.2 What role for public policies?

Finding the appropriate balance between an effective public role and an efficient private role in the modernization of agriculture and the entire food system has always been a difficult challenge. In Asia, as in the rest of the world, most of the food system is market based and, aside from some major public procurement schemes in some countries, governments have by and large retreated from direct interventions in agriculture and food markets. To influence future food system development, governments will have to rely on a variety of policy tools. Among them are price incentives, and institutional and regulatory frameworks for land tenancy, food safety and quality standards. Also needed are financing and/or provisioning of public goods, such as education, basic infrastructure, and research and development. They must adopt broader development policies, including for taxation, trade, exchange rates, and credit markets. Those policies must create an enabling environment for agrifood businesses to thrive.

Section 3 showed how the use of these policy instruments has helped promote or deter processes of agricultural transformation in Asia. The main lessons from the past experiences, to the extent they can be generalized, are that:

- Land and institutional reforms are designed and put in place to underpin secure tenancy, more equal land distribution, greater commercialization and improved credit access. These are essential to get agriculture moving at early stages of economic transformation, remain essential to incentivize farmers to invest and innovate, support continuous productivity growth and, with it, improve farm incomes, reduce poverty and secure affordable access to food.
- Agricultural transformation processes typically have accelerated when countries remove anti-agricultural biases in tax, trade and price policies.
- Public investments in education, research, extension services, energy supply, water management, and irrigation are crucial to support improved access to markets, commercialization, and the development of agrifood value chains.
- Ultimately, no country has succeeded without an adequate combination of these policies and types of public investments. They should complement and reinforce each other. These ingredients have been especially important in initial stages to get agriculture moving, but adapted to the changed context. They remain equally important in subsequent stages of agricultural transformation.

These types of policies have been instrumental to support agricultural productivity growth, overall income growth, poverty reduction and food security. Moving forward, they will remain important for countries in Asia that are still in stages 3 and 4 of agricultural transformation, the early stages (Table 4). However, they will have to do so in a context much different from several decades ago. Importantly, population pressures on land, water, and other natural resources have increased significantly and most food demand is from people living in urban areas. This will require that the mere focus on productivity growth and food availability of past agricultural transformation strategies will have to be rebalanced to ensure public policies are redesigned to:

- promote productivity improvements through sustainable intensification of natural resource use;
- leverage the midstream of agrifood supply chains, including logistics and transportation, packaging and distribution, processing, and retailing;¹²
- promote diversification of food supplies and guarantee food quality to support dietary diversity and healthier food intake.

Countries in more advanced stages (1 and 2) of agricultural transformation will also face policy challenges. The emphasis, however, may have to be much more on the first and the third challenge. New incentives may also be needed to encourage midstream food supply actors to limit and change resource use for environmental sustainability and provisioning for healthier diets.

¹² See e.g. FAO (2017) and Vos and Cattaneo (2020, forthcoming) for ways to leverage the potential of this “hidden middle” not just for efficient food delivery to both urban and rural consumers, but also to tap the employment potential of developed food supply chains and to dynamize farm system change, as discussed in section 2.2.4 of this paper.

This is not the place to define this new policy agenda for the promotion of agricultural transformations in the coming decades. Clearly, this agenda will be more difficult to implement in the decades ahead given the vested interests that may wish to preserve the current system. However, policy makers are must embark on balancing multiple major and existentialist objectives: farm efficiency, broader economic development, food security for all, food-system-wide environmental sustainability, and healthy diets for better nutrition and health.

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Appendix

A.1 Cluster analysis methodology

Cluster analysis is often used for grouping data objects or observations with a goal to have objects within a group that are similar to each other and unrelated to other objects in different groups. The closer the objects within a group, and the wider the differences between groups, the more distinct the clustering. Several studies (Laborde *et al.*, 2018 and 2019) use this analysis to examine clusters of agricultural transformation in the countries, and performance in the dimensions of food security and nutrition. Laborde *et al.*, (2018) use a qualitative and quantitative assessment of agricultural transformation with three families of clusters: the first cluster analysis defines inclusive agricultural transformation, a second identifies the structural drivers in which the transformation process takes place, and the third maps the policy space associated with this phenomenon. Following Laborde *et al.*, (2018), the cluster analysis for agricultural transformation in Asia is performed with an added dimension – combining inclusive agriculture with productivity.

Cluster analysis can be regarded as a form of classification, meaning that it labels objects by cluster. There are various types of clustering, such as centroid-based, graph-based, density-based clustering etc. and these depend on the data types and the goal of the analysis. Since our objective in this study is to cluster countries based on the stage of agricultural transformation, structural context and policy space, and most of the data are of continuous types, we aim to deploy centroid-based clustering. This means finding the average of all points in a cluster. Implementation of this clustering is done through the K-means technique that defines a cluster in terms of a centroid, usually the mean of each group of points.

After the data is selected and analysed, and data gaps are addressed, either using alternative sources or interpolation, we harmonize variable units. In addition, we also transform the data into logarithm scale for selected monetary variables, such as value addition per worker etc. as they appear in wide range. Finally, where relevant, we compute the data as 5-year averages for six periods (1990 = average for 1989 to 1992, 1995 = 1993 to 1997, 2000 = 1998 to 2002, 2005 = 2003 to 2007, 2010 = 2008 to 2012, and 2015 = 2013 to 2017) to smooth annual variations and maximize coverage. In this framework, the cluster analysis was performed based on a pooled set of data with country and year as dimensions.

Following the typology and methods in the study on agricultural transformation by Laborde *et al.*, (2018), we experimented with a number of additional variables, such as agriculture value added per worker, fertilizer use, water stress as percentage of total renewal water resources etc. The last two variables (fertilizer use and water stress) bring sustainability perspective into the analysis. The results of such exercise didn't yield anything meaningful. Consequently, we decided to follow the typology of agricultural transformation used by Laborde *et al.*, (2018) but with the added dimension of labour productivity, and discarded these variables from the final run of cluster analysis in studying agriculture transformation stages. However, we added water stress as a structural constraint and put in the sequence of variables for clustering of structural drivers.

A.2 List of variables and definitions

Category	Domain	Variable	Description	Unit	Source
Agriculture Transformation	Undernutrition	PUNDP	Prevalence of undernourishment	% of population	WDI
Agriculture Transformation	Agricultural Productivity	AGVDW	Agriculture value added per worker	Constant 2010 US\$ per worker	IFPRI
Agriculture Transformation	Economic Structure	AGEMP	Employment in agriculture	% of total employment	WDI, ILO
Structural	Agricultural assets	LNCAP	Agricultural land per capita	Hectare per capita	FAO
Structural	Agricultural assets	SUITAB	Potential land productivity	US\$ per ha	IFPRI based on GAEZ dataset, FAO
Structural	Agricultural Productivity	FERTI	N Fertilizer Use	Tonnes per ha	FAOSTAT
Structural	Agricultural Productivity	PESTI	Pesticides Use	Tonnes per ha	FAOSTAT
Structural	Agricultural Productivity	TFPAG	Total Factor Productivity in agriculture (changes)	%, growth rate	IFPRI
Structural	Agricultural Productivity	YIELD	Cereals Yield	Kg per hectare	FAO
Structural	Economic Structure	AGGDP	Agriculture, forestry, and fishing, value added	% of GDP	WDI
Structural	Economic Structure	GDPPC	Per Capita GDP PPP	US\$ PPP	WDI
Structural	Economic Structure	NARSD	Dependency to natural resources (Raw commodities exports in GDP)	% of GDP	IFPRI based on WDI, COMTRADE
Structural	Geography	LANDL	Landlocked country	Dummy	CEPII
Structural	Institutions	CCORP	Control of corruption	Index	WGI
Structural	Institutions	EFIND	Economic freedom index	Index	Heritage Foundation
Structural	Institutions	FSIND	Fragile State Index	Index	
Structural	Institutions	GOVEF	Government effectiveness	Index	WGI
Structural	Institutions	PSIND	Political stability index	Index	Heritage Foundation
Structural	Population dynamics	PGRWT	Population growth (birth rate)	Per 1,000 of population	WDI
Structural	Sustainability	WATSR	Water stress	% of total renewable water resources	Euromonitor

Chapter 3

KOREA

Agricultural transformation in the Republic of Korea

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Abstract

In the aftermath of the Korean War, which lasted from 1950 to 1953, the Republic of Korea, or South Korea, was one of the poorest countries in the world. However, it did not remain that way. South Korea has developed rapidly over the last 60 years.

As the Korean economy grew, the share of agriculture in gross domestic product (GDP) declined from 46.7 percent in 1957 to 2.2 percent in 2018. Similarly, in 1957, the agricultural sector's share in overall employment was 63.0 percent, while in 2018 it had fallen to just 5.0 percent. As the economy expanded, agriculture underwent several stages of transformation. In each stage, agriculture contributed to the development of the economy.

This study examines the transformation of Korean agriculture using the framework formulated by C.P. Timmer in his 1988 article "The agricultural transformation." Our analysis divides the structural changes in Korean agriculture into four of the six stages outlined by Timmer.

The first stage, "getting agriculture moving," began in 1958 and lasted until 1967. Agriculture held an important position in the national economy during this stage. The government implemented farmland reform and organized agricultural technology development and extension systems.

The second stage, "agriculture as a contributor to growth," occurred during 1968–1977. During that period, the economy grew at an average annual rate of 10 percent. The stable supplies of food and labour in the agricultural sector helped drive economic expansion, which in turn contributed to improving agricultural productivity.

The third stage, "integrating agriculture into the macroeconomy," transpired from 1978–1985. Korean leadership shifted from a policy of government-led high growth to one in which the private sector took the leading role in creating more stable growth. Market principles were introduced in the agricultural sector, including the abolition of a dual-price system. However, farm incomes stagnated.

The fourth stage, "agriculture in industrial economies," began in 1986 and continues through today. During this period, the Korean economy began integrating into the global economy. The nation joined the World Trade Organization (WTO) and signed several free trade agreements (FTAs). As agriculture's share in the Korean economy decreased and agricultural incomes stagnated, the government implemented new policies, including agrifood value chain development and rural economic development.

The government played a major part in the agricultural transformation process. However, its role varied depending on the political situation, farmers' demands, and the nation's policy objectives, such as the import-substitution approach of the 1960s, the export-oriented industrialization approach since the 1970s, and the market-opening approach of the 1990s. These government policies and institutional improvements were the main factors behind the changes in Korean agriculture.

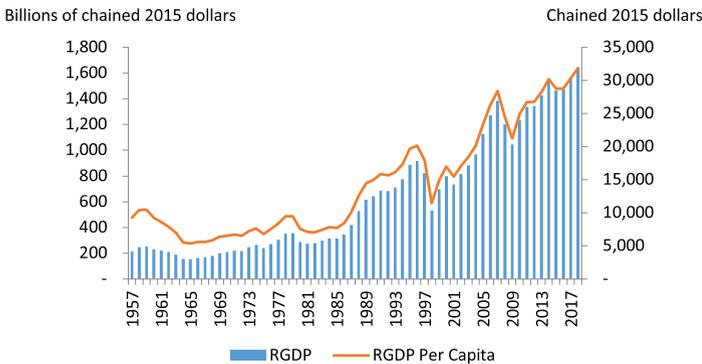
To analyse how government policies contributed to the transformation of agriculture, this study examines farm mechanization, agricultural research and extension, farm and crop diversification, agrifood value chain development, and agricultural finance. We also investigate changes in institutions and public investments.

1. Introduction

The 1950–1953 Korean War left the Republic of Korea (South Korea) one of the poorest countries in the world. In 1961, nominal GDP per capita was \$94 (Figure 1). Forty-eight percent of the population was living in absolute poverty. Nonetheless, during the past 60 years, Korea has rapidly developed. Nominal GDP per capita rose to \$31 362 in 2018, and absolute poverty had declined to less than 5.2 percent by 2015.

Figure 1. Real GDP and GDP Per Capita of Korea (1957–2018)

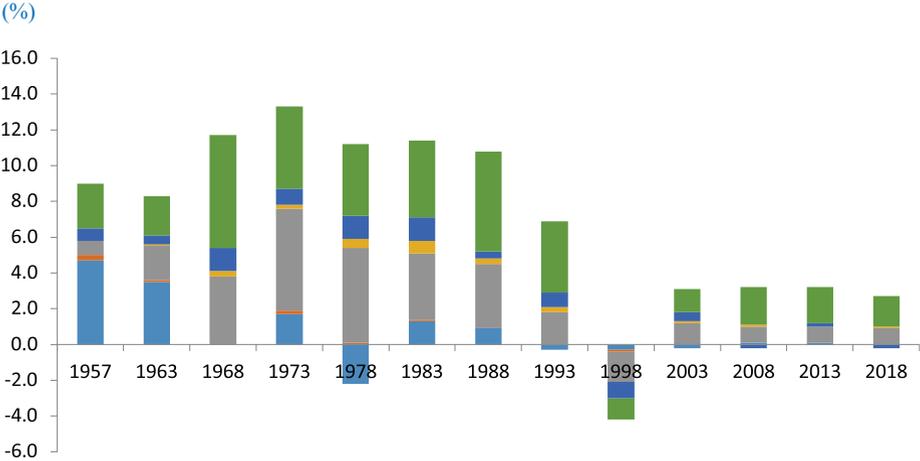
Billions of chained 2015 dollars Chained 2015 dollars



Note: Chained dollars is a method of expressing real prices over time
 Source: The Bank of Korea Economic Statistics System (ECOS)

By the early 1970s, the agricultural sector was growing, and playing a key role in Korea’s economic growth (Figure 2). However, the sector’s contribution to the economy decreased from 4.7 percent in 1957 to almost zero in 2018. In the early stages of economic development, agriculture’s contribution to the economy was higher than that of manufacturing. After the 1970s, the structure of the Korean economy changed. Manufacturing drove overall growth. Since the 1980s, agriculture’s contribution to growth has gradually decreased. In particular, after joining the World Trade Organization (WTO) in 1986, the contribution of agriculture to GDP was lower than that of other main sectors, and the decline continued to accelerate. During the 1997 Asian economic crisis, agriculture’s contribution to GDP was negative. It bounced back into positive territory as the economy recovered, but then gradually declined again.

Figure 2. Contributions (%) to GDP Growth by Sector in Korea



Source: The Bank of Korea Economic Statistics System (ECOS)

Agricultural development facilitated the growth of the industrial sector, and improving agricultural productivity helped speed up poverty reduction. In 1955, 65.5 percent of households were living below the poverty line, but the figure dropped to 15.1 percent in 1975 and 5.2 percent in 2015 (Table 1).

Table 1: Poverty Rate (%) in Korea

	1955	1960	1965	1970	1975	1980	1990	1996	2000	2010	2015
Poverty Rate	65.5	56.1	40.1	25.4	15.1	9.5	-	3.1	8.2	6.4	5.2

Source: Data from 1955 to 1980 by Yoon (2015). Data from 1996 to 2000 by Kim (2007). Data from 2010 to 2015 by KIHASA (2017)

After the Korean War, food shortages were rife, especially in rural areas. In 1957, 15.4 percent of all farm households suffered food shortages a few months after the harvest. Korea received grain assistance, mainly wheat, barley, and corn from the United States under the Agricultural Trade Development and Assistance Act (PL 480) from 1956 to 1964. Grain from the United States peaked at the equivalent of 22.3 percent of domestic grain production in 1963 and averaged around 10 percent during the entire aid period.

This study examines the transformation of Korean agriculture in the context of the country’s economic development and growth. It uses the theoretical framework formulated by C.P. Timmer in his 1988 article “The agricultural transformation.” In particular, the study emphasizes the role of government in bringing about changes in agriculture and takes a closer look at what policies, regulations and systems the government implemented in each stage of the agricultural transformation.

This paper is organized as follows. In Section II, we divide Korea's agricultural transformation into four stages based on Timmer's framework. The criteria for our classifications are factors such as general economic conditions, changes in agricultural productivity, agricultural infrastructure maintenance, poverty and nutrition conditions, and food stability. We determine the characteristics of each stage through describing the major agricultural policies, regulations, and institutions at the time.

In Sections III, IV, and V, we examine factors that affected agricultural change. The main factors included farm mechanization, seed systems, agricultural research and extension, farm and crop diversification, agrifood value chain development, agricultural financial systems, institutions and policy changes. In Section VI, we offer conclusions. We reviewed a variety of literature and used multiple data sources for this study. We referred to literature that describes the changes in Korea's agriculture and rural areas over the past 100 years. This included research reports in each field, writings in international journals, and government publications. We used data from the Korean Statistical Information Service (KOSIS), the Bank of Korea Economic Statistics System (ECOS), the Korea Rural Economic Institute, and the Ministry of Agriculture, Food and Rural Affairs (MAFRA). Data series usually start from the mid-1950s, after the Korean War, to the present, mainly the early 2000s.

2. Agriculture transformation

2.1 Agricultural transformation stages

The criteria for distinguishing the stages agricultural transformation include the development of agriculture from a macroeconomic perspective; the increase of productivity within the agricultural sector through mechanization and technology development; the level of integration into the market economy, and the performance of agricultural development in areas such as nutrition levels. Table 2 provides a snapshot of key indicators and policies by agriculture transformation stage.

Table 2. The process of agricultural transformation in Korea

Stages	Years	Description		Key Policies
Getting Agriculture Moving	1958–1967	Agr. Labour Productivity (1965)	KRW 2 338	<input type="checkbox"/> Farmland reform (1951–1957) <input type="checkbox"/> Establishment of Rural Development Administration (1962) <input type="checkbox"/> Founding of Ag. Cooperative organization (1961) <input type="checkbox"/> Basic Agricultural Law (1967)
		Agr. Land Productivity (1965)	KRW 521 791	
		Agr. Output Share of GDP (1965)	27.2%	
		Agr. Share of Employment (1965)	58.5%	
Agriculture as a Contributor to Growth	1968–1977	Agr. Labour Productivity (1975)	KRW 5 708	<input type="checkbox"/> Number of farmers starts to decline (1968) <input type="checkbox"/> High rice price policy (1968–1971) <input type="checkbox"/> Farmland begins to decrease (1969) <input type="checkbox"/> Development and dissemination of agricultural technologies <input type="checkbox"/> Consolidation of farmland and creation of high-yield rice variety called ‘Tongil (1971)’ <input type="checkbox"/> Self-sufficiency in staple grains (1977)
		Agr. Land Productivity (1975)	KRW 908 149	
		Agr. Output Share of GDP (1975)	25.2%	
		Agr. Share of Employment (1975)	45.7%	

Stages	Years	Description		Key Policies
Agriculture Integrated into the Economy	1978–1985	Agr. Labour Productivity (1980)	KRW 5 371	<ul style="list-style-type: none"> □ Open domestic market for agricultural imports (1978) □ Easing of high-price policy for staple grains □ Rural industrial policy (1983)
		Agr. Land Productivity (1980)	KRW 864 672	
		Agr. Output Share of GDP (1985)	12.1%	
		Agr. Share of Employment (1985)	20.9%	
Agriculture in Industrialized Economies	1986–Present	Agr. Labour Productivity (1986)	KRW 7 019	<ul style="list-style-type: none"> □ Start Uruguay Round negotiations (1986) □ Raising agriculture competitiveness (mid-1990) □ Farm machinery half-price policy (1993–1997)
		Agr. Land Productivity (1986)	KRW 1 159 717	
		Agr. Output share of GDP (2018)	11.5%	
		Agr. Share of Employment (2018)	5.0%	

Note: \$1 = 1,156.4 KRW in 2019. Agr. Labour Productivity = KRW/Hour, Agri. Land Productivity = KRW/10a, The two productivities are deflated by GDP-deflator (2015 = 100).

Getting Agriculture Moving (1958–1967)

The first stage is titled “getting agriculture moving.” In Korea, this stage lasted from 1958 to 1967.¹ Before this first stage began, the Republic of Korea underwent many changes in its politics, culture, society and economy. In 1945, at the end of the Second World War, the Allies liberated the Korean Peninsula from Japanese colonial rule. Owing to ideological conflicts, the peninsula was divided into separate countries with two different governments. Both countries were established in 1948, and each followed a different economic system. War broke out between the two countries in 1950 and ended with an armistice in 1953.

The reason for setting the beginning of this stage at 1958 was that the effects of the Farmland Reform Act of 1949, one of the most significant pieces of agriculture-related legislation, did not begin to be effective until 1958. The Korean War, social conflicts, and revisions of the Act all delayed the impacts of the legislation. Before that, large landholders owned most farmland. About 85 percent of farming households were tenant farmers. Consequently, as a result of rents and poor productivity, the incomes of most farmers were low. Under the Farmland Reform Act, the government

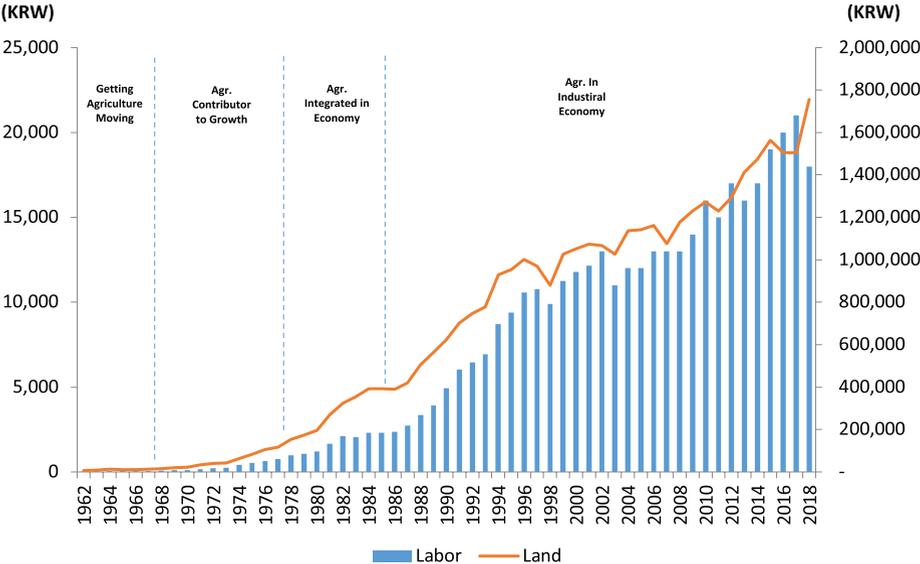
¹ In this period, the productivity per person of agricultural sector starts to rise (Timmer, 1988).

purchased farmland and distributed it to farmers. This reform created an ecosystem of independently owned farms, which improved the economy and the safety net in rural areas.

Farmland reform had ripple effects beyond agriculture. Improving the lives and incomes of farmers was a foundation for broader economic development that came later. As farm incomes improved, farmers were able to send their children to school, and those children became educated workers in manufacturing and other industries. We have chosen to set the endpoint of this stage at 1967 because in that year the government enacted the Basic Agricultural Law and the number of agricultural sector workers peaked.

From that point on, the share of the agricultural sector in Korea’s economy and workforce began to decline. Nonetheless, agriculture remained the most important economic sector during this period. In 1965, agriculture accounted for 42.8 percent of GDP and 63.0 percent of the workforce, and the contribution of agriculture to annual GDP growth was 3.5 percent, about two times higher than that of manufacturing. Agricultural labour productivity increased from Korean Won (KRW) 2 030 in 1962 to KRW 2 501 in 1976. However, land productivity was somewhat stagnant during this period. Both labour productivity and land productivity increased rapidly on a nominal basis in this time (Figure 3). Poverty also sharply fell. The poverty rate decreased from 65.5 percent of the population in 1955 to 40.1 percent in 1965.

Figure 3. Labour productivity and land productivity



Source: Korean Statistical Information Service (KOSIS)

Note: labour productivity = agricultural value added/working hours, land productivity = agricultural value added/ land area (10 acres). The productivities are nominal values.

Agriculture as a contributor to growth (1968–1977)

The second stage, “agriculture as a contributor to growth,” spanned the years from 1968 to 1977. It coincided with the most active period of Korea’s economic expansion. In the 1970s, Korea’s economic growth averaged over 10 percent per year. The agricultural sector contributed to this expansion in two important ways: by providing a supply of labour and a stable supply of food.

During this period, the number of farms and farmers started to decline, and the total area of farmland decreased. The number of farm households fell from 2.48 million in 1970 to 2.3 million in 1977. The plentiful supply of labour, and the growing availability of land began to be used for industrial development rather than agriculture.

The rural population thinned during this period as people, mostly younger people, began migrating to urban areas. As young people left for better jobs in the cities and older people stayed behind, rural areas began to go grey.

Agriculture’s share in the national economy also continued to fall. The sector’s share was 24.5 percent (13.9 percent in real terms) of GDP and 45.7 percent of the workforce in 1975. The agricultural sector contributed to 1.7 percent of the real GDP growth in 1973 compared with the manufacturing sector’s contribution of 5.7 percent.

However, agricultural productivity increased significantly. The government aimed to expand food production and improve the production process. It engaged in the development and spreading of agricultural technologies, gave guidance to rural areas, was involved in the management of farmland, improved agricultural water resources, seed development and mechanization. Labour productivity increased from KRW 2 770 KRW in 1968 to KRW 5 936 KRW in 1977 (KRW 82 to KRW 749 in nominal terms). Land productivity increased from KRW 524 020 to KRW 932 187 (KRW 15 511 to KRW 117 614 KRW in nominal terms) in the same period. Also, poverty decreased significantly, falling to 15.1 percent in 1975.

Integrating agriculture into the macroeconomy (1978–1985)

The third stage, “integrating agriculture into the macroeconomy,” covered the years 1978 to 1985. Korea’s fourth five-year economic development plan also began in 1978. The policy underlying the plan sought to transform government-led high growth into stable growth led by the private sector. In line with that, the government adopted an open-market-oriented agricultural policy.

The Korean economy grew an average of 7.7 percent per year between 1978 and 1985, but the annual growth rate in agriculture was 4.0 percent. During this period, agriculture’s share in GDP declined from 10.0 percent to 7.8 percent, and agriculture’s share in employment decreased from 38.4 percent to 24.9 percent. As the economic growth rate decreased, agriculture’s contribution to GDP also decreased. In 1985, agriculture contributed 0.7 percent to GDP growth, compared with 1.7 percent for the manufacturing sector. On the other hand, in 1985, labour productivity and land

productivity increased to KRW 7 225 and KRW 1 219 760 KRW, respectively (KRW 2 318 and KRW 391 360 in nominal terms).

Economic policy was aimed at stable growth and market liberalization. The goal of agricultural policies was to move from self-sufficiency in staple grains to cultivating cash crops and encouraging non-agricultural work so that rural household incomes would rise. To help achieve that goal, in 1978 the government planned to open the agricultural markets. As a result, the commercialization of agriculture and diversification of the rural economy were pushed forward together. Cultivation of profitable commercial crops expanded. Industrialization was introduced to rural areas in the forms of agricultural-industrial complexes, development of the livestock industry, and other measures.

Agriculture in industrialized economies (1986–Now)

The fourth stage, “agriculture in industrialized economies,” began in 1986 and continues to this day. In 1986, the Uruguay Round of multilateral trade negotiations began, and the international community put strong pressure on Korea to further open its agricultural markets. With the conclusion of negotiations in 1993, Korea aggressively liberalized its trade in agriculture, providing greater access to foreign competition. The Korean agricultural sector had no choice but to adapt to an open market situation.

During this period, Korea graduated from developing country status to a developed country. It became a member of the Organization for Economic Cooperation and Development (OECD) in 1996, and a member of the OECD Development Assistance Committee (DAC), a forum for assisting developing countries. In trade, Korea is one of the top ten trading countries in the world, and the share of agriculture in the Korean economy is similar to that of Western developed countries. The share of the agricultural sector was 2.0 percent (1.8 percent in real terms) of total output and 5.0 percent of total employment in 2018. Agriculture’s contribution to the economy decreased to 1.5 percent in 2018, and the manufacturing sector accounted for 3.7 percent (Figure 4). The growth gap between the two sectors narrowed as the economy developed.

The agricultural policies of this period focused on improving international competitiveness and changing the structure of agriculture to adapt to liberalized markets. Korea signed its first Free Trade Agreement (FTA) in 2004 with Chile. By 2017, Korea had signed FTAs with more than 50 countries. The FTAs led to a surge in imports of agricultural products.

Agricultural policy was aimed at reinforcing agricultural competitiveness and increasing agricultural exports. Farmland regulations were eased to strengthen competitiveness, and eco-friendly agricultural policies were implemented for small-scale farmers. The direct payment system (a kind of government subsidy) was also introduced to maintain the public interest function of agriculture (food security, environmental protection, etc.) and increase incomes for farmers.

Since the year 2000, Korea’s agricultural policy expanded beyond a sole focus on agricultural production to include measures to support safe food consumption, processing of agricultural products, and exports. The government passed the “Food Industry Promotion Act” and implemented the “Comprehensive Plan to Develop the Food Industry.” It formulated a range of policies for exports. As a result, exports soared for processed food, in particular fruits and vegetables, which were grown on industrial scale.

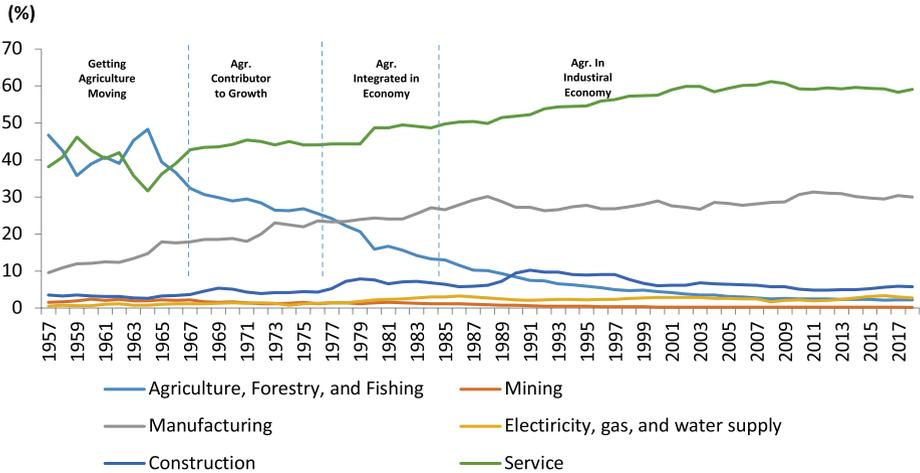
However, in the 2010s, farm incomes remained stagnant and the decline of the farming population continued. As the decade dawned, the average age of a Korean farmer was 74. Economic and social planners recognized that rural revitalization could only go so far by relying solely on agricultural policy. In 2013, the government launched its rural vitalization policy in earnest through the Sixth Industrialization of Agriculture strategy. This policy included the development of specialized local industries, modern production methods, processing, and tourism in rural areas.

Although the proportion of agriculture as part of the national economy continued to fall, the government pursued various agricultural policies from an international and overall industrial perspective.

2.2 Agricultural transformation from a macro perspective

Korea’s agricultural transformation followed similar patterns to those of advanced countries, but the pace of change was faster. The share of agriculture in GDP declined from 46.7 percent in 1957 to 2.2 percent in 2018. However, the share of services and manufacturing in GDP increased from 38.1 percent and 9.6 in 1957, to 59.1 percent and 30.0 percent in 2018, respectively (Figure 4).

Figure 4. Composition of nominal GDP by sector 1957–2017



Source: Korean Statistical Information Service (KOSIS)

Agriculture’s share declined because it grew at a slower rate than the economy as a whole. The average growth rates of the agricultural sector were 4.5 percent in the 1960s, 2.1 percent in the 1970s, 3.9 percent in the 1980s, 2.0 percent in the 1990s, 1.3 percent in the 2000s, and 0.7 percent from 2010 to 2018 (Table 3). Korean agriculture grew continuously, but the growth rates declined over time.

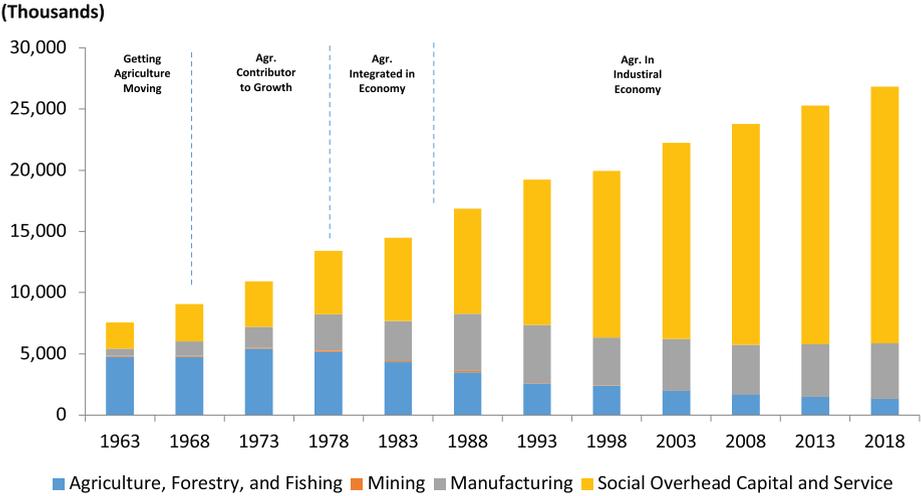
Table 3. Real gdp growth rate (%) by industry in Korea

Industry	1960–1970	1970–1980	1980G–1990	1990–2000	2000–2010	2010–2018
Agriculture, Forestry, and Fishing	4.5	2.1	3.9	2.0	1.3	0.7
Mining	8.5	4.3	-0.7	-2.0	-2.3	-3.3
Manufacturing	16.6	16.1	12.2	9.4	6.3	3.0
Electricity, Gas, and Water Supply	21.8	15.4	17.5	10.2	5.0	1.5
Construction	18.7	9.8	9.5	1.1	1.6	2.2
Service	8.9	9.0	9.7	7.4	4.6	3.2
Total	9.5	9.3	10.0	7.1	4.7	3.0

Source: The Bank of Korea Economic Statistics System (ECOS).

The number of people employed by industries also changed with economic development (Figure 5). In 1963, agriculture, forestry, and fishing employed over 4.76 million people, a 63 percent share in employment. In 1986, the number of workers in the manufacturing sector surpassed that of agriculture. By 2018, the number of workers in agriculture decreased to 1.34 million people, a 5 percent share (Figure 5).

Figure 5. Employment by industry in Korea 1963–2018

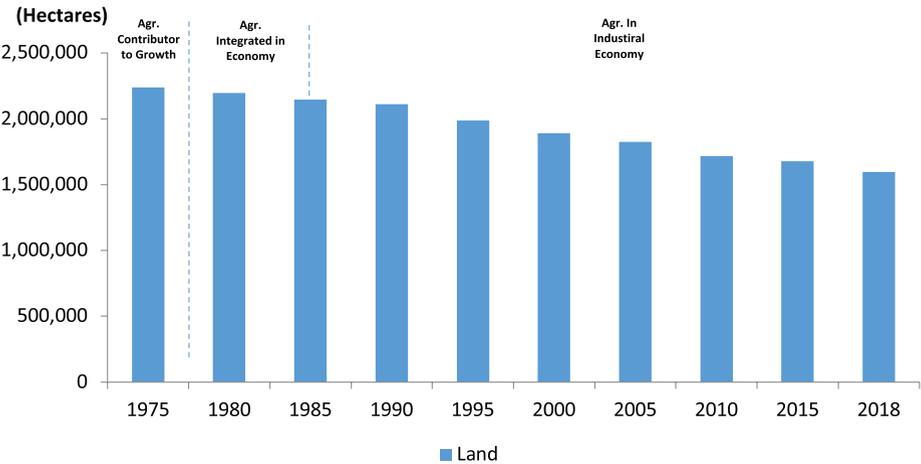


Source: Korean Statistical Information Service (KOSIS)

Note: The number of those employed in agriculture, forestry, and fishing only includes those engaged in the production of agricultural and fishery products except processing.

Korea’s total arable land decreased from 2.24 million hectares in 1975 to about 1.59 million hectares in 2018 (Figure 6). The decrease was due to the conversion of land by urbanization and industrialization. Farmland was converted for use for government facilities, housing developments, manufacturing facilities and agro-industrial facilities (Table 4).

Figure 6. Agricultural land in Korea 1963–2018



Source: Korean Statistical Information Service (KOSIS)

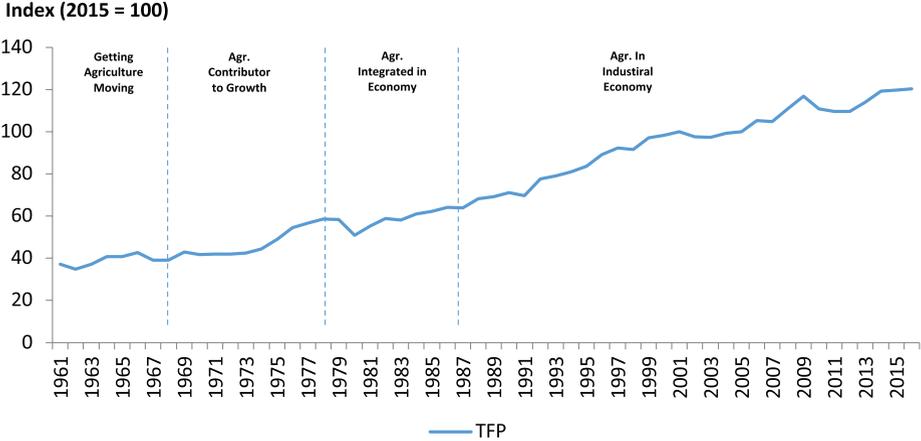
Table 4. Arable land (hectares) conversion by type of use

Year	Total Converted Area	Government and Public Facilities	Housing Facilities	Mining and Manufacturing Facilities	Agricultural and Fishery Facilities	Other
1980	975 (100)	289 (29.6)	264 (27.1)	125 (12.8)	30 (3.1)	267 (27.4)
1985	2,122 (100)	1,327 (62.5)	296 (13.9)	200 (9.4)	50 (2.4)	249 (11.7)
1990	10,593 (100)	4,474 (42.2)	2,229 (21.0)	2,415 (22.8)	593 (5.6)	882 (8.3)
1995	16,295 (100)	5,252 (32.2)	2,352 (14.4)	1,675 (22.8)	4,687 (5.6)	2,313 (8.3)
2000	9,883 (100)	4,059 (41.1)	1,742 (17.6)	1,142 (11.6)	1,581 (6.0)	1,359 (13.8)
2005	15,659 (100)	7,396 (47.2)	2,340 (14.9)	862 (5.5)	2,245 (14.3)	2,816 (18.0)
2010	18,732 (100)	7,603 (45.9)	4,378 (33.3)	2,766 (33.7)	768 (4.9)	3,217 (22.2)
2014	10,718 (100)	3,950 (36.9)	2,311 (21.6)	1,198 (11.2)	579 (5.4)	2,662 (24.9)

Source: Korea Rural Economic Institute (2015)

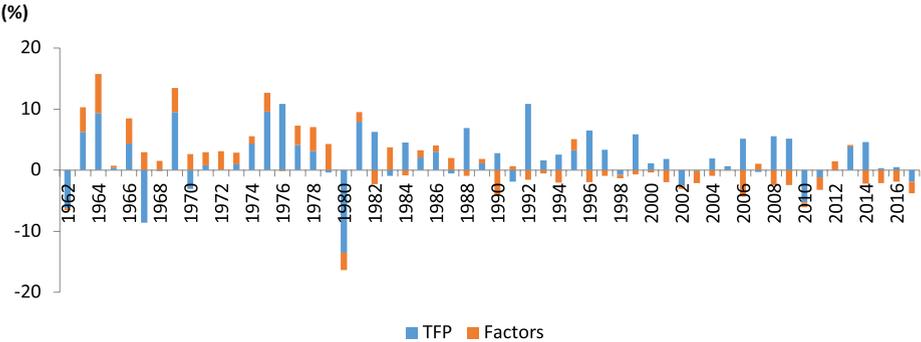
On the other hand, improving agricultural productivity drove agriculture's output growth. Although the size of the labour force and available land declined as the economy developed, agricultural total factor productivity increased. But over time, the contribution of TFP to agricultural GDP has decreased (Figure 8). The conversion of farmland and the reduction of agricultural manpower reduced the contribution rate of input materials, even as mechanization increased the contribution rate of input materials.

Figure 7. Agricultural total factor productivity of Korea



Source: USDA, Economic Research Service

Figure 8. Sources of agricultural production growth



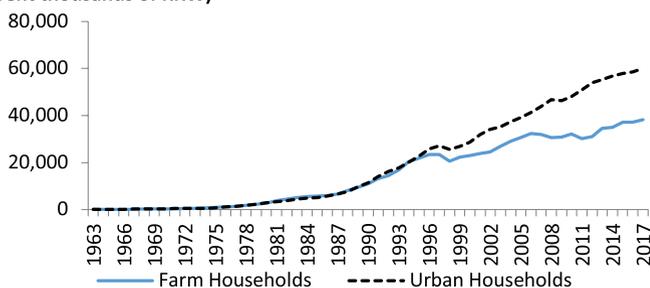
Source: USDA, Economic Research Service

Note: TFP means total factor productivity, and factors indicate inputs (labour, land, capital, intermediate goods)

As the economy grew, the urban-rural income gap widened (Figure 9). Before the mid-1960s, the average farm household income was higher than the average urban household income, despite the vicissitudes of weather and harvests. But starting in the 1970s, as the manufacturing sector developed, the gap in income between urban and farming households narrowed. With WTO accession in 1995, imports of agricultural products increased and urban household incomes started to surpass farming household incomes. The gap is increasing to this day.

Figure 9. Farm household income and urban household income

(Current thousands of KRW)



Source: Korean Statistical Information Service (KOSIS)

The composition of farm household income changed over time. In 1962, the share of agricultural income in the total income of farming households was 79.6 percent, with non-farm income at 20.4 percent (Table 5). As the economy developed, non-farming activities of farming households increased. Employment opportunities in nearby factories and service industries increased, and transfer income, such as direct payments from the government, rose. By 2018, the share of agricultural income in farming households had decreased to 30.7 percent, the share of non-farming income increased to 40.3 percent, and transfer income reached 23.5 percent (Table 5).

Table 5. The Composition of Farm Household Income

(Unit: Constant KRW)

Year	Farm Household Income	Agricultural Income	Non-Farm Income	Transfer Income	Non-Current Income
1962	6,002 (100.0%)	4,766 (79.6%)	1,236 (20.4%)	-	-
1970	6,600 (100.0%)	5,001 (75.9%)	1,598 (24.1%)	-	-
1980	11,857 (100.0%)	7,727 (65.2%)	4,130 (34.8%)	-	-
1990	24,968 (100.0%)	14,184 (56.8%)	6,433 (25.8%)	4,350 (17.4%)	-
2000	31,992 (100.0%)	15,110 (47.2%)	10,305 (32.2%)	6,577 (20.6%)	-
2010	34,647 (100.0%)	10,892 (31.4%)	13,964 (40.3%)	6,051 (17.5%)	3,740 (10.8%)
2018	40,161 (100.0%)	12,335 (30.7%)	16,184 (40.3%)	9,443 (23.5%)	2,198 (5.5%)

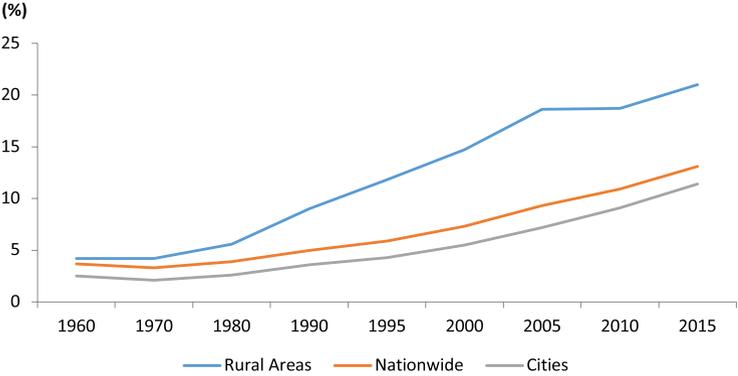
Source: Korean Statistical Information Service (KOSIS)

Note: The values are deflated by GDP-deflator (2015 = 100). Due to the revision of the classification method of farm income, there are differences in income items.

People migrating from rural to urban areas left the rural population smaller and older. From 1965 to 1970, about 1.827 million people, or 11 percent of the rural population, moved to cities, and about 1.764 million people, or 12 percent of the rural population, moved to cities from 1970 to 1975. The migration from rural to urban areas was particularly noticeable among young people. People aged between 15 and 34 accounted for 50 percent of those who moved from rural to urban areas between 1965 and 1970. This rose to 64.2 percent between 1970 and 1975. Opportunities for higher education and better jobs were the main magnets in urban areas for young people. Those who found jobs in cities were not likely to return to the countryside. As a result, the aging problem in rural areas has been increasing (Figure 10).

In the 1960s, the percentage of senior citizens over 65 did not differ much between urban and rural areas. People over 65 years old accounted for 21 percent of the rural population in 2015, nearly twice as high as 11.4 percent in cities (Figure 10). The aging of farm households weakened the vitality of rural society. It was a social problem as well as a labour and economic problem. The government is implementing policies to support young farmers to address this problem. For instance, the government provides more financial support to young farmers than elderly farmers. Also the government implements a pension policy for elderly farmers using their farmland as collateral to expand the supply of farmland through stable retirement of elderly farmers.

Figure 10. Percentage of people over 65 (%)



Source: Korean Statistical Information Service (KOSIS)

3. Decomposing agricultural transformation in Korea

3.1 Farm mechanization

Using Timmer’s framework, table 6 details some of the advances in farm mechanization.

Table 6. The farm mechanization policies with the transformation stages

Stages	Years	Important policies
Getting Agriculture Moving	1958–1967	<ul style="list-style-type: none"> • Domestic development of low-speed kerosene engines (1949) • Import of power-tillers (1961) • Agricultural machinery training begins in rural cities and Counties (1962) • Domestic development of kerosene engine power-tiller (1963) • Development of Agricultural Mechanization Pilot Complex (1976)
Agriculture as a Contributor to Growth	1968–1977	<ul style="list-style-type: none"> • Assembly of tractors under the technical cooperation with Ford Motor Corporation (1968) • First Farm Mechanization 5-Year Plan (1972–1976) • Organizations for the joint utilization of agricultural machinery as part of the Saemaul Undong Movement (1972)
Agriculture Integrated in the Macro-Economy	1978–1985	<ul style="list-style-type: none"> • The Second Farm Mechanization 5-Year Plan (1977–1981) • Development and distribution of a walking-type transplanter, a combine harvester, full mechanization of rice cultivation, transplanters, harvesters etc. (1978) • Validation of “Farm Mechanization Promotion Act” (1978)
Agriculture in Industrialized Economies	1986–onwards	<ul style="list-style-type: none"> • Distribution of multi-purpose cultivator (1988) • Development of a large 40 HP farm machine tractor, a 6 line riding-type transplanter, a 4 line combine harvester (2000) • Development of a tier engine (2005)

In the first stage, getting agriculture moving, the government helped lay the foundations of an agricultural-machinery manufacturing industry as the need for mechanizing agriculture increased. It distributed electric power-tillers, which reduced reliance on human labour and replaced livestock. The manufacture and supply of farm machines expanded to water pumps, threshers, chemical sprayers and other items. In 1963, power-tillers began to be manufactured in Korea, and starting in 1966, farm households were able to buy cultivators. As the supply of cultivators expanded, cities in rural areas began offering agricultural machinery training programmes.

In the second stage, agriculture as a contributor to growth, the government carried out a more active agricultural mechanization policy. The 1st Farm Mechanization 5-Year Plan of 1972–76 included providing power-tillers, long-term low interest rate loans (50 to 70 percent of the machine price), domestically manufactured machinery, and building a farm machinery training system with 141 training centres in cities and counties. These policies supported the development of an agricultural-machinery manufacturing industry and the use of machinery by farmers. In 1973, the Ministry of Agriculture and Fisheries established a Department of Agricultural Machinery, and conducted farm machine training in rural guidance centres of all cities and counties in 1974.

In the third stage, integrating agriculture into the macroeconomy, the government promoted agricultural machinery projects. These projects were in response to the dwindling of the rural workforce as country people migrated to urban areas. The government crafted another agricultural mechanization plan and in 1978 enacted the Farm Mechanization Promotion Act for the expansion of agricultural machinery.

The 2nd Farm Mechanization 5-Year Plan (1977–81) included:

- Promoting full mechanization of rice farming by supplying transplanters, tractors, binders, and combine harvesters (mostly imported machines).
- Securing farm machinery supply funds and continuous support to farmers to buy machines.
- Establishing the Farm Mechanization Research Institute in Rural Development Administrations (RDAs) to provide domestic machines.
- Enforcing customer service, training, and joint-use systems to support farm mechanization contracts.
- Establishing farm mechanization pilot farms for testing new machines.

The Farm Mechanization Promotion Act of 1978 formed the basis for the government's policy support. The government made it a requirement to draft a farm mechanization plan every five years and inform farmers of the details. The eighth basic plan is ongoing in 2020. The government also needed to recommend good machines and provide funds to farmers, establish good prices and a marketing system for farm machinery, manage a farm machinery registration system and safety standards for users, and establish customer service centres. From 1977 to 1981, the government set up 513 farming mechanization centres managed by regional agricultural cooperatives.

In the fourth stage, agriculture in industrialized economies, the government encouraged farmers to mechanize by subsidizing 50 percent of the purchase price of agricultural machinery through the Farm Machinery Half-Pricing Policy (1993–1997). Under this policy, farm mechanization cooperatives and agricultural mechanization firms could purchase machinery with a 50 percent subsidy, 40 percent as a loan, and 10 percent from their own pockets. Individual farmers could buy machinery with a 50 percent discount as a subsidy. The government also promoted joint use of farm machinery.

As a result, the use of farm machinery increased rapidly during 1993–1997. For example, the number in thousands of power-tillers, tractors, combines, cultivators, and grain dryers increased by 385, 87, 41, 234, and 29, respectively (Table 7).

Table 7. The number of major agricultural machines in use (in thousand units)

Industry	1965	1970	1980	1990	2000	2010	2017
Power-Tiller	1.1	11.9	289.8	756.5	939.2	698.1	567.1
Tractor	-	0.1	2.7	41.2	191.6	264.8	290.1
Transplanter	-	-	11.1	138.4	342.0	276.3	195.7
Binder	-	-	13.7	55.6	72.3	-	-
Combine Harvester	-	-	1.2	43.6	87.0	81.0	77.0
Cultivator	-	-	-	50.7	378.8	408.0	407.2
Grain Dryer	-	-	1.6	17.7	55.6	77.8	79.0
Speed Spryer	-	-	1.2	4.9	28.9	43.9	57.3
Other Dryer	-	-	-	59.4	164.5	207.8	245.3

Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

At the same time the rate of mechanization also increased. In 1990, just over 68 percent of rice farms were mechanized, which rose to about 98 percent by 2017 (Table 8). Rice production on dry land increased from 40.6 percent in 1996 to 58.3 percent in 2017 (Table 9).

Table 8. Mechanization of paddy fields (%)

Year	Average	Ploughing & Harrowing	Transplanting	Harvesting	Pest Control	Drying
1988	56.7	80.1	54.2	52.8	86.7	9.5
1990	68.3	83.9	78.3	71.9	92.8	14.5
1995	82.9	95.4	96.6	94.5	96.5	31.7
2000	87.2	98.5	98.2	98.4	98.9	42.1
2006	89.9	99.1	98.4	99.4	99.5	53.2
2010	91.5	99.9	99.8	99.9	99.3	58.5
2015	97.8	100	99.9	100	99.0	90.1
2017	97.9	100	99.9	100	92.6	97.1

Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

Table 9. Mechanization of dry land fields (%)

Year	Average	Ploughing & Harrowing	Sowing, Transplanting	Mulching	Pest Control	Harvesting
1996	40.6	88.0	-	32.0	82.0	1.0
2000	45.9	94.4	-	37.0	90.8	7.3
2007	46.3	96.2	7.5	25.2	98.5	4.2
2010	50.1	99.7	4.0	43.9	90.7	12.1
2015	56.3	99.8	5.0	67.6	95.8	13.3
2017	58.3	99.9	8.9	66.8	92.0	23.9

Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

Local governments began to operate machinery rental and leasing centres with central government budget support. This enabled joint use of agricultural machinery. By 2017, there were 443 centres operated by 143 local governments. Beginning in 2008, agricultural cooperatives started farm machinery banks that bought machinery and rented it to farmers at low prices. More than 600 regional agricultural cooperatives were running these banks in 2018.

Other laws also encouraged farm mechanization. For example, a special law exempted taxes on fuel for 86 types of farm machinery, including power-tillers, tractors, TPs, harvesters, dryers, sprayers, livestock facilities, forest machinery, and others.

Rice-processing complexes (RPC) were expanded to strengthen post-harvest management in the 1990s. Drying, storage, milling, packing, and selling of rice were combined and managed. Grain drying and storage facilities were supplied to farmers, and grain-cooling systems were provided to RPCs to increase the drying efficiency.

3.2 Seed systems and seed security

In 1965, during the getting agriculture moving stage, the government set up a full-scale seed variety development system and a crop test site. Table 10 presents key policies by agriculture transformation stages. The purpose was to develop high-yield rice varieties so the country would become self-sufficient in rice.

Table 10. Seed system policies in the transformation stages

Stages	Years	Important Policies
Getting Agriculture Moving	1958–1967	<ul style="list-style-type: none"> Establishment of a test site for the development of high-yield rice varieties (1965)
Agriculture as a Contributor to Growth	1968–1977	<ul style="list-style-type: none"> Development of the Tongil high-yield rice variety in collaboration with the International Rice Research Institute (IRRI, 1968) Establishment of Korea Seed & Variety Service (KSVP, 1974)
Agriculture Integrated in the macroeconomy	1978–1985	<ul style="list-style-type: none"> Increased international pressure to open the Korean seed market
Agriculture in Industrialized Economies	1986–Present	<ul style="list-style-type: none"> Establishment of the Seed Bank at the Rural Development Administration (1987) Enactment and revision of the Seed Industry Act (1996) Promotion of the Golden Seed Project (2012)

In 1968, during the agriculture as contributor to growth stage, the Rural Development Administration (RDA) created a high-yield rice variety, Tongil, with the International Rice Research Institute (IRRI) in the Philippines. The Korean government cooperated with the IRRI and other research institutes in developed countries to advance rice-breeding technology. By 1997, in part because of these relationships, Korea achieved rice self-sufficiency. That achievement was branded as the Korean Green Revolution. In addition, the International Bank for Reconstruction and Development (IBRD) and partners in more advanced countries assisted in developing Korea's seed production and supply system.

In 1974, the Korea Seed and Variety Service (KSVP) was founded for handling the production, processing, and distribution of seeds. The service produced seeds for rice, barley, corn and other crops managed as national varietal list crops. This institution aimed to improve the quality and yields of seeds, and worked with the central and local governments to distribute them.

In stage 3, agriculture integrated into the macro-economy, international pressure increased on Korea to open its seed market. As a result, in the mid-1980s, Korea experienced its first seed-development crisis and its seed development base weakened. Foreign firms acquired many Korean seed development companies, and imports of seeds increased.

In stage 4, agriculture in industrialized economies, the government implemented various seed development policies as the need for domestic seed development increased. This was because interests increased in improving agricultural productivity and added value through seed development suitable for the Korean agricultural environment increased. In 1987, the government established the Seed Bank at the

Rural Development Administration. It was renamed the Genebank Information Centre in 2008. The centre has carried out the systematic conservation of genetic resources, collecting Korean traditional species and major foreign genetic resources. In 2016, it contained 1 553 species and 211 253 resources, and was the sixth-largest gene bank in the world. In 1996, the Seed Industry Act was passed and revised to promote the production, assurance, support, and distribution of seeds and the seed industry.

In 2012, the government launched the Golden Seed Project (GSP), a national research and development endeavour. The GSP focuses on developing seeds for export and promoting the industry. It has five divisions, and investment plans (Table 11). Each division aims to develop new varieties and strategies for global markets.

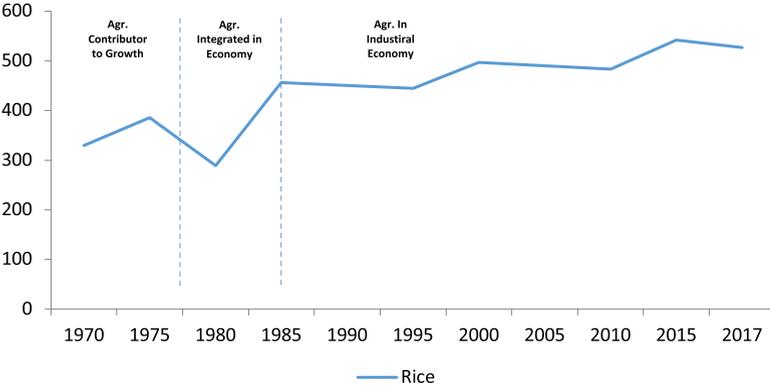
The government began actively developing a range of rice varieties in 1962 when it set up the Rural Development Administration to strive for self-sufficiency in rice. As a result, the yield of rice per 10 acres increased from 330 kg in 1970 to 527 kg in 2017 (Figure 11).

Table 11. GSP project and investment plan 2012–2021 (billion KRW)

Project group	Crops	Budget 2012–2021
Staple seed development division	Rice, potato, and maize, etc.	53.4
Horticultural Seed Development Division	Cabbage, onion, tomato, etc.	115.5
Vegetable Seed Development Division	Chili pepper, napa cabbage, radish, etc.	94.7
Breeding Stock Development Division	Pigs and chickens, etc.	44.1
Fisheries Development Division	Flatfish, halibut, gim, etc.	71.1
Total	-	378.8

Source: Golden Seed Project (www.gsp.re.kr)

Figure 11. Rice Yield (kg/10a)



Source: Korean Statistical Information Service (KOSIS)

3.3 Agriculture research and extension

During the getting agriculture moving stage, organizations for rural guidance were strengthened. Basic agricultural technical skills were spread for improving agricultural products. In 1962, the Rural Development Administration (RDA) was founded for implementing agricultural extension services. The RDA promoted research and development, rural guidance, education and training, and international cooperation in science and technology for agricultural development and agricultural extension. Table 12 presents key policies to promote agriculture research and extension by agriculture transformation phases.

Table 12. Agriculture research and extension in Korea

Stages	Description	Main polices
Getting Agriculture Moving	<ul style="list-style-type: none"> Strengthening research and extension system 	<ul style="list-style-type: none"> Establishment of research and extension service institutions (Rural Development Administration) Establishment of branch offices of RDA at the province level Start Training Programme for Rural Leaders (1962) Opening a real extension course at a university (1965)
Agriculture as a Contributor to Growth	<ul style="list-style-type: none"> Period of Green Revolution Specialization and capacity building of extension workers 	<ul style="list-style-type: none"> Dissemination of new varieties and agricultural technologies in order to improve the self-sufficiency of food grains Establishment of branch offices of RDA at the county level Start Winter Agricultural Education for Farmers (1969) Distribution of Standard Agricultural Farming Textbook on Crops (1974)

Stages	Description	Main polices
Agriculture Integrated into the macroeconomy	<ul style="list-style-type: none"> • White Revolution and farm mechanization 	<ul style="list-style-type: none"> • Development of agricultural technologies focusing on farm machineries and automotive equipment • Enlarging dissemination of comprehensive farming technologies • Implement year-round in-depth education (1978)
Agriculture in Industrialized Economies	<ul style="list-style-type: none"> • High quality and diversified products • Decentralization and reduction of extension personnel 	<ul style="list-style-type: none"> • Dissemination of agricultural technologies to meet the diversified consumer needs such as high quality, safe and health-oriented products • Support of local extension bodies with scientific equipment and facilities • Organization of Extension Workers Study Group (1996)

The RDA had two bureaus, one division, and 11 research and experiment institutes for achieving each objective. The two bureaus were for research and experiment and extension. The one division was for general affairs, and the 11 research and experiment institutes were for training. In addition, the RDA opened branch offices at the provincial level (PRDA) for effective operations and rural guidance. The number of extension workers increased from 3 173 in 1962 to 4 790 in 1964.

Farmers received education during this period. In 1962, the government launched the Start Training Programme for Rural Leaders to improve agricultural production technology. In 1965, major national universities opened a course to train extension workers. The training of extension workers and the education they provided to farmers contributed greatly to the improvement in agricultural productivity.

In the agriculture as a contributor to growth stage, rural extension organizations and rural guidance were expanded as farmers' trust in the Saemaul Undong Movement, or New Community Movement, increased, as did their faith in the newly developed 'Tongil' rice variety. The Saemaul Undong Movement, launched in 1970, was intended to modernize the rural economy.

In 1970, the provincial RDAs expanded. The Research and Experiment Division, the Extension Division, and the General Affairs Division were reorganized into the Research and Experiment Bureau, the Extension Bureau, and the General Affairs Bureau. The Extension Bureau consisted of three divisions: extension, technology dissemination, and rural societies. The number of branch offices at the local level increased to 1 473 in 1970 to satisfy the needs of people in rural areas and to disseminate agricultural technology.

In 1976, the RDA added a Crops Protection Division within the Technology Dissemination Division to promote prevention and management of diseases and insects. The RDA placed a technical officer in rural offices to fulfil these tasks. The number of extension workers increased from 3 173 in 1962 to 7 628 in 1977, and most of the extension workers carried out their duties in rural offices.

During this period, the government and its partners developed various farmer education programmes. From 1969, the winter education programme was held annually for four months (1 December to 31 March), and this programme became the most important education for farmers, contributing to their acceptance and adoption of the new direction of agricultural policy and agricultural technology. In 1972, professional technology education by crop began. Education and extension during this period greatly contributed to the rapid development of agriculture and rural areas in connection with the Saemaul Undong Movement.

In the third stage, agriculture integrated into the macroeconomy, agricultural policy paid more attention to increasing the income of farm households as self-sufficiency in food grains improved, and the demand for cash crops increased as the commercialization of agriculture progressed. In response, the agricultural extension system was reorganized. It focused more on rural development than increasing agricultural production, and the RDA strengthened global projects to develop agricultural technology through international cooperation and partnerships.

Also, the demand for training and skills increased as farm mechanisation grew and the pool of agricultural labour shrank. Farmers wanted knowledge on how to use new farming machinery and technology, the use of agricultural chemicals and other skills. For example, farmers sought courses on how to use rice-planting machines and combines effectively, and various programme taught how to use rice primordium, remove weeds, and use agricultural chemicals. A year-round in-depth education was promoted three or four times a year in leading farm and production areas beginning in 1978.

In the fourth stage, agriculture in industrialized economies, agricultural technologies for high-quality products spread rapidly as the economy developed and demand increased for safer and healthier food products. In addition, technologies and methods to reduce farming costs were also disseminated because competition had intensified from cheaper imported food.

The development of agricultural technology was more specialized and the education of farmers was institutionalized. In 1996, study groups were formed so farmers could solve technical problems occurring in agricultural sites on their own, with extension workers available as a resource. Also in 1997, The Korea National Agricultural College was founded to train future elite farmers. In this process, the number of extension workers increased (Table 13). However, the number of extension workers declined over time as agriculture's share in the national economy fell.

Table 13. Numbers of agricultural extension personnel

Year	Total	Central	Province	City / County		
				Sum	Main Office	Branch
1961	1,444	63	151	1,230	1,230	-
1964	4,790	71	210	4,509	2,017	2,492
1975	7,626	82	226	7,318	2,667	4,651
1980	7,980	106	226	7,648	2,997	4,651
1989	7,979	105	226	7,648	7,250	398
1994	6,964	95	289	6,580	6,286	294
2004	4,901	71	240	4,590	4,528	62

Source: Ko et al. (2014), RDA (2004), RDA (2012)

Until 1980, as Korea worked to develop its agriculture, the number of farmers who received training increased (Table 14). Since 1980, the absolute number of trainees decreased, but the number of trainees in cash crops and women's groups rose. As the number of farmers declined and farmers grew older, the numbers trained since 1990 fell further. In 1990, 30 percent of all farmers were educated, whereas by 2010 it was 23 percent (Table 14).

Table 14. Farmer training

Year	Total No. Of Trainees	No. of Trainees by Courses				
		Comprehensive (food grain)	Specialized (cash crops)	Women's group	Farming successor	4-h
1969–1970	5,889,436	5,889,436	-	-	-	-
1971–1975	12,934,704	12,934,704	-	-	-	-
1976–1980	13,367,827	10,313,341	3,054,486	-	-	-
1981–1985	12,032,015	8,300,221	3,448,887	282,907	-	-
1986–1990	10,405,554	5,458,720	4,027,204	919,630	-	-
1991–1995	4,271,313	2,888,710	611,393	702,204	34,657	34,349
1996–2000	3,181,217	2,667,396	-	513,821	-	-
2001–2005	2,795,007	2,411,688		383,319	-	-
2006–2010	2,039,217	1,814,557		223,265	-	-

Source: RDA. 2014. Agricultural Extension System in Korea: Lessons from 1962 to 1997. Seoul

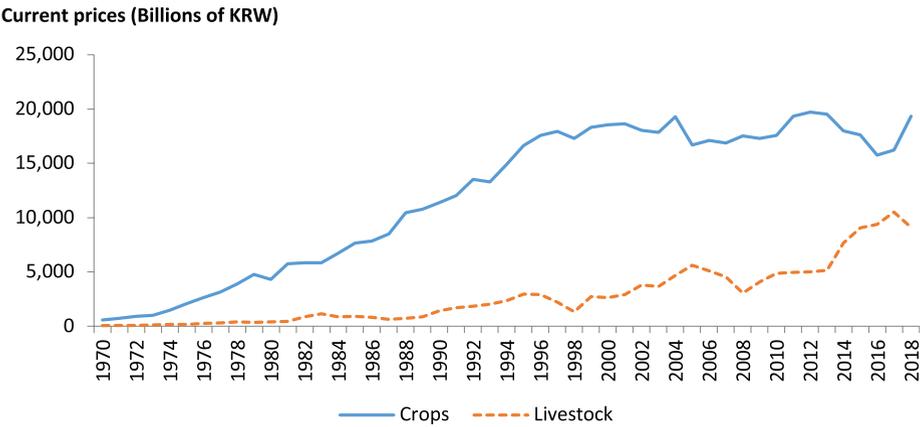
In conclusion, the research and extension system played an important role in the development of Korean agriculture. Korean farmers began to apply modern farming techniques acquired from the extension programme after the 1960s. Professional extension programmes have increased farmers' expertise, including on farming machinery, farming techniques, soil making, pest control, and marketing since the 1980s.

3.4 Farm and crop diversification

As the economy developed, farmers began responding to market demand. The production of crops, especially rice, had increased rapidly before 2000, but the growth rates of production decreased over time. As mentioned before, self-sufficiency in staple grains was the main policy objective when the economy started to develop. However, as the economy grew, consumers changed their diets and farmers started to raise more cash crops and livestock.

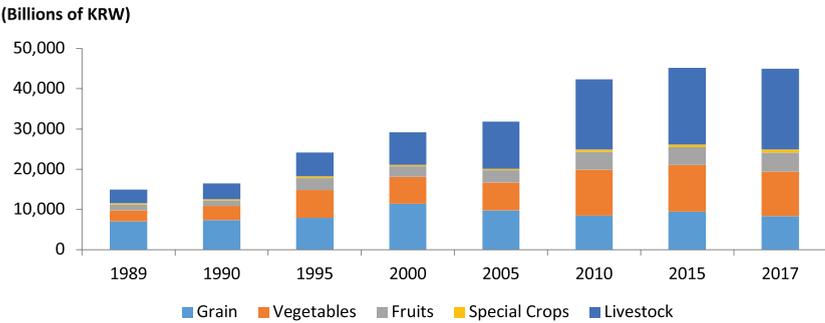
The gap between crop production and livestock production narrowed over time (Figure 12). Rice production was dominant before 2000, but the production totals have decreased slowly since then. On the other hand, growth rates have been rising for cash crops, such as fruits and vegetables, and livestock production for meats such as pork and beef (Figure 13).

Figure 12. Crops and livestock gdp 1970–2018



Source: The Bank of Korea ECONOMIC Statistics System (Ecos).

Figure 13. Agricultural Production



Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

As agriculture developed, the nutrient intake of Koreans also increased. The amount of intake per capita per day was 2 486 kcal in 1969, and it increased to 3 086 kcal in 2017 (Table 15). But the amount has not risen significantly since 2000. Better nutrition was associated with greater agricultural production. In the getting agriculture moving stage, cereals were by far the main source of food energy intake. As agricultural transformation progressed, the intake of meat, oils, and fats increased significantly (Table 15).

Table 15. Annual change in the nutrient intake from each food group per capita per day (in kcal)

Products	1969	1980	1990	2000	2010	2017
Total	2,486	2,485	2,853	3,139	3,149	3,086
Cereals	1,921	1,730	1,697	1,665	1,447	1,265
Starchy Roots	160	65	27	29	33	22
Sweeteners	61	112	162	188	239	250
Pulses	96	103	112	116	111	97
Tree Nuts	0	2	2	8	14	19
Oil Crops	2	7	9	10	9	14
Vegetables	65	119	116	126	105	102
Fruits	14	22	34	54	58	58
Meat	56	91	143	201	235	258
Eggs	15	26	36	37	37	34
Milk	8	23	64	92	102	136
Fish and Shellfish	53	61	92	87	101	102
Seaweed	2	2	4	5	5	11
Oils and Fats	34	123	352	391	493	577
Alcoholic Beverages	-	-	-	129	158	145

Source: KREI (2018)

3.5 Agrifood value chain development

Agrifood value chain development took place in earnest in the fourth stage, agriculture in industrialized economies. Before that, agrifood value chains were mainly a feature of agricultural marketing. The agricultural wholesale market system had not yet been developed. Since 1985, a total of 32 public wholesale markets for agricultural products have been set up throughout the country for agricultural product distribution. Large retailers also began to appear in the 1980s.

Since 2000, the Korean government has promoted agricultural products processing centres (APCs). These centres perform several functions, such as loading, selecting, packaging, shipping and storage. They support the standardization and commercialization of farm products. They are an integral part of the government's policy of creating agrifood value chains. These centres focused on horticultural products, such as fruits and vegetables, and aimed to improve value added to agricultural products through strengthening the bargaining power of farmers. APCs have been established in large agricultural production areas and major logistics areas. The number of APCs increased from 175 in 2000 to 365 in 2014. In 2013, the National Agricultural Cooperative Federation operated about 70 percent of the APCs and farmer organisations operated the other 30 percent.

Creating agrifood value chains has been a policy goal in Korea since 2007. In particular, the government elected in 2008 recognized agriculture and the food industry as priorities, and implemented various policies to support them and help them grow. It created the Ministry for Food, Agriculture, Forestry and Fisheries by integrating the Ministry of Agriculture and Forestry, the Ministry of Maritime Affairs, and the food industry promotion policy of the Ministry of Health and Welfare.

The policy for the food industry was based on the Food Industry Promotion Act of 2007. The act was designed to develop local food processing industries, protect the knowledge of traditional food, and improve the quality and safety of food, among other measures. Government policy on agriculture started to shift attention away from production and towards consumers and quality. As a result, sales of processed food increased from KRW 28.1 trillion in 2000 to KRW 78.2 trillion in 2017 (Table 16).

Table 16. The number of businesses and sales of the food processing industry

Year	Number of Businesses	Sales (millions KRW)	Sales per business (millions KRW)
1991	4,749	16,930,557	3565.1
1995	6,250	26,222,358	4195.6
2000	3,166	28,091,355	8872.8
2005	3,664	36,666,317	10007.2
2011	4,108	61,633,208	15003.2
2016	5,014	75,355,093	15028.9
2017	5,220	78,164,065	14974.0

Note: The figures of 1991 and 1995 include businesses with 5 or more employees, and the figures from 2000 include businesses with 10 or more employees.

Source: Korean Statistical Information Service (KOSIS), Mining and Manufacturing Industry Survey, each year.

The Sixth Industrialization Act contributed to strengthening agrifood value chains by promoting the industrialization of agriculture and rural tourism.

3.6 Agricultural finance

In the first stage, getting agriculture moving, the government established the basis and institutions for agricultural finance. In 1957, the Agricultural Cooperative Act and the Agricultural Bank Act were passed. These laws facilitated the founding of the Agricultural Bank and the Agricultural Cooperatives organization one year later. However, the two institutions did not coordinate and support each other in policies or operations. To remedy that problem, in 1961, the government merged the two institutions into the National Agricultural Cooperative Federation (NACF). The NACF has been playing a leading role in providing funds for agricultural production, distributing farm inputs and consumer goods, and marketing farm products. Additionally, the government began allocating budgets for agricultural policy funds. For example, in 1967, it established the Agricultural and Rural Stability Fund.

In the second stage, agriculture as a contributor to growth, agricultural finance grew and expanded in rural areas. The total amounts of deposits in the NACF increased rapidly due to the savings drive in farming and fishing villages. As the NACF's deposits increased, it implemented full-scale projects to sell agricultural products and repurchase agricultural materials. In this period, the government's financial strength improved and it allocated larger budgets to supply the agricultural policy funds. In 1974, it founded the Agricultural Mechanization Fund, and in 1977 created the Livestock Promotion Fund.

In the third stage, integrating agriculture into the macroeconomy, government policy responded to ballooning farm debts. Farm household debts began rising rapidly in the 1970s because farmers were buying machinery and setting up more modern facilities. The rising cost of living, including the cost of education for their children, also contributed to their increased debts. In 1985, farmers fed up with mounting debts held anti-government protests nationwide. The government used policy funds to clear KRW 1 trillion of farmers' debts in 1986, lowered the interest rates of policy funds, and delayed debt repayment periods. In this process, NACF branches increased their loans to farmers, which reduced private loans from private sector banks and money lenders. Households with private loans dropped from 63.6 percent in 1975 to 28.9 percent in 1985 (Table 17).

Table 17. The changes in informal financial market share and interest rates (%)

	1971	1975	1980	1985	1990
The informal market share of Farm Household debts	60.0	63.6	49.0	28.9	13.9
Interest rates					
Informal markets (A)	54.0	49.2	46.8	26.4	21.0
Mutual credit loan (B)	28.0	22.0	22.0	14.5	14.0
A-B	26.0	27.2	24.8	11.9	7.0

In the fourth stage, agriculture in industrialized economies, the government continued implementing policies to reduce farm household debts. The agricultural market opening and the 1997 Asian economic crisis exacerbated these debts. In 2001, the government passed the Special Measures Act for the Reduction of Farm Household Liabilities, which is still in force. The act enabled the government to defer the repayment of policy funds, provide special funds for joint surety damages, and reduce interest payments on overdue loans so farmers could recover from financial difficulties.

To assist the development of rural areas, in 1987 the government set up the Rural Community Development Fund. The government also started to pay more attention to supporting young farming households as the debt problems became resolved and the problem of aging farmers grew serious.

4. Important institutions and policy changes

Important changes in institutions and policies were linked to changes in Korean agriculture. Table 18 presents key policies by transformation stage. Each transformation stage was marked by innovations in policies and institutions designed to support and facilitate the changing nature of agriculture.

Table 18. Key policies and institutions by transformation stage

Stages	Key policy and institutional innovations
Getting Agriculture Moving (1958–1967)	<ul style="list-style-type: none">• Building of farmland system• Secure food shortages policy• Established an institutional foundation
Agriculture as a Contributor to Growth (1968–1977)	<ul style="list-style-type: none">• Rural development policy through the Saemaul Undong Movement• High rice price policy• Farmland conservation policy
Agriculture Integrated into the Macroeconomy (1978–1985)	<ul style="list-style-type: none">• Diminishment of high price policy for staple grains• Non-farm income policy• Improvement of rural living conditions
Agriculture In Industrialized Economies (1986–present)	<ul style="list-style-type: none">• Reform farmland system• Introduction of direct payment system

4.1 Getting agriculture moving stage

The most important institutional reform during the getting agriculture moving stage was farmland reform. The farmland system of Korea is based on the Farmland Reform Act of 1949 and the Land Reform Act of 1950. The Farmland Reform Act aimed to increase the numbers of independent farmers. The act empowered the government to purchase farmland owned by large landowners and sell it to farmers provided they would use it for farming. The law limited farmland ownership to farmers, prohibiting using the land for other purposes. This reform fostered a population of farmers who owned their farms as opposed to tenant farmers. The reform was intended as a means of building a stable social foundation and contributing to national economic development. It restricted non-farmers from acquiring farmland and limited farmland ownership to no more than 3 hectares per household. The government also regulated the acquisition of farmland by issuing confirmation certificates for farmland transactions.

The farmland reform contributed to the creation of a farming system based on small-scale independent farmers. The ratio of independent farms increased from 35 percent at the start of the reform to 88.2 percent in 1960.

In the 1960s and 1970s, the goal of farmland expansion policy was to increase food grain production. In 1962, the Reclamation Promotion Act was passed to develop uncultivated areas. The law gave officials power to examine land reclamation plans, established a process to approve land reclamations, allowed the purchase of privately owned uncultivated land, and other measures. Thanks to the enforcement of this law, 110 275 hectares of land were reclaimed between 1961 and 1966. The Farmland Development Act was passed in 1967. This law transferred authority for approving land reclamations from the central government to local governments.

During 1958–1967, government policies prioritized food security to avoid shortages similar to those after the Korean War. The government implemented actions for the reclamation and re-cultivation of land, set up research and training programmes for improving agricultural productivity, and upgraded irrigation systems.

This was also the period when Korea built an institutional foundation for agricultural development. The National Agricultural Cooperative Federation was founded in 1961, which merged the Agricultural Bank and Agricultural Cooperatives. The new organization promoted the activities of agricultural cooperatives and created new financial services. In 1962, the Rural Development Administration (RDA) was established. The RDA promoted rural guidance projects, agricultural technology development, and set up an extension system. These initiatives greatly contributed to the development of agriculture in Korea. New technologies and methods in cultivation, soil making, pest control, farm machinery and marketing increased the productivity of agriculture. Agricultural education and technology dissemination were also important.

4.2 Agriculture as a contributor to growth

The Saemaul Undong Movement, or New Community Movement, was a government initiative launched in 1970. It was designed to modernize the rural economy and improve living conditions in rural areas.

The government inaugurated the Saemaul Undong Movement by providing cement and steel to 33 000 communities so they could improve their homes and living conditions. Afterward, the movement expanded to include projects for raising incomes, renovating the production base, and changing people's attitudes under the slogan of "diligence, self-help, and cooperation." It restructured organizations in central and local governments, including community-based organizations, and expanded to 34 665 villages nationwide. Villages were categorized as underdeveloped, developing, and developed so that projects could be implemented that were appropriate to each village's situation. The movement used trained agents to elicit changes and development in rural villages. Under the slogan, the movement educated and trained agents for Saemaul Undong projects, and the trained agents led the projects in cooperation with villagers in each hamlet.

The Saemaul Undong Movement also had a political dimension: the government wanted to mobilize villagers so it could control rural society, by force if necessary. But it was also the first national modernization campaign since the 1950s. It improved living conditions, and nurtured residents' development capabilities. The movement was in line with and supported national campaigns to increase production and fight poverty, hunger and malnutrition (Park, 2019).

The flagship agricultural policy of this period (1968–1971) was to raise rice prices and maintain them at high levels so farmers' incomes would rise. To make this palatable, the government implemented a dual-price policy: it purchased grains such as rice and barley from farmers at high prices and provided them to urban residents at low prices. In addition, the extension system, which disseminated knowledge from agricultural technology research, was reorganized and contributed to the improvement of agricultural productivity. Also notable was the development in 1971 of the high-yield rice variety called 'Tongil.' These policies and programmes resulted in self-sufficiency in staple grains in 1977, and bolstered farm household incomes. Equally important, the food supply was stabilized. Technology and mechanization improved farm productivity so that workers could migrate to urban areas for jobs in the industrial sector. This allowed Korea to achieve a high economic growth rate.

Farmland conservation policies were also introduced in this period. As the Korean economy began developing in the 1960s, farmland was rapidly being converted for other purposes. To prevent the excessive conversion or abuse of farmland, the Farmland Preservation and Utilization Act was passed in 1972. This act required farmland users to obtain permission from the government to use farmland for other purposes.

Korea's total arable land decreased from 2.29 million hectares in 1970 to 1.62 million hectares in 2017, while the average farm size increased from 92.5 acres in 1970 to 155.5 acres in 2017. However, small farms of less than 1 hectare still accounted for 70.9 percent of all farms in 2018.

Table 19. Agricultural land use

	Land Area (thousand ha)	Arable Land (thousand ha)	Land Use (thousand ha)	Land Use Rate (%)	Average Farm Size (a)
1970	9,848	2,298	3,264	142.0	92.5
1980	9,899	2,196	2,765	125.9	101.8
1990	9,926	2,109	2,409	114.2	119.4
2000	9,946	1,889	2,098	111.1	136.5
2010	10,003	1,715	1,825	106.4	145.7
2017	10,036	1,621	1,641	101.2	155.5

Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

4.3 Integrating agriculture into the macro economy

A signature policy change during the third transformation stage was an adjustment of the dual-price system. To ease the mounting financial burden on the national budget, the Korean government found it necessary to lower the purchase prices for grains from farmers and raise the selling prices to urban residents.

In the early 1980s, the government set its purchase price for rice at a level below the general inflation rate because of the widening deficit in its special account for grain management – as a result the dual-price system implemented in the 1970s.

The lower purchase prices for grains and an increase in imports of agricultural products caused farm incomes to stagnate. To remedy that, the government introduced a policy to increase non-farm income among farming households. This involved rural industrial development. The Act on Promotion of Income Source Development for Farming and Fishing was passed in 1983 to increase the income of rural people by attracting industrial and service industries to the countryside. The Rural Industrial Estate Programme was launched to build industrial estates in agrarian areas.

This policy aimed to accelerate rural industrialization through integrated packages and support. It aimed to build low-cost but well-equipped industrial parks, provide financial support to firms willing to locate to them, and simplify government administrative processes, which are usually complicated and tedious. The efforts required to obtain all the necessary government permissions and approvals before factory construction could begin were deterrents to some companies.

The size of each industrial estate ranged from 33 000 to 99 000 square meters. Government support was provided to the firms or farm households participating in this programme. Firms participating in the Rural Industrial Estate Programme received direct subsidies for land acquisition, subsidized loans for plant construction and operation, and exemption from income and property taxes for three to five years. From 1984 to 1988, a total of 122 rural industrial estates were built, and 1 335 companies moved to them.

The government carried out large-scale rural development projects nationwide. In this period, the major objective of rural development policy was improving rural infrastructure. The government constructed roads, waterways, communication networks, and facilities for welfare, education, and medical services.

4.4 Agriculture in industrialized economies

Agriculture's share in the national economy has continued to decline in the fourth transformation stage, but the government is still pursuing agriculture-related policy and systems reforms because they are in the public interest.

The farmland system required new reforms. Despite the Farmland Reform Act's restrictions, non-farming use of farmland and non-farmers' ownership of farmland increased. This was because farmers bequeathed their farms to non-farming children who had jobs in cities. Also, the price of farmland increased continuously as the economy developed. This situation caused farmers to hold farmland as an asset even though farming was no longer profitable for them. As a result, the land-to-tiller principle of the Farmland Reform Act had been weakened in reality. The ratio of leased farms increased from 17.8 percent in 1970 to 37.4 percent in 1990, and the proportion of farmland owned by farmers decreased (KREI, 2010).

The 1994 Farmland Rent and Lease Act was passed to partially allow farmland rental. Before 1992, farmers were not allowed to own more than 3 hectares of farmland due to the Farmland Tenure System, which was created by the farmland reforms of the 1950s. In 1993, restrictions on the size of ownership were raised to 10 hectares within the agricultural promotion area, and in 1999, up to 5 hectares were allowed outside the area. In 2002, all restrictions on farmland ownership were removed. The Farmland Bank was also created in 2005 to address the farmland ownership problem. Through the bank, non-farmers could own limited-scale farmland if they lease their farmland to the bank on a long-term basis.

A farmland expansion policy was also implemented in 1990 with the aim of enlarging the size of farmlands, enabling integrated use of farmland, and enhancing competitiveness by reducing production costs.

The direct payment system to guarantee farmers' incomes and stabilize farming as a business also expanded over time. The system was first studied as part of an income preservation plan to cope with the opening of Korea's agricultural markets in the mid-1990s. The system was partially introduced in 1998 to promote the early retirement of aged farmers. In 2001, it expanded to farmers who owned rice paddies. It started to include some dry-field farmers in 2012, and then covered all dry-field farming in 2015. Furthermore, the direct payment system contains other programmes, such as payments to incentivize environmentally friendly farming, farming in regions with unfavourable conditions, rural landscape conservation and environmentally friendly livestock farming.

5. Public investment

Until the 1970s, the government budget was small. Public investment in the agricultural sector required foreign capital. The International Bank for Reconstruction and Development provided a loan to renovate agricultural production facilities. Local groups such as the Saemaul Undong Movement carried out the actual work. As the budget situation improved in the late 1970s, the government began expanding investments for agricultural development. The share of the agricultural budget in the overall budget was less than 6 percent until the mid-1980s. Then the agricultural budget started rising to address the opening of markets to imported agricultural products. The share of the agricultural budget increased to 15.9 percent of the overall budget in 1995 when the government implemented an agricultural restructuring policy, but it started to decline after the financial crisis in 1997 and fell to 5.4 percent in 2005 (Table 20).

Table 20. Government budget and agricultural budget in Korea (current hundred million KRW)

	1975	1980	1985	1990	1995	2000	2005
Government Budget (A)	16,435	65,755	127,007	283,520	594,011	1,194,011	1,597,293
Agricultural Budget (B)	965	3,962	11,772	27,352	94,448	83,446	85,459
Percentage (B/A)	5.9	6.0	9.3	9.6	15.9	7.0	5.4

Source: Ministry for Food, Agriculture, Forestry and Fisheries, Major Statistics of Agricultural, Forestry and Fishery Products, each year.

Government expenditures in the agricultural sector were focused on agricultural infrastructure improvement and staple grain production in the 1970s. In 1980, 61.8 percent of total agricultural public expenditures were allocated to agricultural infrastructure, 10.2 percent to mechanization, 9.8 percent to marketing channel improvement, and 9.7 percent to increasing farm household incomes. In 1990, just 38.9 percent was allocated to agricultural infrastructure improvement, 33.8 percent was devoted to the increase of farm income including the development of agricultural and industrial complexes, and 14.6 percent to the improvement of rural living conditions. In 2000, 39.3 percent of the agricultural budget was used for supporting farm incomes including reducing farm debts, followed by 29.7 percent for improving agricultural infrastructure, 13.4 percent for marketing channel improvement, and 6.9 percent for human resources and agricultural technology including fostering farmers' successors (Table 21). As Korean agriculture changed, the proportion of budget allocation for the agricultural production base and agricultural production sectors decreased, while the proportion for income support, marketing, and human resources for farmers increased.

Table 21. Allocation of agricultural public expenditure by projects (current billion KRW and percentage shares)

Classification	1970	1980	1990	2000
Agricultural infrastructure	13.33 (49.5)	149.4 (61.1)	552.4 (39.4)	2134.0 (29.7)
Agricultural mechanization	0.76 (2.8)	24.5 (10.2)	98.5 (7.0)	239.0 (3.3)
Agricultural production	7.6 (28.3)	13.4 (5.5)	16.4 (1.1)	398.8 (5.5)
Marketing improvement	3.4 (12.6)	24.0 (9.8)	43.2 (3.1)	965.5 (13.4)
Farm-household income	1.8 (6.7)	23.8 (9.7)	473.3 (33.8)	2827.5 (39.3)
Rural living conditions		3.9 (1.6)	204.5 (14.6)	132.7 (1.8)
Human resources and agricultural technology		5.4 (2.2)	13.8 (1.0)	494.5 (6.9)
Total (Share of agricultural Budget in Agricultural GDP)	26.89 (100) (4.2)	244.4 (100) (5.1)	1,401.7 (100) (10.8)	7,192.0 (100) (33.3)

Source: Ministry of Agriculture and Forestry (MAF), Statistical yearbook of agriculture and forestry, each year.

Note: Budgets for the dual-price system in rice and barley were excluded. The classification has been modified since 1998.

Government investment contributed to improving productivity and strengthening competitiveness in the agricultural sector.

The declining rural population, farmland size, and profitability of agriculture caused private investment in the agricultural sector to fall. However, the government played a leading role in agricultural growth by increasing its investment and financing activities. Government investment contributed to increasing agricultural products and productivity, and stabilizing agricultural product prices.

Living conditions in rural areas improved significantly because of government policies. In rural villages, 29 percent of houses were renovated, and the kitchens and bathrooms of those houses were modernized. Rural roads were paved and linked so that people could reach almost every village in Korea by automobile. The water supply service rate increased to 40 percent of all households, and local authorities collected and processed the garbage. Centres for the elderly and community centres were built in every village. Medical services in rural areas also greatly improved. Public health facilities were established, one for each regional government. Clinics were opened, one for each 'Eup' or 'Myeon' (Korean rural towns). Clinic outposts began providing for additional medical services: doctors and dentists were assigned to clinics, and old medical equipment was replaced with new equipment.

6. Summary and conclusions

This study examined the transformation of Korean agriculture in the course of Korea's economic growth and development. Following the framework of Timmer, the structural changes in Korean agriculture were divided into four stages. The first stage, getting agriculture moving, spanned 1958–1967, the second stage, agriculture as a contributor to growth, lasted from 1968–1977, the third stage, integrating agriculture into the macro-economy, covered 1978–1985, and the fourth stage, agriculture in industrial economies, began in 1986 and is ongoing (Table 22).

Table 22 summarizes key policy and institutional innovations across the different transformation stages using Timmer's framework.

Table 22. Summary of key policy and institutional innovations in Korea

Stages	Macroenvironment	Key policy and institutional innovations
Getting Agriculture Moving (1958–1967)	<ul style="list-style-type: none"> • Start of high growth in manufacturing industry • Beginning of a reduction in the proportion of agriculture in the economy • Small farmers escape poverty 	<ul style="list-style-type: none"> • Farmland reform • Establishment of the Rural Development Administration • Establishment of the Agricultural Cooperative Federation. • Enactment of Basic Agricultural Law • Agriculture productivity begins to increase
Agriculture as a Contributor to Growth (1968–1977)	<ul style="list-style-type: none"> • Averaged over 10% economic growth rate • Start of rural-to-urban migration • Self-sufficiency in staple grains • Improvement in poverty level 	<ul style="list-style-type: none"> • High rice price policy • Development and dissemination of agricultural technologies • Creation and consolidation of farmland improvement • Development high-yield rice variety called ‘Tongil’
Agriculture Integrated into the Macroeconomy (1978–1985)	<ul style="list-style-type: none"> • Averaged over 8% economic growth rate • Government-led to private-led growth transition • Productivity improvement • Progress in agricultural mechanization 	<ul style="list-style-type: none"> • Easing of high price policy for staple grains • Introduction of rural Industrial policy • Carrying out large-scale rural development projects
Agriculture in Industrialized Economies (1986–present)	<ul style="list-style-type: none"> • Join WTO and FTAs • Less than 10% of the agricultural sector in the economy • Increased demand for safe food • Emphasis on multidisciplinary functions of agriculture 	<ul style="list-style-type: none"> • Pursuit of international competitiveness in agriculture • Deregulation of farmland, reorganization of farmland rental system • Promotion of eco-friendly agriculture policies • Introduction of direct payment system • Implementation of food consumption and value chain related Policies

Getting agriculture moving: Korea started to grow rapidly, and agriculture held an important position in the national economy. The development of agriculture played an important role in national development.

The government created a foundation for the growth of agriculture. The farmland reform provided a pathway for small farmers to escape poverty, and the government was able to pursue agricultural technology development and extension through

the creation of the Rural Development Administration. In addition, an institutional foundation was formed in which agricultural investment was made possible through the founding of the National Agricultural Cooperatives Federation.

Agriculture as a contributor to growth: During this stage the annual economic growth rate exceeded 10 percent. Agriculture still played an important role in national development, even though its share in the national economy began to fall.

The government implemented various policies to improve agricultural productivity. These improved agricultural production infrastructure, and promoted the mechanization of agriculture. Farm household income was stabilized by the development of high-yield varieties and the dual-price system for staple grains, which also stabilized the food supply for the urban population. The labour pool for the industrial sector grew as workers in rural areas moved to cities. Agriculture greatly contributed to the development of the Korean economy during this period.

Integrating agriculture into the macroeconomy: Leadership changed direction from a policy of government-led high growth to one of private-sector-led stable growth. Market opening was promoted in response to internationalization. The economic growth rate remained above 8 percent, but the growth rate of agriculture slowed, and the share of agriculture in the national economy decreased to less than 20 percent.

Government policy shifted to embrace market principles as the agricultural market gradually opened. The government abolished the dual-price policy for staple grains. It supported the cultivation of commercial crops and introduced policies for rural industrialization to develop non-farming income to stabilize farm households. Market principles spread to the agricultural sector.

Agriculture in industrialized economies: Korea accelerated the internationalization of its economy, joining the WTO and signing FTAs with more than 50 countries. Agriculture accounted for less than 10 percent of the national economy, while people's demand for safe food increased.

Government supported policies for enhancing the competitiveness of agriculture and agrifood value chain development. It continued supporting the mechanization of agriculture and the scaling up of farm size to address the opening of markets to imported agricultural products. Meanwhile, the government fostered agrifood value chain development to meet consumer satisfaction and to develop the rural economy. Investment in agriculture became more of a public interest, rather than an imperative for growth, and was used to improve the quality of life in rural areas. This was because people's interest in safety in food, urban and rural coexistence, and environmental protection increased in this period.

As mentioned, the Korean government has implemented a menu of policies during each transformation stage, and Korean farmers responded by making efforts to increase agricultural productivity. Significant policies undertaken by the government included:

The government promoted agricultural mechanization. This began in earnest when power-tillers became available in 1963. The agricultural mechanization policy contributed to the distribution of farming machines to small and medium-sized farms. Mechanization increased agricultural competitiveness. However, the oversupply of agricultural machinery and the high purchase cost caused problems such as worsening household debt.

Policies for seed systems and seed security were also implemented. The government set up a full-scale variety development programme in 1965. The Rural Development Administration (RDA) created Tongil, a high-yield rice variety in 1968. In 1974, the Korea Seed and Variety Service (KSVP) was formed for handling the production, processing and distribution of seeds. The government established the Seed Bank at the Rural Development Administration in 1987, and subsequently started the Golden Seed Project (GSP), which is a national research and development project in 2012.

The agriculture research and extension system played an important role in the development of Korean agriculture. The Rural Development Administration, established in 1962, has contributed to improving the level of agricultural technology and the productivity of farmers through the development and dissemination of agricultural technology and education for farmers.

In 1957, the Agricultural Cooperative Act and the Agricultural Bank Act were passed. The National Agricultural Cooperative Federation (NACF) has been playing a leading role in providing funds for agricultural production, distributing farm inputs and living goods, and the marketing of farm products.

The laws on farmland and land reform of 1949 and 1950 were the most important institutional reforms. These laws fostered the growth of independent farmers as a means of building a stable social foundation, and contributed to the economic development of Korea. The Reclamation Promotion Act (1962), the Farmland Development Act (1967), and the Farmland Expansion and Development Promotion Act (1974) also contributed to improving grain production. Although it was created for political purposes, the Saemaul Undong Movement (1971–1978), promoted by the government, improved living conditions in rural areas and brought a focus on developing rural infrastructure. The high price policy for staple grains during the 1970s increased food production and farm income.

Beginning in 1980, the government introduced policies to increase non-farm income. Agricultural income had stagnated as the government eased its high-price policy for staple grains and allowed the increase of imported agricultural products. Also, the government carried out large-scale rural development projects nationwide to improve rural infrastructure: roads, waterways, communications, and facilities for welfare, education and medical services.

Since the 1990s, the government has pursued agriculture-related systems and policy reforms to promote the multiple functions of agriculture. The farmland system was reformed again. Since 2000, direct payment systems were introduced to support environmentally friendly farming, farming in regions with unfavourable conditions,

rural landscape conservation, and environmentally friendly livestock farming. Direct payments were also used to promote the early retirement of aged farmers and increase the multiple functions of agriculture.

The government was able to bring about transformation in agriculture through public expenditure. The share of the agricultural budget in the national budget was less than 6 percent until the mid-1980s, but the share increased to 15.9 percent in 1995. Government expenditure in the agricultural sector during the 1970s was focused on agricultural infrastructure improvement and staple grain production. In the 1980s, it concentrated on agricultural infrastructure and mechanization. Since the 1990s, the funding grew to include marketing, development of agricultural human resources, and driving an increase in farm household income through creating opportunities for additional non-farming income. Government investment contributed to increasing the range of agricultural products and productivity, and stabilizing agricultural product prices.

To summarize, the Korean government's policies played an important role in the transformation of agriculture as the economy developed, and the development of agriculture contributed to national economic development. However, farmers' high dependence on the government and its increased fiscal spending on the agricultural sector remain challenges that need to be addressed.

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Chapter 4

THAILAND

Agricultural transformation in the Kingdom of Thailand

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Abstract

Thailand's agricultural transformation has been affected by internal and external factors. Agricultural transformation in Thailand has followed similar patterns to other countries. This chapter traces the brief history of agricultural transformation in Thailand, following the framework discussed in chapter 1 and 2. The chapter describes key characteristics of each stage of the agricultural transformation, and analyses the factors behind the transformation as well as specific public policies, interventions and institutional innovations that may have contributed to or impeded the process of transformation. The chapter also discusses the success of value chain development and attempts to identify some key challenges to further advancing the process of agricultural transformation in Thailand.

1. Introduction

Thailand is an upper middle-income developing economy that has undergone a highly successful agricultural transformation. As Thailand is an important exporter of food and agricultural products, external shocks and changes in world markets have always had large impacts on Thai agriculture. Those impacts heavily influenced the responses and decisions of all actors in the agricultural sector, particularly the government. Both external shocks and domestic responses, especially institutional changes and policy reforms, triggered a dynamic agricultural transformation process that helped maintain the export competitiveness and resilience of Thai agriculture. This report will explain how those shocks and changes influenced Thailand's agricultural transformation.

Despite voluminous literature on Thai agricultural development, very few studies have been done on agricultural transformation in Thailand. Earlier works only describe the general pattern of agricultural transformation in the regional context (Timmer, 1988, 2009 and 2018) or transformation in specific sub-sectors, especially the supermarket and modern-food sectors.¹ Two recent studies on agricultural transformation by the author of this report focused mainly on the overall success of agricultural development rather than the process of transformation and its different stages (Nipon, 2018; Nipon and Kamphol, 2019). Following the approach in chapters 1 and 2, which are based on recent studies by Vos (2018), Laborde *et al.* (2018) and Mamun *et al.* (2020), this country study will contribute to the literature by using time series data to describe the stages of Thai agricultural transformation, specifying the time period of each stage, explaining the transformation process, and explaining specific public policies, interventions and institutional innovations that may have contributed to or impeded the process of transformation.

The objective of this study is to provide a detailed analysis of Thailand's agricultural transformation through six different stages, as discussed in chapters 1 and 2 of this publication. The study emphasizes institutional innovations, policy changes and reforms, the role of the markets and agents in agriculture, as well as key drivers of each stage of transformation. The paper also describes the development of Thailand's modern food value chains, which are relatively more advanced than those of most developing Asian economies, except Malaysia (World Bank, 2018; Nipon *et al.*, 2020).

The analysis relies heavily on the indicators developed by Laborde *et al.*, (2018) and further elaborated in chapters 1 and 2, time series of official statistics, and findings from previous studies. It also uses Rodrik's method of decomposing changes in overall labour productivity (McMillan, Rodrik and SepÚveda, 2016). The analysis of institutional changes is based on the conceptual framework of induced institutional innovation (Ruttan and Hayami, 1984), and new institutional economics (Williamson, 2000; Kherallah and Kirsten, 2002).

After this introductory section, part 2 describes the stages and drivers of agricultural transformation in Thailand. This is followed by a detailed analysis of structural

¹ Reardon, Timmer, Barrett and Berdegue, 2003; Reardon, Minten and Chen, 2012; Reardon and Timmer, 2012; Nipon, Phunjasith and Kamphol, 2020; Phunjasith, Viroj and Kennedy, 2018.

change in agriculture (with an emphasis on sources of productivity growth) and food value chains in part 3. Part 4 examines the institutional and policy reforms in each transformation stage. Finally, part 5 presents some observations on key aspects of transformation, summarizes the key institutional changes and policy reforms in different transformation stages, and presents some major challenges for future agricultural transformation.

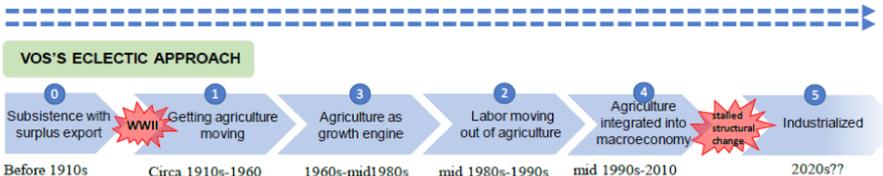
2. Stages of agricultural transformation in Thailand

Using the definitions in chapters 1 and 2, this section identifies six stages of agricultural transformation in Thailand (Figure 2.1) and explains their salient characteristics, with a focus on the transformation stages after the 1970s when time-series data is available. Despite scant evidence, a brief description of the first two stages, namely the subsistence agriculture (stage 0) and getting agriculture moving (stage 1), is necessary because the trade-opening agreements with other countries, and important institutions as well as policies, which were the necessary conditions for agricultural development in later stages, were created and took place during the late 19th and early 20th centuries.

The transformation pattern in Thailand did not move linearly from stage 1 to stage 2 (labour moving out of agriculture), which is a pattern experienced by most countries as discussed in chapter 2. This section will explain why Thai agriculture jumped to stage 3 (agriculture as an engine of growth), a pattern similar to the transformation process among Southeast Asian countries as described by Timmer (2009) and further highlighted in chapters 1 and 2. Moreover, it will also analyse the slowing pace of structural transformation after 2008 when the transformation was in stage 4 (agriculture integrated into the macroeconomy). Another objective of this part is to point out that the beginning of the next transformation stage may take place before the end of the earlier stage, e.g. Thai agriculture began to integrate into the macroeconomy (stage 4) during stage 2 (labour moving out of agriculture) as a result of its strong linkages with industrial and service sectors due to the increasing food demand from the tourist industry.

The salient characteristics of each stage are qualitatively described in Table 2.1, while Table 2.2 provides the data for important indicators of five agricultural transformation stages between 1950 and 2018.

Figure 2.1: Stages of agricultural transformation in Thailand



Source: Adapted from Vos (2018).

2.1 Subsistence agriculture in the 1800s: a period of institutional foundation after the Bowring Treaty

In 1850, Siam was not a pure subsistence economy (Ingram, 1971). Though nearly all Thai farmers tried first to grow enough rice and other supplementary crops for their own family, Silcock (1970: 37) argues that “this does not mean, however, that there was no growing of crops for sale apart from rice and rubber. Some specialisation undoubtedly occurred.” There was always surplus rice that was exported even during the fourteenth to eighteenth centuries. The trade was carried out by Chinese acting as royal agents.

Almost all the working population of Siam worked in agriculture. About 95 percent of cultivated areas were used for rice production, and the remaining 5 percent for other agricultural products, including fruits, vegetables, sugar cane, betel nut, tobacco, silk and cotton.

Most internal trade included bartering within individual villages, with little commerce between villages and regions. Foreign trade essentially did not exist after Siam expelled Westerners and avoided trading and diplomatic contacts with the West in 1688, except for small amounts of rice exports to southern China and neighbouring kingdoms. The turning point came in 1855, when King Mongkut, or Rama IV (*r.* 1851–1868), signed the Bowring Treaty with Great Britain, lifting the royal monopoly on rice and salt exports. That treaty marked the beginning of rapid changes in Siam. Rice exports surged in response to the demand for rice from markets in British colonies, such as Malaya and India, and in the Dutch East Indies (Silcock, 1970). Trade was also supported by a decline in ocean transport costs. During 1925–1929, rice exports were estimated to account for 40 percent of rice production, compared to negligible amounts in 1850 (Ingram, 1971).

The increased export demand for rice led to some labour scarcity. In response, King Mongkut accepted immigrant Chinese as paid labourers and offered special tax inducements for farmers to open up new land (Ingram, 1971).

His successor, King Chulalongkorn, or Rama V (*r.* 1868–1910), implemented even more ambitious reforms to modernize Thai agriculture. In response to the increased demand for rice, he initiated a series of major institutional reforms to alleviate the shortage of labour and land. He reduced the corvée labour requirement on adult men in 1877 and then implemented the Slavery Abolition Act of 1905, which helped free up labour for rice farming. In 1901, Siam introduced a modern land registration system, in which the government issued land titles to private owners.² Both the land and labour reforms generated more government revenue and, most importantly, resulted in the establishment of private property rights to land (D.H. Feeny, 1982; Ruttan and Hayami, 1971). This greatly facilitated the expansion of rice production and exports (Silcock, 1970; Ingram, 1971).

Other important initiatives included the holding of two Agriculture and Trade Exhibitions where awards were given for the best quality of native paddy varieties, the granting of five scholarships for Thai students to study modern agriculture in Europe and the United States, and establishment of an agricultural school.

During his reign, King Chulalongkorn supported the construction of canals and railways in response to the increasing trade in rice. This also led to a rapid increase in appropriating land for commerce and farms along the new canals and railways. Such reforms and infrastructure investments laid a strong foundation for agricultural development in stage 1, “getting agriculture moving,” in the 1900s.

² Soontari Asawai, 1987; Wirawat, Buddhakarn and Lae, undated; https://www.silpa-mag.com/history/article_6630.

2.2 Stage 1: Getting agriculture moving, 1910–1960

Thai agriculture began to move after the 1910s because agricultural growth was broad-based and diversification of new crops began to take place (Table 2.1), although lack of data makes it difficult to pinpoint exactly when agriculture entered stage 1. Table 2.1 identifies the salient characteristics of structural change, productivity growth, and indirect evidence about poverty in this stage.

From 1907 through 1952, agricultural growth was widespread throughout the country. All regions experienced rapid expansion of agricultural production but differed in terms of the types of crops because of their comparative advantages, such as maize and mung beans. As a result of rapid expansion of several crops, agricultural exports soared. Exports of rice, rubber and teak all increased (Silcock, 1970; Table 3.5). Some farmers also specialized in minor crops for domestic consumption, such as vegetables and fruits in the western coastal provinces (Silcock, 1970), a clear pattern of diversification of new crops outside the central plains (Silcock, 1970). Consequently, the growth of non-rice crops was exceptionally high at 284 percent between 1951–1953 and 1962–1964, which was higher than the growth of rice output (30 percent). Agricultural growth was not only partially explained by the public investment, but it was also a major source of government revenue. According to Ingram (1971), although public investment accounted for only 11 percent of total government expenditure during 1892–1941, railroads and irrigation projects accounted for most of the investment expenditure, followed by urban electricity and water supply. Revenue from agricultural and land taxes as well as forest concessions accounted for at least 35.7 percent of government revenue.

By 1950s, the growth of the non-agricultural sector surpassed that of agriculture as evidenced by the fact that agricultural output grew more slowly than real GDP between 1951–1953 and 1962–1964. Agriculture's share of GDP slowly declined from about 38 percent in 1950 to just below 35 percent in 1965 (Table 2.2). The decline was due to the implementation of an import-substitution industrialization policy after the Second World War. However, agriculture's share of employment only slightly dropped from 85 percent between 1950 to just over 82 percent in 1960 (Table 2.2). The disparity between non-agriculture and agriculture income continued to widen during the 1960s. The ratio of per capita income in the non-agricultural sector to that in agriculture increased from 8:1 in 1960 to 11:1 in 1970 (Table 2.2).

A major characteristic of stage 1 was an increase in agricultural productivity. Rice yields rose from 1.28 tonnes per hectare in 1947 to 1.60 tonnes per hectare in 1965 (Silcock, 1970). During 1907–1912, the average rice yield was as high as 1.86 tonnes per hectare. However, our estimate from available statistics shows that labour productivity in rice production rose from 0.36–0.54 tonnes per worker in 1911–1919 to 0.74–0.91 tonnes in 1911–1947.³ The main reasons were the increase in irrigated areas after the completion of the Chao Phraya dam in 1957, along with the rapidly developing road transport (Silcock, 1970). In response to water availability, fertilizer

³ Estimated labour productivity in rice production is not published in this report but can be obtained from Kamphol Pantakua, kamphol@tdri.or.th.

use multiplied, as did the use of imported tractors (Silcock, 1970), resulting in higher yields as well as higher labour productivity.

One important consequence of getting agriculture moving is poverty reduction, as deduced from proxy poverty indicators in the absence of more direct and accurate indicators. First, real GNP per capita increased 3.47 percent per year between 1951 and 1965, which was faster than population growth. Second, the growth rate of the available supply of rice for domestic consumption was also slightly higher than the population growth (3.29 percent vs 3.1 percent), implying that Thai people should have had a higher energy intake. Since there was also a rapid increase in the variety of crops for local consumption, these facts imply that the nutrition situation improved in the 1950s (Table 2.1). But after the end of the Second World War, the government had to impose a rice export tax – the so-called rice premium – at first to pay for war reparations to the Allies of World War II, but later as a means to stabilize domestic rice prices. The burden of the rice premium was mostly borne by farmers, and resulted in high rural poverty incidence until its elimination in 1986 (more discussion in part 4).

Table 2.1: Five stages of agricultural transformation and indicators

Stages	Indicators					Drivers/ policy
	Structural change	Productivity	Poverty/ inequality	Nutrition	Sustainability	
<p>1. Getting agriculture moving: 1910s (or later) to 1950's. (Mosher Stage: Rapid increase in production of several crops for exports and domestic use)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Very high share of agricultural employment 85%-88% and high but declining share of agricultural GDP - Broader economic growth: (a) Rapid growth of several non-rice crops in all regions; (b) Diversification of new crop outside Central Plains - Export of more products grown in different regions, e.g., teak in the North rubber in the South, maize in Central Plains & Northeast, etc. 	<ul style="list-style-type: none"> <input type="checkbox"/> Agric productivity increased - Higher Labour productivity - Rice yield increased after 1947 - Yield of other crops increased (Silcock 1970) 	<ul style="list-style-type: none"> <input type="checkbox"/> Poverty Reduction - No information - Indirect evidence: per capital income and rice production rose faster than population 	n.a.	<ul style="list-style-type: none"> <input type="checkbox"/> Environment - No information - Minimal impact on environment 	<ul style="list-style-type: none"> - End of WW II - Economic nationalism

Indicators						
Stages	Structural change	Productivity	Poverty/ inequality	Nutrition	Sustainability	Drivers/ policy
2. Labour moving out of agriculture: 1985 to 2000s (elimination of agricultural taxation)	<ul style="list-style-type: none"> □ Inclusive structural employment - Increased non-agric employment from 33.9% in 1985 to 31.2 % in 2000 - Higher real wages in both agric & non-agric sectors - Elimination of agric export tax - Supermkt revolution - Non-agric employment surpassed agric employment in 1998 	<ul style="list-style-type: none"> □ Agric productivity is not lagging - The only period when land productivity growth is higher than that of land productivity - Both land & labour productivity increased from specialization & mechanization - Higher real wage in agriculture 	<ul style="list-style-type: none"> □ Poverty reduction - Sharply reduced from 45.1% in 1985 to 12.7% in 1996 - Inequality: Per-capita non-agric income/ agric income increased from 8.7 in 1980 to 15.1 in 1993; then declined to 10.8 in 2000 	<ul style="list-style-type: none"> - Reduction in undernutrition 	<ul style="list-style-type: none"> - Environmental degradation 	<ul style="list-style-type: none"> - Export-led Industrialization policy - Plaza Accord - Depressed global commodity prices drove migration - Uruguay Round Agreement

Stages	Indicators					
	Structural change	Productivity	Poverty/ inequality	Nutrition	Sustainability	Drivers/ policy
<p>3. Agriculture as contributor to growth: 1960s to mid 1980s (Johnston-Mellor: Surplus creation by rural investment)</p>	<ul style="list-style-type: none"> □ Dynamic agriculture (Silcock 1970: 168) - High but declining agric share of GDP & still high agric share of employment - Diversification of upland crops - Expanding non-agric employment: non-agric employment increased from 17.7% in 1960 to 33.9% in 1985 - AFS employment was stable between 1975 and 1985 (Table 2.2) - Increased land pressure 	<ul style="list-style-type: none"> - Sources of growth: technology and movements of factors into new places, new combinations, and new types of production in rural areas. 	<ul style="list-style-type: none"> □ Poverty reduction - Reduced from 57.5% in 1961 to 33.4% in 1980 but surged in 1985 - Inequality increased 	<ul style="list-style-type: none"> - No information on under-nutrition - 2 proxies a) Anemia reduction, b) more food supply availability, i.e., “Small gap between actual & required calories intake” 	<ul style="list-style-type: none"> • Environment - Logging and reduction of forest land - Land conflicts 	<ul style="list-style-type: none"> - More open economy - Massive rural infrastructural investment - High population growth - High global commodity price

Stages	Indicators					
	Structural change	Productivity	Poverty/ inequality	Nutrition	Sustainability	Drivers/ policy
4. Agriculture integrated into macroeconomy: late 1990s to 2010s	<ul style="list-style-type: none"> -Agric employment declined, still significant but not dominant (30% in 2010 but over-estimated) as % of farm household income from agric is 40% -Agric GDP share less than 10% -Strong linkages with food processing services & tourism: -High shares of non-ag AFS* value added and employment -Financial liberalization reducing formal informal interest rate -Modern & safe FVC -Increasing urbanization 	<ul style="list-style-type: none"> -Highest growth of labour and land productivity -Agri real wage increased 10% p.a. -TFP** growth as largest source of agric growth -High contribution of labour productivity to overall labour productivity growth 	<ul style="list-style-type: none"> -Low poverty incidence 4.1% of pop living on less than \$5.2/day in 2000s --High sectoral income disparity 	<ul style="list-style-type: none"> -Under-nourishment declined from 27.5% in 1995 to 13.38% in 2005 -Overweight in increasing from 13.5% in 1990 to 22.67% in 2005 	<ul style="list-style-type: none"> -Environmental degradation 	<ul style="list-style-type: none"> -Rising middle class -Urbanization surged after 2000. -Commodity price boom in 2008 -Increasing farm subsidy

Indicators						
Stages	Structural change	Productivity	Poverty/ inequality	Nutrition	Sustainability	Drivers/ policy
5. Industrialized economy: challenging issues affecting transformation	<ul style="list-style-type: none"> - Agric GDP share less than 9% in 2015 - Decline in agric employment to 32% in 2018, but only 20-25% on full-time basis - Some agric subsectors become industrialized e.g., poultry & hydroponic vegetables - Stalled structural transformation due to (a) structural factors, and (b) I/GDP ratio is low and lower than S/GDP 	<ul style="list-style-type: none"> - TFP** growth as the largest contribution to GDP growth - Negative land productivity growth - Land per worker begins to increase, and larger farms having higher productivity 	<ul style="list-style-type: none"> - Very low poverty incidence of 0.4% in 2010s - Declining but still moderately high sectoral income disparity -- Reaching upper middle- income status in the 2010s 	<ul style="list-style-type: none"> - Rapidly changing dietary pattern - Undernourishment dropped to 5.5% in 2015 - Overweight increased to 33% in 2015 	<ul style="list-style-type: none"> - Chemical residues in agric products - Air pollution from burning agric materials on rice, corn and sugar farms 	<ul style="list-style-type: none"> - High per capita income - Agri-tech digital Technology - Aging farmers

Note: S 1 = agriculture moving out of agriculture; S2= labour moving out of agriculture; S3= agriculture as growth engine; S4= agriculture integrated in industrialized economy

*Semi-log regressions 1938-1955 from Ingram (1971). 1961-2018 from WDI

**AFS = non-agricultural, agri-food system; IO = Input-output Table

*** Share of wages in value added

**** Calculated from NESDB data (GDP in Baht @1988 price) and labour data 1950-1960 from Ingram (1971)

***** Poverty incidence (1) is estimated by TDRI. Poverty incidence (2) is based on the national poverty line estimated by the National Economic and Social Development Council

Source: Various tables and figures in this report. Original sources are NESDB, NSO, MOPH, WDI and Ingram (1971).

Table 2.2: Selected proxies of agricultural transformation in five stages, 1950–2018

Item	S1					S3					S2					S4					S5	
	1950	1955	1960	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2018	2018	2018						
GDP growth*	7.6%	5.6%	5.8%	7.9%	5.8%	7.9%	5.3%	10.2%	7.9%	-0.3%	5.6%	3.2%	3.1%	3.8%								
Agricultural GDP growth*	9.3%	3.8%	5.4%	4.1%	7.6%	4.8%	-1.6%	6.6%	-1.2%	7.7%	5.7%	7.7%	-0.6%	1.1%								
Agricultural GDP share	37.9	35.4	36.4	25.9	26.9	23.2	15.8	12.5	9.1	8.5	10.5	9.2	8.9	8.1								
Agricultural employment share	85.0	83.6	82.3	79.3	72.3	71.1	67.6	60.3	52.0	48.8	38.2	42.6	32.3	32.0								
Non-ag AFS value added IO** (%)					38.8	38.7	38.3	35.9	34.0	39.8	35.4	38.1	33.6									
Non-ag AFS employment share** IO (%)					29.0	29.4	28.1	22.7	19.8	21.1	23.4	26.6	25.3									
Non-ag AFS value added NESDB (%)							27.0	26.0	28.0	26.0	23.5	24.0	24.0	27.3								
Non-ag AFS employment share NESDB (%)								8.0	8.4	10.6	14.8	13.0	20.4	21.6								
Agri labour productivity (US\$/worker)					811.4	816.2	666.2	827.8	899.4	933.3	1,501.8	1,331.0	1,465.9	1,503.1								

Item	S1					S3					S2					S4				S5	
	1950	1955	1960	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2018	2018	2018					
Aggregate labour productivity**** (1,000Baht/worker @1988 price)	12.8	14.5	16.4	28.7	32.4	40.0	45.6	65.1	90.0	84.9	103.0	119.3	141.1	159.7							
- Growth (% p.a.)		2.4%	2.5%	5.9%	2.6%	4.4%	2.7%	7.5%	6.6%	-2.1%	4.2%	2.4%	3.6%	4.1%							
Agri labour productivity**** (1,000Baht/worker @1988 price)	5.9	6.1	6.3	9.9	10.6	11.1	11.9	14.4	16.9	16.1	24.2	35.7	41.6	43.3							
- Growth (% p.a.)		0.6%	0.5%	3.4%	5.4%	2.5%	-2.5%	5.4%	0.5%	-1.4%	9.0%	7.0%	4.0%	1.6%							
Agricultural real wages (□/Day)							77.6	72.9	80.9	116.8	118.5	237.1	219.5	220.4							
Poverty (1) (%)*****				57.5	39.0	38.5	33.7	45.1	31.4	12.7	15.4										
Poverty (2) (%)*****								67.3	58.0	38.9	42.3	16.4	7.1								
Undernourishment (BMI) (% of population)									27.8	25.0	18.8	9.8	8.0	7.8							
Undernourishment (weight by age) (% of pop 18+)	10.2	12.1	14.1	16.3	18.8	22.2	26.7	31.5	10.2	12.1	14.1	16.3	18.8								
Overweight (% of pop 18+)					8.5	10.2	12.1	14.1	16.3	18.8	22.2	26.7	31.5								
Obesity (% of pop 18+)					0.8		1.6		2.1	2.8	3.7	7.3	10.1								

Item	S1		S3					S2			S4			S5
	1950	1955	1960	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2018
Per capita income differential between non-ag and agri sector	9.3	9.3	8.1	11.0		8.1		10.6	10.8	10.3	7.3	5.3	4.9	5.3
Urbanization (% population)				20.9	23.8	26.8	28.1	29.4	30.3	31.4	37.4	43.9	47.7	

Note: S1 = agriculture moving; S2= labour moving out of agriculture; S3= agriculture as growth engine; S4= agriculture integrated in macroeconomy; S5= industrialized economy

*Semi-log regressions 1938-1955 from Ingram (1971). 1961-2018 from WDI

**AFS = non-agricultural, agri-food system; IO = Input-output Table

*** Share of wages in value added

**** Calculated from NESDB data (GDP in Baht @1988 price) and labour data 1950-1960 from Ingram (1971)

***** Poverty incidence (1) is estimated by TDRI. Poverty incidence (2) is based on the national poverty line estimated by the National Economic and Social Development Council

Source: Various tables and figures in this report. Original sources are NESDB, NSO, MOPH, WDI and Ingram (1971).

2.3 Stage 3: Agriculture as an engine of growth, 1960s–1980s

Thai agriculture, which was the largest economic sector at the time, transformed rapidly from stage 1, getting agriculture moving, to stage 3, agriculture being a growth engine, in the 1960s and 1970s (Figure 2.1), a pattern similar to other Southeast Asian countries (Timmer, 2009). That agriculture was the growth engine, responsible for a transformation of the economy, was made possible by a confluence of factors, events and policies.

First, the non-agricultural sector, particularly industry, was small and very weak because of the economic nationalism policy after the Second World War, which resulted in widespread corruption. After the military coup in 1958, the new government introduced a new direction for economic policy, aiming towards an open economy and market-based policies. The main objective was not only to accelerate economic growth but also to spread prosperity to the impoverished rural areas as⁴ evidenced by the master plan on infrastructure investment in Thailand's first national economic development plan in 1961 (Ammar, 1996-a). These investments included multi-purpose water management, roads, irrigation, agriculture, forestry, fisheries, social services and compulsory primary education. In 1965, over 75 percent of total government economic expenditure was spent in the rural sector (Silcock, 1970: 190). Silcock also estimated that nearly 50 percent of the annual budget was spent in agriculture in the 1960s.

Secondly, Ammar (1966-a) argues that Thailand started the postwar period blessed by a relatively abundant resource of forest land, but much of it was left unoccupied, mainly on account of malaria. The actions of the government quickly opened up these unoccupied uplands for the production of upland crops. They included the DDT programme, which made the clearing of malaria-infested forests less hazardous, the road building programme, and large logging concessions to private companies which unintentionally promoted the clearing of forests. The land clearing movement proceeded at an unprecedented pace, mainly because of population pressure, which grew at more than 3 percent per annum in the 1960s. Since agricultural output expansion was achieved almost entirely by means of area expansion, yields remained low. Part 3 will analyse the sources of agricultural output per capita growth, which grew at 3.13 percent per year in the 1961/63 – 1976/78 period. The universal primary education and adult literacy policies have been widely credited with helping farmers adopt modern farm technologies, thus improving productivity and marketing.

Thirdly, significant investment in rural infrastructure, rural-urban connectivity and a booming world commodity market during the 1960s had a propeller effect on agriculture development. The result was a continuous growth of agricultural exports and rapid growth of agricultural GDP, which rose to 7.6 percent in 1975 from just over 4 percent in 1955 (Table 2.2).

Moreover, the policies and institutions during this stage also “establish (agricultural) market links with industry; technology and incentives to create a healthy agricultural

⁴ The Financial Advisor at the time wrote: “In May 1946 Siam was starting from scratch; the till was completely empty and the only asset she possessed was her potential power to acquire stocks of foreign exchange.” (Ammar, 1966-a).

sector; (and) improve factor markets to mobilize rural resources” (Timmer, 2009).⁵ The rural network did not only lower transportation costs, but also increased competition for farm products among rural middlemen as farmers had more marketing channels. The expansion of upland crops, such as cassava, sugarcane, jute and maize, mostly for export, also led to a rapid increase in food processing plants as well as retailing outlets selling fertilizers, agricultural chemicals, and seeds near the production areas as evidenced by the high percentage share of employment and value added in the non-agricultural, agrifood sector (Table 2,1-b). Thanks to the successful agricultural credit policy, and the establishment of the Bank for Agriculture and Agricultural Cooperative in 1966, millions of farmers had access to cheap agricultural credit, resulting in a declining share of the informal credit market (Ammar *et al.*, 1990).

Yet the importance of agriculture began to decline, thanks to the import-substitution industrialization policy. Agricultural share of GDP fell from 36.4 percent in 1960 to 23.2 percent in 1980, but its employment share was still very high, declining from 82.3 percent to 72.5 percent in the same period (Table 2.2 and Figure 2.2). This implies that per capita income inequality between agriculture and non-agriculture was still very high (Figure 2.3). Moreover, the absorption of considerable numbers of people in the agricultural sector also kept the rate of urbanization low (Table 2.2), compared to other countries at the same level of income.

As a result of rapid economic growth, poverty incidence fell from 58 percent in 1962/63 (the first year that the National Statistical Office launched the Socio-Economic Survey) to 38.5 percent in 1968/69, 38 percent in 1975/76, and 33.7 percent in 1981 (Table 2.2, and Ammar, 1996). Although there is no data on undernourishment incidence before⁶ 1986, the incidence of anaemia among pregnant women fell from 57 per 1,000 in 1960 to 50 in 1980, and almost 19 in 1990 (Winichagoon, 2013). Though food supply availability increased, the ratio of actual calorie intake to reference daily intake (RDI)⁷ still declined from over 97 percent in 1960 to more than 94 percent in 1986, if one used the 1960 RDI table.⁸ The evidence on undernourishment is, therefore, inconclusive.

Though agricultural expansion could accommodate high population growth and helped reduce poverty, the government failed to issue land titles to the farmers who cleared and occupied new lands. This led to land conflicts in the mid-1970s and deforestation (Table 2.1), thus the transformation was not sustainable.

⁵ This is the so-called “Johnston-Mellor” environment” policy setting, according to Timmer (2009).

⁶ The oldest data on undernourishment incidence was reported in the Third National Nutrition Survey by MOPH in 1986. The definition is weight by age (6–19 years) below 10 percentile. The incidence increased from 417 in 1986 to 174 in 1990.

⁷ RDI is the daily intake level of a nutrient that is considered to be sufficient to meet the requirements of 97–98 percent of healthy individuals.

⁸ But it should be noted that the survey covered very small sample and different samples in each survey.

Figure 2.2: Agricultural and non-agricultural shares of GDP and employment

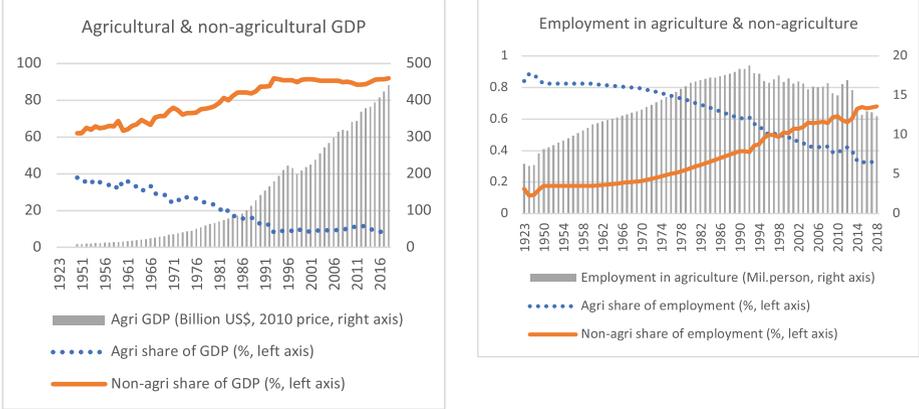
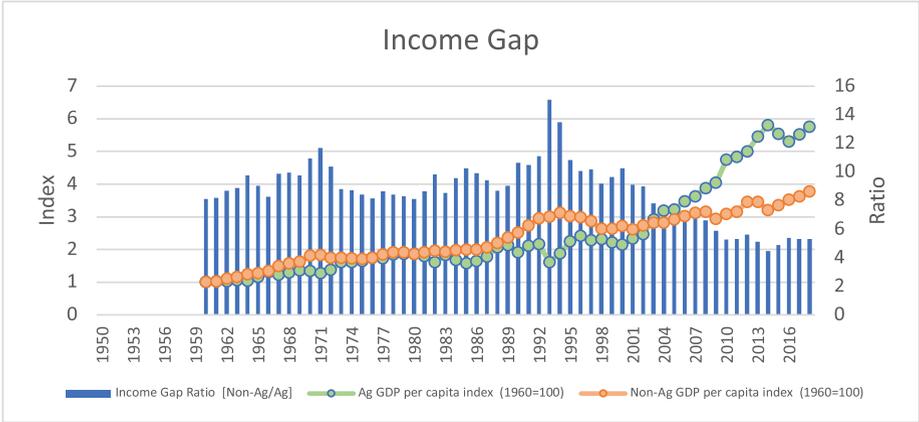


Figure 2.3: Per capita income differential between non-agricultural and agricultural sectors



Note: Employment 1961-1969, 1971-1979, 1981-1989 estimated by trend.

Source: NSO, LFS and WDI.

2.4 Stage 2: Labour moving out of agriculture, mid-1980s to early 2000s

Thai economy experienced a major structural shift in this period, when large numbers of agricultural workers were shifting to higher labour productivity sectors, resulting in an unprecedented aggregate labour productivity growth of 7.5 percent in 1990 (Table 2.2). Throughout this stage, agriculture continued to be the highest source of employment and only in 2000 dropped to about 49 percent (Table 2.2, Figure 2.2). However, the average agricultural labour productivity for the stage grew at the lowest rate compared with the other three transformation stages. Therefore, per capita income in non-agriculture, which was 8.1 times that of agriculture in 1980, widened to 10.8 times in 1995, and has been declining thereafter (Table 2.2). Given the exhaustion of land and continued population growth, another problem emerges: environmental degradation.

The early 1980s was an extremely painful period for the Thai economy as a whole. In addition to the urgent need for macroeconomic adjustment to cope with a fiscal crisis, there was a structural problem created by the declining comparative advantage of agriculture. The serious trouble faced by agriculture was evidenced by the increase in poverty (Table 2.2 and Figure 2.5) and massive rural-urban migration. Besides the severe worldwide agricultural depression of the 1980s, agriculture suffered the Dutch disease, caused by the booming industrial and non-traded real estate sectors, which drew resources (especially primary inputs such as labour and land) away from the tradable agricultural sector (Ammar 1996-b). This, in turn, affected both agricultural competitiveness and farmers' income. Fortunately, the industrial boom in the second half of the 1980s spurred by the relocation of Japanese labour-intensive industries to Thailand, triggered an exodus of rural workers, particularly young people aged 15–34⁹ in the early 1990s (Ammar, 2004). Another brief period of temporary rural-urban migration took place among those aged 35–54 during 1999 and 2001 (Figure 2.4). These migrations enabled farm households to earn extra and higher income either from non-agricultural jobs in the dry season or by sending family members to work in the manufacturing sector. The agricultural employment share fell below that of non-agriculture for the first time in the 1990s (Figure 2.2a), and by the mid-2000s, migration levelled off. At the same time, the number of farmers aged 35 and older began to increase after 2004, resulting in a “greying” population of farmers in the next transformation stage. The industrial boom also led to the rapid growth of the food processing industry and employment as the value-added share of the non-agricultural, agrifood sector (AFS) increased from about 36 percent in 1990 to 40 percent in 2000 (Table 2.2)

Although stage 2 was a period of relatively low growth in agricultural output and agricultural labour productivity, the real agricultural wage began to increase in the late 1980s (Figure 3.3) as a result of rural-urban migration. Total factor productivity growth is the largest contributing factor to the growth of agricultural value added, and land productivity is quite impressive (Table 3.1). This is mainly because of the surge in government research intensity between the 1980s and 1990s (Figure 3.7). The government also invested heavily in irrigation and rural electrification.

Although sectoral income disparity widened, the transformation was somewhat more inclusive, not less, as characterized by Laborde *et al.* (2018). First, the poverty incidence dropped sharply (Figure 2.5) because of the abolition of the so-called rice premium (or rice export tax), other export taxes and export quotas on agricultural products in the mid-1980s¹⁰ (Ammar and Suthad, 1988). Secondly, the undernourishment of the population aged 12 and over also dropped (Table 2.2).

⁹ Most of the young people aged 15–24 years went to study in the cities and never returned to agriculture (Ammar, 2004; Nipon, 2008).

¹⁰ The elimination of agricultural export taxes and quotas and phase-out of the trade-related investment measures between the mid-1980s and 1990s resulted in “neutral agricultural trade policy” (Warr and Achanun 2007).

Figure 2.4: Exodus of agricultural labour: Number of agricultural labour by age groups, 1992–2016

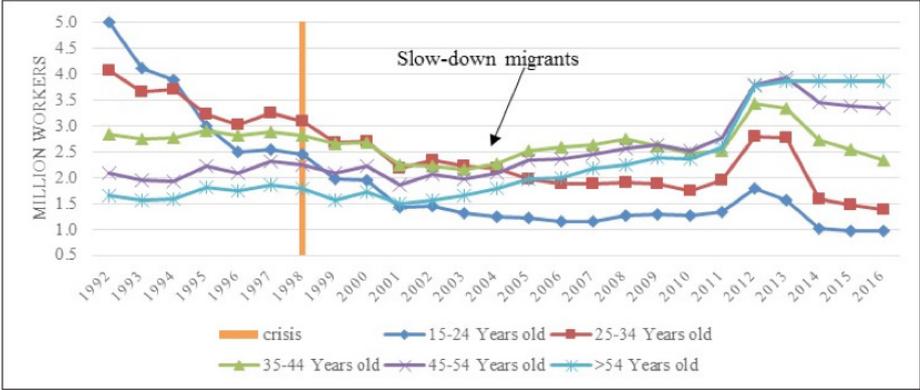
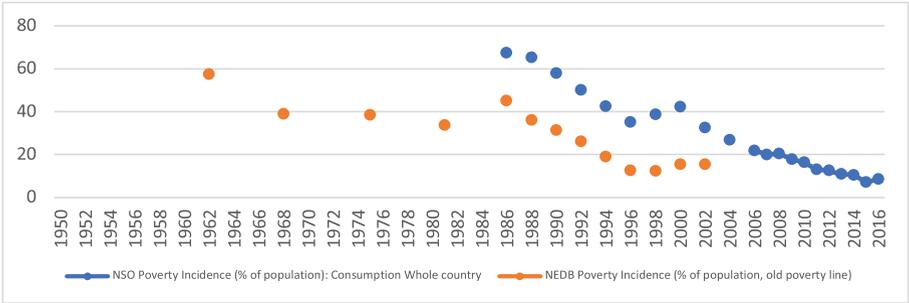


Figure 2.5: Poverty incidence, 1962–2016.



Note: NSO used ratio at \$5.50 a day and NESB 1962–2002 used NESDB old poverty line

Source: NSO, NESDB, 1993 in Jitsuchon, 2004.

2.5 Stage 4: Agriculture integrated in the macro economy, 2000s–2010s

As a consequence of sustained rapid economic growth from 1985 through 1996 (as evidenced by high investment-to-GDP ratio of 35 percent), the Thai economy underwent fast-paced structural transformation in the 2000s. Both aggregate and agricultural labour productivity grew rapidly during stage 4 (Table 2.2 and Table 3.2).

Agriculture continues to be a significant source of employment, accounting for nearly 43 percent of total employment in 2005, which dropped to 32 percent in 2018 (Table 2.2). The non-agricultural sector provided the bulk of employment, dominated by the service sector. The sectoral per capita income differential between agriculture and non-agriculture declined significantly, partly because there was a large labour productivity gain in agriculture in this period (Figure 2.3). However, Box 2.1 argues that the agricultural employment figure is overestimated, and the actual income disparity may be smaller. Poverty incidence and undernourishment – the main characteristics of this transformation stage – also declined to very low levels (Figure 2.5). However, problems of overweight and obesity are more prevalent (Table 2.2), and environmental

degradation became more serious as a result of excessive use of agricultural chemicals (Table 2.1).

Evidence shows that agriculture has begun to integrate into the macroeconomy since the mid-1990s, when Thai agriculture was still in stage 2, labour moving out of agriculture. First, there was a strong link between agriculture, food processing, services and tourism¹¹ as shown by the high share of non-agricultural, agrifood system (AFS) value added and employment (Table 2.2). The linkages came from three major sources. The first, and the most important one is the fact that Thailand has always been one of the world's major exporters of processed food products.¹² Therefore, the food processing industry has been one of Thailand's major industries and the largest employer in the industrial sector. The second source of linkage is a rapid growth in domestic demand for milk and dairy products, which stimulated the expansion of the dairy farms and dairy processing industry. At first, the expansion of milk production in the 1980s and 1990s was due to the school milk policy and other farm support measures, such as research and extension services. Additionally, drivers of the AFS sector include tourist markets, and the transformation of modern food value chains (Section 3.4). Since Thailand has been one of the world's top ten destinations for international tourists,¹³ both foreign and local tourists have generated increasing demand for food and agricultural products as evidenced by the increasing number of street food vendors and restaurants. The transformation of the AFS sector, particularly logistics, such as cold chain, and modern distribution centres, was driven by the supermarket revolution in the mid-1990s and dietary changes. Government policies and institutional changes in the 1990s aided this transformation, such as the Board of Investment (BOI) income tax exemption/reduction and non-tax privileges (such as land ownership).

The second factor that has integrated agriculture into the macroeconomy was the financial liberalization of the 1990s that increased the supplies of loanable funds for the retailers of durable consumer products in the rural areas. This, in turn, narrowed the interest rate differentials between formal and informal money lenders in the urban and rural areas because farmers have easy access to cheaper consumer credit from those retailers (Nipon *et al.*, 1998).

¹¹ Tourism has become one of the largest foreign exchange earners as the number of foreign tourists reached 40 million in 2019.

¹² According to FAO statistics, Thailand has been the world 11th to 14th largest exporter of agricultural and food products since 1980s.

¹³ Tourism has become one of the largest foreign exchange earners as the number of foreign tourists reached 40 million in 2019. Tourism industry accounted for 14 percent of GDP in 2019.

BOX 2.1: Too large agricultural employment? A puzzle.

Anyone who visits villages in rural Thailand will find that there are only grandparents living with their young grandchildren. The Socio-Economic Survey shows that at least 10 percent of households are the ‘skip-generation families’ as most adult parents are working outside the village. That is why 60 to 65 percent of agricultural household income is from non-agricultural activities, and 90 percent of farm households use mechanization.

So why is there still a very large agricultural work force, accounting for almost 30 percent of total employment? Even if one estimates the full-time equivalent workers to adjust for a sharp fall in working hours among farmers, the number is still almost 25 percent.

In a recent side meeting of the National Committee on Organizing the Statistical System, National Statistical officers admitted that there are weaknesses in the Labour Force Survey, for example, it underestimated the number of unemployed persons, and overestimated the number of agricultural employment. The weaknesses are caused by the survey method (e.g. 60 percent of respondents answered the questions for other absentee family members), employment definition (e.g. anyone working at least one hour or who did not work but had a regular job during the survey week is classified as employed), and using the same sampling weight and population forecast for 10 years (such as, the 2017 Labour Force Survey, which used a new sampling frame obtained from the latest population census showing that the agricultural employment share is 4 percent lower than in the 2016 survey). Respondents also have a tendency to report that they as well as their absentee family members are farmers despite the fact that farming is not their main occupation. The farm subsidy is another possible reason. Because there is a ceiling of 12 to 15 rai (1.92 to 2.4 hectares) for the subsidy, farmers whose farm size is larger than the ceiling have a tendency to break their families into two or three families and report that those absentee members are farmers so that they obtain more subsidies.

If the survey actually over-estimated agricultural employment, Thailand might be almost in the industrialized stage, similar to Malaysia. The income disparity between agriculture and non-agriculture would be much lower if the actual agricultural employment share is 15 percent, rather than the reported 28 to 30 percent.

2.6 Toward stage 5: “industrialized economies,” an aspiration

The sustained rapid economic growth and fast-paced agricultural transformation during the 1980s and 2000s resulted in a rapid increase in agricultural labour productivity in stage 4. The relative agricultural shares of GDP and employment declined. The income per capita gap between non-agriculture and agriculture narrowed from over seven times in 2005 to nearly five times in 2015 (Tables 2.2 and 3.2). Thailand was on track to become an industrialized economy and enter the fifth stage of agriculture transformation. In 2011, the World Bank upgraded Thailand’s income categorization from a lower-middle income economy to an upper-middle income economy based on its gross national income per capita of US\$4 210. Agriculture, or at least a few sub-sectors (especially the poultry industry), has already become industrialized and is moving towards the industrialized economy status since the 2000s. Due to the rapid development of modern food value chains and digital technology, small farmers now have direct access to supermarkets and consumers.

Poverty incidence and hunger have been nearly eradicated as there are increasing income transfers to the rural population, e.g. farm subsidy, universal health care, village funds, and social welfare programmes for the poor, etc. Urbanization has surged from 32 percent in 2000 to 50 percent in 2018,¹⁴ according to the Ministry of Interior. The low urbanization rate, relative to other countries with similar income levels, is not a serious concern, thanks to a decentralization policy that enables peri-urban areas to accommodate increased population density in the cities.

Contrary to expectations, the process of structural transformation in Thailand has slowed down significantly since the late 2000s. The economy grew at an average of 6.6 percent per year in during 1985 to 2000, then declined to 3.4 percent between 2010 and 2018. The World Bank (2021) estimates that the COVID-19 impact on the Thai economy in 2020 was less severe than earlier estimates and the economy is expected to grow by 4 percent in 2021 and 4.7 percent in 2022. The same report also warns of critical vulnerabilities in the economy, which may compromise economic growth. Agricultural GDP declined by 0.6 percent in 2015 and registered a mere 1.1 percent growth in 2018. Labour productivity in the industrial sector has declined by an average of 1.4 percent per year between 2010 and 2017 (Table 3.3). This may explain why outmigration from agriculture has virtually stopped over the recent past and agriculture continues to employ a significant share of the labour force, 32 percent in 2018. In fact, Dilaka and Thitima (2013) find that the slowing pace of transformation already began in the late 2000s, as agriculture's share of labour declined by only one percentage point from 37 percent in 2006 to 36 percent in 2011. Consequently, the growth of both overall and agricultural labour productivity slowed down sharply from 27 percent in 2001 to 2006 to 5 percent and 3 percent, respectively, during 2006 to 2011 (Dilaka and Thitima, 2013).

Since a detailed explanation of stalled structural transformation of the Thai economy requires a more rigorous analysis of the structural change both at the macroeconomy and sectoral levels, it is beyond the scope of this study, but a brief outline of those factors is identified here, followed by a discussion of factors that impede agricultural transformation.

Some of the key factors explaining the slowdown in the pace of Thai agricultural transformation may include the following listed below. Some of these are discussed in more detail in Section 4.

- (i) Thailand has rapidly become an aging society, including aging farmers who have no incentive to make long-term investments in technology and land.
- (ii) The government has provided increasing farm subsidies, which not only reduce the farmers' incentive to restructure their production system, and crowd out public investment in agricultural research, but have also attracted some urban workers to move back to agriculture.

¹⁴ Data can be obtained from kamphol@tdri.or.th.

- (iii) Agricultural commodity exports, particularly rice, rubber and cassava are losing comparative advantage because of rising production costs and the failure of the public plant-breeding programmes to respond to consumer demand in the major importing countries.
- (iv) Climate change and volatile weather patterns as well as increased risk of crop and animal diseases.

3. Potential sources of agriculture transformation

This section aims to (i) provide a quantitative analysis of the potential sources of agricultural transformation and growth; (ii) identify and explain potential contributing factors to the agricultural transformation stages identified in part 2, and (iii) explain the transformation of food value chains and the contributing factors.

Agricultural transformation is intimately linked to structural transformation of the whole economy and dietary transformation, each driven by basic global forces, highly specific local forces and government policies. Section 3.1 begins with a decomposition of two sources of economic transformation, i.e. structural and within sector productivity changes by three broad economic sectors, using the McMillan-Rodrik's method of labour productivity growth decomposition; and decomposition of sources of agricultural GDP growth. Section 3.2 attempts to identify the list of contributing factors at three levels of transformation, i.e. economy-wide transformation (ET), agricultural transformation (AT), and food value chain (or dietary) transformation (DT) levels (Table 3.1). The transition of food value chains, driven by dietary change, one of Timmer's three transformations, and its contributing factors are analysed in Section 3.3.

The potential contributing factors discussed in this section are organized by several categories summarized in Table 3.1. These relate to (i) changes in resource endowments; (ii) influence of the global and domestic markets – increased specialization as markets expand, and changes in relative input/output prices; (iii) action and efforts of the farmers – mechanization, cropping choices and diversification; (iv) traders, processors – clustering of service delivery businesses, organization, scale and response of private retailers, especially the emergence of foreign supermarkets. Factors that relate to public policies and institutions will be analysed in part 4.

Table 3.1: Sources of growth and contributing factors to agricultural transformation described in part 2

Stages	Sources of agric growth transformation	Contributing factor (policies & responses by farmers/ private sector)
0. Subsistence with surplus for export	Sources <ul style="list-style-type: none"> • Land abundance • Export of rice, teak & rubber 	<ul style="list-style-type: none"> • Institution <ul style="list-style-type: none"> ○ Property rights in land (ET, AT) ○ Elimination of slave labour (ET, AT) ○ Establishing agriculture ministry and college (AT)
	Environment <ul style="list-style-type: none"> • Steamship & lower cost of ocean transport • High world demand for rice • The great Depression and World War I 	<ul style="list-style-type: none"> • Policy and reform <ul style="list-style-type: none"> ○ Bowring Treaty & deregulation of rice/salt exports (AT) ○ Railroad & irrigation (ET, AT) ○ Collection of native rice varieties (AT) ○ Scholarship for modern agric study in Europe & USA (AT)
1. Getting agriculture moving	Source <ul style="list-style-type: none"> • Land expansion along canals & railroad 	<ul style="list-style-type: none"> • Institution <ul style="list-style-type: none"> ○ Rice breeding training project (AT) ○ Rice Standard Law (AT) ○ Land & Settlement law (AT) ○ Abolition of multiple exchange rate (ET)
	Environment <ul style="list-style-type: none"> • End of World War II 	<ul style="list-style-type: none"> • Policy <ul style="list-style-type: none"> ○ Rice premium (export tax) (AT) ○ Chao Phraya river dam (AT) ○ Rural investment (ET, AT) • Diversification of crops (AT)

Stages	Sources of agric growth transformation	Contributing factor (policies & responses by farmers/ private sector)
<p>2. Moving labour out 1985-2000</p>	<ul style="list-style-type: none"> • Sources of growth <ul style="list-style-type: none"> ○ Capital (largest source) ○ TFP (2nd largest) • Transformation <ul style="list-style-type: none"> ○ Agric labour productivity +46% ○ Structural change -6% • Environment <ul style="list-style-type: none"> ○ Public debt crisis in early 1980s ○ Economic crisis in 1997-98 ○ Industrial and asset price booms ○ El Nino-induced drought in 1998 	<ul style="list-style-type: none"> • Macroeconomic policy (ET) <ul style="list-style-type: none"> ○ Baht depreciation in early 1980s (ET) ○ Managed flexible exchange rate since 1998 (ET) ○ Financial liberalization in the early 1990s (ET) • Institution <ul style="list-style-type: none"> ○ Food safety law for food export (ET, AT) ○ GAP & HACCP (ET, AT) • Agricultural policies (AT) <ul style="list-style-type: none"> ○ R & E intensities increased between 1974 and 1993 and declined in 1993-2012 ○ Rural electrification ○ Debt moratorium policy for farmer ○ First Nutrition Policy ○ Agricultural restructuring policy failed
		<ul style="list-style-type: none"> • Farmers' response (AT) <ul style="list-style-type: none"> ○ Mechanization in response to scarce labour & rising wages ○ Specialization (single crop) increased after elimination of export tax (premium) ○ Diversification increased due to FTAs and higher per capita income
		<ul style="list-style-type: none"> • FVC <ul style="list-style-type: none"> ○ Liberalization of foreign supermarkets (DT)

Stages	Sources of agric growth transformation	Contributing factor (policies & responses by farmers/ private sector)
<p>3. Agriculture as growth engine 1960-85</p>	<ul style="list-style-type: none"> • Source of high agric growth <ul style="list-style-type: none"> ○ 1st schooling ○ 2nd capital ○ 3rd land ○ 4th research & irrigation • Agric transformation (1997-85) <ul style="list-style-type: none"> ○ Agric labour productivity -20% ○ Structural change -8% • Environment <ul style="list-style-type: none"> ○ Green revolution ○ World commodity price declining (1960-1972) and boom in 1973 ○ Population boom in the 1960s ○ Land abundance ○ Democratic movement 	<ul style="list-style-type: none"> • Institution <ul style="list-style-type: none"> ○ Macro+-econ law reform: price stability (ET) ○ First national plan & infrastructural master plan (ET) ○ Compulsory primary education (DT) ○ Public research system (AT) ○ Bank for Agriculture & Agricultural Cooperative (AT) <ul style="list-style-type: none"> ▪ Cheap credit policy ○ Land reform law reducing land conflicts (AT) • Public investment policy <ul style="list-style-type: none"> ○ Building rural primary schools (AT) ○ Road & irrigation (ET, AT) ○ Agric research breeding high yield varieties with good quality rice (AT) ○ Scholarships for agric study abroad (AT) • Agricultural policy: encouraging agric expansion into upland forest (AT) <ul style="list-style-type: none"> ○ Logging & malaria control • Farmers' response (AT) <ul style="list-style-type: none"> ○ extensification of upland crops ○ Diversification in response to agric export tax (AT) • Import substitution industrialization policy - declining role of agric (ET) <ul style="list-style-type: none"> ○ Deregulation of slaughterhouse (DT) • FVC: modern contract farming in broiler, swine & tomato (DT, AT) • Poverty alleviation plan (ET, AT)

Stages	Sources of agric growth transformation	Contributing factor (policies & responses by farmers/ private sector)
<p>4. Integrated with macro 2000-2010</p>	<ul style="list-style-type: none"> • Source of growth <ul style="list-style-type: none"> ○ TFP (largest) ○ Capital (2nd largest) • Transformation <ul style="list-style-type: none"> ○ Agric labour productivity +21% ○ Structural change -5% • Environment <ul style="list-style-type: none"> ○ Rice price increased after 2005 ○ High rubber price in the early 2000s-chinese demand ○ Political conflicts 	<ul style="list-style-type: none"> • Macroeconomic policy <ul style="list-style-type: none"> ○ Flexible exchange rate improved agric competitiveness (ET, AT) ○ Expansion of secondary/ college education (ET) • Institution <ul style="list-style-type: none"> ○ Establishment of National Bureau of Agricultural Commodity & Food Standards (AT) ○ GAP and food safety standard (DT) ○ Health for All reduced poverty (ET) • Agricultural policy (AT) <ul style="list-style-type: none"> ○ Public R&E declined ○ But private sector research increased ○ Beginning of farm subsidy policy • FVC <ul style="list-style-type: none"> ○ Income tax exemption for social and community enterprises (DT) • Farmers' response (AT) <ul style="list-style-type: none"> ○ Surge in mechanization ○ Diversification slowed down and specialization increased in 2008-13 due to <ul style="list-style-type: none"> ▪ Subsidy (AT) ▪ Chinese market for rubber (AT) ▪ Increased area of fruits due to rising per capita income (AT)

Stages	Sources of agric growth transformation	Contributing factor (policies & responses by farmers/ private sector)
<p>5. Transformation slowed down, 2010-2018</p>	<ul style="list-style-type: none"> • Sources of growth <ul style="list-style-type: none"> ○ TFP (1st) very high due to negative agric growth ○ Capital (2nd) • Transformation <ul style="list-style-type: none"> ○ Agric labour productivity +18% ○ Structural change -8% • Environment 	<ul style="list-style-type: none"> • Institution <ul style="list-style-type: none"> ○ Reforming public research system, 2019 (AT) ○ IUU law (illegal, unregistered unregulated), 2018 (AT) • Industrial Policy <ul style="list-style-type: none"> ○ Eastern Economic Corridor (new industries) (ET) • Agricultural policies (AT) <ul style="list-style-type: none"> ○ Increasing farm subsidy ○ Seizure of land under ALR Law from illegal occupants ○ PM 2.5 policy • FVC (DT) <ul style="list-style-type: none"> ○ Excise tax on sugary drinks • Farmers' and private sector (AT) <ul style="list-style-type: none"> ○ Increasing specialization in 2008-2013 ○ Stable diversification but increasing fruit production due to rising per capita income ○ Small farmers having access to supermarkets/ consumers ○ Emerging of agritech start-ups

Note: ET = factors contributing to economic/ structural transformation;
 AT = factors contributing to agricultural transformation;
 DT = factors contributing to dietary transformation of FVC transition

Source: Compiled by author; and Figure 3.3. See details in text.

3.1 A closer look at labour and land productivity

Aggregate labour productivity grew at 3.5 percent per year and agricultural labour productivity registered the highest annual growth rate among three sectors at about 3.2 percent between 1977 and 2017 (Table 3.3). Agricultural labour productivity growth was positive in three of the four transformation stages: 1985–2000, labour moving out of agriculture, 2000–2010, agriculture integrated into the macroeconomy, and 2010–2017, when structural change stalled. During the third stage of agriculture serving as a growth engine, 1977–1985, agricultural GDP and its labour productivity suffered negative growth of -0.01 percent and -2.68 percent, respectively (Table 3.3), because of depressed world agricultural prices and the end of frontier land in the early 1980s (Figure 3.3). Agricultural labour productivity growth was also relatively low (2.5 percent) in stage 2 (labour moving out of agriculture) than that in stages 4 and 5 because of the slow growth of agricultural GDP (1.6 percent). If agricultural employment did not decline (-0.82 percent), agricultural labour productivity growth would be much lower.

In stage 4 (2000 to 2010) both labour and land productivity growth were the highest at 7.3 and 5.6 percent, respectively (Table 3.2), as a result of an international market commodity boom, in particular for rice, Thailand's major export. Land productivity suffered negative growth in 2010 to 2018 (stalled structural change) because of a decline in agricultural GDP while total cultivated land increased negligibly (Table 3.2).

Table 3.2: Growth rate of GDP, labour, land, input productivity and total factor productivity (TFP) in agriculture by transformation stage, 1960–2018 (percent per year)

	1961-2018	Stage3 (Ag as growth engine)	Stage2 (labour moving)	Stage4 (Ag integration)	Stage5 (stalled structural change)
		1961-1985	1985-2000	2000-2010	2010-2018
1. Output growth					
- GDP	5.83%	6.78%	6.57%	4.56%	3.43%
- Ag GDP	3.43%	4.51%	1.64%	6.37%	-1.57%
2. Contribution of TFP to Ag GDP growth*					
- TFP growth	1.55%	1.32%	1.58%	1.71%	1.88%
- Contribution	49.71%	32.93%	60.19%	78.51%	170.02%
3. Input growth					
- Agri Labour	0.30%	1.87%	-0.32%	-0.94%	-3.77%
- Agri Land	0.87%	2.45%	-0.49%	0.75%	0.38%
- Agri Land/worker	0.54%	0.68%	0.00%	1.70%	4.15%
4. Input productivity growth					
- Agri labour productivity	3.13%	2.65%	1.96%	7.32%	2.20%
- Agri Land productivity	2.56%	2.07%	2.14%	5.62%	-1.95%

Note: Annual growth rate (% p.a.) is estimated by semi-log regression; *calculated from USDA 1961-2016.

Source: WDI, NSO, FAO, NESDB and USDA.

Table 3.3: Sources of aggregate labour productivity growth*, 1977-2017**

	1977-2017	Stage3 (Ag as growth engine)	Stage2 (labour moving)	Stage4 (Ag integration)	Stage5 (industrialized)
		1977-1985	1985-2000	2000-2010	2010-2017
1. GDP growth 1977-2017, (% p.a.) <i>McMillan-Rodrik</i>	5.17%	5.62%	6.54%	4.56%	3.04%
- Agriculture	2.82%	-0.01%	1.64%	6.37%	-1.45%
- Industry	5.77%	6.63%	7.29%	5.40%	1.44%
- Services	5.43%	7.35%	7.17%	3.56%	5.01%
2. Growth of employment 1977-2017 (% p.a.) <i>McMillan-Rodrik</i>	1.64%	3.52%	1.68%	1.61%	-0.59%
- Agriculture	-0.34%	2.67%	-0.82%	0.09%	-4.43%
- Industry	3.70%	5.26%	5.69%	0.97%	2.84%
- Services	4.04%	5.61%	4.91%	3.44%	1.35%
3. Growth of labour productivity, 1977-2017. (% p.a.) <i>McMillan-Rodrik</i>	3.53%	2.10%	4.86%	2.92%	3.63%
- Agriculture	3.16%	-2.68%	2.46%	6.28%	2.98%
- Industry	2.08%	1.37%	1.59%	4.43%	-1.40%
- Services	1.39%	1.74%	2.25%	0.12%	3.66%
4. GDP (Billion USD@2010)	54.4	54	87	218	341
- Agriculture, value first year, (last year share %)	13.5 (8.7%)	13.5 (15.8%)	13.7 (8.5%)	18.5 (10.5%)	35.9 (8.7%)
- Industry, value first year, (last year share %)	16 (35.0%)	16 (31.8%)	27.6 (36.8%)	80.2 (40.0%)	136.5 (35.0%)

	1977-2017	Stage3 (Ag as growth engine)	Stage2 (labour moving)	Stage4 (Ag integration)	Stage5 (industrialized)
		1977-1985	1985-2000	2000-2010	2010-2017
- Service, value first year, (last year share %)	25 (56.3%)	25 (52.3%)	45.4 (54.7%)	119 (49.5%)	168.7 (56.3%)
5. Employment (Million workers)	19.1	19	25	33	39
- Agriculture, number first year, (last year share %)	13.8 (33.5%)	13.8 (67.6%)	16.8 (48.6%)	16 (40.8%)	15.7 (33.5%)
- Industry, number first year, (last year share %)	1.3 (15.8%)	1.3 (8.4%)	2.1 (14.7%)	4.8 (13.4%)	5.2 (15.8%)
- Services, number first year, (last year share %)	3.9 (50.6%)	3.9 (23.9%)	5.9 (36.7%)	12 (45.8%)	17.6 (50.6%)

Note: * labour productivity growth rates in Table 3.1-b are different from those in Table 3.1 because GDP in Table 3.1 is in Baht, and the latter uses GDP in US\$.

** Time period (1977-2017) in Table 3.1-b is shorter than that in Table 3.1 (1960-2018) due to data availability.

Source: from WDI, NSO and NESDC, using McMillan-Rodrik method.

Table 3.2 also indicates that the growth of agricultural labour productivity is higher than that of land productivity in all but one transformation stage (stage 2), explaining a less than 45-degree slope of land and labour productivity movement in Figure 3.1. This is because Thailand was a land-abundant, but labour-scarce economy, especially after a rapid decline in population growth in the 1980s, as evidenced by an increase in cultivated land but declining agricultural employment, which resulted in increasingly higher land per worker after 1989 (Figure 3.2). After the massive rural-urban migration in the third transformation stage, triggered by industrial and asset price booms in the late 1980s and 1990s, the real agricultural wage rate began to surge (Figure 3.3). This resulted in rapid agriculture mechanization to substitute for an increasing farm labour shortage (AT in Table 3.1). By 2003, 98 percent of rice farmers hired combine harvester services (Table 3.4). Agricultural labour productivity growth was also higher than that of land productivity in stage 3 when there was both agricultural extensification (in the rain-fed upland areas) and a population boom.

Figure 3.1: Land and labour productivity movement

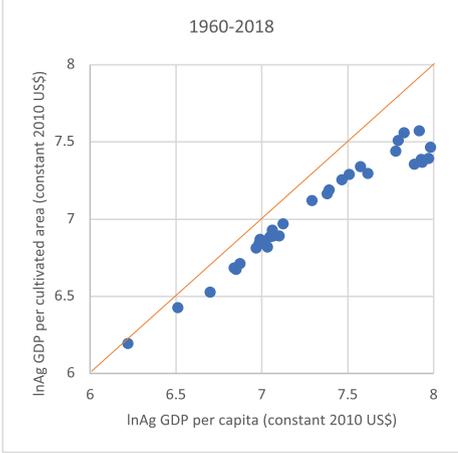
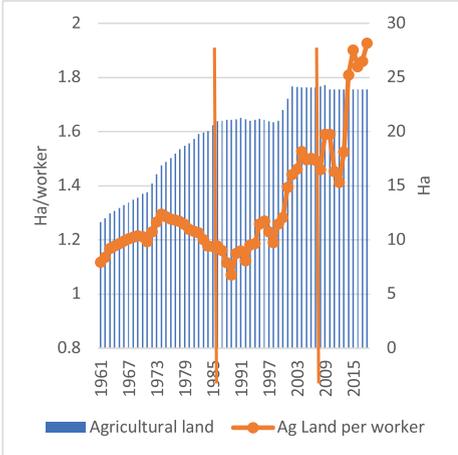


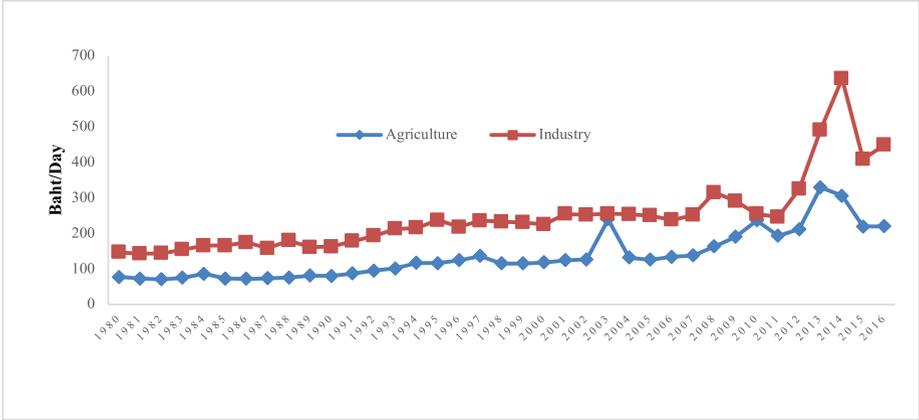
Figure 3.2: Total agricultural area and agricultural area per worker



Note: Since 1992, the new land use data has been based upon the satellite maps. The higher resolution images have been used since 2000, resulting in large increase in agricultural land. The surge in land per worker since 2014 is also attributed to a change in sampling weight in the Labour Force Survey (see explanation in the text).

Source: (1) NSO, Labour Force, (2) TDRI, Dynamics Data Base (3) Office of Agricultural Economics (4) NESDB, (5) WDI, (6) FAOSTAT.

Figure 3.3: Real wages in agriculture and industry (2000=100)



Source: NSO, Labour Force Survey.

Table 3.4: Farm machinery used and hired among Thai farmers by types of machines

Type of Machines	2003					2013				
	Households hiring machineries		Households using machineries		% hire of total usage	Households hiring machineries		Households using machineries		% hired of total usage
	number	%	number	%		number	%	number	%	
Tractors	1,173,109	20.25	1,412,172	24.38	83.07	1,895,402	32.06	2,233,200	37.78	84.87
walking tractors	1,569,497	27.10	3,737,015	64.51	42.00	621,428	10.51	2,427,066	41.06	25.60
water pumps	330,367	5.70	2,021,362	34.90	16.34	327,156	5.53	1,663,742	28.15	19.66
sprayers	667,616	11.53	2,342,156	40.43	28.50	843,332	14.27	2,284,102	38.64	36.92
weeding machines	177,279	3.06	674,887	11.65	26.27	756,805	12.80	1,937,338	32.77	39.06
planters	284,022	4.90	684,059	11.81	41.52	741,953	12.55	1,070,618	18.11	69.30
harvesters										
- sugarcane	31,523	0.54	39,197	0.68	80.42	89,916	1.52	93,477	1.58	96.19
- rice	984,555	17.00	1,004,056	17.33	98.06	1,548,606	26.20	1,581,434	26.75	97.92
threshing machine	2,223,162	38.38	2,279,784	39.36	97.52	710,382	12.02	729,132	12.33	97.43
transportation										
- land vehicles	2,581,659	44.57	4,859,989	83.90	53.12	2,025,539	34.27	3,032,147	51.29	66.80
- boats	5,424	0.09	61,599	1.06	8.80	2,387	0.04	29,195	0.49	8.17
Total	5,792,519		5,792,519			5,911,287		5,911,287		

Source: Thailand's Agricultural Census 2003 and 2013

The slow growth of land productivity was due to three constraints, i.e. labour shortage, water scarcity and rice breeding policy. Given the relatively higher wage in the non-agricultural sector, farmers prefer to grow the less labour- and care-intensive crops, namely rice, cassava and sugar cane, and spend most of their time working in non-agricultural activities, which in turn, account for 65 percent of total household income of agricultural households. Rice farmers have the lowest share of farm income. Over the last 50 years (1970 to 2020), irrigated areas expanded from about 2.2 million hectares to 4.8 million hectares, or only 22 percent of total cultivated areas. Finally, maximizing yield is not an overriding objective of the public rice breeding programme and universities because most rice production areas are rainfed. In addition to yield improvement, the rice breeders have to focus on quality improvement (which will generate higher revenue per unit of land for farmers in the non-irrigated areas), and varieties that are drought and flood tolerant and disease resistance, the major problems faced by most farmers in the flood plains and rainfed areas. In recent years, the breeding programmes have increasingly focused on developing varieties that meet the health and functional food markets. It should be noted that there is no proactive public programme on high yield “hybrid rice” as in China, India and Vietnam, explaining the relatively low rice yield in Thailand.

3.2 A look at the macro-economic transformation

Employing a method developed by McMillan and Rodrik (2011), total or economy-wide labour productivity growth is decomposed into (a) the reallocation of activity of labour across three broad sectors of the economy (Lewis–Ranis–Fei structural transformation), and (b) within sector productivity growth of the neoclassical model (see the estimation method in McMillan and Rodrik, 2011).¹⁵

The decomposition shows that 55 percent of changes in total labour productivity for the overall economy comes from within sector productivity changes, and 45.0 percent from structural transformation (Figure 3.3). During 1985–2000,¹⁶ structural change contributed 65.6 percent to total labour productivity, which was larger than the within sector productivity at 34.4 percent (Figure 2.4). Ammar (1996) suggests that this was caused by the industrial and real estate booms. The industrial boom was triggered by the relocation of labour-intensive industries from Japan after the sharp yen appreciation in 1986, and the change in industrialization policy from import substitution to labour-intensive export-led industrialization. Then in the mid-1990s, the Bank of Thailand began liberalizing the movement of capital, which led to falling domestic interest rates, and large foreign borrowing by Thai businesses, generating significant growth in the non-traded sector.

¹⁵ In short, the contribution of structural change is measured by the product of average labour productivity in each sector at the present period and a change in their corresponding employment share. The contribution of within-sector productivity changes is the product of changes in labour productivity in each sector and its corresponding share of employment at the beginning period. The changes in structural labour productivity (in three sectors) and changes in within sector productivity (also three sectors) are expressed as the percentage changes of aggregate labour productivity. That explains why structural changes in agriculture have negative contribution when there is outmigration from agriculture, which results in a smaller share of agricultural employment.

¹⁶ The results are somewhat consistent with two other studies that found that structural change was the main contributor to labour productivity growth. Warr (2009) found that during 1980–2006, when aggregate GDP grew at an annual average rate of 6 percent, the reallocation effect (or structural change) accounted for 35 percent of Thailand’s aggregate output growth, while TFP growth contributed only one-tenth. Lathapipat and Chucherd (2013) find that between 1986–1991 and 1991–1996, structural change was the principal source of economic growth.

As mentioned earlier, most of the changes in productivity growth of the overall economy during 1977 and 2017 came from the within sector productivity growth because the rapid growth of the modern industry and service sectors enabled agricultural workers to move to higher productivity jobs in the non-agricultural sector. The economic development policies that brought about such productivity growth are the labour-intensive export-led industrialization policy and asset price booms induced by the capital account liberalization in the mid-1980s and early 1990s, which enabled agricultural workers to move to higher productivity jobs in the non-agricultural sector. Other

Crop yields in Thailand are relatively lower, compared with the main competitors in the region. Rice yields are particularly low because 78 percent of rice in Thailand is cultivated under rainfed conditions. According to FAOSTAT, paddy yields in 2019 were 2.9 tonnes/ha in Thailand, 7.06 tonnes in China, 5.8 tonnes in Vietnam, 4.3 tonnes in Malaysia, 4.1 tonnes in India (now the world's largest rice exporter), and 3.7 tonnes in Myanmar. High yield varieties, which require intensive use of fertilizer, are widely used by farmers in the irrigated areas, which account for only 22 percent of the cultivated land, compared with 49 percent in Vietnam and 41 percent in China. Therefore, the average use of chemical fertilizer for Thai farmers was just below 162 kg/ha in 2016, compared to 503 kg/ha in China, and 223 kg/ha in Vietnam.

factors include the free trade agreements between the 1990s and early 2000s, which included the Uruguay Round Agreement, the ASEAN Free Trade Agreement (AFTA), and the free trade agreement (FTA) with China. Incentives for foreign direct investment and expansion of secondary and tertiary education in the 1990s also contributed to productivity growth (Table 3.1). Furthermore, the contribution of structural change is explained by a) the reduction in agricultural employment which leads to higher agricultural wage, b) the increase in employment shares of the industrial and service sectors, which are higher productivity activities.

An examination of changes in Thai labour productivity in three broad economic sectors shows that between 1977 and 2017, the contribution of structural changes in agriculture to the growth of labour productivity of the overall economy is negative, -7.4 percent (Figure 3.1) because of a decline in agricultural employment share by -40.3 percentage points between 1975 and 2018 (Table 2.2). On the other hand, the contribution of within agriculture labour productivity was 11.5 percent (Figure 3.3). The negative contribution of structural change is the result of a decline in agricultural share of employment multiplied by the average agricultural labour productivity at the current period. The positive contribution of within agriculture labour productivity change is the consequence of higher average farm labour productivity (or higher real wage rate).

Since most of the migrants from agriculture moved to the service sector, the contribution of structural change in the service sector to the overall productivity growth at 31.5 percent was the largest, followed by the manufacturing sector at 18.4 percent. The service sector also has the largest contribution of within sector labour productivity growth at 26.5 percent, followed by industry at 18.5 percent and agriculture at 10 percent (Figure 3.3).

Figure 3.3 provides estimates of the contribution of structural change and within sector labour productivity in agricultural, industry and service in four transformation stages. Explaining the transformation process in the latter two sectors is beyond the scope of this chapter.

Surprisingly, the contribution of within agriculture labour productivity growth to overall productivity growth was negative at -19.5 percent (Figure 3.3) in stage 3 (1977-85) when agriculture was the engine of growth. The main reason is a negative growth of agricultural labour productivity (Table 3.1) as a result of severe worldwide agricultural depression in the 1980s, which led to negative growth of agricultural GDP. This is also a late period of rapid population explosion in rural areas and exhaustion of forest land, resulting in a decline in land per agricultural worker (Figure 3.3), and a rise in land conflicts.

When labour began to move out of agriculture in the second transformation stage (1985–2000), the contribution of within agriculture labour productivity growth to the growth of economy-wide productivity rose to 5.5 percent (Figure 3.3) because of the reduction in surplus labour, which in turned raised the marginal productivity of agricultural production and real agricultural wages (Figure 3.3). Consequently, farmers began to adopt farm mechanization (Tables 3.1 and 3.4, and more discussion in part 3.2). The abolition of agricultural export taxes (part 4), and an exchange-rate devaluation in the mid-1980s that had a positive impact on domestic agricultural prices (Ammar and Suthad, 1988), might also have an indirect impact on agricultural wages, and thus mechanization.

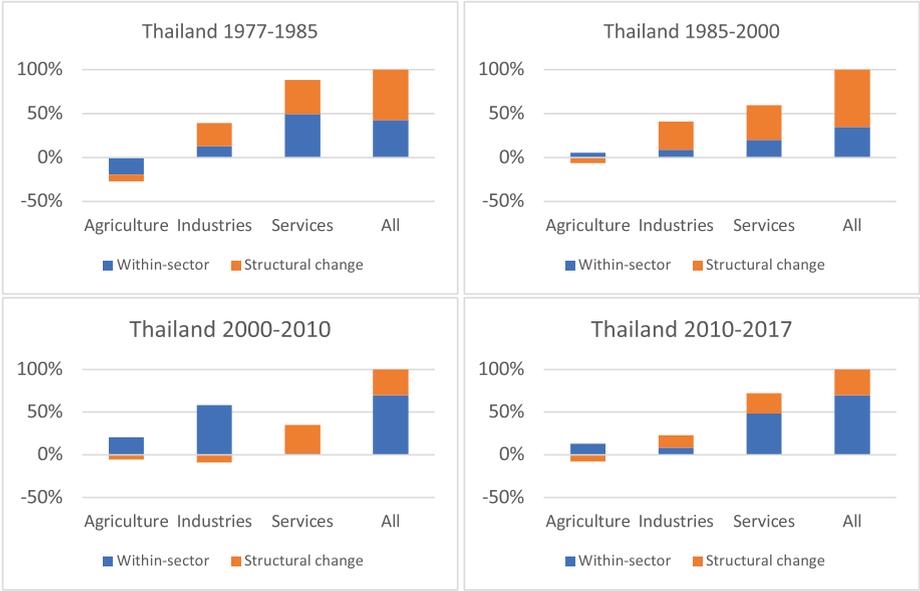
The contribution of agricultural labour productivity growth to overall productivity growth was very high at about 21 percent in the stage of agriculture's integration into the macro economy during 2000–2010, and slowed down to just over 13 percent in 2010–2017 when structural change slowed down (Figure 3.3). These were periods of rapid mechanization. More important, the contribution of within industry labour productivity growth reduced significantly from 58.5 percent to 8.1 percent during the same periods. Since industry is the highest productivity sector, the pace of economic transformation was slowing down. Although the contribution of agricultural structural change to overall labour productivity growth declined from -5.5 percent in 2000 to 2010 to -7.9 percent in 2010 to 2017 because of the negative growth of agricultural employment at -4.43 percent in 2010 to 2017, this does not necessarily mean that there is actual outmigration from agriculture. In fact, the fall in agricultural share of employment after 2014¹⁷ was mainly attributed to the statistical effect of changing the sampling weight in the Labour Force Survey from the one calculated from the 2000 Population Census to the 2010 Census, which found smaller rural population.

Our finding of the slowing pace of transformation and its causes is consistent with that of Dilaka and Thitima (2013) who used a different but more elaborate decomposition method to measure the structural transformation of Thai economy between 1986 and 2011 (section 2.6).

¹⁷ In 2012 when the old sampling weight was used in the Labour Force Survey, the agricultural share of employment was 32 percent. It declined to 29 percent in 2014 after the use of new weight.

In conclusion, structural change was the most important source of overall labour productivity growth from 1985 to 2000 when there was massive rural labour migration and rising real wages (Figure 3.3). After that, within sector productivity growth was the largest source of labour productivity growth at 69.8 to 80.5 percent between 2000 and 2017. In agriculture, sector productivity growth (almost 20.7 percent) was the most important source of growth in 2000–2010, thanks to the rapid mechanization and high rice price. After that, its relative contribution declined to 13.2 percent in 2010–2017, raising concerns about the future of Thai agriculture.

Figure 3.4. Labour productivity decomposition, Thailand 1977–2017



Note: McMillan and Rodrik.2011 Method

Source: WDI, and NSO, Labour Force Survey.

3.3 Total factor productivity and sources of agricultural growth

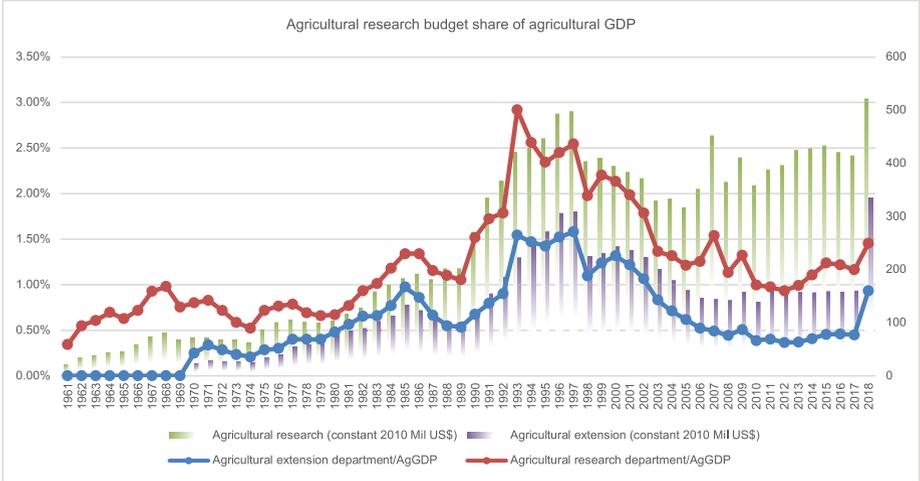
This section will measure the contribution of total factor productivity (TFP) growth to agricultural growth in different transformation stages, using the United States Department of Agriculture (USDA) estimates for 1961–2015. Agricultural capital is constructed from the indices of machinery (tractors), livestock and fertilizer. It is not possible to estimate the contribution of capital, labour and land because the authors do not provide the relative shares of these inputs. Fortunately, there are other studies that allow us to measure the relative contribution of other inputs.

The estimate shows that TFP is the most important source of agricultural growth at 49.7 percent during 1961–2017. The highest contribution of TFP occurred in 2010–17 at 170 percent¹⁸ when agricultural GDP growth was negative (-1.45 percent) but

¹⁸ Note that TFP contribution can be larger than 100 percent and its growth can be higher than agricultural growth because of the estimating method employed by USDA.

the research budget at constant price had an increasing trend between 2010 and 2018 (Figure 3.6). The second highest contribution of TFP was in 2000–2010 at 78.5 percent¹⁹ when agriculture was integrated in macroeconomy. This is a period of declining research budgets and research intensity because of the fiscal impact of the 1997/98 economic crisis. Yet the high TFP contribution was the consequence of a cumulative rise in research spending in the previous decades, and research spending by the private sector in maize and vegetable seeds, poultry and shrimp. The TFP growth rate was the lowest during 1961–1985 at 1.3 percent per year when agricultural research and extension intensities began to increase. This is a period of large increases in land and labour. The findings on TFP contribution are consistent with the long-term trend of research and extension (R&E) intensity and public R&E expenditure.

Figure 3.6 Intensity of agricultural research and extension expenditure



Note: The research budget of some departments includes extension services, resulting in an underestimate of extension budget, and over-estimate of research budget. These departments include Department of Agriculture, Department of Livestock Development and Department of Fishery.

Source: Budget Bureau and WDI.

Interestingly, Rungsuriyawiboon (2009) decomposes the TFP changes into technical efficiency and technical change and finds that technical change, at about 0.9 percent, is more important than the former, at 0.15 percent, in explaining TFP growth in Thailand. The large contribution of technical change to agricultural output growth is obviously the result of heavy public investment in agricultural research and extension services, which have boosted the long-term yield of important crops. Poapongsakorn *et al.*, (2006) also estimate the sources of growth of three sub-sectors in agriculture: crops, livestock and fishery. TFP was the second-largest contributor to the growth of livestock value added during 1981–2003 and was the largest contributor during 1996–1998. However, the TFP contribution was negative for the fishery sector, signalling that Thailand has had a serious problem of overfishing for a long time.

¹⁹ The result is consistent with a study by Poapongsakorn *et al.*, (2006), which find that TFP growth and its contribution were highest in the periods of 1981-85 and 1998-2003, and the second largest in 1985-96 period (Table 3.4).

Since it is not possible to measure the contribution of primary inputs (land, labour and capital) from the USDA method, results from other studies are summarized here. During stage 3 (1961–1985), the largest source of growth was schooling of farmers – an outcome of compulsory primary education in the 1960s – followed by land productivity, thanks to land abundance (Table 3.1). During this stage, capital productivity growth contributed nearly 19 percent and expenditures on research and irrigation were also significant sources of agricultural productivity growth, contributing nearly 19 percent and 16.3 percent, respectively, to the growth of agricultural output per capita (See Ammar *et al.*, 1990: 12).

Later studies, which cover the time period after 1985, find that capital was always the most important source of agricultural growth. For example, Tinnakorn and Sussangkarn (1998) estimate the contribution of capital to growth at 60.4 percent and TFP contribution at 25.1 percent during 1981–1995, and Nipon *et al.* (2006) find that capital contribution is 59.9 percent and TFP contribution is 43.55 percent in 1981–2003, which covers the late stage of agriculture as growth engine and the whole period of labour moving out of agriculture. Capital investment is, thus, the major source of agricultural growth. The growth of labour contribution to agricultural GDP growth is slightly higher than that of land during 1981–2003, i.e., 6.81 percent vis-à-vis 4.64 percent (see Nipon *et al.*, 2006).

3.4 Crop diversification, specialization and economies of scale

Table 3.1 provides a list of factors that contribute to the agricultural and dietary transformation (AT and DT) by stages of transformation. This part will highlight important factors contributing to AT, focusing on the factors that involve the decisions of farmers. Some of these have already been highlighted in section 2 for stage 1 and 2, which will not be repeated here. The institutions and policies that contribute to structural and agricultural transformations will be explained in detail in part 4.

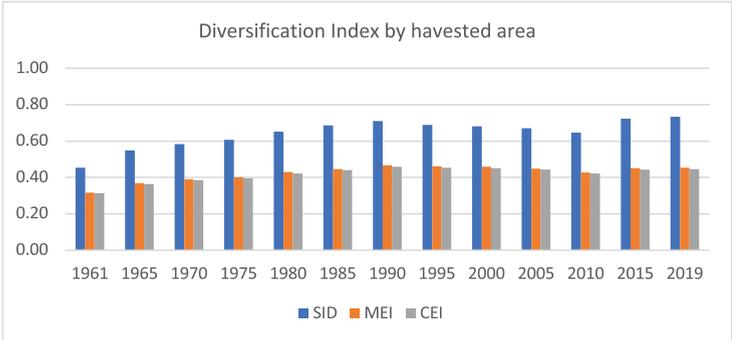
AT Stage 3 – Agriculture as growth engine: The most important contributing factors to this stage are a number of institutions, public investment and agricultural policies (see part 4 for more details) that encouraged farmers to expand into the upland forest areas. The result was the rapid expansion of production and export of upland crops such as cassava, corn, and sugar cane. Other important actions taken by farmers in this stage are contract farming, which was introduced by private agribusinesses (section 3.3), and crop diversification.

Crop diversification over the past six decades has been fluctuating. The national average crop diversification indices between 1961 and 1990 (stages 3 and 2) increased but decreased again between 2000 and 2010 (stage 4). Between 2010 and 2013, the diversification indices remained more or less stable but higher than those in 1960s.

The increased diversification between 1961 and 1985 (Figure 3.7) is mainly attributed to the export tax on agricultural products, especially rice exports (the so-called rice premium). The rice premium was an important source of government revenue and meant to keep the urban cost of living low to achieve industrialization. However, it resulted in large transfers of income from rice farmers to urban consumers until 1986 (Ammar

and Suthad, 1998). Crop diversification declined between 2000 and 2010 (stage 4) probably because of the expansion of the Chinese markets for rubber and cassava. The increase in rice prices in the mid-2000s may have been another contributing factor. The index increased again between 2010 and 2019 due to the increasing acreage and output value shares of fruits, vegetables, roots and tubers, and the declining share of cereals. This was a period of rapid increase in per capita income, which according to Bennett Law, led to the increase in demand for fruits and vegetables and meat, but declining consumption of cereals.

Figure 3.7. Three indices of crop diversification



Note: The Crop diversification index (Simpson index) is estimated using the formula $SID=1-\sum_{i=1}^n P_i^2$, where P_i is the proportion of land allocated to i crop. CDI equals 0 when there is complete specialization and approaches one under complete diversification. The Modified Entropy Index of Diversification (MIE) is computed using the formula $MEI=\sum_{i=1}^n P_i \ln_n (\frac{1}{P_i})$. Where n is number of crops. MEI equals 0 under complete specialization and 1 under complete diversification. The Composite Entropy Index formula is $CEI=\sum_{i=1}^n P_i \ln_n (\frac{1}{P_i}) (1-\frac{1}{n})$

Source: FAO

AT stage 2 – Moving labour out of agriculture: The most important factors contributing to Thailand’s economic transformation were the adoption of labour-intensive export industrialization and the Eastern Seaboard Industrial Development area in the mid-1980s. The switch from the fixed exchange rate to the managed float exchange rate regime in 1997, and a series of free trade agreements in the 1990s are also considered important contributing factors (Table 3.1). Key agricultural policies in this stage include the abolition of the rice premium in 1985, the increase in R&E between 1974 and 1993, and export food safety regulations in the early 2000s (part 4). The most important farmers’ actions behind AT and higher agricultural productivity were mechanization in response to family labour shortages, and increased farming specialization between 1993 and 1998 (Figure 3.8), which was a period after the elimination of all agricultural export taxes.

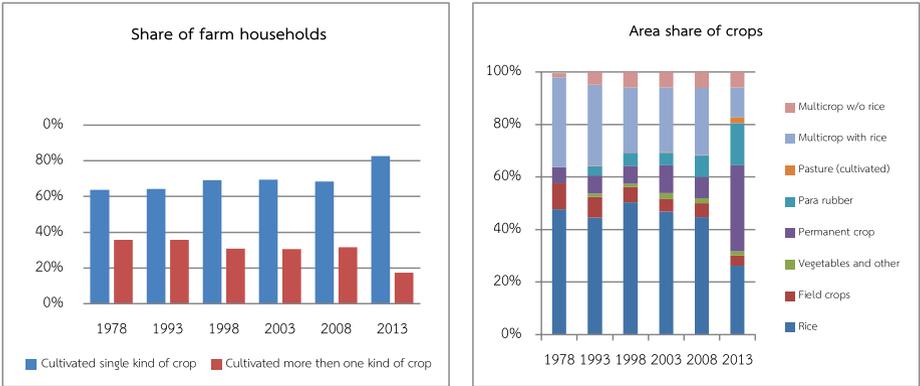
Farmers becoming more specialized: To understand the changing pattern of specialization during various stages of transformation, it is important to recognize that Thai agriculture has always been export-oriented since the mid-19th century. Between 1980 and 2018, Thailand was the 11th to 14th largest exporter of agricultural and food products in the world, up from the 21st to 23rd rank in the

1960s (FAOSTAT). International agricultural trade has always been a major driver of Thai agricultural cropping patterns as well as economic growth.²⁰ Access to international markets has provided Thailand with a large enough market to specialize in the products for which it has comparative advantage.

Thai farm households have become more specialized in the last three decades, which cover stage 3, stage 2 and stage 4. The number of households that grew only one crop increased from 64 percent in 1978 to 83 percent in 2013 (Figure 3.8), according to the Agricultural Census. In addition, the share of total planted areas dedicated to one single crop also increased, particularly for rubber and permanent crops (Figure 3.8).

It is also interesting to observe that specialization does not always exhibit a linear pattern. Specialization gradually increased during 1978 and 1998, remained stagnant between 1998 and 2008, and then rapidly increased again during 2008 to 2013 (Figure 3.8). The increased specialization in the first period (stages 3 and 2) coincided with the rapid industrial-led growth that drew resources, particularly labour, out of agriculture. The implementation of the Uruguay Round Agreement on Agriculture and the ASEAN Free Trade Agreements helped boost agricultural trade and specialization. Between 2008 and 2013, the share of farm households with a single crop surged by 15 percent, mainly because of the increase in the number of farmers who grew one single permanent tree crop, such as rubber, oil palm, and fruit trees. There was increasing demand for these products, especially the high Chinese demand during late 1990s and early 2000s, thanks to the Bilateral Free Trade Agreement between Thailand and China. However, farmers have been suffering from declining world rubber prices since the 2010.

Figure 3.8. Farm specialization: share of farm households by number of crops grown and areas share of single and multiple crops



Source: NSO, Agricultural Census 1993, 2003 and 2013. Inter Agricultural Census Change, 1978, 1998 and 2008.

²⁰ According to Nipon and Kamphol (2019), the correlation coefficient between the growth rates of Thai agricultural exports and agricultural value added is 66 percent. Between 1961 and 2016, Thai agricultural export jumped from USD392.2 million to USD 30.066 billion, with annual average growth of 12.1 percent.

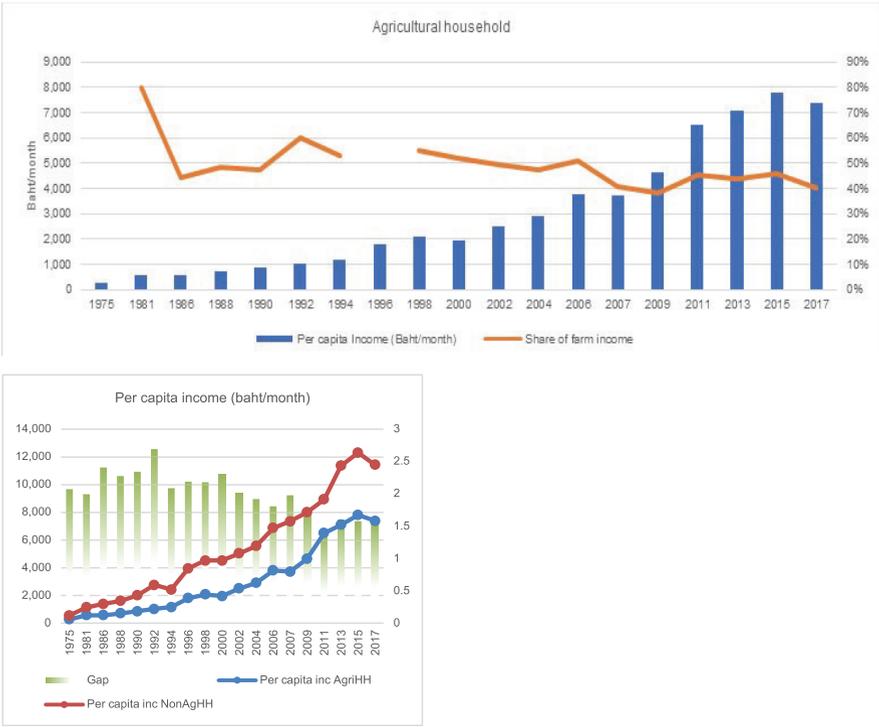
AT Stage 4 – Agriculture integrated into the macroeconomy: The expansion of secondary and college education (particularly engineering) was the most important government policy to alleviate the shortage of skilled labour during the industrial boom. In addition to the food safety law and food standards (DT factors Table 3.1), this period was the beginning of a big jump in farm subsidy. As a result, diversification slowed down (Figure 3.7) and specialization increased (Figure 3.8) because the subsidy was limited to a few important crops, i.e. rice, corn and cassava. Mechanization also surged as evidenced by the increased use of combine harvesting machines and the introduction of rice planting machines.

Slowing pace of AT in 2000–2018: The most important agricultural policies were the surge in farm subsidies, and the new laws to reform public research in 2019. As already explained, farm specialization increased in 2008–2013 (Figure 3.8). Two important changes were the farmers’ increasing direct access to supermarkets and the emergence of agritech startups (DT in table 3.1; part 4).

Less labour-intensive crops: Despite the fact that land per agricultural worker in Thailand is relatively higher than in most Asian countries, except Malaysia (Nipon and Kamphol, 2019), farm size in Thailand, averaging 3 to 4 hectares per farm household, is still too small to make a decent living. An efficient Thai farmer with a few hectares of double paddy cropping still earns much less than someone who works in the non-agricultural sector.²¹ To keep up, the farmer adopts two strategies simultaneously. First, he or she mechanizes most of the tasks so that more time is available to work in other higher wage jobs. Agriculture machinery rental services have made access to machinery feasible. The second strategy is choosing less care-intensive crops, such as rice, cassava or sugar cane, which will allow some family members to work in non-farm activities. This explains why the farm-income share of agricultural household “total” income declined between 1981 and 2009, and remained at 35 to 40 percent in recent years (Figure 3.9). The poorer the farmers, particularly rice farmers, the higher their share of non-farm income (Socio-Economic Survey). The additional non-farm income helped reduce rural poverty and the income gap between agricultural households and non-agricultural households to only 1.5 times (Figure 3.9) compared to five times in cases of the differential sectoral per capita GDP in Figure 2.2.

²¹ A farmer in a three-member household with 20 rais (3.2 ha) of irrigated land will earn net income of 160 000 baht per year (4 000 baht per rai * 20 * 2 crops/year). So per capita income is 53 000 baht. Someone who works in the city for minimum wage will make at least 99 000 baht per year.

Figure 3.9: Per capita income of agricultural and non-agricultural households, share of farm income, and income gap between agriculture and non-agriculture households



Source: National Statistical Office, Socio-economic Survey

Some farmers have switched from low-value regular rice production to jasmine (or Hom Mali) rice, which commands a higher price and thus higher return. According to the Office of Agricultural Economics, the production area of jasmine rice increased from just over 32 percent of total rice area in 2007 to 35.5 percent in 2013.

Concentration of farm-related non-agricultural activities and external economies of scale: As a result of increasing export volumes, crop production has become increasingly concentrated in certain areas that have a comparative advantage. In addition, the production areas would also attract related non-farm activities such as food processing, transportation and other value chain clusters. For example, the location of rice mills (as well as their capacity) and retailers of inputs such as fertilizer and seeds have tended to cluster in the provinces with large production of paddy, particularly in the central plains and the northeastern region. The same pattern also occurs for rubber and broiler chicken, which are concentrated in different provinces across the country.

As a result of the clustering of input retailers, commodity traders and agroprocessors, the markets for both inputs and outputs are highly competitive. Moreover, the logistics

and distribution costs are also competitively priced. Farmers, therefore, have access to cheaper inputs and are able to sell their products at higher farm-gate prices.

3.5 Development of modern food value chains

A significant aspect of the agricultural transformation process is the development of modern food value chains (FVC), which is mainly driven by the supermarket revolution and changing dietary patterns, (Timmer, 2009). The emergence of modern FVCs has had profound impacts not only on the traditional supply chains of agricultural and food products, which saw their relative share of retail markets decline from more than 80 percent in the 1990s to 54 percent in 2019²² (Figure 3.10), but also on the direct link between farmers and consumers and the farmers' capacity to respond to the consumers' increasing demand for high quality and safe products.

This part will describe three phases of the transition from traditional food supply chains to modern FVCs and argue that the foundation of modern FVCs had been laid during stage 3 of transformation, which took place long before the emergence of foreign supermarkets in the mid-1990s (stage 2). The analysis will explain the major characteristics of supply/value chains and organizations in each period, their drivers, as well as their impacts and contribution to food value chain transformation.

Characteristics of the FVCs

Based on the literature on supply chain management, the following salient characteristics are used to distinguish the traditional chains from the modern ones. First, traditional agricultural trade is governed by the competitive spot markets in rural areas dominated by smallholders and small traders. Price risks are mostly borne by farmers. Under the modern agricultural trade, farmers have long-term direct contracts with the exporters, large suppliers or supermarkets. Price is agreed upon in advance, thus drastically reducing price risks for farmers. The second characteristic is a difference in the flows of products, credit (or money) and information. The traditional chains are very long sequences of fragmented transactions involving many small parties, e.g. transactions between small farmers and village middlemen, middlemen vs town suppliers, town suppliers vs wholesalers (or processors), wholesalers vs retailers, and finally between small retailers and consumers. The exchange of goods, money and information between "two trading parties" in each transaction stage, has no links to other trading agents in either the upstream or downstream stages. On the other hand, the modern FVC is a much shorter chain in which the supermarkets (or exporters) deal directly with the groups of small farmers, and thus bypass most of the middlemen. The market information flows directly from the retailers (or exporters) to the farmers, allowing the retailers to directly buy goods and settle payment (credit) directly with the farmers.²³ The third difference is the market structure. The modern FVCs tend to

²² Unfortunately, there is no time series on the share of modern retail trade between 1990 and 2010, except estimates by a few studies which are not comparable. See the estimated modern trade share of total retail trade in the footnote of Figure 3.11.

²³ There are different arrangements between farmers and buyers in Thai modern FVCs, e.g., a contract farming to produce vegetables and poultry between farmers and processors/suppliers/ exporters, a dairy contract farming between farmer groups and dairy processors, a contract between farmer groups and supermarkets, a digital platform (by agritech startups) that directly links farmers or farmer groups with the consumers, an arrangement between farmer groups and NGOs, as well as that between farmer groups and supermarkets in importing countries.

be dominated by a few large supermarkets, while the traditional chains consist of large numbers of small wholesalers (or suppliers) and retailers. Although both the modern and traditional chains handle similar types of fresh agricultural products, the former tend to be the major suppliers of safe, hydroponic and organic vegetables, fresh and processed poultry products, and dairy products, which are dominated by a few large-scale suppliers and processors. Most, if not all fresh products in the supermarkets have Good Agricultural Practice (GAP) certification, brand names, and labels giving information about their origin and safety.

Figure 3.10: Grocery market share of traditional trade (orange) and modern trade (blue), 2011–2019



Note: The modern trade share of total retail trade is estimated at 20 to 25 percent in the 1990s, and 34 to 40.5 percent in 2001 (Nipon et al., 2002).

Source: Euromonitor.

3.4.1 Transition to modern FVCs Phase-I, mid-1975 to 1987 (stage 3)

The first phase of FVC transition occurred during the latter part of stage 3 when agribusiness exporters established contract farming with small farmers and the integrated poultry companies between the mid-1970s and 1980s.

The first stage of FVC transformation in Thailand took place when agribusinesses introduced modern contract farming with small farmers in the mid-1970s. Charoen Pokphand (CP) Co., a Thai agribusiness company, was the first in Asia to adopt contract farming (Table 3.1) and introduce new poultry production technologies. Contract farming is an effective means to recruit farmers to grow modern varieties of broiler chickens, which require effective extension services of new production techniques. While the new technology brought about a better feed conversion ratio, and hence higher output yield, the contract also provides a risk-sharing scheme.²⁴

²⁴ Contract farming is a “relational contract” in which the adjustment processes of a more thoroughly transaction-specific, ongoing administrative kind between two parties are used to maintain flexibility (Williamson, 1977; Schrader, 1986). The key characteristic of contract farming is that the transactions between the farmers and the contractor idiosyncratically involve specialized physical and human capital, transforming the exchange relationship into bilateral monopoly. To encourage farmers to invest in such assets and enjoy benefits of such exchanges, the contractor must maintain a continuing contractual relation.

It should be noted that CP established an integrated subsidiary that consisted of all vertically integrated activities. Another important group of medium-scale agribusiness companies with contract farms²⁵ is the exporters of fresh vegetables and fruits to Europe and Japan. Contract farming has thrived in Thailand, with the 2008 Agricultural Census counting 1.6 million contract farms, including cooperative farms.

There are a few important drivers of contract farming, the first two of which are probably the most important. The first driver was the poultry export market opportunity in Japan and vegetable export opportunity in Europe and Japan. The second was the Sugar Cane and Sugar Act BE 2527 (CE 1984) that created a farmers-sugar mills cartel with a 70:30 revenue-sharing system,²⁶ and enabled the sugar mills to establish formal contracts with the large farmers who promised to sell all of their sugar cane to the contracting miller in exchange for cheap credit. After that, contract farming spread to other crops.

The success of contract farming has resulted in a rapid expansion in production of broilers, providing a cheap source of protein meat for mass consumption, particularly for the poor. Productivity in broiler production has surged, increasing farmers' income. A TDRI study (Nipon *et al.*, 1996) found that contract farmers received higher prices and income than non-contract farmers who produced similar products, such as vegetables, but sold them in the spot markets. Moreover, the value chains have been shortened because products flow directly, information and capital (or credit) are shared or provided solely between the farmers and the contractor, and the need for middlemen has been eliminated. Finally, the broiler sector has become an "industrial activity." The pig industry has followed suit and become industrial production. However, transformation in this phase is limited to farms and processing plants engaged in exports.

Another important institutional development was the development of food safety standards and traceability systems by both the government and the agribusiness exporters during the mid-1990s and early 2000s (stage 2). In addition to compliance with the 1994 WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS), Thai exports of chicken, vegetables and shrimp were also under threat as some contained excessive chemical residues. As a result, the government passed a food standards and safety law and established the National Bureau of Agricultural Commodity and Food Standards (Table 4.1). The farmers also responded by adopting the closed biosafety farming system and expanding the size of their farms. As a result, broiler production has become more concentrated and industrialized (Phunjasit *et al.*, 2018). Although this development was initially limited to contract farming for export, it brought about new processes for food safety standards, traceability and technology, which were the foundation for supporting Thai agricultural transformation in the following phases.

²⁵ In Thai agriculture, there are also many types of traditional contractual arrangements, known as interlocking markets, such as credit provided by the rice mills or sugar mills to the farmers in exchange for a promise to deliver their harvested crops. The traditional contractual arrangements have some differences from the new contract farming (Nipon, *et al.*, 1996).

²⁶ The new arrangement, which includes the minimum domestic retail sugar price to shore up the price of sugar cane, has provided a big incentive for millers and farmers to expand sugar production to the extent that Thailand has become the world's second-largest sugar exporter.

3.4.2 Second phase of transition: the rise of foreign supermarkets and the middle class at the end of stage 2 “labour moving out of agriculture”

The second FVC transition phase took place after the emergence of foreign supermarkets in the mid-1990s (Table 3.1), which was the end of stage 2, labour moving out of agriculture. The Board of Investment policy first allowed a foreign retailer (Carrefour) to establish a firm with 100 percent foreign ownership in 1999. The foreign hypermarkets were Carrefour, Ahold Delhaize, and TESCO-Lotus (a joint venture with a Thai company). Advances in information communication technology (ICT) allowed them to use bar codes and computer software to analyse consumer demand and automate warehouses to reduce inventory costs. With central procurement systems and bulk purchasing, supermarkets were able to offer “every day low prices” to consumers (Nipon *et al.*, 2002). The business model has been so successful that the share of modern grocery stores jumped from 20 to 25 percent in the early 1990s to 41 percent in 2011, and 46 percent in 2019 (Figure 3.10).

The value chains for other food and food products have also been modernized. According to our interviews with supermarket executives, supermarkets source fresh meat and processed meat directly from the large-scale meat processors, who have their own slaughterhouses and processing plants. Suppliers deliver these products directly to the supermarkets.

BOX 3.1: The modern vegetable chains and spill-over effects on the traditional FVC

The modern vegetable chains consist of three main contractors: export contractors, some of whom are also suppliers for the domestic supermarkets, and their contract farmer groups; the suppliers for the supermarkets and their contract farmer groups; and a few supermarkets which have direct contracts with farmer groups. Vegetable contracts between exporters and farmers were first initiated in the 1980s. Contracts between supermarkets and farmer groups began in the late 2010s, with supermarkets learning from the experience of the export contractors who are their suppliers.

Vegetables exported to the EU and Japan must meet the safety standards (e.g. EUREP GAP) of the buyers, and so the exporters have established traceability processes throughout the chains. In addition to providing technical training for the farmers, the exporters must be able to monitor every activity from upstream to downstream, including the proper use of chemicals, testing, cold-chain transport, distribution, and performing the post-audit. To meet such stringent requirements, the exporters usually help the farmer groups invest in a packing station and assign staff to work closely with the farmer groups. The supermarkets that have contracts to buy from farmer groups (such as Makro and TESCO) also use the packing station business model.

The packing stations have generated employment for villagers in the production areas. Moreover, since most farmer groups have a tendency to produce some surplus as insurance that they can meet the purchase requirement of the supermarket, the surplus of safe vegetables is sold to middle men and suppliers in the traditional FVCs, resulting in a positive spillover for some consumers in the traditional wet markets who want to buy safe vegetables.

In response to regulations on location and competitive pressure in the retail markets, retailers have adopted new strategies. In addition to super centres (e.g. Tops Superstore, Big C Super Centre) and large-scale discount stores, there are now smaller stores in small communities and low-income areas, such as the Lotus Express format, Tops Market and Tops Daily formats. The players in traditional markets have also adopted new competitive strategies through having an increasing number of “Sunday markets” in suburban low-income residential areas, which operate only in the late afternoon and evening.

The most important driver of supermarket transformation and changes in food expenditure or dietary pattern (Figure 3.11)²⁷ was the rise of the middle class, particularly the young generations Y and Z.²⁸ These groups have new demands influenced by globalized culture and their new way of life. The rapid growth of condominiums with smaller rooms along the new subway lines, a result of serious traffic jams in Bangkok, has led to a rapid expansion of convenience stores (Apiwat *et al.*, 2020). Most condominium units are too small to have kitchen areas, therefore, young people consume convenience store ready-to-eat food, which has spawned demand for new types of ready-to-eat food but may also lead to bad health (section 4.1).

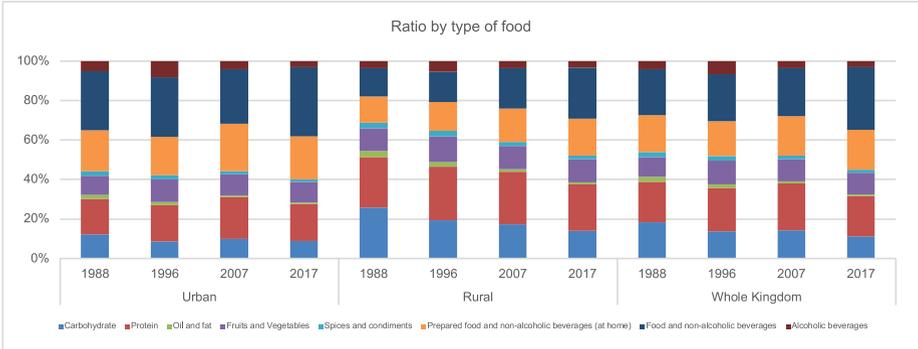
The supermarket revolution shortened the flows of goods and significantly reduced transaction costs. Supermarkets have now begun to directly source from farmer groups and large farmers, resulting in shorter value chains, higher more stable farm gate prices, and transformed food value chains into modern chains. The transformation also had a positive spillover effect on the traditional food value chains, such as the increasing number of specialized wholesale food markets. Perhaps the most important positive impact of greater roles for supermarkets and modern FVCs is the increasing convenience and availability of more varieties of food and processed foods for consumers, and consumers’ access to high quality and safe food products that used to be mainly for export.

However, a serious issue is the high level of pesticide contamination of vegetables and fruits in supermarkets (Nipon *et al.*, 2020). Although food safety is not an important issue in the framework of this project, it is the major issue of FVC transformation for a food exporting country like Thailand. The threats of losing its export revenue from shrimp, chicken and fruits between the late 1990s and early 2000s have significantly transformed the whole FVCs in Thailand. To assess the validity of goods, three private associations – the Federation of Thai Industries, the Thai Chamber of Commerce and the Thai Banking Association – in cooperation with the National Bureau of Agricultural Commodity and Food Standards (ACFS), have introduced the “Quality Mark” or “Q-Mark” label for safe products in 2013. Yet, inspection tests found 62.5 percent of sampled products with the Q-Mark logo failed to pass the maximum residue limit in 2014 (Bangkok Post, 19 August 2014).

²⁷ Major changes include less consumption of carbohydrate, increasing expenditure on protein, processed food and eat-out.

²⁸ Generation Y (also known as Millennials) is the demographic cohort born in 1981 to 1996. Generation Z is the children of Generation X, but some are children of millennials.

Figure 3.11: Pattern of household food expenditure, 1988–2017



Source; NSO, SES.

Modern FVCs (i.e., fast food, processed foods, sweetened beverage and snacks, etc.), and changing dietary patterns as a result of income growth and urbanization have had other negative consequences related to malnourishment, namely, obesity and overweight and rising incidences of non-communicable diseases, or NCDs (Nipon *et al.*, 2020). Data from the Ministry of Health shows that obesity incidence among the population aged 18 and over jumped from 0.8 percent in 1975 to nearly 10 percent in 2016. The incidence of overweight and obesity among children aged 6–14 years increased from about 10 percent in 2014 to almost 12 percent in 2018 (Health Data Centre Report, MOPH, 2019). The economic loss from sodium-related NCDs is estimated at 122 billion baht (US\$3.75 billion) in 2016 (Surasak Kantachuesiri, 2020). Malnutrition problems are partly caused by overconsumption of sugar and salt²⁹ and processed food (Nipon *et al.*, 2020). Thais also eat very salty food because most Thai households spend 15 to 21 percent of their food budget on eating out or buying prepared food for consumption at home. Most of the food prepared outside homes tends to be very salty and contain excessive sodium content (Surasak Kantachuesiri, 2020). Nielsen Retail Index found that one-third of sources of sodium intake come from home cooking, one-third from restaurants and food shops, and one-third from ready-to-eat food, semi-finished food (e.g. instant noodles) and seasoning. These issues are partly due to inadequate information, consumer habits, advertising by the food processors, and inconsistency between the private and social costs of the food providers (farmers, processors, traders and restaurants).

3.4.3 The third transition: emergence of new type of producer organizations and start-ups

The third transition began in the fourth stage of “agriculture integrated in the macroeconomy” in the late 2000s when a new breed of producer organizations emerged in response to the increasingly health-conscious middle class. The most proactive group is the Green Net, which successfully launched the project in the northeastern provinces

²⁹ Thailand is one of the top three Asian countries with the highest per capita consumption of sugar and salt (OECD-FAO Agriculture Outlook 2018–2027). Per capita sugar consumption surged from 30.4 kg in 2008 to 39.4 kg in 2016, and slightly declined to 37.8 kg in 2018 (Office of the Committee on Sugar Cane and Sugar). Salt intake is 10.8 g/day, comparing to WHO recommendation of 5 g/day (Ministry of Public Health National Consumption Survey, 2006–2007).

to commercialize organic vegetables in the early 1990s, becoming the first Fair Trade producer of rice in 2002.³⁰ In response to the success of Green Net Cooperative, a non-governmental organization, the Thai government quickly introduced policies to promote organic farms, resulting in the number of farms that have GAP certificates rising from 3 489 farms in 2010 to 197 320 farms in 2020 (Department of Agriculture, 2020). However, the number of farms and farmer organizations that actually engaged in organic production was still small. Later in the 2010s, there was an increasing trend of new producer organizations and young smart farmers, due to how the Thai Chamber of Commerce (TCC), in cooperation with Kasetsart University, has set up the ThaiGAP Institute to promote the Thai GAP standards. Training programmes provided by TCC and NGOs have generated a spillover effect for other farmers.

The third factor is a rising new trend of young entrepreneurial and innovative farmers, sometimes part-time farmers, who formed new business models of producer organizations, some of them using the social enterprise format, which is income-tax exempt (e.g. Farm-To). These young farmers grow high-value crops and use modern digital technology – especially precision agriculture and social media – as a marketing channel, thus reducing business transaction costs. They form alliances with other young farmers or university professors to share technological information and provide training for farmers.

Another development has been the emergence of agritech startups, which use application platforms (apps) to help farmers make production decisions. The farmers using them tend to produce high-value commodities.³¹ Farmers, who grow low-value commodities, do not yet use apps because the cost is still too high, except a few farmer groups with private or public sector support. Mitr Phol Co., the largest sugar company in Asia, may be the most active provider of digital technology services for their sugarcane contract farmers. A few startups have also linked farmers to consumers, such as Farm Book and Farm-To (Box 3.2).

In effect, digital technology has begun to have a positive impact on output yields and farmers' income, but the use of apps is still very limited according to Lathaporn *et al.*, (2019). There are major differences between the new farmers and those supported by NGOs. The differences include marketing approach, differences in business models, types of leadership, and use of modern digital technology, but these issues are beyond the scope of this study.

³⁰ www.greennet.or.th.

³¹ According to Lathaporn *et al.* (2019), there are at least 61 agritech startups, 37 of which are developed by the government agencies and state enterprises. NIA reports that there may be more than 100 startups in 2020.

BOX 3.2: Farm-To

The business model of Farm-To, a new social enterprise, is very interesting. It does not only use social media to invite farmers to join the enterprise, but Farm-To employs a new marketing strategy by asking consumers who want to buy organic products to pay 50 percent of the price in advance so that farmers can use the advance as working capital. Consumers who place the orders will know which farm the products come from and can monitor the farms from the application. After harvesting, the products will be delivered to the customers' house at the agreed-upon prices, which are comparable to those in the supermarkets. Farm-To charges 20 percent of farmers' revenue for its services.

Another FVC development has been public-private-producer participation (PPPs). PPPs focus on improving the weakest link in the value chains between smallholders and institutional buyers such as supermarkets. An example is Friesland Campina, which coordinates a dairy development programme and provides technical support to dairy farmer groups spanning production and processing to marketing. Another example is the Pracharat Committee on Agriculture (PCA), a joint public-private programme established in 2016. It aims to enhance productivity and reduce the costs for smallholders through multiple PPP projects. Tax holidays and training programmes provided by the private sector and other government support also facilitate the transformation of FVCs. Finally, the new farmer groups also benefit from the knowledge spillovers from existing farmer organizations.

4. Institutions and policy: Reform, success and weakness

This part will address three issues of agricultural transformation in Thailand: a) What is the government approach to agricultural transformation? b) How do the institutional and policy reforms affect each stage of transformation or successfully bring about agricultural development? c) What are the institutional and policy weakness and their impacts on the transformation process?

Although the discussion will be organized by transformation stages, it is important to note that some institutions and policy reforms usually take place long before their outcome is realized and others may have impact in more than one transformation stage. Table 3.1 in part 3 summarizes the major policy reforms and institutions that have had significant impact on each stage of agricultural transformation.

4.1 Stages 0 (subsistence) and 1 (getting agriculture moving): institutional innovation matters

Thai agriculture transformed from subsistence to the first stage of getting agriculture moving in the late 1800s as a result of new policies and institutions of modern agriculture. According to Ruttan and Hayami (1984), changes in the demand for institutional innovation were induced by changes in relative resource endowments and technological changes. The increase in foreign demand for rice³² after the 1855 Bowring Treaty, which abolished the royal monopoly on exports of rice and salt, resulted in a shortage of free labour and higher demand for land and water, and led to the elimination of slavery and the introduction of private property rights on land, and investment in irrigation canals in the 1900s. Other important policies included the investment in railroads and roads, sending students to study agriculture in western countries, reduction in taxes on labour and land. Without such institutions and investment, rice yields would not increase, and Thai agriculture would not have begun to move in the 1950s.

Moreover, a modern agricultural research system was first established with technical assistance from the United States Agency for International Development (USAID)³³ and FAO during 1947–1957 when Thai agriculture was still in the first transformation stage. Its impact on TFP began in stage 3. After that, TFP has been the second or the most important contributor to agricultural growth (Table 3.2, and more discussion below).

³² Steam ship technology, which reduced the transportation costs of rice trading and increased sea transport, also increase the demand for rice.

³³ Perhaps the most important technical assistant project was a rice breeding training programme in which a Cornell professor in modern breeding technology trained almost 200 Thai officers to be plant breeders (see Harry Houser Love 1955).

4.2 Stage 3 (agriculture as a growth engine): policy redirection and massive infrastructural investment

As mentioned earlier, the new government in 1958 initiated a new economic policy direction toward a more open economy and promotion of the private sector. It instituted extensive economic reforms,³⁴ following advice from the International Bank for Reconstruction and Development (IBRD/World Bank). Since the country was endowed with abundant forest land, an agricultural development strategy was the right and successful choice in retrospect. The first major reform that helped increase farm production and transformed agriculture to become the growth engine (stage 3) was the macroeconomic reform of fiscal and monetary policies in the early 1960s. This reform was aimed at maintaining economic stability, a necessary condition for private investment. At the same time, the first national development plan was introduced. The first three national plans comprised the master plan for infrastructure investment. It included rural road networks, irrigation and electricity generation investment, compulsory primary education and the rapid expansion of primary schools in rural areas, establishment of the modern public agricultural research and extension system and supporting agricultural research in universities. As described in part 2, the government used a number of measures, intentionally as well as unintentionally, to facilitate and support the expansion of farming and rural settlements in the unoccupied upland forests.

Farmers could expand their production only if they had access to cheap credit. In the 1960s, the interest rate charged by the rural informal money lenders was exorbitantly high at 5 percent per month. The government, therefore, passed an important law establishing the Bank for Agriculture and Agricultural Cooperatives (BAAC) in 1966, the early period of agriculture as the growth engine. The success of the BAAC, which has been well documented (Yaron, 1992; Ammar *et al.*, 1990; Nipon, 2000), is mainly attributed to its innovative group-guaranteed lending and highly dedicated staff. As a result, most farmers have access to cheap credit both for working capital and medium-term loans. Without the BAAC, rapid agricultural growth would not have been possible. Yet, it began to over-lend to farmers in the early 1990s (labour moving out of agriculture) because of the availability of low-cost funding after the financial liberalization. The farmers' heavy outstanding debt burden resulted in the first debt moratorium policy initiated by the Thai Rak Thai Party in 2000. After that, every government has used a debt restructuring policy to woo the farmers' vote, resulting in farmers' over-borrowing and excessive debt, estimated at 80 percent of farm income.

Perhaps the most important public investment that has successfully boosted the long-term export competitiveness of Thai rice is the ability of the Thai rice breeding research programme to breed new high yield varieties with good quality. The Thai farmers did not want to switch to the new HYV of IR-8 when it was first introduced by IRRI in the 1970s mainly because the Thai consumers did not like it. Rice quality has

³⁴ Ammar (1996-a) argues that Thailand's careful and successful management of large public investment was because "it is Thailand's good fortune that the charismatic leader's grand vision was effectively wedded to the cold pragmatism of the country's financial officers."

always been the main focus of Thai farmers and millers³⁵ because it can fetch a higher farmgate price. It took some years after the cross-breeding of IR-8 with the traditional variety (Leung Thong) that the Rice Department could successfully develop a rice variety with good cooking quality and good grain characteristics (Benjawan, 2007). As a result, the market took off and its yield also increased, resulting in a surge of irrigated area for dry-season rice from in the same period (Ammar and Viroj, 1990).

In this stage, a series of land reforms also occurred as the exhaustion of forest land led to a decline in agricultural land per worker in the late 1970s and early 1980s (Figure 3.3). The government first revised the 1942 Land Allocation for Living Act in 1961. Under the land settlement programme, unexploited public land was allocated to the rural poor for farming. After a series of protests, the government passed a new law on agricultural land reform in 1975 with the objective of redistributing land owned by the state and private owners to poor landless farmers. The Agricultural Land Reform Office (ALRO) was established to implement the land reform programme. Both the land settlement and the land reform acts have the same objective of rural poverty alleviation, but the former has broader political, security and religious objectives. Additionally, lands that farmers acquire under the allotment law will become private properties that can be bought and sold, while the land reform act only grants the farmers the usufruct rights to use and profit from the land. Thus, the land cannot be bought and sold, but the rights to use it can be passed on to the farmers' offspring. However we will argue later (section 5) that nowadays the programme is no longer an effective means of fighting poverty and the land policy has become misguided.

While Thai agriculture was undergoing rapid growth and structural change during stage 3 (between the 1960s and 1980s), most agricultural exports were taxed, except sugar cane and sugar (more discussion below). This seriously reduced farm gate prices as the tax burden fell mostly on farmers. The result was high incidence of rural poverty (Table 2.1 and Figure 2.5). The measures included the export tax and quotas on some agricultural exports such as rice, rubber and maize, which were imposed in 1949, 1960, and 1965, respectively (Table 3.1). Moreover, there was another set of measures that lowered the agricultural prices relative to those of industrial products, i.e. tariff protection for industrial products, and government foreign borrowing to finance the budget deficit in the late 1970s and early 1980s. The tariffs increased the price of industrial products that farmers bought relative to the prices of agricultural products. The external borrowing resulted in baht appreciation, which is like a tax on agricultural exports. These measures resulted in a net resource transfer out of agriculture. Ammar and Suthad (1988) estimated the price effects of both the direct price intervention (agricultural taxes) and indirect effects of tariffs and exchange rates (the macroeconomic effect).

Another interesting finding was the impact of both direct and indirect price interventions on rural-urban income distribution in 1980, the year when direct price intervention resulted in positive transfer of resources into agriculture. The total effects

³⁵ Thai rice has the long-term quality reputation, thanks to a traditional system of decentralized rice quality control, which has two important processes, i.e. first, local taste dictates acceptability or rejection of a variety grown for home use; and secondly, farmers are given a strong message not to grow a certain variety again when local buyers reject their rice harvest on the evidence of poor grain quality (Benjawan, 2007)

of all policies resulted in a 2.5 percent loss of income for the rice farmers. The richest farmers – both rice and non-rice – suffered the most. The middle-income farmer groups suffered smaller income reductions, while the poorest farmers did not suffer. The policies benefited the non-farm households both in rural and urban areas, but it was the richest non-farm households in urban areas that received the most benefit, as their income increased by 10 percent. Over time, the policies leading to transfers out of agriculture were reversed, thanks to the democratic movement by students, farmers and workers in 1973. Although public spending for agriculture exceeded the negative impact of agricultural taxes, farmers still suffered from the biased industrial tariff and fiscal policies between 1976 and 1984, the late stage of agriculture as growth engine. As a result, poverty, though declining, was still high (Figure 2.5), and income inequality was also very high when agricultural transformation was near the end of stage 3.

Unlike rice and other agricultural exports, sugar cane and sugar are highly protected. In 1968 the government passed the Sugar Act to control sugar production, followed by the Cane and Sugar Act in 1984 to protect the sugar cane and sugar industry (see Table 3.1). The laws and policy measures – particularly the price support for sugar, strict measures to limit domestic sale, high import tax on sugar and the revenue sharing between farmers and millers – have resulted in the high price of sugar cane, and high incentives for both farmers and millers to rapidly expand their production, at the expense of consumers and food processors who have to buy sugar at higher prices. As a result, sugar cane production surged from less than 40 million tonnes in the 1990s to more than 100 million tonnes in the 2010s. Thailand has become the world's second largest exporter of sugar.

Distorted policies and law: Yet, there were also a number of laws that allowed the government to intervene in the marketing of some agricultural products. Occasionally, the government used its legal power to control prices of inputs and agricultural products. For example, the price control of animal feed in the 1980s (Nipon, 1980), the zoning and regulation of slaughterhouses, occasional price controls on pork in the 1970s to 1980s (Nipon, 1985-a), and the paddy land rent control tenant law in 1974. Such controls highly distort the markets and produce negative consequences on farmers and input suppliers.

4.3 Stage 2: (moving labour out of agriculture): export industrialization and structural change

Throughout the 1980s, Thai agriculture was in serious trouble that left the government with no choice but to take drastic policy reforms. In addition to the structural problem of declining comparative advantage of Thai agriculture, there was a need for macroeconomic adjustment to recover from fiscal imprudence, which resulted in slow economic growth. Yet, there was also good news for the economy: the discovery of large reserves of gas and oil in the Gulf of Thailand, and the global economic recovery after the 1986 Plaza Accord that resulted in the yen appreciating.

The depressed world commodities prices (particularly rice prices) and the 1981 El Niño drought led to a series of new policies. In the short run, the government quickly initiated a large “rural employment generation” programme that employed the rural

workforce to dig ponds, underground water wells and build village roads (Medhi *et al.*, 1981).

Four successful policy reforms had a strong influence on economic growth and massive rural-urban migration, which led to a major structural change in the Thai economy and a reduction in poverty and malnutrition. The first major reforms to shore up the rice price were a) a series of baht devaluations in the early 1980s, b) an elimination of the rice premium, export taxes and export quotas on other agricultural products after 1986, and c) a decision to actively participate in the Uruguay Round negotiations, particularly the negotiation on agricultural trade liberalization. Since then, the agricultural policy regime has moved from a pro-consumer to a pro-producer stance, as during the 2000s the latest estimate of the nominal rate of assistance changed from a negative to positive value (Anderson and Nelgen, 2012).

The second reform was a shift in industrial policy from import substitution to export promotion in the mid-1980s. A combination of events led to this shift, such as the influence of the Washington Consensus and the Plaza Accord by the G5 in 1986. Thailand embraced the Washington Consensus by initiating a unilateral liberalization in the early 1980s, and implementing a series of structural adjustment programmes imposed by IMF loan conditionalities in the mid-1980s. The most successful reform was the adoption of labour-intensive export industrialization and the establishment of the Eastern Seaboard (ESB) Development project to attract Japanese investment. The subsequent industrial boom, which was attributed to the yen appreciation after the Plaza Accord in 1986, generated large demand for unskilled young workers, triggering an exodus of young workers from agriculture as already mentioned in part 3 (Figure 2.4). One consequence was an increase in rural wages, which led to rapid mechanization. Another was that the poverty incidence and undernutrition started to decline sharply (Figure 2.5, Table 2.2).

The third important set of policy changes that transformed the traditional food supply chains into the modern FVCs were the partial liberalization of foreign direct investment in supermarkets by the Board of Investment in the mid-1990s and the institutional reforms of food safety in response to the export threats from the developed importing countries in the late 1990s and early 2000s. In addition to the links between agriculture and the agricultural and food system (AFS), the penetration of financial services into the agricultural sector has helped move agriculture into stage 2, agriculture integrated into the macroeconomy.

Finally, the turning point for nutrition policy was the fifth national development plan (1982–1986) when agriculture was in the final years of stage 3, and the declining trend in rural poverty reversed (Figure 2.5) due to low rice prices. Despite being food secure because of its large agricultural surplus and access to food, Thailand has malnutrition problems, particularly among children. The MOPH and Ministry of Defence first recognized the problems when they carried out a Nutrition Survey from October through December 1960 (Interdepartmental Committee on Nutrition for National Defence, 1962). Since then, there has been a series of national nutrition surveys between 1975

and 2008 which found that undernutrition and allied deficiency disorders and diseases were highly prevalent. However, the health sector focused mainly on curing major nutrition challenges, with limited attention to preventive measures, which included health and nutrition literacy of mothers. Nutrition was not a development issue until the fifth national plan, which regarded malnutrition as a symptom of poverty. Consequently, the Poverty Alleviation Plan (PAP) was designed to address both poverty and malnutrition, with a focus on rural areas by adopting a decentralized and participatory approach. As a result, the prevalence of underweight and iron deficiency anaemia among children under-five was reduced sharply from 50 percent in both cases in 1982, to around 7 percent and 10 percent, respectively, in 2012. In 1992, the Thai government also initiated school lunch and school milk programmes. Some schools have also adopted the agricultural activities of growing vegetables, fruits, fish and hens for school lunch. Undernourishment incidence declined significantly between stage 2 and 4, from almost 28 percent in 1995 to about 19 percent in 2005, 10 percent in 2010 and 8 percent in 2018 (Table 2.2).

There was also an important human resource development project that granted a large number of scholarships for students to study biotechnology in the late 1980s, and the transfer of the Biotech Centre to be under the National Science and Technology Development Agency (NSTDA) in 1991. The biotechnology capacity development programme was important because it complements the conventional plant breeding research in the Ministry of Agriculture and Cooperatives and universities. Those biotech researchers at the Biotech Centre and Kasetsart University have been able to develop a number of new rice varieties more quickly and efficiently. The success of agricultural research is evidenced by the high growth rate of total factor productivity and its large contribution to agricultural growth, particularly after 1985 when agricultural transformation was in stages 2, and 4 (Table 3.2 and part 3). It should also be noted that the public expenditure and intensities of research and extension services were also on the rising trend during 1983 and the early 1990s (Figure 3.6).

In response to the depressed world prices of commodities, the government introduced an agricultural restructuring policy with the objective of matching crop supplies to market demand by providing incentives for farmers to switch from crops with depressed prices (rice and cassava) to high value crops, such as cashew nuts, cattle, etc. The incentives included subsidized inputs, credit and technical knowhow. The programme was implemented between the early 1980s and the early 1990s (Nipon *et al.*, 1995).

The restructuring policy failed miserably and many farmers who participated in the programme were heavily in debt from borrowing under the programme. There are several reasons for the failure, including the use of a uniform policy to deal with the complex production problems and diversity of agriculture, the farmers' moral hazard generated by the programme incentives, declining prices of crops that the government persuaded the farmers to grow, and the government's lack of knowledge and production technology (Nipon *et al.*, 1995). One policy lesson is the fact that since no one – including government officers – can forecast the future prices of agricultural

products, the programme should only provide farmers with technical know-how, market information and some necessary subsidized inputs, and allow the farmers to make their own crop choices and production restructuring plan.

4.4 Stage 4: populist policies and political instability

After the 1997/98 economic crisis, the Thai economy has begun to slow down, thanks to the decline in investment to GDP ratio to 20 percent caused by a combination of structural factors (as already explained in part 2). The 2000s and 2010s were also the decades of political conflicts and turmoil that included two military coups in 2006 and 2014. Interestingly, Timmer (2009) argues that such conflicts, which were caused by income inequality between the urban and rural areas (Figure 2.3), occurred during the stage of agriculture being integrated into the macroeconomy when the productivity gap between agriculture and non-agriculture is quite large. However agricultural prices remained high during the 2000s.

A major shift in Thai economic and agricultural policies took place in 2001 when the Thai Rak Thai Party (TRT), which campaigned on populist policies for the rural voters, gained power. The TRT won the election by a landslide as farmers were experiencing several problems in the late 1990s and were on the verge of bankruptcy. TRT's two main policies, debt moratorium for farmers and the one million-baht per village fund (approximately US\$1 795 at the time), won the votes of most farmers. Two years later, the government introduced the popular "paddy pledging policy," which was a price support scheme, promising to buy paddy from the farmers at above the market price, then stocking and selling it at a loss. Since then, every government has felt that it must have its own price subsidy policy to win farmers' votes. The Democrat Party initiated an income guarantee scheme in 2007–2008. Because the farmers received the difference between the guaranteed price and the market price at the harvesting time, there was no other market distortion. This policy is now being used by the current coalition government for rice, cassava, maize, rubber and oil palm. The populist agricultural policies and lower economic growth are the beginning of the slower pace of transformation as argued in parts 2 and 3.

Nevertheless, there was rapid transformation of the food value chains from traditional markets to the modern sector during the 2000s, as described in part 3. The major drivers were the pressure for safe food from the importing countries. Aside from the avian flu and rising middle class in Thailand, the government has also played crucial role in developing the new institutions and promoting the development of modern FVC.³⁶ The new institutions include the establishment of the National Bureau of Agricultural Commodity and Food Standards in 2004, GAP certification and accreditation, organic farm certification, issuance of phytosanitary certificates and certificates of pesticide residues, regulations on biosafety farms (shrimp farms) and closed farm systems (for poultry), HACCP regulations, traceability regulations of F&V packing stations, a new social enterprise law, and voluntary safe food labelling. The government has established the chemical residue testing facilities, one-stop service for the exporters of fruits and vegetables, promotion of private investment in fruits and vegetable cold

³⁶ For more details see Nipon, Phunjasit and Kamphol (2020).

storage, etc. The government also grants income tax holidays for the community and social enterprises. The tax exemption for community enterprises enables the small farmers to form new types of producer organizations that are more flexible than the highly regulated agricultural cooperatives in carrying out business. The emergence and survival of most agritech startups can also be partly attributed to the tax holidays for social enterprise.

4.5 Challenges to reach Stage 5: distorted farm subsidies and misguided policies

Thai agriculture has been approaching the industrialization stage since the early 2000s when the per capita income differential between agriculture and non-agriculture began to narrow. Yet structural transformation has significantly slowed down since the late 2000s as explained in parts 2 and 3. The slow-down was caused by both structural factors and policies in both the agriculture and industrial sectors. The most important agricultural policy that distorted the farmers' incentive to restructure their production system is the increasing level of farm subsidy, as well as the land and water policies. However, the future of Thai agricultural transformation still looks somewhat optimistic, as there are important changes in the direction of agricultural research and nutrition policies.

Distorted and rising farm subsidy: The most notorious policy was the policy of paddy pledging for every grain of rice in 2011 and 2014. The government promised to buy all the paddy produced by farmers at a price 50 percent above the market price. Aside from raising income for farmers to win their votes, the government had two more objectives: stabilizing the domestic price for consumers and exporting rice at a price higher than the world market price. The second objective failed while the first objective was accomplished, resulting in a heavy fiscal loss of 540 billion baht, or \$17.8 billion in 2020 dollars (Nipon and Kamphol, 2014). The prime minister, a minister, many senior government officials and private traders were found guilty of corruption by the Criminal Court's Division for Corruption and Misconduct of State Authorities.

After the military coup in 2014, the government introduced a new subsidy scheme between 2015 and 2019. It paid the farmers a fixed cash subsidy of 1 000 baht (US\$32.9) up to a ceiling of 12–15 rai (1.92–2.42 ha) per farm household. There were also other subsidies, such as a paddy storage subsidy for farmers, farmer organizations and millers. The authors of this report estimate that between 2014 and 2018, the total subsidy for rice was higher than the total budget of the Ministry of Agriculture and Cooperatives, and most subsidy programmes were financed off-budget. Since 2019, the elected government has reintroduced the income guarantee scheme, and yet still maintained the fixed subsidy of 1,000 baht (\$32.9). These subsidy policies eliminate the farmers' need to adjust their production systems in response to changes in market prices of output and inputs.

The misguided land policy:

The following quote, written 50 years ago, may help readers understand the thinking and direction of "today's" Thai policy planners and ruling elites about the rural poor:

“In the management of both land and water resources Thai policy is strongly influenced by ideological considerations, which do not always coincide with the need of economic development. Land policy is strongly committed to the idea of the independent, land owning farms. Irrigation policy is influenced by the idea that irrigation ought to be a free service. Both these policies can be presented in terms of a commitment to the welfare of the poorest citizen. Yet in fact, Thai taxation is very regressive in its effects, and Thai overall planning policy gives little attention to the promotion of movement out of agriculture, which is the chief way in which farmers benefit from economic progress.” (pp. 176–177)... “Even more important is the evidence that the realities of the rural situation have not been taken seriously into account in designing the overall policy. Formally there is a shift of emphasis in the second plan away from growth as such to the diffusion of the benefits of growth as widely as possible to farmers. (Yet the actual meaning of) a diffusion of benefits of growth is not raising the relative position of the farmer.” (pp. 188–189).

–Silcock, 1970.

Though land reform has been successful in reducing the number of landless farmers and political conflicts, it was not as successful in raising the productivity of farmers under the programme³⁷ because most of the land is of poor quality and lacks necessary infrastructure. Moreover, the Agricultural Land Reform Office and the Ministry of Agriculture and Cooperatives could not provide adequate extension and marketing services to the farmers. So, many farmers, especially those with excessive debt, illegally sold their land. The law also prohibits the use of land for non-agricultural purposes, but most of the sold land is illegally used for resorts or large farms. Such practices have become common, triggering the process of land grabbing by hiring the poor to encroach into the forests or engaging in illegal logging. The illegal encroachment into national and conservation forests has been a serious problem for decades, with about 135 257 ha of forest lands encroached upon between 2000 and 2017.

In 2018, the military government decided to use its absolute power against such illegal practices by seizing lands under the Agricultural Land Reform that were illegally sold. Yet, the government still insists that those seized lands be reallocated to the rural poor, reflecting the obsolete ideology of welfare and not learning that giving poor quality agricultural land to the landless cannot solve their poverty problems. Instead, it provides the perverse incentive for them to sell the land and continue to encroach into the forest, resulting in more deforestation and forest burning. Additionally, it also provides incentives for poor farmers to remain in agriculture in order to grab land for sale but not to improve farm productivity, worsening Thailand’s high share of agricultural employment (Box 2.1).

³⁷ Historically, the government has failed to grant secure property rights for farm land. When the World Bank provided grants and technical assistance for the land titling project in 1995, more than 60 percent of privately owned land did not have legal title deeds. After the project, most agricultural lands that were converted from the forests still did not have legal deeds.

Free water for farmers: In the Chao Phraya river basin,³⁸ the increasing scarcity of irrigated water in the dry season is mainly attributed to the policy of free water for small farmers.³⁹ The shortage arises in the drought years, which have been more frequent and severe in the last decade. While the available supply of utilizable irrigated water is 3 to 3.4 billion cubic meters in the drought years, total usage is about 5 to 7.5 billion m³, depending on the planted area of dry season rice. There is no shortage in the dry season in the normal years, when available supply is about 7.6 billion m³. Most of the increasing water demand comes from the increase in rice cultivated areas from 0.8 million hectares in 1990 to 1.9-2.2 million hectares in 2018.

Farmers in the Central Plains use every means, but stop growing rice, to obtain adequate water for their paddy farm, i.e., using underground water, pumping any water, including water for ecological as well as human consumption purposes, from the natural canals and rivers. As a result, there are increasing conflicts between different water users, and between upstream rice farmers and downstream farmers who grow high value crops. More important, the farmers' excessive use of water expropriates the rights of other water users under the riparian right system, as well as imposes negative externalities on underground water tables and land subsidence. The free water policy together with the distorted rice subsidy policy might have strongly discouraged farmers in the up- and mid-stream areas of the Chao Phraya river basin from diversifying from low-value rice toward high-value crops, and also discouraged other less water-intensive, but higher value economic activities, thus seriously affecting agricultural transformation.

Increasing trend of agricultural research and public expenditure in agriculture: In recent years, Thai rice has declining comparative advantage partly because the public research system has failed to respond to the changes in world market demand. Thailand's export of jasmine rice declined substantially from 1.6 million tonnes in 2010 to 0.5 million tonnes in 2019. The lost share goes to Vietnam which has successfully bred the higher yield varieties of soft and fragrant rice that meet the preference of Chinese consumers and yet is sold at much cheaper price than Thai Hom Mali rice. Several reasons for the institutional weakness of the existing Thai agricultural research system include (a) lack of market research and systematic links between the export industry, weakness of the funding process and government research institutes; (b) poor incentives for government researchers, particularly incentives to attract younger generations with high potential to replace those who retired during the last decade (TDRI, 2011; Somkiat, 2013).

However, the agricultural research expenditure, which experienced a declining trend after the mid-1990s, has begun to increase since 2010 (Figure 3.7). Moreover, per capita public expenditure in agriculture also surged after 2011 (Figure 4.1). The increase was mainly attributed to spending on irrigation, agricultural extension, and a new restructuring policy. Restructuring included an integrated rice policy aimed at

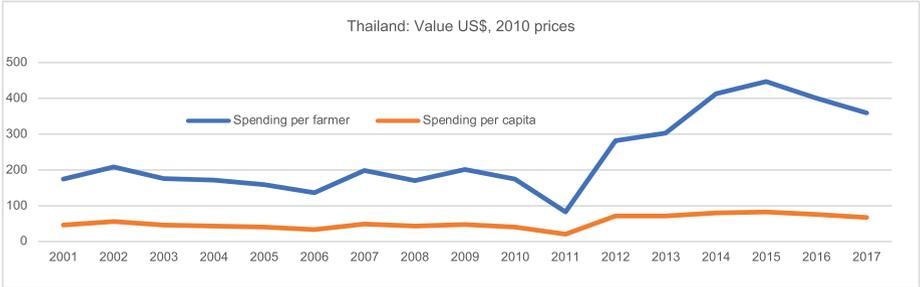
³⁸ The basin covers 30 percent of the country or 160,000 square kilometers in the Northern, Lower Northern regions and Central Plains.

³⁹ Interestingly when the Royal Irrigation Act was legislated in 1942, farmers had to pay for the irrigated water. But that particular clause has never been implemented.

diversifying into other crops, and the cluster farm policy, which provided subsidies and soft loans for small farmers to form a farm management group and carry out joint farm and marketing management to reduce costs and increase productivity.

The increase in agricultural research was first attributed to the government’s recognition of the importance of university research in the late 2000s. But the most significant change occurred in 2019 when the government passed a new law merging the Ministry of Science with the Office of Higher Education Commission and established a new independent agency, Thailand Science Research and Innovation (TSRI). The TSRI is responsible for the formulation of national strategy, policies and plans of science, research and innovation, and allocation of research funds according to the objectives of the new policy of science, research and innovation, etc. The TSRI is also coordinating with the private sector in the promotion of joint public-private research to serve the needs of both the public and private sectors. Since the new policy has clear strategic direction of fund allocation, which has been jointly formulated by key stakeholders, and objective key results (OKRs) for performance evaluation, it is expected that future research will meet the country’s needs.

Figure 4.1: Per capita public expenditures for agriculture (2011 PPP\$)



Note: For Thailand, agricultural spending does not include farm subsidy financed by off-budget
 Source: FAOSTAT, WDI and Laborde et al (2018) and Vos (2018) in Mamun, et.al. 2020

Toward nutrition policy: As Thailand has become a middle-income country with growing urbanization (Table 2.2; Appendix Figure 4.1), and dietary patterns are changing (Figure 3.10; part 3), new nutrition challenges have emerged. Thai people now have greater access to a variety of processed food, including foods containing high levels of sugar, fat and salt. Consumption of fruits and vegetables is low compared to other countries. Most Thai people eat out or bring home food already prepared and bought from street vendors (Figure 3.11).

One undesirable and probably unintended consequence of the transformation towards modern FVCs is the increasing incidence of overweight, obesity and non-communicable diseases (NCDs). The three NCDs which began to show a rapidly rising trend since the 1990s are hypertension, cardiovascular disease, and diabetes mellitus (Kraisid *et al.*, 2013: p.25). The increasing incidence of malnutrition and NCDs are caused by a combination of factors. Among them are excessive consumption of sugary

and fatty foods, salt and sodium, and more processed food (which are the consequences of changes in dietary patterns influenced by globalization, higher incomes and urbanization), reduction in physical activity, lack of nutrition literacy, inconsistency between private costs and social costs incurred by the private food providers, and failure of government regulations.

Several campaigns were initiated to prevent malnourishment and NCDs, such as “Sweet Enough” campaigns to reduce sugar consumption, “Eating More Fruits and Vegetables,” and “Increasing Daily Physical Activity.” However, the campaigns had limited effects. In 2008, the National Food Committee (NFC) Act was passed, which led to a Strategic Framework for Food Management. Sugary beverages and drinks are now subject to excise tax. There is now an ongoing effort among researchers, health officers and the Excise Department to introduce an excise tax on salty processed food.

5. Conclusions and challenges

The objective of this paper is to provide a detailed analysis of Thailand's agricultural transformation at different stages as identified in chapters 1 and 2. It was written with an emphasis on the creation of new institutions (especially those complementing market mechanisms), policy changes and reforms, key drivers of each stage of transformation and some of the policy weakness. The paper also focuses on the development of modern food value chains, which are relatively more advanced than in most developing Asian economies, except Malaysia (Nipon and Kamphol, 2019). The analysis is heavily based on the indicators mentioned in chapter 2, time series of official statistics and findings from previous studies. It uses Rodrik's method of measuring economic structural changes by decomposing changes in overall labour productivity, and the USDA's estimates of the contribution of total factor productivity in various transformation stages.

5.1 Some observations on the stages of agricultural transformation and sources of agricultural productivity growth in Thailand

- a) The stages of Thailand's agricultural transformation do not follow the pattern that happened in most countries identified in the paper by Mamun *et al.* (2020). After a slow and long process of building institutional foundations for agricultural development, which took almost a hundred years, Thai agriculture began to move (stage 1) in the 1950s. Instead of advancing to stage 2, agriculture became the engine of Thailand's economic growth (stage 3) during the 1960s and 1970s. The rapid industrialization of the late 1980s resulted in the exodus of agricultural labour into the industrial sector (stage 2). Agriculture probably began to be integrated into the macroeconomy (stage 4) after the financial liberalization of the mid-1990s, but the transformation process was interrupted by the Asian economic crisis in 1997–1998. Although it is approaching the industrialized stage, structural change stalled in the mid-2000s. As a result, per capita income in agriculture is still much lower than in non-agricultural sectors.
- b) Agricultural transformation has not been a smooth process. It has been interrupted by boom-and-bust cycles, for example the high agricultural growth of the 1960s and the 1973 commodities boom, followed by depressed world prices in the early 1980s, agricultural malaise in the 1990s, then the 2007 commodities boom. But appropriate policy responses and reforms successfully revived agricultural growth and facilitated the transformation process.
- c) Because Thailand has always been an agricultural export-surplus economy integrated into international markets, markets always play the most important role of social coordinator in guiding the decisions of farmers and traders to utilize their resources in the most efficient ways. This is why the export-led industrialization and economic liberalization policies were the most important factors affecting the economic structural change. Yet, government policies are needed when markets fail and there is a need for infrastructure. For example, agricultural public research and extension services are a necessary means to increase the agricultural productivity of the small farmers. Elimination of some

distorted trade and pricing policies that heavily penalized farmers and kept rural poverty at a high level until the mid-1980s, have enabled farmers to be more specialized in products for which they have comparative advantage, enjoying higher productivity gain.

- d) Except for the period of agriculture being the growth engine (stage 2) in the 1960s to early 1980s and in 2010 to 2017, agricultural labour productivity grew faster than agricultural land productivity (Table 3.1) because Thailand has a relatively higher ratio of cultivated land per farmer than most Asian countries and also a labour shortage. While labour (adjusted for education) and land were the most important sources of agricultural growth during the 1960s and 1980s, capital and total factor productivity growth became the most important sources after the 1980s (Suphannachart 2009; Tinnakorn and Sussangkarn, 1998). Yet, during the transformation process, there were other sources of productivity growth that are difficult to quantify, such as farmers' specialization towards single crops, clustering economies made possible by international trade, and changing cropping patterns towards high-valued crops. Most farmers grow crops that are less labour and care intensive because of a shortage of labour. Such cropping patterns free farmers' time and allow them to work in higher-paid non-agricultural jobs, partly explaining why farm income accounts for less than 35 to 40 percent of total income for agricultural households.⁴⁰

5.2 Important institutions and policies affecting transformation in different stages

The following briefly recasts some of the policies and institutions that have had important impacts on each of the transformation stages. Table 4.1 provides more details of the institutions and policies that affect agricultural transformation in each stage.

- a) Thai agriculture quickly moved from the stage of “getting agriculture moving” in the 1950s to the stage of “agriculture as a contributor to growth” between the 1960s and 1980s. That was made possible by the large investment in rural infrastructure, universal primary education in rural areas, changes in development strategy from economic nationalism towards laissez-faire policies, and creation of new development agencies, especially the Bank for Agriculture and Agricultural Cooperative (Table 4.1). The national agricultural research system and research capacity were also built with technical assistance and grants from the USAID and the Rockefeller Foundation, which also played instrumental roles in establishing health care services in the rural areas.

But poverty remained high because of agricultural taxation (through the trade policy), which together with industrial protection, substantially reduced farmers' income. Until 1986, there was a net transfer of resources out of agriculture. In response to the students-farmers democratic movements in the early 1980s, the government initiated the land reform law and established the Agricultural Land Reform Office to distribute government land to the landless farmers.

⁴⁰ Therefore, the comparison of per capita agricultural GDP with per capita non-agricultural GDP may be a misleading indicator of agricultural transformation in Thailand.

Other important policies and deregulation were investment promotion for the chicken export business, and the slaughterhouse deregulation that led to the rapid expansion of the poultry industry. Such investment, together with contract farming, which was not subject to any regulation until the late 2010s, were the important factors that facilitated food value chain transformation in the mid-1990s.

- b) Agriculture faced several problems towards the end of stage 3, such as depressed world commodities prices, exhaustion of frontier land and rising poverty. In response, the government adopted a series of policy reforms to restore agricultural competitiveness, including a series of currency devaluations in the 1980s, an elimination of trade policy distortions that penalized agriculture, actively participating in the Uruguay Round negotiations by joining the Cairns Group, the large-scale rural employment programme, and a new Sugar Cane and Sugar Law to protect and provide cross-subsidies to the industry. But the most important policy change was a shift from an import substitution regime toward the labour-intensive export-led industrialization policy and the Eastern Seaboard economic development project that successfully attracted Japanese labour-intensive industries. As a result, agriculture quickly entered stage 2 of massive rural-urban migration that sharply reduced poverty and malnutrition.

However, one important policy in the 1980s failed, namely an agricultural production restructuring policy (Nipon *et al.*, 1995). Important lessons from the failure include: (i) The government should not provide incentives for farmers to grow certain kinds of crops because no government can forecast the future prices of agricultural products; (ii) The one-size fits all policy does not work because of location-specific factors and diversity of farming practices; (iii) The least distorted but more effective restructuring policy is to provide farmers with the necessary production and marketing information and technology, and let the farmers make their own decisions.

The mid-1990s through the early 2000s was also a period of liberalization of foreign investment in supermarkets, and establishment of food safety institutions for food exports, which marked the beginning of the supermarket revolution and the transformation of the food value chains.

- c) In the 1990s, agriculture began to enter stage 4, agriculture integrated into the macroeconomy, because of increasing linkages between agriculture and the macroeconomy. In addition to the rapid growth of the food processing export industry, the financial liberalization of the mid-1990s sharply reduced the interest rate differential between the informal financial sector, particularly in the rural areas, and the formal sector. The share of informal credit in agricultural lending to farm households declined from 55 percent in the early 1980s to less than 10 percent in the 2010s.

One important consequence of the Poverty Alleviation Plan initiated in the Fifth National Economic and Social Development Plan was a sharp reduction in undernourishment incidence between stages 2 and 4 (Table 2.2).

Unfortunately, the 1997–1998 economic crisis disrupted economic growth. Agricultural transformation was also interrupted by rising farm subsidies, which are now larger than the budget of the Ministry of Agriculture and Cooperatives. Such subsidies not only crowd out the budget for agricultural research and development, but they also discourage farmers from adapting to external changes, thus slowing or stalling the transformation process. To make matters worse, the public agricultural research and extension capacity has weakened and cannot respond to market demand.

- d) Despite the stalled structural change, the modern FVCs have thrived, thanks to the role of the private sector and the emergence of new breeds of farmer groups and entrepreneurial and innovative farmers who have started using digital technology to improve farm productivity and directly access supermarkets and final consumers. Their development has been facilitated and supported by some government policy measures, namely, the provision of free GAP licensing, income tax exemption for community enterprises and social enterprises, subsidies for organic rice farms, and subsidized training for young smart farmers.

5.3 Some challenges for the future of Thailand's agricultural transformation

The most critical challenge concerning the future of Thai agriculture is to “restart the transformation process” by moving labour out of agriculture and increasing agricultural labour productivity. As argued by Timmer (2009), the way out of the trap is:

“In the long run, the way to raise rural productivity is to raise urban productivity (or, as chairman Mao crudely but correctly put it, ‘The only way out for agriculture is industry’).”

Such transformation will further reduce the per capita income inequality between agriculture and the non-agricultural sectors. To achieve such objectives, the most important policy reform should be an inclusive growth strategy, emphasizing the development of non-agricultural sectors and employing the economic decentralization approach. The rationale is that there are provinces with high growth potential, but they lack the required resources and legal power to pursue their own development strategy and plans. However, decentralization of policy reform is outside the scope of this paper.

To increase agricultural labour productivity, a land consolidation policy is needed because larger farm size will generate economies of scale. But instead of the current ineffective large farm policy (or more appropriately, the cluster farm policy), the government should eliminate some institutional constraints that are barriers to farm consolidation. These constraints include (a) the tenant law, which is biased in favour of tenants and destroys the land owners' incentive to rent out their lands. (b) The problem

of the foreclosure law that results in high long-term interest rates for loans to buy land (7–8 percent p.a.), compared with 1–2 percent for car-leasing loans. Reform would reduce the interest rate, which would allow many farmers to obtain credit to buy more farm land. (c) Currently, irrigation water is free for farmers, resulting in excessive use of water for water-intensive crops, especially rice. A TDRI study (2018) for the Royal Irrigation Department proposed that the water user groups should be allowed to charge a water use fee from their member farmers. The policy would enable farm land that is not situated along the irrigated canals to buy water from farmers along the irrigated canals. That would allow some farmers to increase their farm size outside the irrigated areas.

The second policy reform concerns research and extension. The existing public research and extension systems are facing several constraints. For example, research issues and programmes are researcher-led, and do not respond to market demand. Incentives are inadequate to attract high-calibre researchers. Research budgets fluctuate widely and are declining. The objective of reform is that agricultural public research must be market-led and boost farm productivity. The extension system has also weakened because it fails to respond to the farmers' needs, and most extension officers do not have adequate knowledge. The new extension approach is to allow the private sector, university and farmer groups to jointly propose the extension projects and seek funding from the government on a competitive bidding basis.

The third group of policy reforms covers food safety and environmental policies aimed at improving product quality/safety and thus increasing the value of farm products. Some important food safety policy reform measures include (a) streamlining the existing pesticide regulations to reduce the excessive use of pesticides and insecticides (Nipon *et al.*, 2020); (b) allowing private companies and NGOs to issue licenses for GAP, product safety standards, and creating a strong public-private accreditation programme; (c) supporting farmer groups and food suppliers to jointly establish the traceability process for safe farm products by investing in collection and packing stations in the major production areas; and last but not least, (d) providing technical support as well as food safety testing services for the wholesale markets.

Fourth, current agricultural production and practices are not sustainable and have resulted in soil and water pollution, air pollution (or PM2.5), deforestation, and overfishing. These environmental problems need to be seriously addressed if Thailand wants to be the supplier of high-value products in a sustainable way.

The government could convert the current farmer subsidies to finance the above proposed policies.

Lastly, are issues of obesity and NCDs. Fortunately, there are now increasingly large networks of organizations both from the MOPH, the Department of Excise Tax, university researchers in various disciplines, medical doctors and NGOs that are working together to initiate new policies and knowledge campaigns to tackle the issues.

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Chapter 5

VIET NAM

Agricultural transformation in the socialist republic
of Viet Nam

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Executive Summary

In 1975, Viet Nam achieved reunification. Yet, despite reaching peace, it was still battling poverty, food shortages and hunger caused to a large degree by the damages of war. Imports of agricultural products were a necessity. But Viet Nam is a resilient nation. It has grown and developed into a vibrant middle-income country, and today exports a diverse menu of food and agricultural products. Agricultural development helped Viet Nam achieve the Millennium Development Goals much earlier than many of its peers. The agricultural sector has been a key driver of broader economic development and a source of strength during difficult times.

This paper provides an overview of Viet Nam's agriculture transformation process from 1975 to the present using the frameworks developed Timmer (1988) and Laborde *et al.* (2018). The authors examine each development stage through the lenses of policy, legislation, and institutional aspects. They share examples that illustrate the character of each stage. Viet Nam's experience suggests that to facilitate agricultural and rural transformation, strong political will is vital. However, political will cannot be fleeting. It must be sustained and institutionalized through coherent and deliberate policies at all levels, guiding resource allocation and a comprehensive reforms process.

Viet Nam has placed significant importance on agriculture, farmers and rural areas in the country's economic development agenda. In 2008, the government through a resolution enshrined agriculture and rural development as an important component of the vision for social and political development of the country. This resolution is a medium to long term roadmap for an integrated and inclusive development process with the overall goal of ensuring an inclusive social, economic and political well-being of the country.

The achievements of the agricultural sector over the past years have been associated with reforms in different areas. Reforms in land tenure, mechanization, and input intensity played important parts in the early stages of agricultural transformation. Later, crop diversification, labour transformation, and science and technology have received more attention. Recently, value chain development and providing credit for agriculture have become the focus.

Although there has been a gradual decrease in the shares of agriculture and the rural economy in the overall economy, they continue to play important roles in the national structural transformation process. Since 2010, Viet Nam has entered stage 4 of structural transformation, which is proving relatively challenging. Some of the key challenges include:

- (i) the increased severity and frequency of weather-based disasters, epidemics and other impacts related to climate change;
- (ii) technical and procedural challenges to access international markets for high-value and processed agriculture products inhibit value addition to Viet Nam's primary commodity exports;

- (iii) inadequate infrastructure and logistics for agriculture processing;
- (iv) the combined impacts of climate change, urbanisation and industrialisation continues to squeeze agriculture out of key resources such as land, water and labour;
- (v) agriculture income continues to be considerably lower than other sectors, discouraging investment and absorption of youth in agriculture; and
- (vi) the agriculture labour force is greying

The current phase of agriculture transformation requires a different set of policy options to address emerging challenges and build on future opportunities. Policy reform must go hand in hand with institutional innovation. Agricultural policy must be associated with the restructuring of the whole economy. As a result, the development of the agricultural sector would likely continue to be an important driver of the inclusive and sustainable development of Viet Nam.

1. Introduction

1.1 Methodology

Agricultural transformation is an important component of structural transformation and the relative neglect of agriculture in some countries may have caused economic stagnation and increased poverty rates (Timmer 1988, Timmer 2002, and Vos 2018). Agricultural transformation can be broadly defined as a process of transition over time of a farm system that moves in a direction from livelihood and farm orientation to more commercial, production and non-agricultural (Laborde *et al.*, 2018).

According to Timmer (2012), structural transformation follows an established pattern:

- In non-agricultural areas, there is a corresponding growth in specific urban, industrial and modern service activities.
- Workers migrate from rural to urban areas.
- The mortality rate decreases with the gradual decline in fertility and the rapid population growth period then indicates demographic transition.

For a more comprehensive discussion of agriculture transformation and the relevant theoretical underpinnings see chapters 1 and 2 in this publication.

In this study, we use a combination of methodologies to clarify how policies, legislation and institutional innovations play a role in promoting the economy in each transition stage. To illustrate the transformation of agriculture in each transition stage, we use different indicators to assess the contribution of agriculture to the economy, notably:

- The proportion of agricultural gross domestic product (GDP) in total GDP to show the percentage contribution of agriculture or the importance of agriculture to the economy.
- Agricultural labour productivity, calculated by dividing the agricultural value added to the number of employed workers at 15 years of age and above in agriculture, to reflect the efficiency of the sector in economic and social terms.
- The employment share in agriculture to show the sector role in creating job.
- The mechanization rate to represent the level of technical application in agricultural production and also the shift from labour-intensive production.

We also review the policy, legislation, and institution changes in each transition period to see how they facilitate or constrain agriculture transformation and withdraw lessons learned.

Agricultural transformation is a process of development through at least four distinct stages.

In each stage, the roles of public policies, strategies and investments are different (Timmer, 1988). The agricultural transformation stages as defined in chapters 1 and 2 are reflected in Viet Nam's transformation process as follows:

Getting agriculture moving: During this period, the average labour productivity per worker begins to increase and improved technologies are applied in agricultural production. In this stage, the policy options are usually price incentives for farmers to adopt new technologies and investment in rural infrastructure.

Viet Nam entered this stage in 1986, deciding to switch from a centrally planned economy to a market-oriented one. In the following years, owing to policies encouraging farmers to improve their productivity, Viet Nam turned from a food importing country into a rice exporter.

Moving labour out of agriculture: Labour tends to move into areas with higher labour productivity, leading to increasing rural-urban inequality.

Viet Nam reached this stage in 2001, when its agricultural labour force peaked at over 25 million workers. It has started to narrow since then.

Agriculture as a contributor to growth: The surplus value generated in the first stage is invested in non-agricultural sectors, enabling workers to move from agriculture to other sectors. The main policies during this period focus on diversification of agricultural production to match market demands and enhanced rural household participation.

Viet Nam entered this stage in 2010–2011 when the urban-rural income disparity significantly fell, even if the gap remained wide. Overall income inequality, as measured by the Gini coefficient, also began to decline.¹

Integrating agriculture into the macroeconomy: During this stage, the labour productivity gap between agricultural and non-agricultural sectors is narrowed. Resources are reallocated to sectors with higher returns. The main policies typically include establishing cross-sectoral and urban-rural linkages, enabling more efficient factor market operation, and minimizing the vulnerability risk of the agricultural sector.

Viet Nam is expecting to attain this stage in the near future as agricultural and non-agricultural productivity have been converging since 2018.²

Agriculture in industrial economies: In this period, the shares of agriculture in GDP and total employment drop to small proportions. The policies of concern are environmental and health issues, besides efforts to modernize agricultural production and maintain high farm incomes. Viet Nam has set a target of becoming an industrialized economy by 2030.³

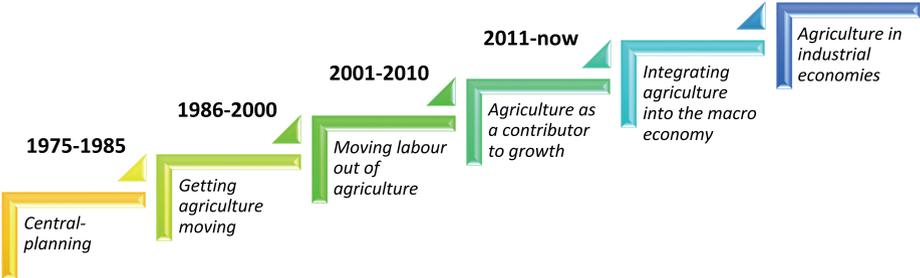
¹ Based on results of Viet Nam household living standard surveys every two years since 2002.

² Based on General Statistics Office (GSO) macro data. Sectoral productivity is proxied by sectoral GDP divided by the number of labourers in that sector.

³ According to Resolution No. 23/NQ-TW of the Politburo in 2018.

In this paper, we divide the agricultural transformation of Viet Nam into six stages as follows:

Figure 1. Stages of agricultural transformation in Viet Nam



Details of each stage are presented in section II on the key characteristics of Agriculture Transformation.

1.2 Data

This paper uses data from the General Statistics Office of Viet Nam (GSO), including the official statistics from the GSO website and publications. The GSO is under the Ministry of Planning and Investment and responsible for conducting statistical activities, surveys, and collecting and synthesizing socio-economic statistics. We use time series GSO data dated from 1986, different rounds of the Viet Nam Rural, Agricultural, and Fishery Census (AgroCensus), and the Viet Nam Household Living Standards Surveys (VHLSS).

The GSO conducted the first round of the AgroCensus in 1994, the second round in 2001, and the following rounds every five years. This is the national census on:

- agricultural production (production units, production means, support activities and other related information);
- fundamental changes in rural areas and rural population (households, labour and living standard, the status of rural socio-economic infrastructure); and,
- gender in agriculture and rural area (the role of women in agricultural production, education and technical skills, etc.).

Due to compatibility issues among survey rounds, this paper focuses on AgroCensus rounds from 2001–2016, which use quite similar questionnaires.

The GSO conducted the first round of VHLSS in 1993, the second round in 1998, and every two years since 2002. Each survey includes two main samples: The first is a household survey to collect information on household characteristics, income, expenditure and some other criteria to assess the living standards. The second is a commune survey to collect information on communal infrastructure, agricultural production, social and environmental security, etc. We use VHLSS data for the period of 2002–2018, which followed similar sampling and questionnaires.

We also use the World Development Indicators (WDI) of the World Bank (WB) and the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). We collect production and market data of some key products and the average agricultural land area per farmer from 1990 to 2014 from these sources.

1.3 Growth in non-agricultural sectors

Since the reunification in 1975, Viet Nam has recovered from the devastation of war to become a middle-income country. GDP has grown quite strong, especially since the reforms in 1986. In the era of central planning during 1975–1986, the GDP growth rate of the agricultural sector was higher than that of non-agriculture. In the later stages, the growth rate of the non-agricultural sector was significantly higher but much more volatile than that of the agricultural sector. However, the agricultural labour productivity growth was negative in the early stage due to the fast growth of the labour force, owing to young population structure and strong population growth in previous periods (more than 3 percent in the 1950s to 1970s).

During 2001–2018, the GDP growth rate in the agricultural sector was lower than that in the non-agricultural sector (negative gap). However, the labour productivity growth rate in the same period in agriculture was significantly higher than that of non-agriculture (positive gap). It could be said that in the later stages, agricultural labour productivity kept increasing thanks to stable agricultural GDP growth as well as recently accelerated labour transformation from agriculture to non-agriculture (Table 1).

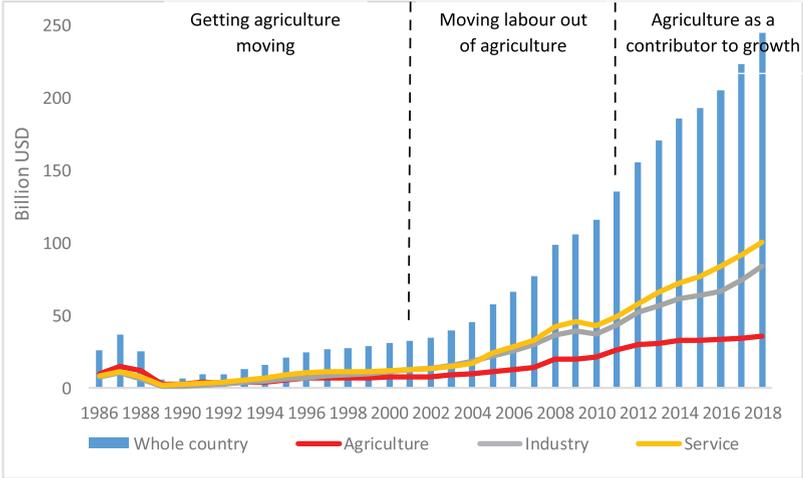
Table 1: Annual GDP and labour productivity growth in Viet Nam (%)

Stages	GDP growth rate			Labour productivity growth rate		
	Agriculture	Non-agriculture	Gap between sectors	Agriculture	Non-agriculture	Gap between sectors
	(1)	(2)	(1)-(2)	(3)	(4)	(3)-(4)
1976-1985: Central Planning	3.74	3.51	0.23	-1.16	1.84	-3.00
1986-2000: Getting agriculture moving	3.85	8.13	-4.28	2.20	4.07	-1.87
2001-2010: Moving labour out of agriculture	3.50	7.65	-4.15	3.97	-0.31	4.28
2011-2018: Agriculture as a contributor to growth	2.77	7.14	-4.37	5.36	3.20	2.17

Source: Authors' calculation from GSO data

During the 30 years of the economic reforms known as Doi Moi, Viet Nam has made strong progress in economic development. In 2018, Viet Nam’s GDP had increased by approximately eight times compared to that in 1986, exceeding USD 245 billion (Figure 2).

Figure 2. GDP by sector (in current Billions USD⁴)



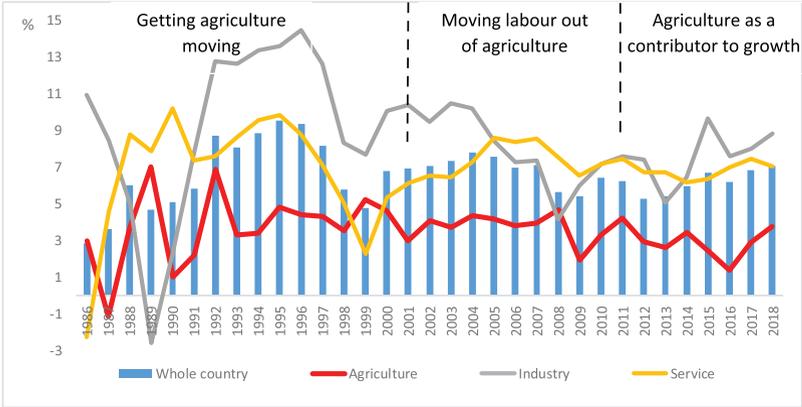
Source: Authors’ calculation from GSO data

The average annual GDP growth rate was 6.78 percent from 1986 to 2000, and reached 6.81 percent during 2001 to 2010. Specifically, the six-year period from 1992 to 1997 was a success in economic development with the GDP growth rates between 8 and 9 percent per year, along with strong growth of the industrial sector (13 to 15 percent per year). However, since 2011, the annual average GDP growth rate has fallen to 6.2 percent (Figure 3).

Industry’s growth rate was strongest from 1986 to 2000, averaging 9.08 percent per year, while the growth rate of the service sector was lower, at 7.43 percent. During the next two decades, the growth rate of the industrial sector slowed, converging with that of the service sector (Figure 3).

⁴ GDP values are in current billion dong, then converted into USD using the nominal exchange rates.

Figure 3. GDP growth rate by sector (%)



Source: GSO

Despite the impressive GDP growth of the last 30 years, Viet Nam still experiences some economic slowdowns. Hyperinflation occurred in the early 1980s and reached the 3-digit, 2-digit level until early 1990s. By that time, state-owned enterprises accounted for a major part of gross production but they could not sell their products. According to the GSO, there were over USD 0.26 billion (about 4.3 percent of total GDP) worth of products that could not be sold just in 1989. It is understandable as production followed central planning rather than market demand. As the products were left in stock, many enterprises had to reduce their production scale or go bankrupt, leading to unemployment. The growth rate slowed again in the late-1990s because of the impact of Asian financial crisis, and again in late 2000s due to the 2008 global financial crisis.

The two crises marked the end of the two agricultural transformation stages, when the role of the agriculture sector changed. It appears that each economic downturn drove the economy to the next stage of development. In the early-2000s, agricultural employment started to contract, while the sectoral growth rate remained between 3 and 4 percent per year, implying strong growth in agricultural labour productivity. In the 2010s, with agricultural restructuring and new rural development programmes, the sector moved towards a more modernized, higher value added with accelerated labour productivity, strengthening the foundation for the whole economy to grow. Fortunately, the agricultural sector has maintained its steady growth even during crises, contributing to economic stabilization (Figure 3).

1.4 Policy and institutional environment in the economy

Since 1986, Viet Nam has been successful in transforming from a centrally planned to a market-oriented economy. The transition was quite smooth, and the country achieved most of Millennium Development Goals ahead of schedule. During that process, the private sector gradually played a bigger role in economic development. Since the 1990s, international integration has resulted in an open economy. The value of international trade is almost double that of GDP, and the foreign direct investment (FDI) net inflow per year is more than 6 percent of GDP.

In 1986, during the getting agriculture moving stage, the 6th National Congress of the Communist Party of Viet Nam adopted key transformative policies, deciding to move to a multi-sector, open market-oriented economy. In 1987, the government passed the first FDI law. In 1989, Viet Nam introduced its first customs tariffs under the Law on Export and Import Duties, abolishing most state price controls and direct production subsidies. Private enterprises were allowed to engage directly in foreign trade.

In the early-1990s, the Company Law and Law on Sole Proprietorships formally acknowledge the right of private investors to do business, and established a legal framework for private registered businesses. The banking system moved from a one-to two-tier banking system, separating the functions of commercial banks from the state bank through the Ordinance for the State Bank of Viet Nam, and Ordinance for Commercial Banks, Credit Cooperatives and Financial Companies. Private commercial banks were allowed. A pegged exchange rate regime was introduced and two foreign exchange centres were established – the predecessor of the inter-bank foreign exchange market. In 1994, the government established Economic Courts and issued the Labour Code, protecting the rights of employees and employers, facilitating the regulation of contracts, creating social insurance and an arbitration mechanism. A milestone in Viet Nam's international integration took place in 1995 when it was admitted as a member of the Association of Southeast Asian Nations (ASEAN) and its free-trade area ASEAN-FTA (AFTA). That same year, the United States lifted its trade and investment embargo and announced a normalization of diplomatic relations with Viet Nam. In 1998, Viet Nam joined the Asia-Pacific Economic Cooperation (APEC). Value added tax (VAT) and corporate income tax (CIT) were introduced in the late-1990s.

In the stage of moving labour out of agriculture, the most prominent policy was the new Enterprise Law in 2000, which consolidated the Company Law and the Law on Sole Proprietorships. This simplified the procedures for new enterprise registration, leading to soaring numbers of new private-sector businesses and non-farm jobs. And the ratification of the US-Viet Nam Bilateral Trade Agreement (BTA) contributed to the strong growth of exports. The base interest rate scheme replaced the ceiling on lending interest rates. In 2007, the World Trade Organization admitted Viet Nam as its 150th member. This paved the way for Viet Nam's exports to international markets, including its agricultural exports.

In 2010, Viet Nam entered the stage of agriculture as a contributor to growth. International integration accelerated with a range of free trade agreements with Chile, Korea, the Eurasian Economic Union (Russia, Armenia, Belarus, Kazakhstan and Kyrgyzstan), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), and the EU-Viet Nam FTA. The government launched a restructuring programme with an emphasis on banking, state-owned enterprises, and public investment. In 2017, Viet Nam's total agriculture export value reached USD 36.4 billion, an increase of over 14 times compared to 1995 when it joined ASEAN. The average export growth rate was 12.9 percent per year during that period. Currently, Vietnam is in the top 20 major agricultural, forestry and fishery exporters in the world. Ten of its agricultural products for export have achieved an annual turnover of over USD 1 billion.

The roles of education and training, and a stable macro-environment should be recognized as basic factors contributing to Viet Nam's achievements. Education is a priority development focus of Viet Nam. Since independence in 1945, President Ho Chi Minh designated illiteracy as an enemy, together with hunger and invaders. Social investment in education has produced a high literacy rate. Among those aged 15 and above, literacy has increased from over 80 percent in 1975 to more than 90 percent in 2000 and 95 percent in 2018, which is 8.7 percent higher than the world average.

Under the “agriculture, farmer, rural development” policy of the last 10 years, the government has invested in vocational training for about 6 million rural labourers in a programme known as Scheme 1956. Following that programme, the government allocated additional funds to sponsor training for rural labourers providing up to VND 3 million per one training course. After the vocational training, rural labourers would be eligible for loans from the National Employment Fund under the National Target Programme on Employment to start up their own businesses.

After more than 30 years of reform, however, the economy still lacks a competitive private sector. Markets for key inputs (land, labour, capital) suffer from inefficiencies. Viet Nam is an upstream contributor to global value chains, earning only a modest share of the value added. Economic development is mainly concentrated in the big cities, leaving rural areas poorly integrated and underinvested.

In such an environment, Viet Nam has transformed itself from a net food importer in 1970s and 1980s to a leading world exporter of many agricultural commodities since the 1990s. This was achieved by interventions to encourage agricultural production through de-collectivization, land-use rights granted to farmers, and opening input and output markets. Directive 100 in 1981 initiated an output-contracting scheme for farmers, allowing them to keep output in excess of the contracted amount. Resolution 10 in 1988 acknowledged each household as an autonomous agricultural production entity, which is considered a bottom-up reform encouraging households to engage in free enterprise. A series of land tenure laws in 1988, 1993, 2003, 2013 gradually secured long-term property rights for farmers and enabled a land market to emerge, helping the capitalization of agricultural land.

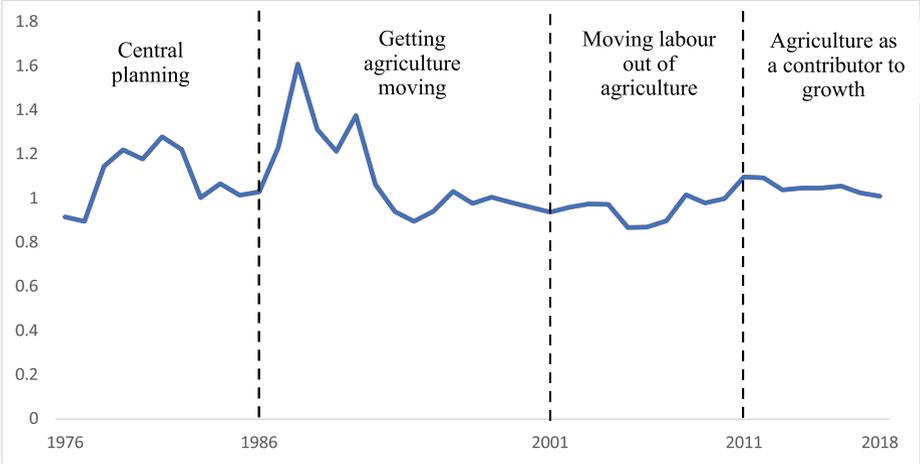
Viet Nam decided to exempt half of the agricultural tax duty for all agricultural production units in 1990 and 1991. This was touted as a reward to farmers for their contributions during the war for independence, and done in honour of the late President Ho Chi Minh. Along with other public policies, this seems to have had positive impacts on agriculture production and productivity, evidenced by significant net agricultural commodity exports, which continues to this day. From 2010 to 2017, households in agricultural areas were exempted from the agricultural land use tax if their size was within the specified range (as defined in the Land Law). Building on the success of earlier land tax policies, the government has exempted all agricultural land areas from the land use tax since 2017. This was part of the government's efforts to bridge the rural-urban income divide and to further propel agricultural productivity. Critics suggest that the blanket land-use tax exemption may discourage the efficient use of

land – individuals might retain agricultural land as a form of savings or investment at no cost rather than putting it to productive use.

One of the most important policies in recent years is the Tam Nong policy enacted in 2008, which places agriculture, rural areas and farmers at the centre of the industrialization and modernization process. The government has institutionalized the policy through the Agricultural Restructuring Programme in 2013, the National Targeted Programme of New Rural Development, sectoral strategies, and 5-year plans.

The macroeconomic conditions for agricultural development could be reflected in the terms of trade and the exchange rate. When terms of trade are greater than 1 it means that agricultural products have a price advantage over non-agricultural ones. Terms of trade are most favourable to agricultural products in the first half of the “getting agriculture moving” stage (and agricultural GDP growth is the strongest), and least favourable in the “moving labour out of agriculture” stage (Figure 4).

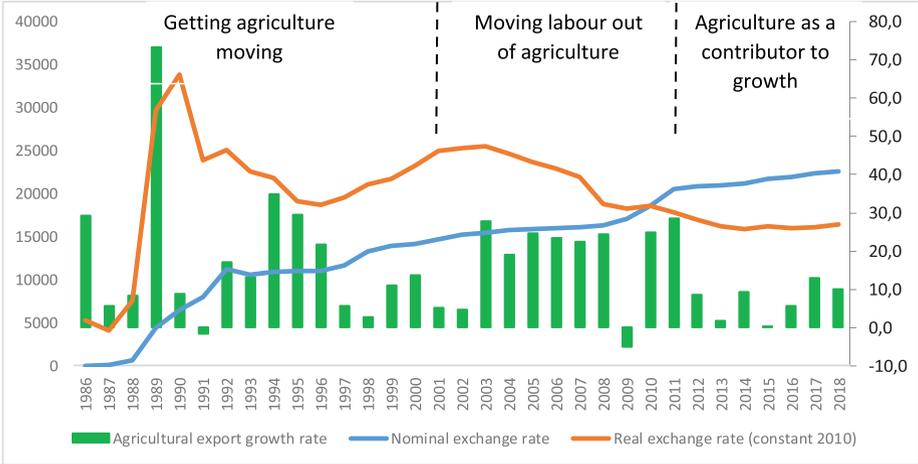
Figure 4. Agriculture versus non-agriculture terms of trade from 1975 to 2018



Source: Authors’ calculation from GSO data

Nominal exchange rates have kept increasing. However, an examination of real exchange rates shows two periods of local currency devaluation in 1990–1996 and 2003–2014. Agricultural exports seem to benefit from Viet Nam’s weak currency as their growth rates in these two periods was relatively high. Since 2010, the nominal exchange rate has been higher than the real one, along with the build-up of foreign exchange reserves. The rising value of agricultural exports contributed to the strong agricultural GDP growth in these periods (Figure 5).

Figure 5. Exchange rate and agricultural export growth from 1986 to 2018



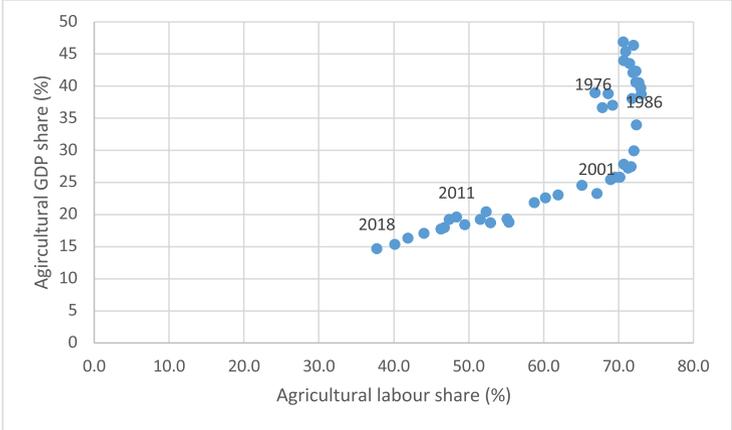
Note: Nominal and real exchange rates are on the left-hand side (in VND/USD) and the agricultural export growth rate is on the right-hand side (in %)

Source: Authors' calculation from WDI data

2. Agriculture transformation: key characteristics

The agricultural sector in Viet Nam has moved towards reducing the proportion of agricultural GDP in total GDP together with reducing the proportion of agricultural labour in the total labour force. In the early years of the Doi Moi reforms, the agricultural sector accounted for a substantial proportion of GDP, about 40 percent. This share has fallen by about two-thirds to roughly 15 percent. The average annual growth rate of agriculture's share in GDP from 1976 to 2018 was 2.3 percent, while that of agriculture's share in the labour force was about -1.3 percent. However, agriculture's falling share in the labour force has been accelerating since 2001 (Figure 6).

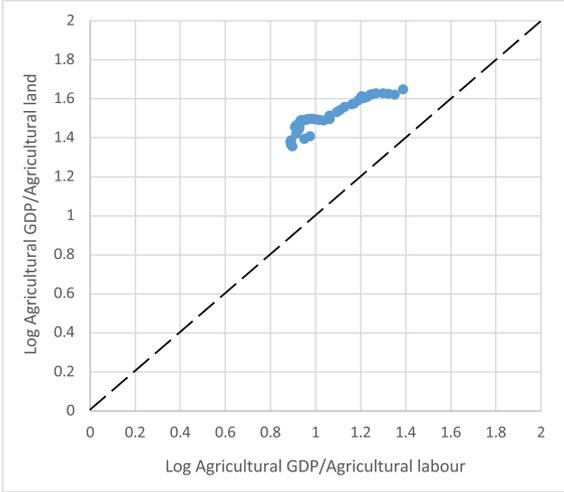
Figure 6. Share of agricultural in labour and GDP (%)



Source: Authors' calculation from GSO data

The Asian path requires strongly rising land productivity in early stages to cope with small farm size and rapid growth in population, but eventually labour productivity grows rapidly as the rest of the economy absorbs rural workers and raises wages (Timmer, 1988). Agricultural labour productivity of Viet Nam has been transformed in a similar way (Figure 7).

Figure 7. Pattern of change in agricultural land and labour productivity in Viet Nam



Note: Productivity measures are in current value
 Source: Authors’ calculation from GSO data

Currently, Viet Nam is entering the fourth stage of the agricultural transformation process. Following are the main characteristics of the four stages that Viet Nam has experienced (Table 2).

Table 2: Characteristics of agricultural transformation stages in Viet Nam

Stages of agricultural transformation	Key characteristics
Stage 1. Central planning. 1975-1985	High and increasing share of agriculture in total GDP and total labour force, low agricultural labour productivity, low and decreasing agricultural land productivity, net food import
Stage 2. Getting agriculture moving. 1986-2000	Strongly decreasing share of agriculture in total GDP but slowly decreasing share of agriculture in total labour force, increasing agricultural land productivity, technological application, starting rice export
Stage 3. Moving labour out of agriculture. 2001-2010	Labour transformation from agriculture to non-agriculture, the absolute number of agricultural labourers starting to decline, accelerating agricultural labour productivity, increasing agricultural land productivity, increasing inequality
Stage 4. Agriculture as a contributor to growth. 2011- present	Relatively small share of agriculture in total GDP and total labour force, fast labour transformation and agricultural labour productivity growth, slowly increasing agricultural land productivity, more diversified agricultural production, strong growth of agricultural export, inequality in control

Source: Authors’ compilation

i) *Stage 1. Central planning (1975–1985)*

Following reunification in 1975, Viet Nam attempted to extend the central planning system, especially large-scale agricultural collectivization, to the whole country (Kerkvliet, 1995). In this period, collective agriculture performed poorly; farmers lack motivation to produce. The Government of Viet Nam had to import grain because of sharply falling food stocks. Food production per capita was 274.4 kg/person in 1976 and decreased to 238.5 kg/person in 1978. From 1976 to 1980, Viet Nam had to import 1.12 million tonnes of food grains per year. During the first half of 1980s, food production per capita slowly increased to just below 300 kg/person food grain imports shrank to 200 000 tonnes per year. The average rice yield was only about 2 tonnes/ha. Viet Nam faced an economic crisis in the early-1980s.

ii) *Stage 2. Getting agriculture moving (1986–2000)*

In 1986, Viet Nam launched a political and economic renewal campaign called Doi Moi. Since then the country's economy has experienced remarkable changes. Doi Moi was a key milestone of the getting agriculture moving stage (1986–2000). During this period, agricultural labour productivity increased by 2.2 percent per year. The share of agriculture in GDP decreased from 38.1 percent in 1986 to 24.5 percent in 2000. The share of agriculture in the total labour force was stagnant at a high level: 68.6 percent in 1991 and 65.3 percent in 2000. Food production per capita increased steadily, reaching 310 kg/person. Viet Nam became a net rice exporter in early 1990s with an average annual total export volume of 3.6 million tonnes between 1990 and 2000. Rice exports peaked in 2012, reaching 8 million tonnes.

iii) *Stage 3. Moving labour out of agriculture (2001–2010)*

In this period, Viet Nam's agricultural labour productivity increased faster than in the previous stages, with the average annual growth rate approximately 4 percent, and reaching VND 16.3 million per person in 2010. Mechanization and strong labour transformation were the main reasons. The proportion of agricultural in total GDP continued to decrease, falling to 18.4 percent in 2010. Agriculture's share in the total labour force decreased at an average rate of 3 percent per year, from 64.0 percent in 2001 to 48.3 percent in 2010. The agricultural labour force slightly declined from 25.3 million people to 24.3 million people in 2001 and 2010, a rate of 0.5 percent per year.

iv) *Stage 4. Agriculture as a contributor to growth (2011–present)*

In 2011, Viet Nam entered the fourth stage of the agricultural transformation process with agriculture gradually contributing to economic growth. The average agricultural labour productivity increased to 5.4 percent during 2011–2018, and reached VND 24.5 million per person in 2018. Agriculture's share in GDP fell faster than in the previous period. By 2018, it was 14.7 percent, which was 5 percent lower than in 2011. The share of agriculture in the total labour force was 39.8 percent in 2018, down by nearly 9 percent compared to 2011. Owing to the strong growth of the non-agriculture sector, agricultural labour was attracted to non-agriculture, and recently the share of agriculture in the total labour force has been falling faster than the share of agriculture in GDP.

3. Drivers of agriculture transformation

3.1 Policies and legislation

The process of transformation from central planning to a market-oriented economy has been challenging. Viet Nam's achievements have been encouraging. Agriculture development has been credited with creating the basis for social stability and economic growth. Reforms in agriculture began with Directive 100 in 1981, which helped to revive the rural economy and created a larger volume of agricultural products than in the previous period.

In 1988, the Politburo of the Central Committee of the Communist Party of Viet Nam issued Resolution 10 on reforming agricultural management. This resolution allowed farmers to receive at least 40 percent of contracted production, encouraging farmers to invest in production and improve productivity. This was one of the most important policies that helped Viet Nam to become a rice exporter by 1989. Cooperatives were limited to the roles of trading (mainly inputs) and providing services (irrigation, plant protection, extension) to farmers. Many cooperatives simply disappeared in the wake of this measure. It not only recognized the significance for farmers of more secure tenure over the land, it also eliminated the two-tier price system in agriculture once and for all, essentially by eliminating the system of compulsory state procurement of output (FAO, 2006).

The Five-Year Plan of 1986–1990 set up three programmes to increase the production of food, consumer goods and exportable items for socio-economic development. The Five-Year Plan of 1991–1995 considered agricultural development as the prerequisite for industrialization and the modernization of the whole economy. It set specific development targets for the agricultural: (i) develop toward commercialization and associate with the processing industry; (ii) improve agricultural production to not only meet domestic consumption needs but also boost exports; and (iii) promote the country's strengths and protect the environment and natural resources. In stage 2, little attention was paid to sustainability and the role of the agricultural sector in improving rural income and alleviating poverty. By 2000, average rural income was approximately VND 3 million (about 210 USD) per year. The rural poverty rate was about 40 percent.

In Stage 3, the focus gradually switched from economic to social and environmental targets. Agricultural development was linked to rural development. Privatization of state-owned enterprises and reform of state-owned farms began. However, there was a lack of policies to develop private enterprises and industrial clusters, facilitate labour transformation, and provide vocational trainings in rural areas.

In 2008 the government issues a comprehensive set of policies through a resolution (Tam Nong) to support farmers and facilitate agriculture and rural development. This resolution was highly ambitious in many ways and indicated commitment with action plans, including: (i) Building a coherent agriculture modernization, and at the same time developing industry and services in rural areas. (ii) Building rural socio-

economic infrastructure in association with urban development. (iii) Improving rural life, especially in disadvantaged areas. (iv) Innovating and building effective forms of production and services in rural areas. (v) Facilitating research, transfer and application of science and technology in agricultural production, and improving human resources to accelerate agricultural modernization and rural industrialization. (vi) Renovating mechanisms and policies to utilize resources, quickly develop the rural economy, and improve farmers' lives. (vii) Promoting the strength of socio-political organizations in rural areas, especially the farmers' union. By 2010, average annual rural income reached nearly VND 13 million (approximately USD 690) per year. The rural poverty rate dropped to 17.4 percent.

In 2010, the Prime Minister approved the national target programme on New Rural Development 2010–2020. This programme aims to build a new countryside with modern socio-economic infrastructure. This includes a conducive economic structure and production organization, associating agriculture with the rapid development of industry and services. It includes associating rural development with urban planning. It calls for assuring a democratic and stable rural community deeply imbued with national cultural identity. And it aims for protecting the environment, maintaining security and order, and raising people's material and spiritual lives along the socialist orientation. This is an extensive social campaign on rural development at different levels.

In 2012, the Prime Minister approved the master plan on agricultural production development through 2020 with a vision towards 2030. This plan aims to build an agricultural sector that develops comprehensively toward modernity, sustainability and large-scale commodity production based on comparative advantages. It calls on the sector to apply science and technology to increase productivity, quality, effectiveness and competitiveness to ensure food security in the short and long term and satisfy domestic and export demands. The plan calls for increasing the effectiveness of land use, water, labour and capital, and for raising incomes and improving living conditions for farmers, fishermen, salt producers and foresters.

In 2013, the Prime Minister approved the Agricultural Sector Restructuring Project. Its overall goal was to increase added value and sustainable development. The project also aimed to sustain the growth; improve efficiency and competitiveness by raising productivity, quality, and added value. It sought to satisfy consumer demands and boost exports. It was designed to raise the income and improve the living standards of rural residents, ensure food security (including nutrition security) in the short term and long term, and contribute to reducing poverty. The project was also intended to enhance natural resource management, reduce greenhouse gas emissions and negative impacts on the environment, utilize environmental benefits, raise capacity for risk management, and enhance disaster preparedness. The project has provided a general orientation for each pillar of socio-economic and environmental sustainability, and specific sub-sectors. The Ministry of Agriculture and Rural Development (MARD) has developed six restructuring projects to concretize the content, solutions and roadmap of restructuring in each specific sector. These sectors include cultivation, livestock, forestry, aquaculture, irrigation, agroforestry, fisheries and salt processing (IPSARD, 2018).

Since the government launched the restructuring project, it passed nine laws related to agriculture, including decrees on attracting enterprise investment into the sector, on agriculture insurance, on developing linkages, on organic agriculture, and on agricultural finance.

3.2 Farm mechanization

Farm mechanization is an essential agricultural input with the potential to transform rural families' livelihoods by facilitating increased output of higher value products while eliminating the drudgery associated with human muscle-powered agricultural production (Sims, B. Hilmi, M. and Kienzle, J. 2016).

In the central planning stage, farmers mainly used cattle for ploughing, and agricultural machinery was largely used to prepare land for growing rice. In 1976, Viet Nam had more than 1.8 million buffaloes and cows used for ploughing in agriculture. The number increased to about 2.7 million in 1985, an average growth rate of 4.5 percent per year. There were about 18 000 tractors in 1976 and 31 000 in 1985, but these tractors were old models with low capacity. Post-harvest machinery only included rice threshing machines, which numbered about 18 000 in 1976 and nearly 40 000 in 1985. On average, during 1975-1985 (S1), the number of tractors was 24 491 and the number of rice threshing machines was 27 401 (Table 3).

During the stage of "getting agriculture moving," agricultural machinery was more diverse, but still used mostly for land preparation. The number of tractors increased rapidly. The number of tractors in 1994 was three times that in 1985 with an average annual growth rate of 14.1 percent. However, small tractors dominated, numbering three times that of large tractors. The percentage of cropland under mechanization was 33.8 percent in 1994. In the Mekong River Delta, it reached 64.2 percent. For post-harvest mechanization, only rice milling and threshing machines were in use, numbering about 100 000 each in 1994. On average, during 1986-2000 (S2), the number of tractors was 103,929, of which 75 286 were small and 28 643 were medium-large sized tractors. In the same period the number of rice threshing machines was 97 808 (Table 3).

From 2000 onwards, especially after the implementation of the Tam Nong policy, the speed of agricultural mechanisation development increased rapidly. More farmers were using large and complex machines. The number of heavy and medium tractors was half the number of small ones. This trend supported the transformation towards commercialized production. More types of machines were available for agricultural production, such as sowing machines, combine harvesters and food processing machines. On average, the number and types of agricultural machinery during 2001-2010 (S3) was higher than the preceding two 15 years (S2), except for diesel engines (Table 3). However, the mechanization rate was still low, there was a large difference between rice and other crops, and across production stages such as land preparation, planting, tending, harvesting, etc. (Bach, Q. K., 2016). There were also differences among regions. For example, the number of heavy tractors (over 35 CV) in the Mekong Delta was eight times higher than that of the Red River Delta. Similar gaps were also observed in machinery for fisheries (AgroCensus).

Most policies and legislation on agricultural mechanisation in Viet Nam have only been issued relatively recently. In 2009, the government adopted a policy that supported 100 percent of the interest rate for a maximum of 24 months on loans for agricultural machinery with the maximum loan amount equal to 100 percent of the value of goods. Machinery and equipment, such as combine harvesters and tractors, were being produced domestically by that time. Another policy allowed maximum loan interest rate support of 24 months for machinery, mechanical equipment, and transportation mainly for agricultural processing. In 2010, the government adopted measures to reduce post-harvest losses of agricultural and fishery products.

From 2011 onwards (S4), the total number of most machines increased. The exception was rice mowing machines with engines, of which the average number decreased by about half. They were replaced by modern machinery such as combine harvesters and other harvesters for more use and productivity (Table 3). From 2011 to 2019, the number of tractors increases by 48 percent, combine harvesters by 79 percent, and agricultural dryers by 29 percent. The domestic machine industry produces engines and tractors with a capacity of up to 30 horsepower, accounting for over 30 percent of the domestic market share. There were 7 803 enterprises and nearly 100 establishments manufacturing agricultural machines and equipment. The mechanization rate in agricultural land preparation has reached 94 percent and in the sowing and planting stages has reached 42 percent (MARD, 2020).

Table 3: The average number of machines by transformation stage

Indicators	S1	S2	S3	S4
<i>Pre-harvest</i>				
Tractors	24,491	103,929	314,386	774,813
- Small tractors		75,286	218,773	452,083
- Heavy, medium tractors		28,643	95,613	322,730
Electrical engines		90,881	301,486	928,269
Diesel/petrol, diesel engines		346,011	329,761	626,808
Water pumps for agriculture, forestry, and aquaculture		537,809	1,800,000	3,303,086
Sowing machines				28,094
Blade plough				436,737
Harrow/tiller				486,802
Furrowing/grubbing				9,679
Motorized insecticide sprayers			98,089	1,772,205
<i>Post-harvest</i>				
Rice mowing machines with engine	27,401	97,808	576,242	278,187
Combine harvesters				25,728
Other harvesters				188,997
Corn threading machine				94,546
Peanut peeling machine				2,936
Coffee husking machine				113,779
Dryers, ovens for agriculture, forestry, and aquaculture			67,863	80,061
Animal food processing machines (crushing, ⁵ mixing, sorting...)	2,030	15,157	36,760	137,173
Grain processing machines (milling, ⁶ polishing, sorting...)		106,305	236,428	248,539
Aquaculture food processing machines (crushing, mixing, pressing, extruding...)			10,291	14,217

Note: S1 – Central planning, S2 – Getting agriculture moving, S3 – Moving labour out of agriculture, S4 – Agriculture as a contribution to growth

Source: AgroCensus data & GSO data

The share of rural households that own agricultural machinery has increased slightly but the overall agriculture mechanisation remains significantly low. The share of rural households owning small tractors in 2001 was 1.34 percent; in 2016, this increased slightly to 2.2 percent. For heavy and medium sized tractors, the number is even lower. Only water pump ownership rate increased significantly, to 15.4 percent in 2016 (Table 4). Most households rent agricultural machinery because they cannot afford to buy and it might be more efficient to rent given their small production scale. At present, agricultural machinery rental services in many localities have been developing, mostly by private entrepreneurs and less by cooperatives or farmer groups.

Table 4. Share of rural households that own different type of machines (%)

	2001	2006	2016
Small tractors	1.34	1.8	2.2
Heavy and medium tractors	0.41	0.82	1.0
Water pumps for agriculture, forestry and aquaculture	7.65	11.5	15.4
Rice mowing machines with engine	3.83	4.03	1.8
Dryers, ovens for agriculture, forestry and aquaculture	0.03	0.41	0.3
Milling machines	1.77	1.6	1.2
Animal food processing machines	0.1	0.26	0.7
Aquaculture food processing machines	0.03	0.06	0.1
Motorized insecticide sprayers	0.3	0.67	8.4
Motorized fishing boats	0.92	1.54	0.5
Non-motorized fishing boats	2.25	0.09	1.1

Source: Authors' calculation from AgroCensus data (GSO)

The mechanization level is higher in land preparation, tending rice and sugarcane, and rice harvesting. The level of mechanization is still low in tending fruit trees, and harvesting sugarcane and coffee. Particularly in the forestry sector, 70 percent of the workload is still manual, and the mechanization rate is very low (2–5 percent) in planting, tending, fire fighting and handling (MARD, 2020). The level of agriculture production mechanisation in Viet Nam is only 1.4 horsepower per hectare (HP/ha), much lower than that of Thailand (4 HP/ha), China (8 HP/ha) and South Korea (10 HP/ha). Viet Nam imports 70 percent of its machinery and equipment for agriculture, mostly from China (60 percent), Japan and South Korea (MOIT, 2020).

3.3 Technological progress

In the “central planning stage” and the first half of the “getting agriculture moving” stage, agricultural growth relied on exploiting natural resources and labour input. In the second half of the “getting agriculture moving” stage (1994 to 2000), the agricultural growth rate was at its record (4.5 percent per year). TFP made a small but positive

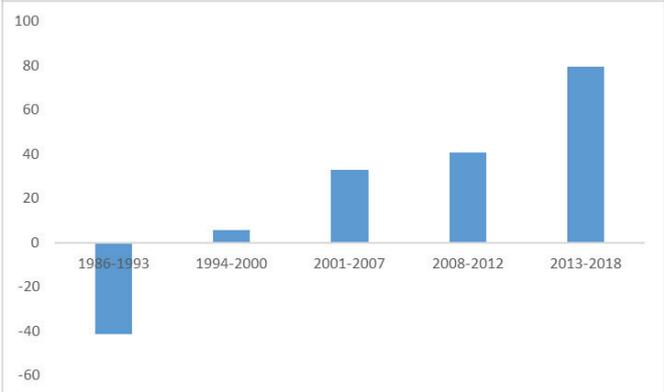
contribution to growth. This was mostly owing to improving farmers’ efficiency through more effective use of inputs rather than technical change (IPSARD, 2015).

In the “moving labour out of agriculture” stage, the agricultural growth rate slowed but the contribution of TFP improved. The sector gradually switched from “extensive” to “intensive” growth, especially after the Tam Nong policy. Before Tam Nong, the focus was on increasing yields: from 2000 to 2007, the whole year yields for rice increased by 0.75 tonnes/ha, maize increased 0.95 tonnes/ha, soybeans by 0.25 tonnes/ha, coffee by 0.4 tonnes/ha, milk production with crossbred cows increased from 3 to 3.9 tonnes/cow/cycle of 10 months (MARD, 2008).

In the early years of implementing the Tam Nong policy (2008–2012), TFP contributed to more than 40 percent of the sector’s growth (MARD, 2008), thanks to improving public investment in science and technology. Identifying innovation as a key solution, in 2014, MARD developed a plan to promote science and technology research and application to restructure agriculture towards higher added value and sustainable development. The plan focused on high tech application⁵ and intensive processing and post-harvest preservation. The contribution of TFP in agricultural growth accelerated in this stage.

In general, TFP’s contribution to Viet Nam’s agricultural growth tended to increase gradually over the years. During 2013-2018, this contribution was much larger at about 80 percent, twice as much as during 2008-2012 (Figure 8).

Figure 8: Contribution of TFP in Viet Nam’s agricultural growth (%)

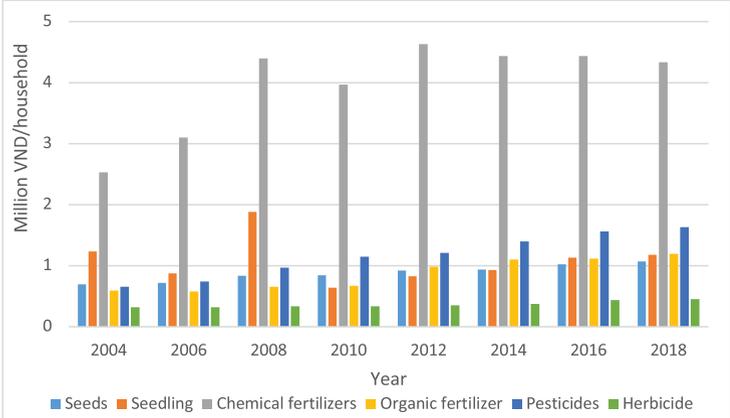


Source: IPSARD 2015 and authors’ estimates from GSO data

⁵ The Prime Minister issued Decision 575/QĐ-TTg in 2015 approving the Master Plan of hi-tech application zones and areas to 2020, and orientation to 2030, supplemented by Decision 694/QĐ-TTg in 2017. Then MARD issued Decision 738/QĐ-BNN-KHCN in 2017 approving criteria for identifying high technology application programmes and projects, clean agriculture, high technology applied in agriculture; Decision No. 5171/QĐ-BNN-KHCN approving the plan to promote research and technology transfer for agricultural restructuring in association with new rural construction in the period 2018–2025 with priorities for scientific research.

As agricultural production intensifies, the costs of seeds, seedling, chemical fertilizers, organic fertilizers, pesticides and herbicides for crop production tend to increase. The abuse of chemical fertilizers may entail more costs than their benefits for crop production. The average cost of chemical fertilizers per household has increased steadily and its value in 2018 of VND 4.34 million per household was 1.7 times higher than the VND 2.53 million per household in 2004 (Figure 9).

Figure 9: Average crop production cost 2004–2018 (2010 prices)



Source: Authors’ calculation from VHLSS data

The proportion of investment in research and development (R&D) in the agricultural GDP of Viet Nam is lower than other countries in the region such as China, Indonesia, Malaysia, Philippines and Thailand. In 1996, the share of R&D investment in agricultural GDP was about 0.1 percent, which increased to about 0.2 percent in the 2000s (Stads, G.J. 2015). In 2017, Viet Nam’s total spending on R&D as a share in agricultural GDP was only higher than Indonesia’s and lower than that of Cambodia, Malaysia, and Thailand (ASTI, 2020).

Even with low investment, agricultural research in Viet Nam has still achieved much in breeding, intensification technologies, and irrigation. The number of published journal articles increased from 76 to 764 between 2000 and 2017 (ASTI, 2020).

Science and technology provide solutions to develop green agriculture, smart agriculture with high added value, and reduce adverse impacts on the environment. Viet Nam has issued several policies to apply science and technology and high technology in agriculture and development, promote high-tech agricultural enterprises and models. High-tech enterprises enjoy the most preferential rates on land, taxes and tariffs, and receive support for research and technology transfer, vocational training support, and soft loans.

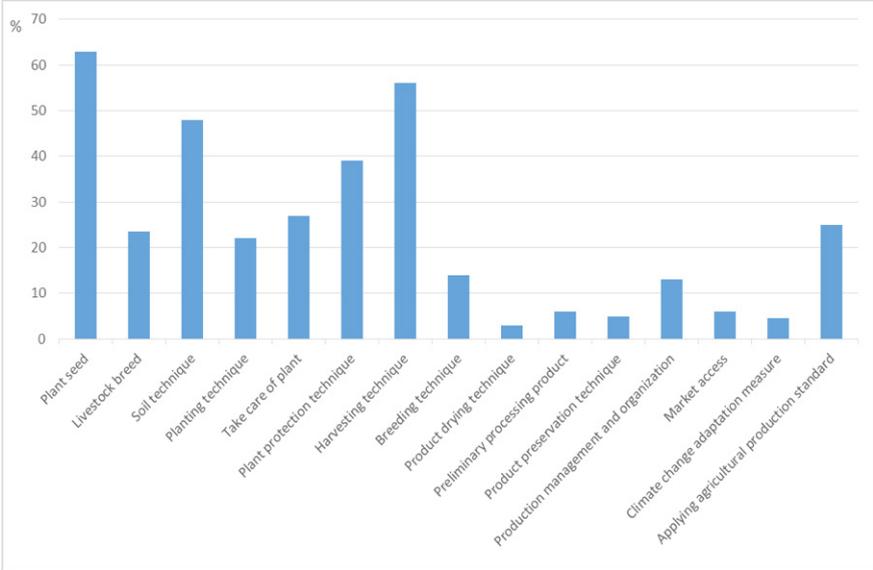
However, agricultural enterprises have difficulty in mobilizing funding, and their innovation capacity is weak. Conditions for accessing the state's preferential credit for science and technology and high-tech enterprises are considered too strict. According to a survey of 200 enterprises by IPSARD (2015), the share of enterprises gaining access to credit for purchasing equipment was only 3 percent. A few competition-promoting processes have been applied in research budget allocations to encourage research institutes to be more autonomous, responsive, and ensure high marketability. The process of reforming agricultural research is still at an early stage.

Recently, there has been some improvement. With the agricultural restructuring programme, the targets shifted from productivity and output to quality and value added. The ST rice strain made the world top three for three consecutive years in 2017, 2018, and 2019, and ST25 rice was honoured as the world's best rice in 2019. The programme to support the establishment, management, and development of intellectual property for local specialties in the form of geographical indications, certification marks and collective marks, has contributed positively to raising product value. The agribiotechnology programme includes experimental projects and production projects for the fields of agriculture (forestry, livestock), veterinary science, and microbiology (enzyme, aquatic biotechnology). Thanks to the technical application, the output value per hectare of arable land in 2018 reached VND 91.9 million, an increase of about VND 19.1 million from 2012.

According to the Ministry of Agriculture and Rural Development, many talented Vietnamese farmers have invented products that engineers respect, such as Cao Phat's automatic spraying and irrigation system in Can Tho City. This system reduced labour costs for irrigating 0.8 hectares of tangerines from nearly VND 300 000 to VND 2 000, can be completed in 10 minutes and controlled by a mobile phone. The washing, sorting, drying and polishing machines for tomatoes invented by farmer Nguyen Hong Chuong in Lam Dong province have been exported to Malaysia, Taiwan, Laos, Cambodia, Singapore and other nations. The useful inventions of farmers come from their practical experience, along with research and learning on the internet. They all aspire to find new cultivation methods, new applications to free up labour, and reduce production costs. The government has acknowledged those farmers and has licensed their inventions.

Recognizing the key role of extension in promoting science and technical applications in agriculture, the government has issued decrees on agriculture and fishery extension. The extension service focuses mainly on the selection of plant varieties, harvesting techniques, soil preparation and plant protection. The percentage of households trained in technical advances ranges from 40 percent to 60 percent. Fewer households, 20–30 percent, have received training and technical assistance in selecting livestock breeds, planting techniques, tending crops, and applying agricultural production standards (Figure 10). Drying techniques, pre-processing, product storage, market access and climate change adaptation measures have not been disseminated to many households. Just 4–8 percent of households have been trained in these techniques (IPSARD, 2015).

Figure 10. Share of households participated in agricultural training and technical transfer (%)



Source: IPSARD 2015

The market for agricultural science and technology in Viet Nam is underdeveloped. The transactions of technology and the dissemination of research results are still limited due to the lack of actors and necessary regulations. The number of suppliers is limited, as public research institutes do not have incentives to participate, while enterprises do not want to invest. Soft and hard infrastructure for the operation of the market is inadequate, including regulations governing intellectual property, trading floors, etc.

3.4 Agrifood value chain development

In Viet Nam, the agriculture value chain wasn't mentioned much before 2000. The value chain includes production and business activities from input, production, collection, processing, and sales. These activities have a close relationship with each other that cannot be ignored in developing the value chain, as well as the relationship between stakeholders in each activity (Nguyen, D. A. T., Atkinson, G. and Nguyen, T. B. H., 2019).

The government issued value chain development orientation in the Agricultural Restructuring Programme and its 2017 action plan, as well as in the national targeted programme on New Rural Development in 2016. Policies encourage the development of agricultural production and consumption linkages⁶ and to for enterprises to invest in agriculture and rural areas.⁷

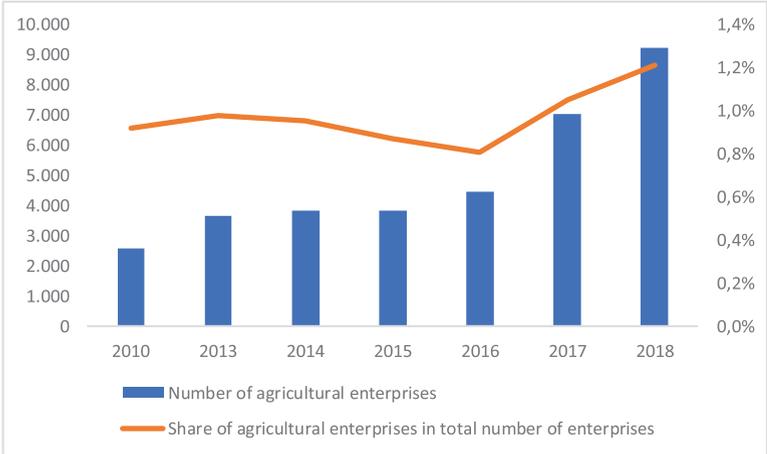
⁶ Decision No. 80/2002/QĐ-TTg on contract farming in 2002, Decision No. 62/2013/QĐ-TTg on large fields in 2013, Decree No. 98/2018/NĐ-CP on linkage development and Decree No. 116/2018/NĐ-CP on agriculture credit in 2018
⁷ Decree No. 61/2010/NĐ-CP in 2010, Decree No. 210/2013/NĐ-CP in 2013, Decree No. 57/2018/NĐ-CP and Circular No. 04/2018/TT-BKHD in 2018

Linkages in agriculture production and consumption are strongly developed with large field models with connections between enterprises and agricultural cooperatives. By 2007, enterprises engaged in contract farming for up to 10 percent of rice output, 80 percent of sugarcane output, 70 percent of tea output, etc. (MARD, 2008). By the end of 2016, 48 out of 63 provinces had built 2 262 large fields, mostly concentrated in the Red River Delta and the Mekong River Delta. Fields mainly used for rice production numbered 1 661, equal to 73.4 percent). According to an IPSARD survey in 2017, in the Mekong River Delta, rice farmers in large field models could reduce production costs by 10 to 15 percent and increase output by 20 to 25 percent, resulting in an additional profit of VND 2.2 to 7.5 million per hectare.

If they join a large field model, producers are eligible for contract farming, which hedges against price volatility, reduces input costs, and can receive technical support from enterprises in the model. Enterprises have a stable supply of raw materials with guaranteed quality and savings on logistics costs.

Agricultural enterprises are expected to lead agricultural value chains and integration into global value chains. However, the number of agricultural enterprises is relatively small and most of them are small and medium enterprises. A trend appears to be emerging of large corporations investing in agriculture, especially in high-tech agriculture production. The number of agricultural enterprises has increased sharply in recent years. There were three times more agriculture enterprises in 2018 compared with 2010. However, the share of agricultural enterprises in the total number of enterprises is still very low at about 1 percent in 2010 and 1.2 percent in 2018 (Figure 11).

Figure 11. Agricultural enterprise development



Source: Authors’ calculation from GSO data

Viet Nam has about 30 cooperative unions, 15 000 cooperatives and 30 000 farmer groups. However, most cooperatives lack capital and qualified staff. Joint production and consumption of products are weak, and they are less active in finding markets.

Many businesses still have to contact farm owners and farmers directly for their supplies. Many cooperatives have a large number of members, but are loosely linked with each other, leading to scattered operations. Government funding for cooperative support mainly focuses on training and retraining (43.7 percent). Access to credit remains the biggest challenge for agricultural cooperatives.

The Agriculture Restructuring Action Plan of 2017 specified three key value chains and actions to be taken:

- National key products (products whose export turnover is at least USD 1 billion, plus pork and poultry meat): review planning, strategy, plans and develop large-scale concentrated production areas; seek cooperation along the value chain and application of advanced technologies.
- Provincial key products: invest in these products according to local advantages and market demand as if national key products in a local scale; introduce policies and find solutions for increasing production scale and competitiveness to include them in national key products.
- Local specialties: includes small-scale products having specific geographical indication, which will be developed together with new rural area development plans of rural districts and communes, according to which, each commune will have a separate specialty.

Viet Nam's agricultural products have participated in global value chains, but most of these exports are raw and not recognized as originating from Viet Nam by end users. One possible cause is that the technology used before and after harvest is still outdated. Viet Nam's participation in the entire chain is still limited, from production, processing to marketing, distribution and consumption. Some agricultural products from Viet Nam are in the world's top five in terms of export volume, but only in the top 10 in terms of export price (Table 5).

Table 5: Ranking of Viet Nam agricultural exports among the world's exporters

	Ranked by export volume	Ranked by export value	Ranked by export price
Cashew nut	1	1	6
Black pepper	1	1	8
Coffee bean	2	2	10
Cassava	2	2	6
Rice	3	4	10
Rubber	4	4	10
Tea	5	7	10

Source: IPSARD 2017, based on FAOSTAT

Local specialties are the target of the One Commune One Product (OCOP) programme. The total revenue of OCOP products in 2013–2016 reached about VND 672 billion, of which the food group achieved the highest revenue with VND 553.2 billion (accounting

for the largest share at 82.3 percent). The quality and design of the province's OCOF products have been getting better with the improvement of food hygiene and safety criteria. Better quality and designed products fetch higher prices. For example, the price of honey increased from VND 180 000 per litre to VND 250 000 per litre, eider duck egg increased from VND 2 400 per piece to VND 4 000 per piece.

Over the past 10 years, MARD and local authorities have focused on reviewing, adapting or proposing that the government adjust regulations and policies to support the development of agriculture, forestry and fishery processing industries and implement a plan to do so. They have called for the development of standards and regulations in the processing field. In June 2017, MARD established the Agro-Product Processing and Market Development Department. The Department advises and assists the Minister in state management and law enforcement on agricultural and forestry market development, seafood and salt. The Department has the role of coordinating market development activities, and acts as the focal point for the management of processing and preservation of agricultural, forestry, aquatic and salt products under the scope of MARD.

However, the above-mentioned policies for agrifood value chain development have revealed shortcomings and limitations. The policies are mainly suitable for rice production, don't take into account the variety of linkage models in different regions and production sectors, such as rice, vegetables and fruit trees. Local budget support is very limited, especially in provinces with small or tight budgets, and implementation procedures are complicated. The policies fall short on issues related to "breaking the contract," the responsibility of the local level sectors, project integration mechanisms, and policies in the real area.

Viet Nam continues to export primary agriculture commodities with minimum value addition to the detriment of farm incomes and the capacity of the sector to create additional jobs. Agriculture processing for the domestic markets, however, has come a long way and seems relatively dynamic. The medium to long-term processing capacities for the domestic market are likely to be harnessed and adapted to the export markets. The agriculture export markets also suffer from lack of adequate economies of scale in production, processing and trading. A large number of small producers and traders operate Viet Nam's export value chain with little or no cooperation among them.

Most value chain actors, except large enterprises, are restricted from accessing formal credit. In addition, during the implementation process, credit institutions are afraid of risks due to lack of a unified framework for production processes for each specific value chain. They base lending decisions on whether previous loans have been repaid.

However, the agricultural processing industry and the agricultural support service industry have not been attracting businesses to invest and innovate in technology. Investors face many obstacles in agricultural value chains. IPSARD's survey of agricultural enterprises in 2015 showed different obstacles to investors, especially in accessing land for agricultural production and processing. Viet Nam's agricultural

business sector remains at a low technology level, is not synchronous, and has been slow to reform, especially in the agricultural support service industries. Viet Nam's export value chains involve too many production and trading agents, but there is little cooperation among them.

3.5 Land tenure

In stage 1, central planning, there were land policies but no land law yet. In this stage, the cooperative system had many limitations and farmers were no longer motivated to work for cooperatives. This led to the agricultural production crisis in 1976–1980. According to the GSO, the average food production output was 13.3 million tonnes/year, equivalent to 259.2 kg/person. The average yield was only 2 tonnes/ha, and Viet Nam had to import an average of 1 million tonnes of food per year.

In the early-1980s, to avoid an economic crisis the government redistributed the economic functions between cooperatives and households in terms of ownership, management, and distribution relations. This opened the process of economic democratization, benefitted farmers, and promoted agricultural production. The government abolished concentration mechanisms in agricultural production management, helped revive the rural economy, and enabled a larger volume of agricultural products.

However, the measures only worked for a while because they relied on a cooperative-style work-point system. Farmers still depended on the cooperatives and did not have long-term land-use rights. All land and production means were managed by the cooperatives. Farmers were responsible for production while the cooperatives were responsible for processing and marketing. Products continued to be distributed to farmers based on their number of working days for the cooperative.

In 1987, during stage 2, the first Land Law was promulgated. Its terms were cautious and intended to foster the piloting of innovation. It recognized households as autonomous economic units and gave them some certain rights. However, land users were not allowed to transfer land-use rights, and long-term land-use rights were not recognized, discouraging perennial crop production.

In 1993, the Land Law was amended. It allowed the issuance of land-use rights certificates for households, gave five rights to land users: inherit, lease, transfer, exchange and mortgage land-use rights for loans. Moreover, land-use rights were extended to 20 years for annual crops and 50 years for perennial crops. This encouraged farmers to invest in their land. After the amendment, agricultural output increased rapidly, crop production increased by an average of 1.3 million tonnes per year, cultivation output increased by 6.4 percent during 1993–2000, which was 2.4 percent higher than in 1986–1992. Farmers had diversified their crops but what type of crops could be grown was still restricted due to food security concerns. Land use quotas for households were fixed at low levels (2 ha in the North, 3 ha in the South for annual crops, 10 ha in deltas and 30 ha for midland or mountainous areas for perennial crops).

In stage 3, the land law continued to be amended to comply with the development of a socialist-oriented market economy. After amendments in 1998 and 2001, a new

Land Law was enacted in 2003, giving five additional rights to households: the ability to donate the land-use rights; guarantee or contribute capital with the land-use rights; receive compensation when the state recovers land. This law officially established a land market through concrete provisions on the process and procedures for land-use right transactions. In 2004, 19 percent of households rented or borrowed land for production, while 3.6 percent of agricultural land and 5.7 percent of annual cropland was leased. At the same time, 10 percent of households rented out land, 2.5 percent of households sold land, 13 percent of households lost land, of which 9 percent went through the marketplace and 4 percent was acquired.

Quotas on the acquisition of agricultural land-use rights were 6 ha for the Southeast and Mekong River Delta, 4 ha for other regions for annual crops, 20 ha for the deltas and 50 ha for mountainous areas for perennial crops. This contributed to alleviating land fragmentation: the average number of plots per household decreased from six to five.

The agricultural land market did not function well. On one hand, there was agricultural land allocated to rural households but left abandoned as rural labourers moved to work elsewhere.⁸ On the other hand, there were enterprises that wanted to invest in agricultural production but could not acquire land. Policies on agricultural land use were not clear about the time of land reallocation in 2013, land acquisition, transfer, and lease. There was no master plan on land use, etc., making people feel uncomfortable to invest and that might have affected social stability.

Millions of hectares, loosely managed by state forestry enterprises and commune authorities, have been encroached upon and used ineffectively. Policies are not strong enough to protect the land fund for rice and food crops to ensure food security. The situation of land acquisition and conversion for non-agricultural purposes in the provinces reached alarmingly high levels in many regions. Meanwhile, the management of forestry land was not linked to the management of forests.

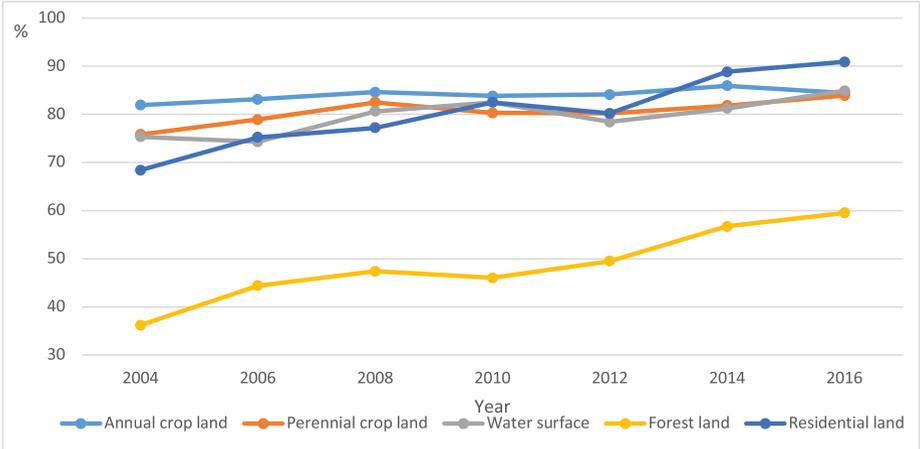
In stage 4, the 2013 Land Law was launched, solving outstanding issues not addressed by the previous land laws. The 2013 Land Law extended the duration of agricultural land allocation for producers. Specifically, the term of agricultural land allocation for annual crops was extended from 20 years to 50 years. Although the agricultural land allocation quota did not change much compared to the 2003 Land Law, the new law specified land allocation quotas for annual crops, aquaculture, and salt production for each region. In provinces in the southeast and Mekong River Delta they were not to exceed 3 ha of each land type, and in other provinces not more than 2 ha. In addition, the quota for land-use rights acquisitions by households was greatly increased to 10 times the permitted level of agricultural land allocation.

The government has promoted the consolidation of agricultural land since the early-2000s with a view to reduce land fragmentation. This continued to be emphasized until recently for developing a land market. However, the current market for agricultural land-use rights is still in its infancy. There is a wide

⁸ According to AgroCensus 2016 results, about 7 percent of rural households have some abandoned paddy land.

gap between the market prices and the official prices, which are issued every five years for each land type in each region. The policy is to accelerate the granting of land use certificates, which should facilitate the land market. The percentage of land granted with a certificate of usage rights in communes in Viet Nam has increased steadily over time for all land use categories: annual cropland, perennial cropland, water surface, forest land and residential land. As of 2016, residential land had the largest percentage with such certificates at about 91 percent, while forestland has the lowest certification rate at 60 percent.

Figure 12. Share of area having land-use rights certificate (%)



Source: Authors’ calculation from VHLSS data

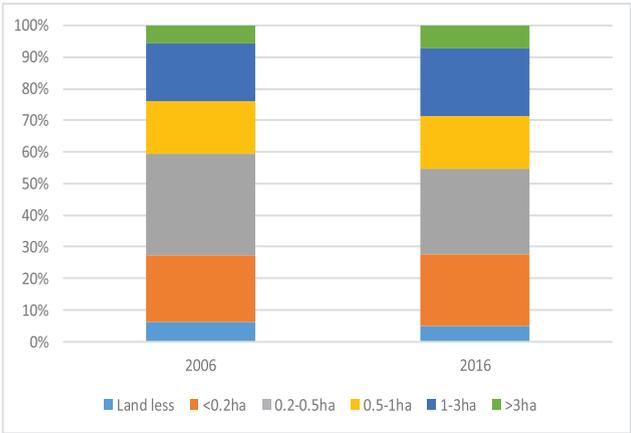
The number of farmers abandoning their fields increased from 2012 onwards when the market for agricultural products was unfavourable. Nearly 50 percent of the farmers cited financial unviability as the main reason for abandoning their farms followed by soil salinization, alum contamination, and other factors (AgroCensus 2016). Low income from agriculture also promoted migration to urban areas. The migration was mostly informal with limited access to urban public services. As a result, many rural inhabitants earning their income mainly from non-agricultural activities still wanted to keep their agricultural land as a mechanism for risk insurance. This exacerbated the dispersion and fragmentation of agricultural land.

The 2013 Land Law encouraged the construction of large-scale production areas⁹ associated with the consumption and processing of agricultural products through contracts. According to the AgroCensus 2016, there were about 2 200 large fields with an area of 580 000 ha, involving nearly 620 000 households. Among households using agricultural land, the number of households with less than 0.2 ha of land accounted for 36 percent, the number of households with 2 ha accounted for 10 percent, of which the number of households with 5 ha or more accounted for just over 2 percent.

⁹ Large-scale production implies land accumulation. The minimum area to be considered “large” depends on type of products and local authorities, ranging from 20 ha for vegetables to 50 ha for rice.

Calculations using survey data of household living standards showed that the average agricultural land area was small and tended to decrease, from 0.65 ha in 2006 to 0.59 ha in 2016 (Figure 13).

Figure 13. Distribution of farms by land size



Source: Results of AgroCensus (GSO 2017)

Small-scale production and land fragmentation have been the main obstacles. They have negatively affected the application of advanced science and technology, mechanization, reduction of production costs, boosting production of goods and improving the quality of agricultural, forestry and fishery products. There have been proposals to revise the land law, which might be realized in the next one or two years. Unfortunately, the cooperative development policy, marked by the 2012 Law on Cooperatives, has yet been unable to address the issue as expected.

3.6 Farm income and crop diversification

Rural household income has been diversified away from agriculture, along with the decreasing share of agriculture in GDP (Figure 14). In 2018, agriculture accounted for roughly 20 percent of the total sources of rural household income. Wage employment and non-agriculture based livelihoods are increasingly key sources of household income in rural areas. However, among households involved in agricultural production, the share of agriculture-specialized ones has been stable, and there has been a trend to combine agricultural livelihoods with wage employment (Figure 15).

Figure 14. Income sources of rural households

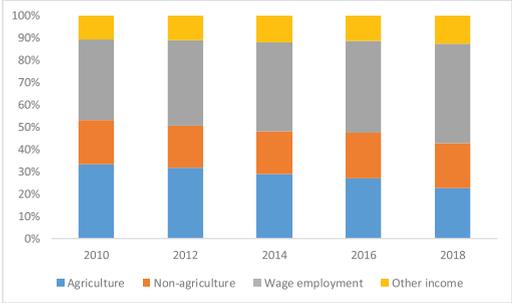
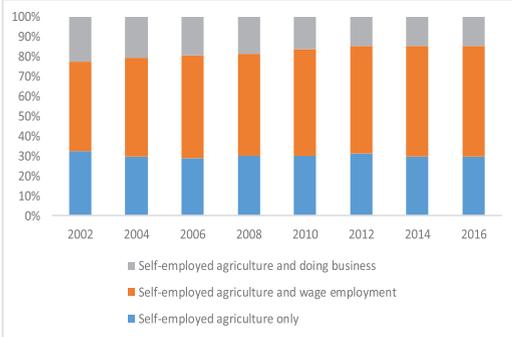


Figure 15. Farm diversification

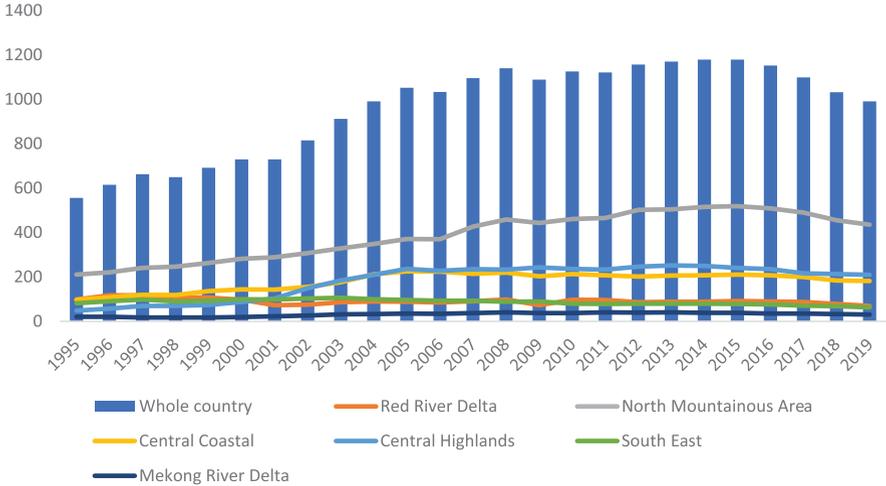


Source: Authors’ calculation from VHLSS data

In terms of crop diversification, rice continues to account for a large proportion of the cultivation area as Viet Nam has a long-standing wet rice culture. Rice accounted for 60 to 70 percent of land cultivation in stage 2. The rice cultivation area increased strongly during this stage, from 6.0 to 7.7 million hectares in ten years from 1990 to 2000. There were strong increases in the areas of perennial crops, in which the coffee area increased 3.7 times and the pepper area doubled. Since 2000, the rice cultivation area has decreased because of the policy to promote diversification out of rice (Figure 17). A 2008 government resolution also promoted agricultural diversification, increasing the added value rather than productivity.

In stage 3, there were significant increases in maize and soybean areas. The area for maize increased from about 0.7 million ha in 2001 to about 1.1 million ha by the end of the decade, with the North Mountainous Area the largest region (Figure 16). Industrial crop areas continued to expand, in which cashew areas increased 1.9 times. In 2005, the Prime Minister approved the planning of structural transformation of agricultural, forestry and fishery production nationwide through 2010 with a vision to 2020. Initially, the goal was to convert 102 000 ha of paddy land to aquaculture and other crops, and expand the area of maize and cassava cultivation to 1.5 million ha.

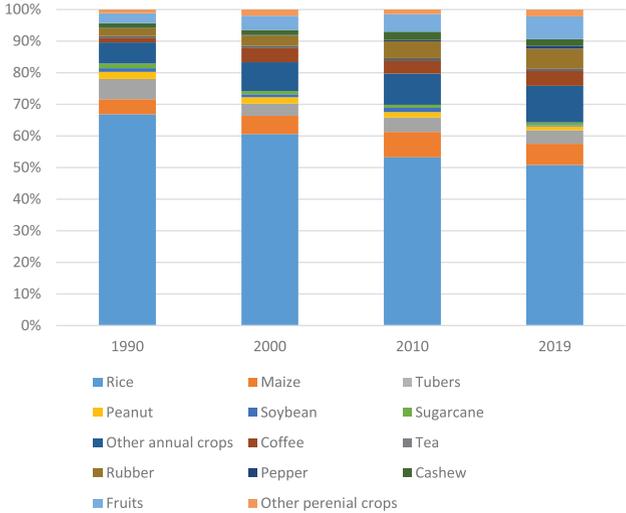
Figure 16. Area of maize by region (thousand ha)



Source: GSO 2020

In stage 4, there have been significant decreases in the area of soybean, peanut, maize, cashew and tea, along with a strong increase in the area of pepper, fruit trees and vegetables. This occurred even in the context of a 2016 government decision to shift support from paddy to maize cultivation (Figure 17). The decision covered the Northern Midlands and Mountains, the North Central Coast and the Mekong River Delta, the South Central Coast and Central Highlands from the summer/autumn crop of 2016 to the end of the winter/spring crop of 2018/19. It included a one-time support not exceeding VND 3 million per hectare of maize seed cost for conversion, accompanied by agricultural extension and mechanization. Most of the farmers were not changing from paddy to maize, mainly because the conversion support policies were limited and because of strong competition from imported products.

Figure 17. Share of cultivation area by crop (%)



Source: Statistical yearbooks, GSO

The 2013 Agricultural Restructuring Programme towards increasing product added value and sustainable development gave a clear orientation on agricultural diversification by maintaining the diversified production scales and methods suitable to the actual conditions of each region. In livestock production, the number of poultry and cattle has been increasing quickly because of the change in consumption and the increase in income among consumers. The number of water buffaloes – the traditional ploughing force in the past – has been decreasing significantly due to the popularity of tractors. In aquaculture, catches have been falling and are gradually being replaced by fish farming as natural fishery resources have been exhausted. Since 2011, the types of uses for paddy land have expanded to aquaculture and then to perennial crops.¹⁰ In 2014, MARD developed rice conversion models to suit the unique advantages of each region. For example, in Mekong River Delta, the focus has been shifting to rotational 2 rice crop-1 vegetable crops, 1 rice crop-2 vegetable crops, rice and aquaculture, etc.¹¹ In forestry, logging has been replaced by afforestation, and wood and furniture processing.

Rice has been the most important part of the Vietnamese diet, thus the focus of national food security policy. Since 2007–2008, when the food crisis began, rice production has received even more attention, aimed at ensuring income for rice growers and guaranteeing food supply in all circumstances. However, the policies have not

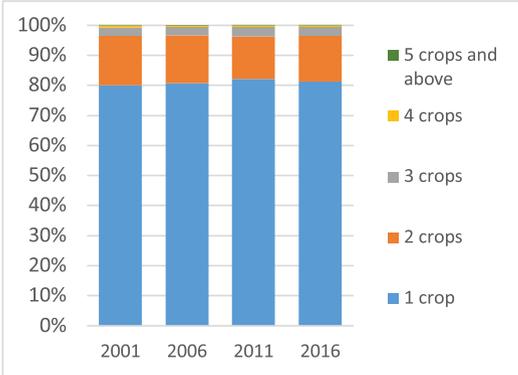
¹⁰ In 2013, MARD issued Circular No. 47/2013/TT-BNNPTNT instructing the conversion from rice cultivation to annual crops, combining aquaculture on paddy land with the principle of conversion: There is no loss of suitable conditions for re-growing rice and the restructure must be in accordance with local plans. MARD issued another Circular No. 19/2017/TT-BNNPTNT in 2017 adding perennial crops to the list of crops that can be converted from paddy land with the principle that the conversion must form centralized production areas, efficient exploitation of available infrastructure.

¹¹ In 2014 MARD also issued Decision No. 3367/QĐ-BNN-TT approving the planning of structural transformation on paddy land in the period of 2014-2020 towards effective, sustainable and high added value agricultural production.

brought about the expected gains for rice farmers as the support went through export enterprises that were the actual beneficiaries. Exports of rice did not bring much benefit for farmers compared to other agricultural commodities. For the sake of sustainably raising farmers’ incomes, experience from other countries and Viet Nam indicate that crop diversification may be more effective than subsidies.

Perennial crop farmers are quite specialized.¹² In 2001, approximately 80 percent of farming households were planting a perennial crop, and this percentage has increased slightly in recent years. The share of households planting two perennial crops was still low at around 16 percent. Very few households planted three or four perennial crops and almost no households have five or more perennial crops (Figure 18). Compared to households, commercial farms tended to diversify their perennial crops more. The ratio of commercial farms planting two or more perennial crops was around 40 percent (Figure 19).

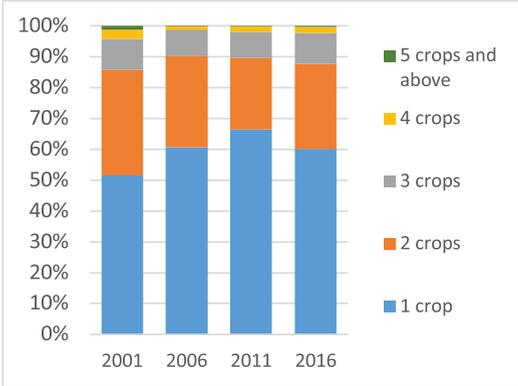
Figure 18.¹³ Household structure by number of perennial crops (%)



¹² According to GSO, perennial crops are defined as crops which grow and produce in many years, including industrial crops (coffee, cashew, pepper, rubber, etc.), fruit trees (mango, banana, pineapple, etc.) and other perennial crops.

¹³ In Figure 18, these are households planting perennial crops with a concentrated planting area of 100m² and above. The share of households planting perennial crops in the total number of agricultural households has been respectively 22.6 percent (2001), 28.7 percent (2006), 38.4 percent (2011) and 42.3 percent (2016).

Figure 19. Commercial farm¹⁴ structure by number of perennial crops (%)



Source: Authors’ calculation from AgroCensus data

MARD has plans for each major commodity based on its competitive advantage and market demand, taking into consideration other factors such as climate change and resource balancing. Viet Nam also focused more on “higher-end” export markets where selling prices are higher but the requirements for quality are stricter. Consequently, exporters have switched to more high-value products. Rice, aquaculture, and fruits are the prominent evidence for this change. During 2012–2017, the export value for rice decreased from USD 3.67 billion to USD 2.66 billion. Meanwhile, the export value of aquaculture increased from USD 6.1 billion to USD 8.3 billion, and the export value of vegetable and fruits increased from USD 829 million to USD 3.45 billion. Within the rice sector, for example, there has also been a switch towards high quality and high value, and the gap between rice export prices of Viet Nam and Thailand has been closing.

3.7 Labour market transformation

The dependency ratio of Viet Nam had decreased since 1975. It fell rapidly in the 1980s and then has stayed under 50 percent until now (WDI). Since 2005, Viet Nam has had a “golden population structure,” meaning that for every two or more people working, there is only one dependent person. Viet Nam is expected to be able to exploit this potential demographic dividend until around 2035. The large number of young people entering the labour market annually is a favourable condition for growth but could turn into a burden if job creation cannot match the new labour supply.

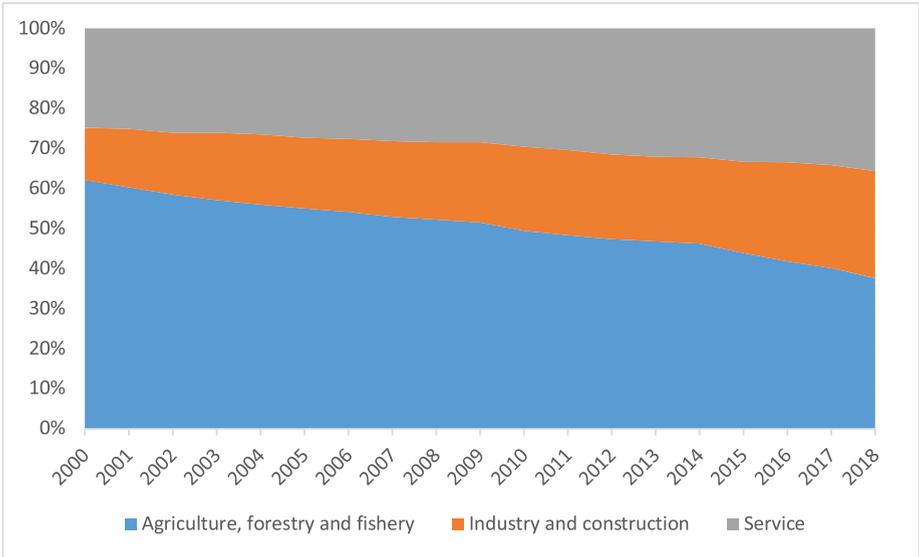
Viet Nam’s economy has developed in the direction of industrialization and modernization. Industry, construction, and services have played an increasingly larger role, while the role of agriculture has been decreasing. Therefore, labour has been shifting from agricultural to non-agricultural sectors. In 2000, the proportion of employed workers 15 years of age and above in agriculture was about 62 percent. By

¹⁴ In Figure 19, these are commercial farms planting perennial crops. The share of the perennial crop farms in the total number of agricultural farms has been respectively 28.2 percent (2001), 21 percent (2006), 30.5 percent (2011) and 16.5 percent (2016).

2018, that had decreased to about 37 percent (Figure 20). The average annual rate of decline from 2000–2018 was approximately 2.7 percent. Also in this period, labour in the industry and construction sectors has had an average annual growth rate double that of service sector.

Nonetheless, the labour exit from agriculture to industry and services has lagged the sectoral GDP. As a result, there has been a surplus of labour in agriculture, reflected in persistently high underemployment and low labour productivity. It should be noted that temporary and seasonal migration have not been accounted for fully by the household registration system, thus the labour transition in Viet Nam might be underestimated. According to Zorya *et al.* (2018), when comparing Viet Nam with some other developed and developing countries – such as China, Thailand, Indonesia, and Philippines – Viet Nam is in the group of countries with relatively fast labour transformation: behind China and faster than other countries.

Figure 20. Labour shifts across economic sectors

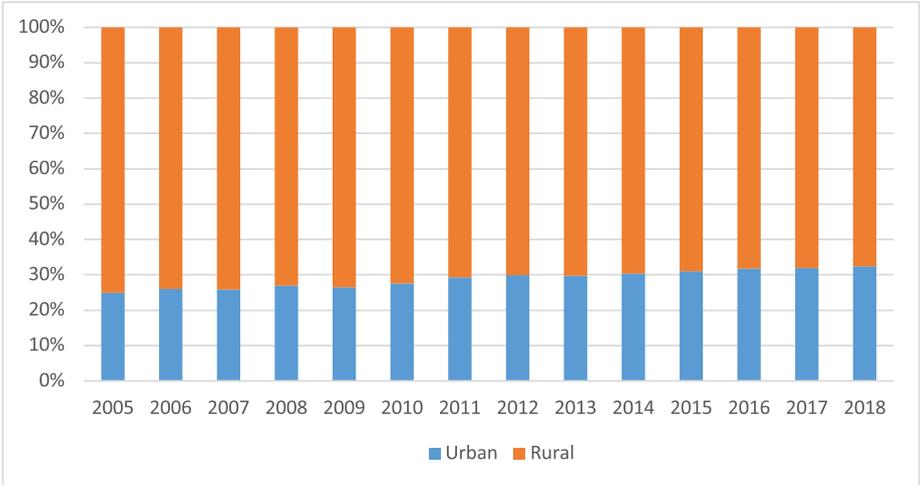


Source: GSO

According to the 2013 Employment Law, rural labourers who change their careers and jobs are entitled to: (i) vocational training support, (ii) free policy advice, labour force, employment, and vocational training, (iii) and free job placement. Small and medium enterprises, cooperatives, cooperative groups, and business households that create jobs for rural labourers are entitled to (i) borrow capital from the National Fund of Employment; (ii) support in providing information on product markets; (iii) and tax exemptions or reductions. The project on vocational training for rural workers through 2020 provides short-term vocational training costs, meals and travel expenses; borrowing capital for vocational training and self-employment; and, long-term vocational training policies.

Fuelled by urban-rural migration, the proportion of workers 15 years of age and above employed in urban areas has increased steadily over the years with an average annual growth rate of about 2 percent during 2005–2018. Although the percentage of labourers living and working in rural areas decreased from 73.1 percent to 68.2 percent, during this period, the rate of underemployment in rural areas was 2.6 to 2.9 times higher than in urban areas (Figure 21).

Figure 21. Rural – urban employment distribution



Source: GSO

With the ongoing digital revolution, businesses using outdated technology or relying on the use of low-skilled workers are expected to lose their competitive advantage and gradually fall behind or go bankrupt. However, the capacity for education and training systems to adapt to new demands for skilled labour has been limited. That remains the biggest challenge for a successful labour transformation process.

From 2010 to 2016, more than 5 million rural workers received vocational training, with over 40 percent of them learning agricultural jobs. The share of skilled workers in rural areas increased from 8.4 percent in 2009 to 14.5 percent in 2016, raising the productivity of agricultural labour from VND 14.1 million in 2009 to VND 32.9 million in 2016. The number of rural workers trained in agriculture in 2017 not only increased by more than 30 percent compared to 2016 but the quality also changed positively. However, vocational training is currently not tailored to the needs and strengths of each locality. The support for training costs is low. If the enterprise hires foreign experts for training and charges international rates for training fees, then there is not enough public funding to cover the costs. Meanwhile, there has been a lack of policies to promote the socialization of vocational training.

3.8 Farm inputs

In 1993, the government established a price stabilization fund for market regulation. This fund was aimed at stabilizing the prices of some agricultural commodities and inputs for agricultural production, but in reality focused on fertilizers. The list of agricultural production inputs was expanded to include fertilizer chemicals, pesticides, a number of veterinary products, and some animal feeds,¹⁵ and then to urea fertilizer, NPK fertilizer, pesticides, and vaccines for cattle and poultry.¹⁶

There are four large urea fertilizer plants in Viet Nam (Phu My, Ca Mau, Ha Bac, Ninh Binh) with total capacity of 2.6 million tonnes a year, and two DAP fertilizer plants (Lao Cai, Dinh Vu) with a total capacity of 660 000 tonnes a year. Nevertheless Viet Nam has always been a major fertilizer importer. In 2017, Viet Nam imported 4.6 million tonnes of fertilizer worth USD 1.2 billion. That represented a 10.8 percent increase from 2016. Of that total, 38 percent came from China and 13.5 percent from Russia.¹⁷

Since 2010, the government started granting land tax exemptions for most farmers and other assigned agricultural land users until 2020. It removed subsidies for inputs and outputs – except for irrigation fee subsidies. Before 2015, fertilizers and animal feed were subject to a 5 percent VAT for import and domestic use and a 0 percent VAT for export. From 2015, fertilizers and animal feeds have been entitled to VAT exemption. Products that were imported or bought to form the fixed assets of fertilizer and feeds producing projects are also entitled to deductions or reimbursement of input VAT.¹⁸

The system of legal documents, standards and technical regulations for agricultural input management is inadequate. Poor supervision and weak coordination among ministries and localities have led to poor control of product composition and origin. In some provinces, false advertising about agricultural inputs usage has led to serious damage to the environment and losses for producers. According to the Ministry of Natural Resources and the Environment (MONRE) in 2014, the use of phosphate and potassium fertilizers in rice production in Viet Nam was over six times of the recommended level. Chemical fertilizer residues pollute water sources, cause eutrophication, harm aquatic life, aquatic resources and degrade soil. In addition, each year from

2011 through 2015, Viet Nam imported and used between 70 000 and 100 000 tonnes of plant protection chemicals. Excess use is absorbed by the soil and seeps into groundwater. The packaging is discarded, not collected and handled improperly (MONRE, 2015).

¹⁵ Decree No. 170/2003/ND-CP in 2003, Decree No. 75/2008/ND-CP in 2008

¹⁶ Decree No. 177/2013/ND-CP

¹⁷ Custom Statistics Office 2017

¹⁸ Document 10867/BTC-CST to instruct the application of VAT for fertilizers and animal feeds. MOF, 2015

3.9 Credit for agriculture

Before 1988, Viet Nam had only the State Bank of Viet Nam and two specialized institutions under the State Bank, namely the Bank for Investment and Development and the Bank for Foreign Trade. There was a state monopoly over finance with a widespread subsidy system and negative real interest rates. This led to a bank crash followed by the development of a two-tier system, consisting of the State Bank of Viet Nam and four state-owned commercial banks including the Viet Nam Bank for Agriculture and Rural Development (VBARD).

In 1995, VBARD began transforming itself into a commercial bank. In 1995 the Viet Nam Bank for the Poor (VBP) was established, a non-profit bank with a focus on poverty alleviation. These developments followed a 1993 government decree enabling agricultural households to access credit and stipulating policies regarding loans for agricultural households. In 2002, the government founded the Viet Nam Bank for Social Policies (VBSP), a social policy bank operating as a non-profit institution and one of the largest microfinance lenders in the world. Its founding was a reform that greatly affected the agricultural sector. This bank allows people in remote areas, ethnic minorities and students to borrow at favourable interest rates. After a financial collapse in the late 1980s, traditional credit cooperatives were reborn in the form of rural shareholding banks or People's Cooperative Funds (PCFs). In 1998, it was estimated that there were 900 PCFs providing services to 0.6 million households.

In 2003, the formal financial sector (VBP, VBARD, PCFs) represented over 90 percent of the outreach by rural financial services in Viet Nam. As of November 2004, there were 901 PCFs in operation. The government has tried to make small credit available in order to assist the poor to develop their own production and business operations. The State Bank of Viet Nam determines interest rates for credit. This means that banks are not able to set interest rates to cover the costs of funds, operating costs and risks. Since August 2000, the mechanism of base interest rates has been applied to all formal financial institutions, as opposed to an interest rate ceiling. This liberalization of the interest rate gives financial institutions a little more freedom in determining the rates on lending and savings. Nevertheless, the base interest rates are not flexibly adjusted to market prices, so the effects of the base interest rate are almost the same as those of an interest rate ceiling.

Since 2010, the government has issued a range of policies on credit for agriculture and rural development.¹⁹ In 2018, it raised the ceiling on lending without collateral for individuals and households, expanded the beneficiaries of credit policies for high-tech agriculture, allowed the use of assets formed from project loan capital and plans for high-tech applications in agriculture, and facilitated agricultural value chain financing.

According to the State Bank of Viet Nam, since 2008, credit growth for agriculture and rural areas has increased by an average of 20 percent annually. The banking sector is determined to prioritize capital investment for rural and agriculture development. Credit investment in the past 10 years has increased dramatically in both quantity

¹⁹ Decree No. 41/2010/ND-CP on credit policies for agricultural and rural development, Decree No. 55/2015/ND-CP amending and supplementing Decree No. 41, and Decree 116/2018/ND-CP amending Decree No. 55.

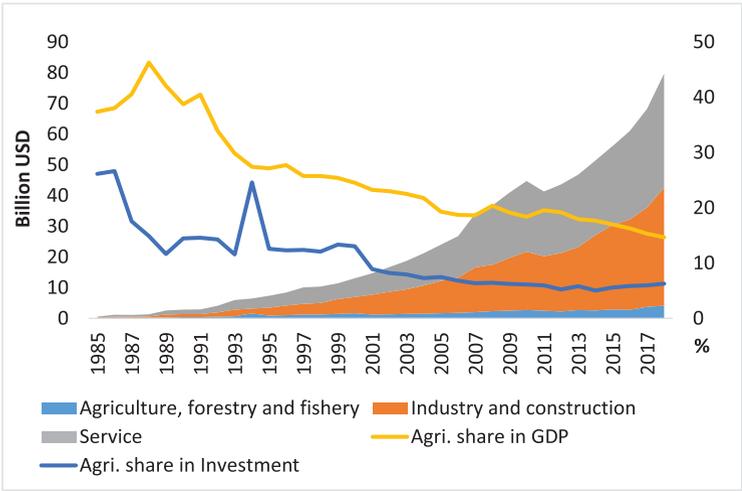
and quality. Non-cash agricultural and rural products play a key role in agriculture development. Currently, there are 66 credit institutions, and more than 1 000 PCFs and microfinance institutions lending to the agriculture and rural development sector. Credit for the sector has steadily increased over the years and is higher than the general growth rate of the whole economy. In 2018, credit to the sector reached over VND 1.6 quadrillion (about USD 75 billion). However, the credit supply has not met the demand in rural areas. That has left room for black-market lending at exorbitant interest rates.

4. Public investment

In general, investment in agriculture, industry and services has increased in absolute terms since 1985. However, investment in agriculture accounts for a low proportion of total investment and has gradually decreased from about 26 percent in 1985 to about 6 percent in 2017 (an average annual reduction rate of about 4.5 percent) (Figure 22).

In the first two stages of agricultural transformation, investment in the agricultural sector accounted for a large share of total investment. During 1985–2000, investment in agriculture was always over 15 percent of all investment. Along with a development orientation towards industrialization and modernization, investment in industry and services increased sharply. Consequently, from 2001 onwards, agriculture’s share in investment has markedly decreased, remaining below 10 percent (Figure 22).

Figure 22. Total investment in agriculture (2010 prices)



Source: Authors’ calculation based on GSO data

Total investment²⁰ in agricultural and rural areas in 2001–2005 was an estimated VND 358 trillion, or 30 percent of total investment, of which the state budget provided VND 193 trillion, or 54 percent. Investment in agricultural, forestry and fishery production was estimated at VND 162.5, equal to 13.6 percent of total investment. However, in 2006, it amounted to only 7.5 percent.

²⁰ According to the statistical year book by the GSO, the total “social” investment is the entire amount of capital spending to increase or maintain capacity and resources for production, including: investment to generate fixed assets, investment to increase current assets, spending on purchasing rare and precious assets, reserves gold in the form of goods, storage of commodities in the residence and other investment to improve people’s knowledge, enhance social welfare, improve the ecological environment, support people’s welfare, etc. Such investment does not include investments that transfer the right of use or ownership among individuals, households, enterprises or organizations ... without increasing fixed assets and current assets in the locality, such as the transfer of land, houses, shops, equipment and other used fixed assets.

The share of public expenditure on the agricultural sector from 1997 to 2006 was stable at 5 to 6 percent compared to the total public expenditure of the economy, which was low compared to the international and regional averages. In 2006, state investment in agriculture reached 15 percent of total state investment, or 7 percent of the agricultural production value, and 1.3 percent of GDP.

Meanwhile, there was little direct support to farmers, mainly seed price subsidies, preferential loans to poor households, and subsidies in case of natural disasters. On the other hand, there were many fees (40 different types of fees) that farmers needed to pay, which accounted for 1.4 to 4.5 percent of farmers' income in 2006. The Prime Minister asked to review and rectify this situation, and decided to exempt or reduce irrigation fees for farmers.

MARD only partly finances and monitors agricultural activities at the central level, which accounts for about 20 per cent of total budget for the whole agricultural sector. Provincial governments deliver the remaining 80 per cent of agricultural activities. As there is a lack of a strict monitoring system by MARD for the performance of agricultural activities at the provincial level, it is unlikely that the ministry can conduct financial and economic evaluations of the impacts of these strategies on the entire agriculture sector and on social welfare. Therefore, from the public spending perspective, it is very challenging to allocate and link sector outcomes to spending.

In 2015, Viet Nam switched to applying a medium-term investment plan for 2016–2020. An annual budget became a five-year medium- and long-term budget, both at the national and sub-national level. These moves were also enhanced by the promotion of decentralization and autonomy for ministries and provinces.

However, public investment could not meet all the sectoral needs as the state budget was limited, and official development assistance had been decreasing as Viet Nam has become a middle-income country. There are other challenges, such as scattered investment, overlap among sources of investment and poor investment management. In addition, investment in public-private partnerships is only at the pilot stage and still small scale.

The Agricultural Science and Technology Indicators (ASTI) Intensity Index (AII), which measures the investment intensity of Viet Nam relative to that of the US, shows that Viet Nam is underinvesting in agricultural R&D. The R&D investment intensity of Viet Nam reached its peak in 2004 with an AII value of 0.244, meaning that the investment effort was 24.4 percent of that of the US in 2011. It could be said that Viet Nam was not investing at its potential (IFPRI, ASTI, 2020).²¹

4.1 Rural infrastructure

Rural infrastructure has increasingly focused on construction, upgrading and improvement in recent years under the motto the “state and people do it together.” In 1994, the ratio of communes in rural areas having access to electricity was 60.4 percent. At that time, electricity service quality was not stable and many households

²¹ <https://www.asti.cgiar.org/>

had to use generators instead of the national electricity grid. There was a big difference in the percentage of communes and villages with electricity in different regions. The Northern Midlands and Mountains and the Central Highlands were the two regions with the lowest rates of communes and villages with electricity.

Regarding rural roads, 87.9 percent of the country had motorable roads connected to the commune people's committee headquarters in 1994. But inter-village roads were mostly poor quality or dirt roads, making mobility difficult. In education, communes with nursery schools, kindergartens, primary schools, junior high schools and high schools were 33.6 percent, 76.8 percent, 99.8 percent, 76.6 percent and 7 percent, respectively. However, many schools had not been built with permanent or semi-permanent structures, especially schools in mountainous and remote areas.

During 2001–2010, rural infrastructure improved significantly. The government invested in the electricity grid, which expanded throughout the communes. The shares of communes, villages and households having electricity in 2001 were 89.7 percent, 77.2 percent and 79 percent respectively. After 10 years these rates have increased and all have reached over 95 percent with the average growth rate each year between 1 and 2 percent.

Rural roads have been built and improved in terms of both quantity and quality, creating favourable conditions for production and living standards in rural areas. The percentage of communes with paved inter-village roads increased rapidly from 33 percent in 2001 to 87.3 percent in 2011 for an average growth rate of 10.2 percent per year. The government focused investment on developing a system of village roads, increasing the percentage of villages accessible by car to 89.5 percent in 2011. Although the village road system has been developing rapidly, progress has been uneven among localities, resulting poor mobility and vehicle access in many localities, especially in provinces in the Mekong Delta and Northern mountainous provinces. The school system in rural areas has continued to expand and develop and has eliminated temporary schools and classes. The percentage of communes with primary schools, secondary schools and kindergartens in 2011 was greater than 93 percent.

Since 2010, the National Target Programme on New Rural Development has been implemented at all levels from central to local throughout the country. Initially, the programme had many achievements, contributing to comprehensive change in rural areas. By 2019, 100 percent of communes and 99.1 percent of households had access to electricity, according to the programme. The electricity quality in rural areas has been improved and is more stable. The rural transportation system has also advanced, especially commune and village roads, which were expanded and improved. The rural school system at all levels has been equipped with functional classrooms and learning equipment.

Some concerns remain, especially regarding infrastructure for a modern commercial agriculture sector. The majority of farmers mainly rely on intermediaries and other informal sources for market information, causing price volatility and speculation that negatively affects production and consumption. Farmers and producers have no

mechanism to monitor the situation of supply and demand at home and abroad, leading producers to often change the scale of investment and switch from one crop to another.

Logistics, including warehousing and storage systems, is still poorly developed compared to other countries in the region. This leads to high transaction costs and volatile agricultural prices. Viet Nam's ranking in the Logistics Producers Index fell from 48th in 2014 to 64th in 2016. Viet Nam is lacking cold chain logistics, adversely affecting the quality and competitiveness of its agricultural products. The country also lacks a modern trading floor and wholesale market.

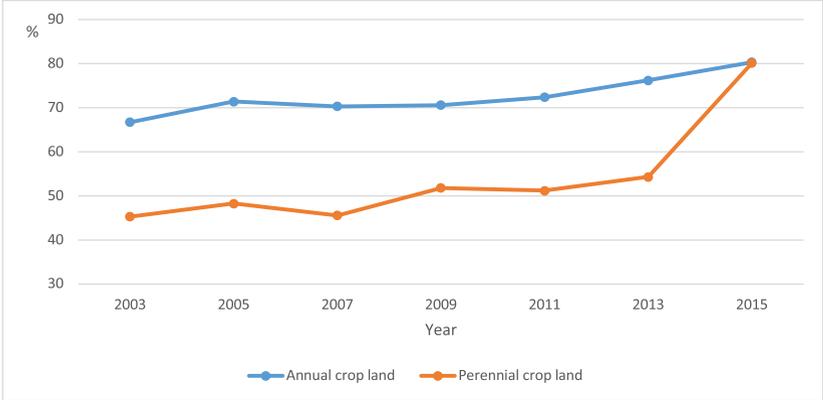
4.2 Irrigation and water management

In 2001–2005, the irrigation capacity increased by 575 000 hectares, and drainage capacity by 235 000 hectares. By 2006, the total designed capacity of irrigation systems ensured 3.45 million hectares of land were arable, of which 6.85 million hectares of paddy land and 1 million hectares of vegetables were irrigated. It provided drainage for about 2 million hectares, prevented saltwater intrusion for 0.87 million hectares, improved 1.6 million hectares of land, and supplied water for domestic, industrial and service activities of over 5 billion cubic meters per year. One hundred irrigation companies with a total of 22 569 employees and 12 000 cooperatives and cooperative groups operate the irrigation systems.

In the five years between 2016 and 2020, irrigation capacity has increased by over 97 000 hectares and increased the drainage of 127 000 hectares of agricultural land. The area with ensured water for rice cultivation reached 7.5 million hectares, equal to 98 percent of the planted area for the whole year. Key infrastructure has been renovated and upgraded. By 2020, a total of 6 750 irrigation reservoirs will have been improved, increasing the total reservoir volume to 14 500 million cubic meters, an increase of about 1 300 million cubic meters, or (9.8 percent, compared to 2015).

The proportion of irrigated cropland has increased. In 2003, about 45 percent of perennial cropland was irrigated, about 22 percent less than that of annual cropland. However, irrigation of perennial cropland increased rapidly and caught up with annual cropland in 2015 (Figure 23).

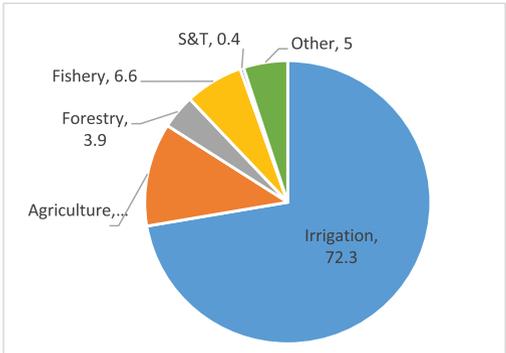
Figure 23. Share of irrigated land (%)



Source: Authors’ calculation based on VHLSS data

Irrigation has always been a priority in agriculture investment. Public investment in irrigation in 1991–1995 increased by 7.4 times compared to 1986–1990 and in 1996–2000 was 3.4 times higher than in 1991–1995 (Dang, K. S., 2008). In 2018, public investment in irrigation accounted for 72.3 percent of the total public investment in agriculture, an increase of about 2 percent compared to 2011 (MARD, 2019). Also in 2018, the share of public investment in the agricultural sub-sector was the second largest, followed by the fisheries sub-sector (Figure 24).

Figure 24. Public investment in agriculture-forestry-fishery (%)



Source: MARD, 2018

The challenge is to develop a multipurpose irrigation system instead of a rice-focused system. A multipurpose system would match the restructuring of agricultural production. As investment in the sector in general, and in irrigation in particular, is limited, extensive development of a multipurpose irrigation system might not be feasible. Priority might be given to developing specialized large fields with comprehensive irrigation systems.

5. Urbanization and resource management

In theory, industrialization and rapid urbanization creates jobs and income for the rural population, facilitating savings and investment. Industrial establishments order raw materials from agricultural producers and help them with higher technology, increasing quality and value. They supply farmers with agricultural materials and equipment at more competitive prices. Diversified services facilitate agribusiness and production. A significant number of workers would move out of the countryside, allowing land to be used for specialized agricultural development and scaling up. The future rural area has the potential to be harmoniously linked with the city and with industrial zones.

In reality, before the 2008 Resolution on agriculture, farmers, and rural areas, the urbanization of rural areas had been taking place spontaneously with little connection to territorial planning of socio-economic regions. Therefore, the process of urban development, industrial development, tourism and culture, lacked the totality and balance to ensure spatial harmony, ecological and spatial economic development. The process of urbanization and the development of urban infrastructure such as roads, water supply and drainage, and energy supply has not really linked urban areas with the surrounding rural areas.

On the other hand, urban areas and industry will continue to attract and contend for resources with agriculture and rural areas, with a focus on land, water and then on labour and capital, increasing the input prices for agricultural production. Those factors will reduce the competitive advantages of agriculture. If development policy is not properly adjusted, and the gaps in income and living conditions will continue to widen between industry and agriculture, and between rural and urban areas. Mass migration could create cultural disruption and fierce conflicts in society, threatening political stability, the environment, and traditional cultural identity.

The growth rate of urban centres and industry in rural provinces has increased rapidly. In this process, agricultural land was taken for industry and urban expansion. When the land was taken from farmers, they received low prices for it. But afterwards, when it was managed by enterprises or the localities for other uses, the prices rose dramatically. These price differences created greater social inequality and led to disputes in many regions.

In addition, the indiscriminate exploitation of natural resources has also led to the decline of biodiversity, ecological imbalance, and depletion of natural resources. Forest resources, groundwater resources, inland aquatic resources, marine resources in coastal areas and some minerals have all shown signs of overexploitation.

6. Poverty alleviation and nutritional improvement

In tandem with economic development, the living standard of Vietnamese people has improved. According to Dang Kim Son *et al.* (2006), in 1988, about 9.3 million people in 21 northern provinces were hungry and Viet Nam had to import almost 2 million tonnes of rice. However, food security at the national level has been secured since 1989, right after the agricultural land reform. By 2007, basically, Viet Nam has eradicated hunger.

The average incomes in both urban and rural areas have increased significantly. Notably, the urban-rural income gap is widest during periods of strong economic growth. In 1996, the average urban household income was 2.7 times higher than the rural one. The gap was much lower in early 1990s at 1.3 times and recently at 1.9 times (Figure 25). A large number of rural labourers have migrated to urban areas and this has helped narrow the gaps in income and employment.

The poverty headcount ratio using the national official poverty line decreased significantly over the past two decades. The urban rate decreased from 9 percent in 1998 to 1.5 percent in 2018, while the rural rate decreased from 44.9 percent to 9.6 percent (Figure 26). However, that is still much higher than the urban rate. Poverty incidence is now mostly found among ethnic minorities. And while the overall inequality index has improved recently (from 0.433 in 2010 to 0.424 in 2018), the rural inequality index has worsened (from 0.395 in 2010 to 0.407 in 2018). Two regions with the highest share of ethnic minorities – the North Mountainous Area and the Central Highlands – experienced a significant increase in inequality. During 2010–2018, the Gini coefficient increased in those regions, from 0.406 to 0.443 and from 0.405 to 0.440, respectively.

Figure 25. Average monthly per capita income (current USD)

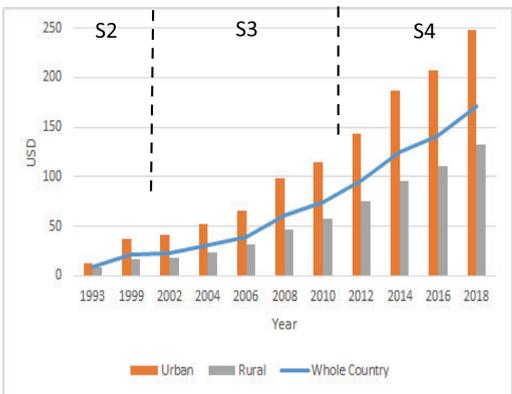


Figure 26 - Poverty rate (percent)



Note: S2 – Getting agriculture moving, S3 – Moving labour out of agriculture, S4 – Agriculture as a contribution to growth

Source: Results of different rounds of VHLSS (GSO)

National food security has always been a special concern for the Communist Party and the government. In 2009, the government issued a resolution on ensuring national food security. It made national food security part of the overall socio-economic development strategy, associated with the goals of industrialization and modernization and solving agricultural, farmers and rural issues. It set goals to improve nutrition and the quality of people’s meals. It promoted the advantages of rice as the staple food. It supported developing food production to create commodity-production areas with high efficiency and competitiveness, towards industrialization, modernization and environmental protection. The resolution affirmed that national food security aims to ensure food supply, meet nutritional needs and safeguard people’s access to food. In 2016, the government established the National Steering Committee for National Action Plan “Zero Hunger” in Viet Nam, 2016–2025, confirming Viet Nam’s participation in the Zero Hunger Initiative of the UN.

Viet Nam’s nutrition has improved significantly. According to the Ministry of Health, there were approximately 10.9 million malnourished people in 2004 compared to 15.9 million in 1994. However, because of the difference in living standards, the percentage of malnourished people in rural areas was much higher. The rate of underweight under 5-year-old children in mountainous areas was twice that in urban centres. In 2004, 42.3 percent of children in remote areas were malnourished, while in urban areas it was 23.4 percent. In recent years, the proportion of underweight under 5-year-old children has decreased significantly, but the disparity between urban and rural areas remains large. According to the GSO, in 2018, the rate of underweight under 5-year-old children in urban areas was 7 percent while the rate in rural areas was 16.1 percent.

At the local level, only the Red River Delta and the Mekong Delta have advantages for rice production and a surplus of rice. Mountainous areas and some coastal areas do not have plans to be food self-sufficient. They produce other goods and buy rice for consumption. When difficulties arise, such as natural disasters, epidemic diseases, and unemployment, the people in non-rice-producing areas may not be able to afford to buy food as a result of falling income. This situation leads to food insecurity at the local level despite a food surplus in the country as a whole.

As a result, food security at the local and household scale should be accompanied by income and market accessibility. The government should ensure food supplies and support measures in urgent situations.

7. Summary of policy, legislation and institutional experiences

Since reunification in 1975, Viet Nam has grown from a poor country, frequently having to import agricultural products, to a middle-income country, exporting many agricultural goods. Thanks to agricultural development, Viet Nam reached its Millennium Development Goals much earlier than many of its peers. The agricultural sector has led the way, serving as a driving force for development and a source of resilience for the country in times of difficulty.

Agriculture, farmers and rural areas have been placed an important position by the government in the development process of Viet Nam. A 2008 resolution on agriculture, farmers and rural areas was an extremely significant milestone, laying the foundation for comprehensive new rural development, which is an important mission of the political system and the whole of society. The National Target Programme of New Rural Development of 2010 and the Agricultural Restructuring Programme of 2013 followed this policy resolution.

International theories and experiences have shown that the development of agriculture and rural areas are strongly associated with socio-economic structural transformation leading to industrialization, modernization and urbanization (VOS R. 2018). Although there is a gradual decrease for the share of agriculture and rural areas in the overall economy in the long term, these sectors plays important roles in the structural transformation process.

Compared with the general pattern of transformation, Viet Nam is entering stage 4 of structural transformation. This development began in 2011, when the share of agriculture in GDP fell to 20 percent and the share of agriculture in the labour force slid below 50 percent. This is the period that poses the most challenges, requiring a strong breakthrough in policies and institutions so that the country can overcome the middle-income trap, and avoid lagging behind in national development.

An economy that undergoes a healthy path to industrialization is marked by a gradual transition of resources from rural to urban, from agriculture to industry and services. This process is reflected in the migration of labour from rural to urban areas, and also the transfer of land, capital and other resources. Viet Nam is gradually reducing the contribution of agriculture to GDP, but the process of transferring resources out of agricultural activities and rural areas has lagged.

The achievements of the agricultural sector over the years have been associated with policy reforms. Reforms in land tenure, mechanization, and input intensity have played important roles in the early stages of agricultural transformation. Later, crop diversification, labour transformation, and science and technology have received more attention. Recently, value chain development and credit for agriculture have been the focus.

In the new stage of development, a completely new policy system must be created in order to foster the conditions and dynamics to respond to challenges and capture future opportunities. Policy reforms must go hand-in-hand with institutional innovation, and agricultural policy must be associated with the restructuring of the whole economy. By doing so, it is highly likely that the development of the agricultural sector would have the power to propel economic growth and open a new stage of development for Viet Nam.

Stable growth of the agricultural sector plays a prominent role in stabilizing the growth of the whole economy. In difficult times, agriculture helped maintaining stable growth, providing a balance for the whole economy. During the economic crisis in the early-1980s or late-1990s, while industrial growth collapsed, agriculture and services expanded, securing overall economic growth.

Agricultural development is a base for inclusive growth. As most of the poor live in rural areas and agricultural production is their main source of income, agricultural development has significantly contributed to rural poverty alleviation.

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Chapter 6

BANGLADESH

Agricultural transformation in the people's Republic of Bangladesh

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Overview

During the early 1970s, Bangladesh was branded as a “bottomless basket”¹ – a place where donors and investors poured in aid and resources with few positive results. However, as time has gone by, Bangladesh has transformed itself into a “basket full of food.” This study examines the role that agricultural transformation has played in this national turnaround. It uses the framework presented in chapters 1 and 2. The agricultural transformation in Bangladesh has been organised into three stages: *Getting agriculture moving* (stage 1), *labour moving out of agriculture* (stage 2) and *agriculture as a contributor to growth* (stage 3). For our purposes, we have included the *subsistence agriculture* in stage 1.

Agriculture entered stage 1 of transformation in 1971 when Bangladesh achieved independence and the stage lasted until 1989. At that time, the country faced a challenging situation to feed its 75 million people. The state developed and adopted a number of policies, strategies and programmes including the establishment of new or refocussing several institutions to address prevailing challenges. In this stage agriculture contributed to 42 percent of the GDP. At the time, Bangladesh had relatively more land per capita than today but the country faced chronic food shortages. Its rice balance was -3.69 million tonnes. Rice is the people’s staple food. Political turmoil seriously disrupted the country’s development.

Stage 2 (1990 to 2010) was characterized by greater political stability under democratic governments. However, production of staple foods was still insufficient. Non-agricultural sectors began to grow and agriculture’s share in GDP fell by about half. Nonetheless, agriculture also began to grow at about 4 percent compared with just below 2 percent in stage 1, despite the constraint of reduced net annual cropped land. The sector had high employment but low mechanization, resulting in low labour productivity. Towards the end of stage 2, political turmoil erupted again. However, democracy was restored at the start of the next stage.

In stage 3 (post-2010), stable government began implementing planned development. The economy become stronger, staple foods were in surplus despite a continued decline in land resources, and farm mechanization increased rapidly. Agriculture’s contribution to GDP declined to around 13 percent, but its value to the national economy increased, indicating that agriculture had become more efficient than in the previous stages.

Agricultural labour productivity increased stage by stage, while the number of agricultural workers declined. In addition, irrigated areas expanded and the use of fertilizers rose. Crop yields increased, especially in stage 3. Livestock and fisheries productivity and production were also higher in stages 2 and 3. However, transformation did not produce noticeable changes in the forestry sector.

This study provides data-driven evidence on the agricultural input supply, value addition, and research and extension services from both the public and private sectors in each stage. It also documents policies, strategies, institutional innovations, and legislation that drove the stages of transformation.

¹ Henry Kissinger, 1974 in a speech in Dhaka as Secretary of State and National Security Advisor of the United States.

Bangladesh has yet to achieve the final two stages of transformation: *agriculture integrated into the macroeconomy* and *industrialized economies*. The future development of Bangladesh agriculture will face challenges from two directions – demand, from population pressure and for product quality, and constraints in the natural production environment exacerbated by climate change. To reach the final stages of transformation, the country would need to sustain its achievements and momentum of progress through agricultural research, development, extension, and structural and policy drivers.

1. Introduction

Agricultural transformation is the process by which an agricultural system passes through distinct stages. It typically begins as subsistence oriented and passes through to fully commercialized. Transformation varies among countries, but is likely to have some common elements. However, within countries it will have different outcomes with respect to economic growth and social inclusion (Berdeque *et al.*, 2014). The first two papers in this publication provide a more detailed definition of agricultural transformation.

In recent decades, Bangladesh has emerged as one of the fast-developing economies in South Asia. From a food-deficit country relying on foreign aid and trade to feed its 75 million people after independence in 1971, Bangladesh has become self-sufficient in staple foods. This has been accomplished despite rapid population growth. The country now has more than 116 million people. The agriculture sector has mechanized swiftly, increased its use of inputs, raised land productivity and improved labour productivity. Many actors made those achievements possible, including the private sector, which is servicing farming and inputs-outputs channels, production and processing. Public policies have triggered this development process.

The agricultural production environment of Bangladesh has been facing many adversities. They include land scarcity, overexploitation of natural resources resulting in an alarming depletion of ground water, arable land degradation, fragmentation of land units and shrinking farm size, among other effects. Rising agricultural wages due to the opportunity cost of agricultural labour is becoming a challenge for continuing agricultural development. Against this background, how far can Bangladesh proceed with agricultural development? Can the country reach the end of the entire transformation? In which stage is it now?

To address those questions, this chapter attempts to understand the performance of the primary indicators of agricultural transformation, such as agricultural labour productivity, agricultural value-added to the share of GDP, the status of staple food production, the agricultural resources base, agriculture's share of employment and the status of farm mechanization. Supported by those indicators, this study characterizes the stages of agricultural transformation in the context of institutions and policy changes.

We reviewed a variety of literature with respect to agricultural transformation. A good number of studies have been conducted on stage-wise development of agriculture as well as rural transformation (Herrendorf, 2014; Salamanca and Rigg, 2017; Wood, 2017). Those works highlighted the importance of transformation as part of the process of poverty reduction and structural change (IFAD, 2016). While several such regional studies are available, there have been few specific to Bangladesh. A few earlier works concentrated mainly on resource endowment and livelihood strategy (IFAD, 2016; Hossain and Bayes, 2018). Regional studies put forward the general pattern of agricultural transformation (Timmer, 1998). More recent studies by Laborde *et al.* (2018) and Vos (2018) contributed to qualitative explanations of agricultural

transformation in the context of developing countries. We used multiple data and information, accessed from secondary sources, for this paper. Data and information sources include the Bangladesh Bank (BB), Bangladesh Bureau of Statistics (BBS), Ministry of Agriculture (MoA) and Ministry of Planning (MoP), the Food and Agriculture Organization of the United Nations (FAO), the International Food Policy Research Institute (IFPRI) and the World Bank (WB).

This paper is organized as follows. Section 2 identifies the evolutionary stages of agricultural transformation in Bangladesh against key stylized facts, and discusses the changes in key structural variables. They include rural farm structure, net cropped area, poverty and health scenarios, productivity of agricultural commodities, farm inputs use, farm diversity and rural electrification. Section 3 examines the state of key components driving agricultural transformation, including farm mechanization, variety and management technologies, agricultural research and extension, agricultural finance and agricultural value-chain development. Section 4 presents agricultural transformation's stage-specific key policies and institutional innovations. Section 5 summarizes the study findings and highlights the future challenges for Bangladesh to reach the subsequent stages of agricultural transformation.

2. Agricultural transformation

In line with the framework and definitions in chapters 1 and 2 of this publication, agricultural transformation in Bangladesh over the past 48 years fits into three transformation stages. This section examines the key attributes that characterise agricultural transformation in each stage. Furthermore, additional structural variables are also examined.

2.1 Agricultural transformation stages

Laborde *et al.* (2018) consider seven stages of agricultural transformation based on the works of Timmer (1998). For more details of the transformation framework see the first two chapters in this publication. This study has defined Bangladesh's transformation into three stages of the framework: *Getting agriculture moving* (stage 1), *labour moving out of agriculture* (stage 2) and *agriculture as a contributor to growth* (stage 3). We have included the *subsistence agriculture* stage, separately categorised by Laborde *et al.* (2018), into stage 1. Judged on the stylized facts of agricultural transformation, Bangladesh has yet to achieve the two most advanced stages, *agriculture integrated into the macroeconomy* and *industrialized economies*. Four stylized facts are summarized in Table 1: agriculture's share of GDP, agriculture's share of employment, agricultural land productivity and agriculture labour productivity.²

Table 1: Characteristics of agricultural transformation in Bangladesh, average by stage.

Transformation stage and period	Agriculture output share of GDP (%)	Agriculture share of employment (%)	Agriculture land productivity (CPI) ¹	Agriculture labour productivity ² (kg/rice/labour/year)
<i>Getting agriculture moving</i> (stage 1, 1971 to 1989)	42.4	79.0 ³	54.5	2500
<i>Labour moving out of agriculture</i> (stage 2, 1990 to 2010)	22.7	59.4 ⁴	91.3	3346
<i>Agriculture as a contributor to growth</i> (stage 3, post-2010)	14.9	42.9	140.1	4170

Data source: Hasan (2012); FAOSTAT (2020);

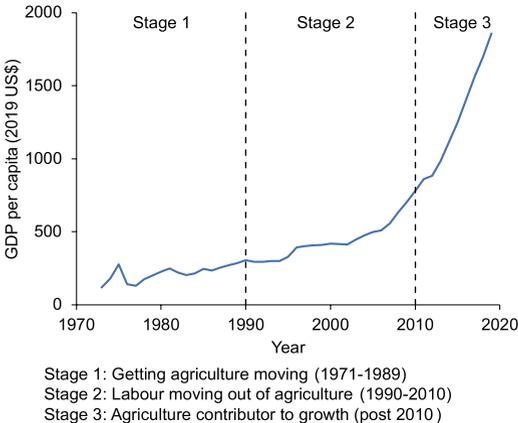
Notes: 1. Crop Productivity Index (CPI) is the average of all crops, except fodder, base year = average of 2004-06; 2. Data from Kabir *et al.* (2020); 3. Only 1974; 4. Excludes 1990.

² Data from Kabir *et al.* (2020); 3. Only 1974; 4. Excludes 1990

Getting agriculture moving (stage 1, 1971 to 1989): The economy of Bangladesh was totally devastated during the nine-month war of independence in 1971. The government at that time faced the mammoth task of rebuilding the country. It had inherited one of the poorest nations of the world with per capita GDP of US\$ 120* (Figure 1). The country suffered continued political unrest during this stage. The military dominated government and politics, directly or indirectly. The post-independence agricultural transformation of Bangladesh began when most farmers were still engaged in *subsistence agriculture*, as categorized by Laborde *et al.* (2018). Those who worked the land consumed most of their own produce. Agriculture’s share of GDP peaked at just below 60 percent in 1972, the beginning of *getting agriculture moving* (stage 1). Its share gradually fell to 30.56 percent in 1989, in the final year of stage 1, having averaged just over 42 percent for the entire stage (Table 1). Agriculture was by far the dominant source of employment, reaching 79 percent of employment in 1974. Land productivity, expressed in the crop productivity index, remained poor relative to the following stages, as did labour productivity (Figure 2).

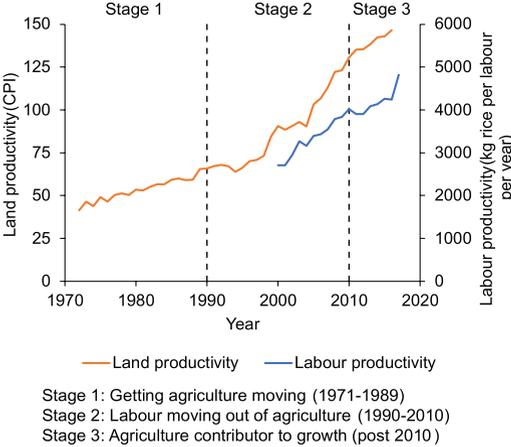
In this stage of transformation, the government laid the institutional foundation of agricultural research and development. It began the research and development activities of the Bangladesh Rice Research Institute (BARI) by establishing strong collaboration with the International Rice Research Institute (IRRI). It also founded a number of non-rice research institutes – the Bangladesh Institute of Nuclear Agriculture (BINA) and Cotton Development Board (CDB) in 1972, the Bangladesh Agricultural Research Institute (BARI) in 1976, the Bangladesh Fisheries Research Institute (BFRI) and the Bangladesh Livestock Research Institute (BLRI) in 1984. The government also initiated input distribution through government channels, provided huge input subsidies, supported output prices and applied targeted tariffs by type of commodity– with high tariff rates for some and low for others.

Figure 1: GDP per capita in Bangladesh 1972 to 2019



Data source: WDI (2020)

Figure 2: Land productivity and labour productivity in Bangladesh



Data source: FAOSTAT (2020); Labour productivity was estimated using data from Kabir et al. (2020)

Labour moving out of agriculture (stage 2, 1990 to 2010): With the restoration of democracy creating an improved socio-political environment, Bangladesh entered into the second stage of agricultural transformation. The economy started growing as evident from per capita GDP. The per capita GDP jumped from US\$ 286 during the final year of stage 1 to US\$ 781 in 2019 (Figure 1). Agriculture’s share of GDP declined sharply to 22.7 percent from 42.4 percent in the previous stage (stage 1). Movement of labour from agriculture to other sectors increased, although the sector still employed 59.4 percent of the country’s workforce (Table 1). Land productivity increased from, an average of, 54.5 in stage 1 to 91.3 (expressed as CPI). Also, labour productivity among rice workers rose to 3 346 from 2 500 in stage 1 (expressed as kg of rice per labourer per year).

In stage 2 of transformation, the government strengthened agricultural research and development together with extension and allowed the private sector to enter into agriculture. The government reduced agriculture input subsidies and its control over the agricultural input and output markets. It lowered tariff and non-tariff barriers and permitted the private sector to procure fertilizers and irrigation equipment.

Agriculture as a contributor to growth (stage 3, post-2010): Bangladesh entered into the current stage of agricultural transformation in 2011. This stage has been marked by political stability, allowing government to formulate and implement development plans. The average per capita GDP tripled from the previous stage 2 to US\$ 1 239* (Figure 1). Agriculture’s share in GDP continued to decline, as did its share of employment. However, agriculture still employed 42.9 percent of the nation’s workforce, dominating other sectors. Land and labour productivity continued to increase during this stage.

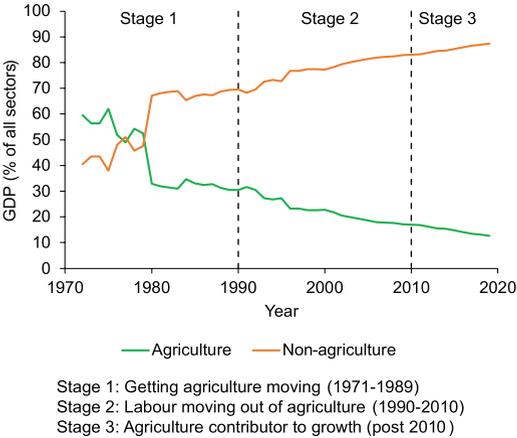
To strengthen wheat and maize crop development, the government established the Bangladesh Wheat and Maize Research Institute (BWMRI) in 2017. In this stage of transformation, the government focused on promoting agricultural diversification

and expanding horticultural crops (7th Five Year Plan, 2016 to 2020). The National Livestock Extension Policy (2013) was framed to update the knowledge and skills of policymakers and extension workers to provide demand-based extension services to livestock farmers in a non-formal participatory and decentralized manner. The private sector began importing feed ingredients at minimal or no tariffs, and invested more in livestock. The government also provided a 30 million Bangladesh taka (BDT) subsidy to help farmers buy farm machinery at cheaper prices so that they could minimize the cost of production.

2.2 Agricultural transformation from a macro perspective

Agriculture’s share of GDP declined from 60 percent in 1972 to 13 percent in 2018 (Figure 3). On the other hand, the share of other sectors increased by 2.2 times during that period, from 40 percent to 87 percent. Agriculture’s share of GDP declined because the sector grew at a slower rate than the economy as a whole. During the initial transformation stage, *getting agriculture moving* (1971 to 1989), the GDP of agriculture grew on average 1.9 percent per year. That pace quickened to 3.9 percent per year, in the next stage *labour moving out of agriculture* (1990 to 2010), but slowed slightly to 3.5 percent per year in the third stage *agriculture as a contributor to growth*.

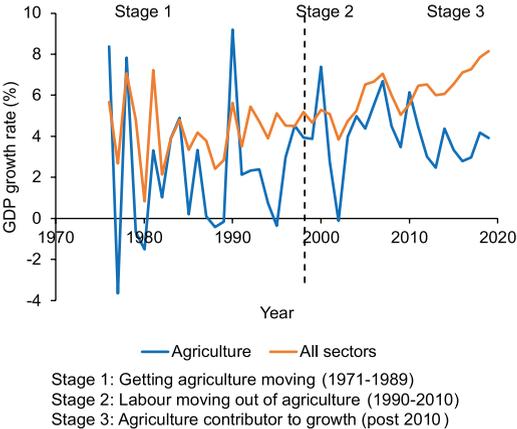
Figure 3: Composition of GDP in Bangladesh by sector 1972 to 2018



Data source: WDI (2020)

By contrast, the national GDP grew faster than agriculture at 4.0, 5.2 and 6.9 percent, respectively, during the three stages (Figure 4). During the first stage, annual growth rates for both agriculture and non-agriculture sectors experienced significant variability. During the second stage, agriculture’s growth was volatile while growth in the rest of the economy was more stable. In the third stage, national growth was much smoother, but agriculture’s growth was still erratic. This indicates that uncertainty has been a consistent issue in the growth of agriculture in Bangladesh.

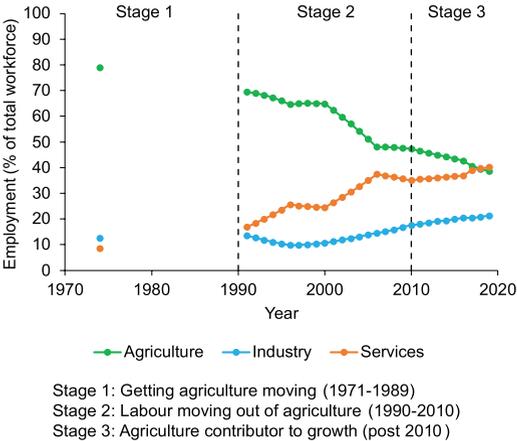
Figure 4: The rate of GDP growth in Bangladesh compared with agriculture and other sectors 1972 to 2018



Data source: WDI (2020)

Agriculture was the largest sector for employment for many years, accounting for 79 percent of the country’s workforce in 1974 and 68 percent in 1991 (Figure 5). Over time, the service sector slowly and steadily surpassed agriculture, employing 40 percent of the workforce compared to 39 percent by agriculture in 2018. Industry’s share of employment is noteworthy in the ongoing stage of transformation, accounting for about 20 percent of jobs in 2018 compared with about 12 percent in 1991 (Figure 5).

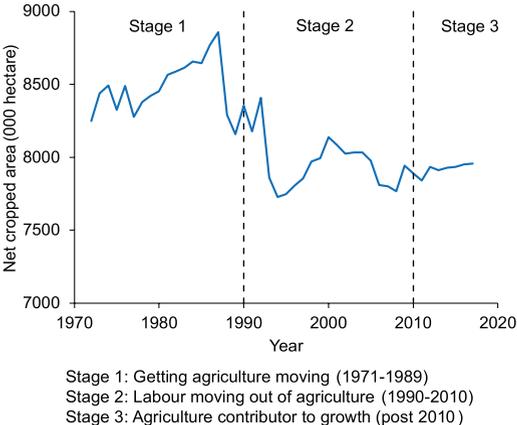
Figure 5: Share of employment in three economic sectors in Bangladesh 1972 to 2018



Data source: Hasan (2012); WDI (2020)

There is significant pressure on agricultural from alternative uses and loss of land to natural disasters. However, during stage 1 of agriculture transformation the net cropped area (NCA) increased by encroaching on fallow lands. The floods in 1987 and 1988 significantly reduced the NCA. Over 1990s the newly created fallow lands were once again converted to agriculture lands, hence increasing the NCA once again but not to the levels of 1970s. It is estimated that Bangladesh has been losing agricultural land at a rate of nearly 1 percent per year over the recent past, according to the Bangladesh Bureau of Statistics and independent sources (Dhaka Tribune, 2016). In 1972, the country had 8.24 million hectares of NCA, which is estimated at slightly less than 8 million hectares (Figure 6). Land conversion to housing and urban development as well as losses to soil salinization, desertification, droughts and rising sea levels are key factors contributing to loss of agriculture land. Rice, synonymous with food security in Bangladesh, is losing land at a rate of 0.4 percent per year (Kabir *et al.*, 2015).

Figure 6: Status of net cropped area in Bangladesh 1972 to 2017



Data source: M. Nasim, Rice Farming Systems Division, Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh (personal communication)

The rural areas of Bangladesh have changed dramatically. The number of households has almost doubled in stage 3 compared to stage 1 of transformation (Table 2). Nearly 73 percent of rural households were considered farm households in stage 1, which declined to just over 63 percent in stage 3. This indicates development of non-farm rural livelihoods over time. The proportion and number of small farms have been increasing, whereas medium and large farms have been decreasing (Table 2). This is happening predominantly due to land fragmentation across generations. Land is fragmented every year in both in rural and urban areas due to growing population, the formation of nuclear family and the inheritance law (Islam, 2014).

Table 2: Status of rural households and farms by transformation stage

Criterion	Timeline			
	Stage 1	Stage 2		Stage 3
	1983/84	1996	2008	2019
Rural households				
All (million)	13.82	17.83	25.35	27.48
Non-farm (million)	3.77	6.03	10.48	10.14
Farm (million)	10.05	11.80	14.87	17.34
Farm (percentage of rural households)	72.70	66.18	58.66	63.11
Percentage of farms by size category				
Small (0.020-1.01 hectare)	70.64	79.87	84.27	90.98
Medium (=>1.01-3.03 hectare)	24.62	17.61	14.19	8.17
Large (3.04 hectare & above)	4.74	2.52	1.54	0.85
Number of farms by size category (million)				
Small (0.02-1.01 hectare)	7.1	9.4	12.53	15.78
Medium (=>1.01-3.03 hectare)	2.47	2.08	2.11	1.42
Large (3.04 hectare & above)	0.48	0.30	0.23	0.15
Average land size across all rural households (hectare)				
Homestead area (hectares per household)	0.028	0.028	0.032	0.032
Cultivated area (hectares per household)	0.810	0.607	0.510	0.263

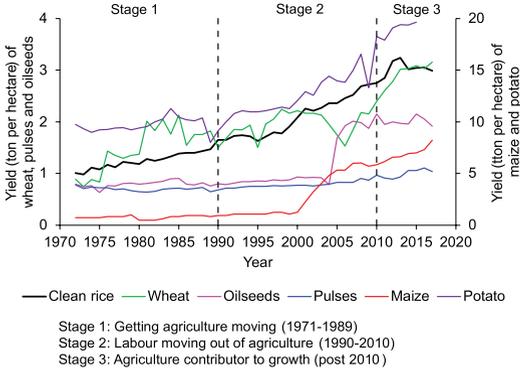
Data source: Agricultural Censuses, Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning, Government of Bangladesh, Dhaka, Bangladesh

Farms in Bangladesh are managed under three operational modes: owner, tenant and a mix of the two (e.g. farmers owning some land but also rent some). Within each mode, there are three farm-size categories – small (0.02 to 1.01 hectares), medium (1.01 to 3.03 hectares) and large (3.04 and above hectares). The latest available statistics (2008 Agricultural Census) show that 8.4 (57 percent of all farms) and about 6 million farms (40 percent of all farms) are managed under the owner and mixed owner-tenant tenure systems, respectively. Some 0.47 million or 3 percent of the total farms are managed by tenants. By comparison, 61 percent of farms were managed by owners, 37 percent by owner-tenant mix and 2 percent by tenants in 1960 (Jabbar, 1978). This indicates very little change in the structure of farm management over nearly five decades.

Crop productivity (expressed as yield per hectare) has increased tremendously during the last five decades. Clean rice (processed) yields have gone up from about one tonne per hectare in 1972 to about three tonnes per hectare in 2017 (Figure 7). This growth has occurred almost linearly during the period. Potato yields grew in a pattern similar

to rice and is a key staple in the national diet. The productivity of other major crops, except pulses, remained low and did not improve much until the early 2000s. A marked jump in yields was noticeable for maize and oilseeds, whereas the productivity of pulses remained low throughout the period. Over 100 mostly minor crops are listed in the agricultural statistics of Bangladesh (BBS, 2018). While long-term statistics are not available, these crops are highly important for a balanced and nutritious diet.

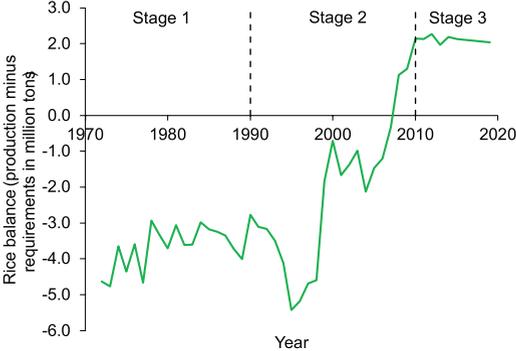
Figure 7. Performance of major food crops in Bangladesh 1972 to 2017



Data source: FAOSTAT (2020)

Achieving self-sufficiency in rice, the staple food, has been the most significant accomplishment of Bangladesh agriculture. The country faced chronic food shortages after the war of independence. There was a shortfall of about 4.6 million tonnes of rice in 1972. The size of this deficit persisted until 1999, when it fell significantly to about 1.8 million tonnes (Figure 8). At that point, the deficit began steadily narrowing until the country produced its first rice surplus in 2008. Since then, Bangladesh has been maintaining rice self-sufficiency.

Figure 8. Rice consumption – production difference in Bangladesh, 1972 to 2019



Stage 1: Getting agriculture moving (1971-1989)
 Stage 2: Labour moving out of agriculture (1990-2010)
 Stage 3: Agriculture contributor to growth (post 2010)

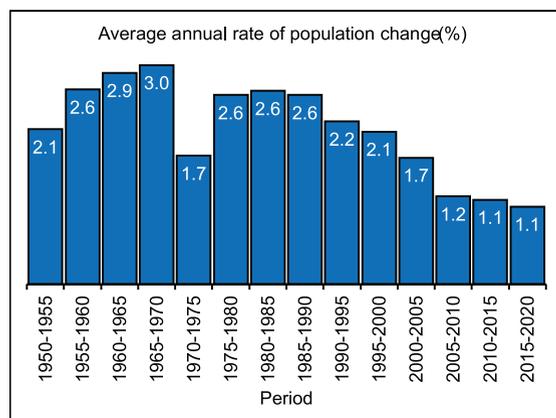
Source: Estimated as the difference between production and requirements, using data from Kabir et al. (2015)

Figure 8 presents the difference between annual rice consumption requirements (food, feed, waste, postharvest losses, seeds and other uses) and production. However, applying the self-sufficiency ratio (SSR) methodology³ indicates that rice self-sufficiency has significantly improved over the years but Bangladesh is still not rice self-sufficient in all years, which figure 8 may imply.

Bangladesh is one of the most densely populated countries in the world. Its population has steadily increased over time. In the early 1950s, the annual rate of population change was high at about 2 percent, which climbed to roughly 3 percent by the late 1960s (Figure 9). The rate has been slowing since then and fell back to about 2 percent by the late 1990s. Today, the population growth rate is about 1 percent.

³ For SSR methodology please see: <http://www.fao.org/3/i2493e/i2493e06.pdf>

Figure 9. Annual population growth in Bangladesh 1950 to 2020



Data source: Department of Economic and Social Affairs, Population Division, United Nations

Table 3 tracks the poverty trend using upper and lower poverty lines in 2000, 2005, 2010 and 2016. Overall, poverty has been falling. Using both the upper and lower poverty lines, the number of poor people living in rural areas had been higher than the number in urban areas. The reasons include high population growth, lack of employment opportunities, lower wage rates, and lack of non-farm jobs in rural areas. While rural poverty was and still is higher in rural areas than urban areas, it is decreasing faster than that of urban poverty (Table 3)). This is likely because of rural-out-migration.

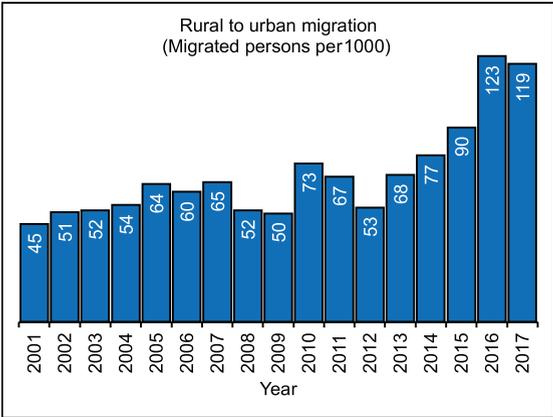
Table 3: Poverty status in urban and rural Bangladesh in four years

Year	Poverty headcount (%)					
	Upper poverty line			Lower poverty line		
	Urban	Rural	National	Urban	Rural	National
2000	35.2	52.3	48.9	19.9	37.9	34.3
2005	28.4	43.8	40.0	14.9	28.6	25.1
2010	24.5	35.2	35.0	12.4	23.4	17.6
2016	18.9	26.4	24.3	10.8	19.8	12.9

Data source: HIES 2000, 2005, 2010 and 2016.

The development of the garment industry played an important role in providing employment to poor people migrating from rural areas. Migration to urban areas rose marginally from 2001 to 2014, but since 2015 it has increased sharply. Around 119 out of every 1 000 persons moved to urban areas in 2017, compared to only about 45 out of 1 000 in 2001. Figure 10 depicts the number of people migrating from 2000 to 2020.

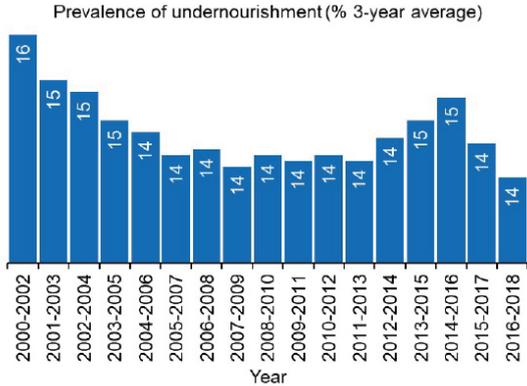
Figure 10. Rural to urban migration in Bangladesh 2001 to 2017



Data source: WDI (2020)

The prevalence of undernourishment decreased from 16 percent in 2000 to 2002 (3-year moving average) to 13 percent in 2017 to 2019 (Figure 11). Overall, undernourishment has been falling since 2000, despite a brief spike. From 2011 until 2016, undernourishment rose, but started to decline and stands at around 14 percent.

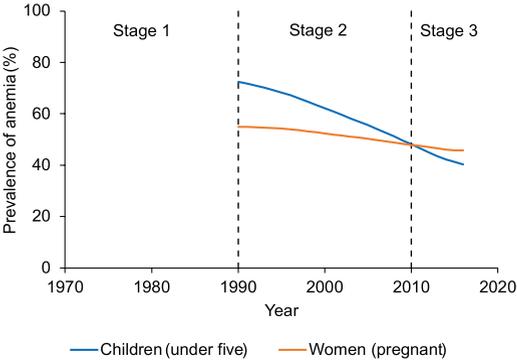
Figure 11: Prevalence of undernourishment in Bangladesh 2000 to 2018



Data source: WDI (2020)

Bangladesh has made important progress in curbing the prevalence of anaemia as evident from declines in the prevalence of anaemia among children under 5 years and among pregnant women (Figure 12). The percentage of anaemia among children and among pregnant women fell from 72.5 and 55 percent, respectively, in 1990 to 40.3 and 45.7 percent in 2016. The rate of decline was much faster among children under 5 years than among pregnant women.

Figure 12. Prevalence of anaemia in Bangladesh among children under 5 years and pregnant women

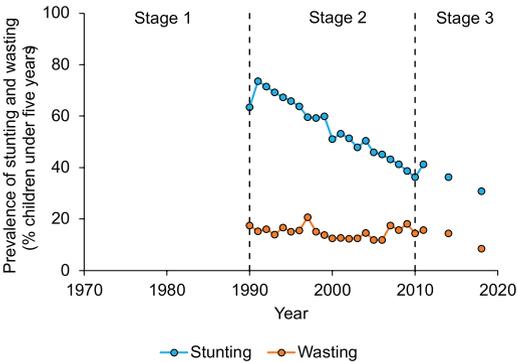


Stage 1: Getting agriculture moving (1971-1989)
 Stage 2: Labour moving out of agriculture (1990-2010)
 Stage 3: Agriculture contributor to growth (post 2010)

Data source: WDI (2020)

The country has also made good progress in curtailing its child malnutrition rate as documented in data on the prevalence of stunting and wasting among children under 5 years. The percentage of child stunting and wasting fell from 63.4 and 17.5 percent in 1990 (stage 2) to 30.8 and 8.4 percent, in 2018 (stage 2), respectively (Figure 13).

Figure 13. Prevalence of stunting and wasting among children under 5 years in Bangladesh



Stage 1: Getting agriculture moving (1971-1989)
 Stage 2: Labour moving out of agriculture (1990-2010)
 Stage 3: Agriculture contributor to growth (post 2010)

Data source: FAOSTAT (2019) and WDI (2020)

3. Key components of agricultural transformation

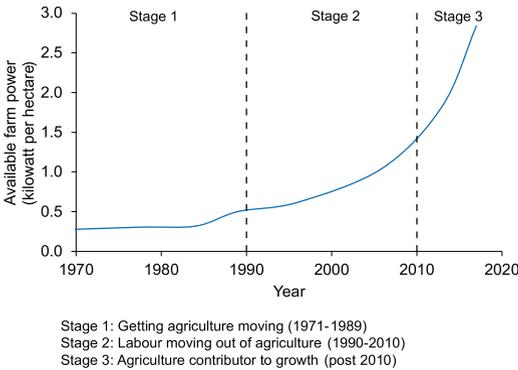
The development of key components that contributed to agricultural transformation is discussed in this section. The associated policies that influenced the growth of the components are also examined. This section only highlights the main factors contributing to agricultural transformation.

3.1 Farm mechanization

During 1960 to 1965, the government distributed 2 238 low lift pumps (LLPs), 200 four-wheel tractors and 13 828 sprayers. Following a fierce cyclone in 1970, international charitable organizations donated 135 tractors and 569 power tillers. In the aftermath of a devastating flood in 1988, the government liberalized its import policy, resulting in accelerated mechanization. It also provided a modest subsidy to help farmers purchase machinery. This was the major factor in the growth of farm mechanization in Bangladesh (Mandal, 2017).

On average, the power available to farms was 0.27 ± 0.03 (\pm is standard deviation) kW per hectare in stage 1 of transformation, which increased by over three times (0.84 ± 0.37 kW per hectare) in stage 2 (Figure 14). Farm power availability continued to grow in stage 3, increasing by 2.26 times over the previous stage (2.26 ± 0.43 kW per hectare). However, the current installed power (2.84 kW per hectare of cultivable land in 2017) is considered inadequate to sustain profitable farming operations (Alam, 2019). Table 4 illustrates how the use of farm machinery grew rapidly, particularly in land preparation, irrigation and post-harvest, with a focus on rice cropping.

Figure 14. Trend in farm power availability in Bangladesh 1970 to 2017



Data source: Mottaleb and Krupnik (2015); MoA (2016); Ahmmed (2017); Islam (2018); Alam (2019)

Table 4: Farm mechanisation: Total No. of machinery and units [per 1000 ha] by stage

Agricultural operation/ Machinery	Agricultural transformation stage		
	Stage 1	Stage 2	Stage 3
Land preparation			
Tractor	567 [0.27]	13,787 [2.13]	30,6855 [3.88]
Power tiller	1900 [0.23]	301,946 [44.86]	560,014 [70.78]
Seeding/transplanting			
Seeder	-	606 [0.08]	3,095 [0.39]
Rice transplanter	-	-	400 [0.05]
Weeding			
Weeder	-	-	250,000 [31.43]
Fertilizer application			
Prilled urea applicator	-	-	800 [0.10]
Granular urea applicator	-	-	18,000 [2.26]
Chemical application			
Sprayer	-	1,250,000 [160.92]	1,275,000 [161.42]
Irrigation			
Deep tube well	10,842 [1.30]	29,837 [3.97]	35,322 [4.44]
Shallow tube well	97,912 [11.81]	1,122,508 [168.28]	1,575,136 [198.01]
Low lift /power driven pump	36,765 [4.41]	119,397 [17.67]	300,613 [37.79]
Solar pump	-	-	320 [0.04]
Harvesting			
Reaper	-	40 [0.01]	1,525 [0.19]
Combined harvester (mini)	-	30 [0.004]	650 [0.08]
Post-harvesting			
Thresher (open drum)	1,750 [0.21]	70,000 [16.65]	170,000 [21.54]
Thresher (closed drum)	550 [0.07]	25,000 [5.76]	142,500 [17.97]
Maize sheller (Hand & power)		475 [0.11]	24,250 [3.05]
Jute ribboner		-	40,000 [5.03]
Sugarcane crusher		-	50,000 [6.29]
Winnower		500 [0.06]	1,100 [0.14]
Dryer		-	500 [0.06]
Rice milling		-	15,000 [1.89]
BRRI improved parboiling tank		-	70 [0.01]

Notes: Figures in [bracket] are the number of units per 1 000 ha of cultivable land.

Data source: Authors' compilation and analysis using data from Mottaleb and Krupnik (2015); MOA (2016); Ahmmed (2017); Islam (2018); Alam (2019).

Bangladesh agriculture has gone through a significant change since the 1990s (the start of stage 2) with the liberalization of the farm machinery market and the emergence of private sector machinery companies. Alongside the import and after-sales service provisions by private sector companies, the farm machinery manufacturing sub-sector had also started to grow (Alam, 2019). The major policy changes and actions influencing farm mechanization are presented in Table 5 and discussed below.

Table 5: Highlights of farm mechanization in the agricultural transformation of Bangladesh

Stage of transformation	Key policies and/or actions ⁴
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Early part, public sector control of import and distribution of irrigation equipment ○ Late part, reduced public sector control; STW import duties reduced, liberal credit offered
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ Withdrawal of equipment import ban and spacing regulation ○ Removal of import duties and engine standardization ○ Credit and extension support
Stage 3. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ Rapid growth of local manufacturing, repair facilities, rural mechanic services, supported by vocational training provisions largely in private sector. ○ Innovative contractual arrangements led to operational consolidation of fragmented holdings. ○ Farm mechanization road map 2016

In stage 1, *getting agriculture moving*, the first government of newly independent Bangladesh provided strong support for agricultural mechanization, facilitated large-scale irrigation by establishing deep tube wells (DTWs), renting out LLPs through the Bangladesh Agricultural Development Corporation (BADC), and providing diesel for irrigation pumps at a subsidized rate of 75 percent. Some of the key initiatives included:

- The BADC abandoned tillage machinery extension during 1977/78. In 1978, the government decided to change its policy of direct involvement in the input market and embraced a market liberalization policy because of the heavy financial and management burdens related to the large number of irrigation pumps. In addition, it gradually started selling pumps and DTWs to farmer cooperatives and to individual farmers.

⁴ Some policies and/or actions overlap between the stages

- In 1979, the government allowed the private sector to import and distribute shallow tube wells (STWs), with credit facilities from commercial banks. As a result, the private sector started workshops for repairing irrigation equipment. It reduced the import duty on STWs to 15 percent in 1980, and the private sector started manufacturing pumps.
- From 1984 to 1987, the government promulgated and enforced the ‘Groundwater Management Ordinance.’ It imposed a ban on the private sector’s import of small diesel engines in response to a drawdown of aquifer during the 1983 drought. During this period, the private sector was limited to trading a few standardized engine brands. Sales of STWs dropped because of restrictions on installation within specified zones and spacing regulations.
- During 1985 to 1987, the government established a workable foreign exchange market and lifted many non-tariff barriers. However, it retained non-tariff barriers for diesel engines for irrigation and power tillers.
- In 1988, the government eliminated import taxes on standardized (approved for agriculture) diesel engines and power tillers. Consequently, private sector imports accelerated.
- In 1989, the government ended standardization, allowing imports without taxes for all 3-20-hp diesel engines and all power tillers. During this period, private sector bans on small engine imports were removed, import duties were eliminated, standardization requirements for equipment were abolished, and tube well boring restrictions were withdrawn. Private traders started importing cheaper STWs from China, and multiple engine brands and sizes entered the market (Gisselquist *et al.*, 2002; Hossein, 2019; Mottaleb *et al.*, 2017).

In the beginning of stage 2, *labour moving out of agriculture*, the BADC started clearing out its stock of irrigation equipment and stopped monitoring boring equipment. The market expanded for engines, pumps, and spare parts. Repair shops mushroomed all over the country. During 1995, the import of power tiller/2WT was made duty-free, and credit support was provided for the purchase of those machines. In 2009, the government took up a 1.5 billion taka scheme to speed up farm mechanization by offering a 25 percent subsidy for agricultural machinery, such as power tillers, tractors, power threshers and combine harvesters. The project was extended until June 2019 and the government raised the subsidy to farmers for purchasing agricultural machinery to 50 percent in two stages. The subsidy was raised to 70 percent in January 2017 (Hossein, 2019).

In stage 3, *agriculture as a contributor to growth*, the government provided a subsidy of Taka 30 billion to help farmers buy farm machinery so that they could minimize labour costs (Bangladesh Post, 2020). With this allocation, farmers in Haor region will receive 70 percent subsidy on the purchase of farm machinery and all other regions will receive 50 percent subsidy (Financial Express, 2020).

The Minister of Agriculture recently said that the government would be able to ensure 100 percent use of agricultural machinery in the paddy harvest in three years while transplantation will take more time (Daily Star, 2020).

3.2 Seed system

The staged development of the seed system in the agricultural transformation of Bangladesh is highlighted in Table 6. In the early stage of transformation, the government relied on the public sector to multiply and supply quality seeds to farmers through two organizations: the Bangladesh Agricultural Development Corporation (BADC) and the Department of Agricultural Extension (DAE). Major policy changes have been made since then for seed production and distribution. However, most breeding and variety testing still occurs in the public sector. For non-strategic crops - other than rice, wheat, jute, sugarcane and potato- testing by the government is not required for cultivar registration.

Table 6: Highlights of seed system in the agricultural transformation of Bangladesh

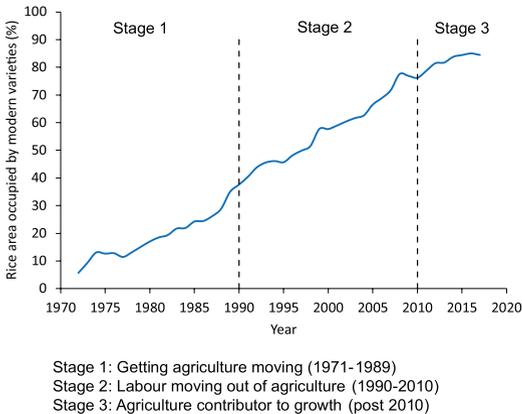
Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Seed Certification Agency established (1974) ○ Seeds Ordinance of 1977
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ Seed Policy of 1993 ○ Seed Rules of 1998
Stage 2. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ Private sector led hybrid seed market

In the early part of stage 2, the seed system was gradually liberalized under the National Seed Policy of 1993 (NSP 1993) through a series of amendments to the Seeds Ordinance of 1977. These included the Seeds Amendment Acts of 1997, 2005 and 2007 and the Seed Rules of 1998. Many restrictions for strategic/notified crops (rice, wheat, potato, jute and sugarcane) were reduced and imports made easier. The government allowed the private sector to import and sell hybrid seeds in 1998 to boost food production.

In stage 3, the public and private sectors together are meeting 26.2 percent of the national annual seed demand for non-vegetable crops. Farmers meet the rest of their requirement through the seeds they preserve and informal markets. Rice is the most important crop in Bangladesh, where modern (both inbred and hybrid) varieties have reached coverage of roughly 85 percent of the rice area (Figure 15). However, only 60.78 percent of seed demand has been met formally, with 51.41 percent and 9.37 percent, respectively, coming from the public and private sector. For vegetable seeds, the country has met about 84.12 percent of the total requirement, with 3.19 percent and 80.93 percent contributions from the public and private sectors, respectively. NGOs and private seed companies are heavily involved in hybrid seed multiplication and marketing. They are supplying around 90 percent of hybrid seeds, mainly for maize, vegetables and spice cultivation. About 150 seed companies are active in Bangladesh. The private sector still faces stiff competition from the BADC in subsidized seed

distribution for notified crops, which currently include rice, wheat, jute, potato and sugarcane.

Figure 15. Coverage (percentage by area) of modern (inbred and hybrid) rice varieties in Bangladesh 1970 to 2017

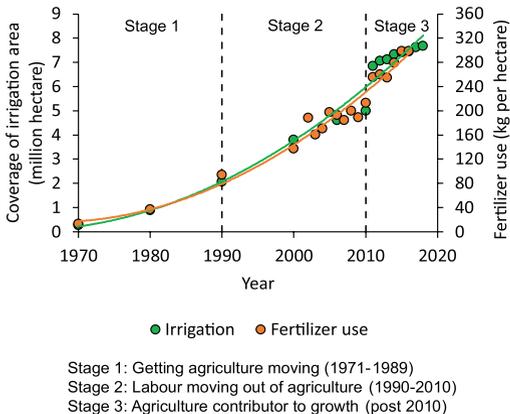


Data source: Md. Abdullah Al Mamun, Agricultural Statistics Division, Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh (personal communication)

3.3 Irrigation and fertilizer sector

Areas under irrigation have continued to expand. In stage 1 of transformation, the crop area covered by irrigation was relatively small, averaging 1.1 million hectares per year, but rose to 3.9 million in stage 2 and 7.3 million in stage 3 (Figure 16). Government involvement in facilitating the use of irrigation machinery helped to rapidly expand irrigated areas (Section 3.1).

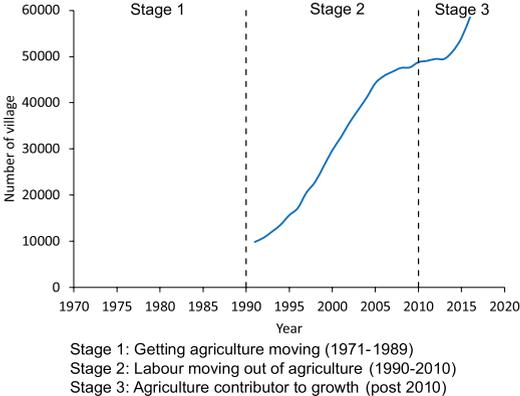
Figure 16. Trend in irrigation area and fertilizer use in Bangladesh 1970 to 2018



Data source: MoA (2019) and FAOSTAT (2020)

The expansion of electrification in rural areas facilitated the use of electric-powered irrigation equipment. Within a span of two decades, there has been a five-fold increase in access to electricity in rural Bangladesh (Figure 17).

Figure 17. Trend of rural electrification in Bangladesh 1990 to 2016



Data source: Annual report (2016/17), Bangladesh Rural Electrification Board

Fertilizer use increased, following almost the same pattern of irrigated area expansion. On average, total fertiliser application in stage 1 was 48 kg per hectare per year. In stage 2 the fertiliser use jumped by over 3.5 times to 175 kg per hectare per year, and over 1.5 times in stage 3 to 275 kg per hectare per year in stage 3 (Figure 16).

Table 7: Highlights of irrigation and fertilizer sectors in the agricultural transformation in Bangladesh

Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Subsidy on urea fertilizer
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ Subsidy extended to TSP, MOP and DAP
Stage 2. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ Increased subsidy for all fertilizers

The use of fertilizer in Bangladesh dates back to the 1950s. Initially, all chemical fertilizers were imported and distributed free of cost. The fertilizer subsidy programme was linked with the ‘Green Revolution’ in the 1960s that encouraged improved agricultural input use, such as fertilizer, seeds and irrigation. Until 1992 (stage 2), the BADC gave a fertilizer subsidy in different forms, although with breaks in some years. The progress toward developing a competitive fertilizer market structure was

hampered in 1994/95 because of a severe shortage of fertilizer supply. Subsequently, the government again started controlling the fertilizer market. In 1997/1998, the Bangladesh Chemical Industries Corporation (BCIC), a government agency, was tasked to manage fertiliser import and marketing. The BCIC was the sole agency importing fertilisers, fixing domestic prices and covering the gap between import and domestic prices (Alam, 2018). In 1996, the BCIC began importing urea, bringing in between 500 000 to 700 000 metric tonnes per year. Initially, the government provided subsidies only for imported urea. In stage 2, to ensure balanced nutrients, from 2004 to 2005 the government also started giving subsidies for imported Triple Super Phosphate (TSP), Muriate of Potash (MOP) and Diammonium Phosphate (DAP). According to the Ministry of Agriculture, Bangladesh has a yearly demand of approximately 5 million tonnes of fertilizer, of which 2.7 million tonnes are urea and the rest are non-urea fertilizers.

Since 2019, the government repeatedly reduced the fertilizer price in stages with the latest selling price per kg of TSP dropping to 22 taka from 80 taka, and of MOP to 15 taka from 70 taka and for DAP to 16 taka from 90 taka (the Daily Star 2021). The budget implications have been significant particularly when international fertiliser prices are high.

3.4 Diversifying agricultural production and diets

The traditional farming activities in Bangladesh include production of crops, raising animals, culturing/catching fish, collecting fuel, growing fuel, and growing timber trees. As the economy developed, farmers began responding to political and market demands. The initial policy objective was to achieve self-sufficiency in rice. From stage 2 onwards, consumers changed their diets and farmers started to raise more cash crops, livestock and fisheries. As of 2018, the Bangladesh Bureau of Statistics (BBS,2020) estimates that the agriculture sub-sectoral GDP breakdown is 53.5 percent from crops, 13.4 percent from livestock, 23.0 percent from fish and 10.1 percent from forestry. The gap between crop production and livestock and fisheries production is widening in stage 3, relatively more between crops and livestock than crops and fisheries (Figure 19).

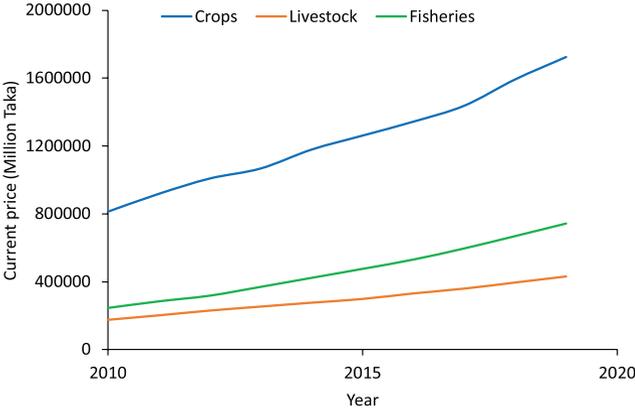
Table 8: Agricultural production and diet diversification, policy focus by stage

Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Poor crop and farm diversification
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ National Fisheries Policy in 1998 ○ Crop Diversification Programme (CDP)
Stage 2. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ Livestock Development Policy 2007 ○ National Poultry Development Policy (2008) ○ National Food Policy Plan of Action (2008 to 2015) ○ National Agricultural Policy (2018) emphasized crop diversity

Value addition in the crops sub-sector is increasing because of the growth of vegetables and fruit cultivation. During stage 3 (post-2010), the area harvested to maize (as feed to livestock and fisheries sectors) has increased by nearly 300 thousand hectares, while area harvested to rice has been essentially constant. Area harvested to fruits and vegetables has also increased by nearly 300 thousand hectares during the period (FAOSTAT 2020). This shows some diversification within the crops sector.

Rice, however, remains the dominant crop. In 1989, realizing the importance of growing non-rice crops, the country launched the Crop Diversification Programme (CDP), undertaken jointly by the Government of Bangladesh, the Government of the Netherlands and Canada's International Development Agency (Policy Options for Supporting Agricultural Diversification in Bangladesh, 2013). The intention was to increase the area and production of minor crops such as potato, sweet potato, pulses, maize and millet. This was contained in the 5th Five-Year Plan 1997 to 2002 (Miah, 2011), and in subsequent five-year plans. The 7th Five Year Plan 2016 to 2020 focused on promoting agricultural diversification and expanding horticultural crops. The National Agricultural Policy (NAP, 2018) also emphasized crop diversity.

Figure 18. GDP from crops, livestock and fisheries sub-sectors in Bangladesh 2010 to 2019



Data source: Statistical Year Book (various issues), Bangladesh Bureau of Statistics (BBS).

To improve the poultry sector, the National Poultry Development Policy (NPDP, 2008) was formulated to support the poultry industry and to control the quality of inputs for sustainable poultry development. In 2007, the government issued, the National Livestock Development Policy (NLDP, 2007). Later, the National Livestock Extension Policy (NLEP, 2013) was framed to update the knowledge and skills of policymakers and extension workers to provide demand-based extension services to livestock farmers in a non-formal participatory and decentralized manner.

The fisheries sector is contributing to diversifying agriculture production and diets. Freshwater aquaculture in Bangladesh took off around 1994, during stage 2. Although initial development mainly concerned carp, since 2009, catfish and tilapia cultivation have grown rapidly. Carp production has been stagnant or even declining. From 2009 to 2017, freshwater aquaculture had an average annual growth rate of 10 percent, ranging from 2 percent for carp and 156 percent for tilapia. The main driver has been the continued rise of domestic demand for fish with the rapid increase in population. The maize-based feed industry accelerated the expansion of inland freshwater aquaculture production. Reduced import tariffs and non-tariff barriers on animal feed ingredients in the early 2000s contributed to this expansion. To foster the development of the sector, the government adopted the National Fisheries Policy (NFP, 1998) aimed at enhancing fisheries resources and production to fulfil the demand for animal protein, achieving economic growth through exporting fish and fisheries products, maintaining ecological balance, conserving biodiversity, ensuring public health, providing recreational facilities, alleviating poverty through the creation of self-employment, and improving the socio-economic conditions of the fishers.

The government developed its National Food Policy Plan of Action (2008 to 2015) for increasing and improving management of production of high value crops, fish

and livestock products. Diversified agriculture that supplements crop production with livestock production would be crucial for increasing dietary diversity and stabilizing the micronutrient daily intake.

3.5 Agricultural research and extension

The significant events on research and extension during the three agricultural transformation stages in Bangladesh are presented in Table 9 and discussed afterwards.

Table 9: Highlights of research and extension in the agricultural transformation in Bangladesh

Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Establishment of research institutions ○ Research linkage with the International Research Institute (IRRI)
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ Release of high genetic potential crops, livestock and fish ○ New Agricultural Extension Policy 1996
Stage 3. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ National Agricultural Extension Policy 2012 ○ National Livestock Extension Policy 2013 ○ Agricultural Research Vision 2030 ○ Rice Vision 2050 ○ Achieving SDGs

Getting agriculture moving (1971 to 1989): During this stage, the government gradually started building agricultural research institutes to initiate research and development activities. Establishment of all the major research institutes was completed in stage 1. Importantly, strong linkages were established between the Bangladesh Rice Research Institute (BRRI) and the International Rice Research Institute (IRRI). The IRRI especially helped on developing breeding capacity for high yield varieties. During this period, the BRRI developed a ‘rainfed mega rice variety’ (BR11).

The training and visit (T&V) agricultural extension system model, developed by the World Bank, was piloted in a few regions in Bangladesh in 1978. In 1983, it was expanded to the whole country. Its unique and distinguishing features were: (i) one block supervisor would take rotational visits to eight designated sub-blocks once in a fortnight, and (ii) transmit information through contact farmers assuming that they, in turn, would transmit this information to other farmers (Afrad *et al.*, 2019). The system gradually lost both effectiveness and the support of stakeholders. The reasons included (i) lack of participation of farmers and field-level extension staff in the predominantly ‘top-down’ mode of planning process; (ii) the model had a scale bias to the disadvantage of small and marginal farmers, (iii) the extension message did not trickle-down from contract farmers to other farmers, and (iv) extension messages and

support did not fully reflect farmer needs. In addition, poor linkages between research, extension and education also contributed to the divergence between farmer needs and extension services.

Labour moving out of agriculture (1990 to 2010): The research capacity of agricultural research institutes increased, and new high yield crop varieties were developed. The BRRI released BRRI dhan28 and BRRI dhan29, two ‘mega-rice varieties’ early in this stage. Research and development of improved and exotic species of vegetables and fruits gained momentum. Improved species of animals, birds and fish were introduced. An agricultural research vision and rice vision were developed. Research institutes started to create action plans for achieving related Sustainable Development Goals (SDGs).

The New Agricultural Extension Policy was launched in 1996 (NAEP, 1996) linking the role of agricultural extension to national policy. In 1999, the Agricultural Services Innovation and Reform Project (ASIRP) was launched to enhance the capacity of all categories of farmers, especially landless, marginal, and small farmers. It taught them to optimize the use of their resources on a sustainable basis. In addition to stepping into demand-based extension, the NAEP, 1996 aimed at decentralizing extension programmes because the agro-climate conditions and information needs of farmers vary from region to region.

Agriculture as a contributor to growth (post-2010): This stage highlights the strong growth of research in all sub-sectors of agriculture. The BRRI released BRRI dhan48, another promising mega-variety of rice. Fingerlings of a variety of fish species were made available to commercial farmers based on research by the Bangladesh Fisheries Research Institute.

In order to address emerging challenges in agriculture, particularly in achieving food security, the government has been implementing the National Agricultural Technology Project (NATP) towards the end of stage 2. The NATP added an additional USD 71 million to the Department of Agriculture Extension (DAE). As explained by Afrad *et al.* (2019), under NATP concept, farmers are organized in groups, called the common interest groups (CIGs) or Farmer Producer Groups (FPGs); they are based in village, union (the smallest rural administrative and local government unit), and block⁵ levels. Farmers, in groups, learn how to produce and market different crops through trainings organized by the extension service providers. A CIG has more of small and marginal farmers (as high as 80 percent), of which a minimum of 30 percent are women farmers. Five types of CIGs are constituted: (i) crop farmers, (ii) livestock farmers, (iii) fish farmers, (iv) farmers interested only in high-value crops, and (v) farmers producing special agricultural commodities under contract farming. In addition, one-stop services are provided to farmers at the Farmer’s Information and Advice Centres (FIACs) established in the Union Parishad⁶ Complex. One Sub Assistant Agriculture Officer (SAAO), belongs to the DAE, serves in the FIAC rotationally and provides necessary

⁵ The lowest unit of crops agriculture extension operation in Bangladesh. Each ‘union’ is divided into three blocks; a block is serviced by a Sub Assistant Agriculture Officer (SAAO).

⁶ Union council or rural council, the office of the smallest rural administrative and local government, run by an elected body.

extension and advisory services to the farmers. The FIACs are composed of SAAOs and other field extension personnel of the Department of Livestock Services (DLS) and the Directorate of Fisheries (DOF), and local NGO representatives.” The second phase of the NATP has increased the DAE budget by an additional USD 180 million.

Built on nine principles, the government formulated the NAEP 2016 by revising the NAEP 1996. The principles are: (i) Increasing production (horizontal and vertical) and productivity as a whole; (ii) cost-effective efficient decentralized demand responsive extension services; (iii) targeting and mobilizing farmer groups and their federations; (iv) bottom-up planning and implementation; (v) coordinated and integrated extension services through the National Agricultural Extension System (NAES); (vi) development of agribusiness and contract farming for export promotion; (vii) adapting to climate change and development of specialized extension services for climatically distressed areas; (viii) broad-based extension support (in-time input support and subsidies, credit, price enhancement etc.); and, (ix) digitalized agricultural extension services (e-agriculture).

In the livestock sector, based on the recommendations of the National Livestock Development Policy 2007, the National Livestock Extension Policy 2013 was launched to: (i) strengthen the Department of Livestock Services (DLS) extension to union councils; (ii) organize farmer communities; (iii) coordinate activities of service providers both in the public and private sector; (iv) strengthen market-based networking; and, (v) encourage investors.

3.6 Agricultural finance

Agricultural and rural credit programmes in Bangladesh distribute credit to nine broad areas: crops/food grains, fisheries, livestock, agricultural equipment, irrigation equipment, food grains storage and marketing, poverty alleviation and income generating activities (Alauddin and Biswas, 2014). Two state-owned specialized banks established during the first stage of transformation, the Bangladesh Krishi Bank (BKB, founded in 1973) and the Rajshahi Krishi Unnayan Bank (RAKUB, founded in 1987), have been supporting rural credit. As of 2018-19 financial year, together, they have provided about 30 percent of formal bank loans in rural areas, with private commercial banks and state-owned commercial banks each providing 25 percent of the total rural loans. The Central Bank’s Department of Agricultural Credit suggests that during the 2018-19 financial year, about 50 percent of agricultural credit from banks went to the crops sub-sector, followed by livestock (13 percent), fisheries (11 percent) and income generating activities (6 percent). In the same year irrigation equipment accounted for 4 percent of the total agriculture loans, grain 2 percent for storage and marketing and the remaining 13 percent for other agriculture activities. In addition, the Bangladesh Samabaya Bank Ltd, the country’s first cooperative bank, has continually provided service since independence through the system of primary cooperative credit societies and the central cooperative societies. The bank receives deposits and provides loans only to its members.

Table 10: Highlights of agricultural finance in the agricultural transformation in Bangladesh

Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> ○ Establishment of Bangladesh Krishi Bank ○ Establishment of Rajshahi Krishi Unnayan Bank
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> ○ Dominance of NGOs and micro-credit institutions in small scale rural credit market
Stage 2. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> ○ Agricultural and Rural Credit Policy and Program of Bangladesh Bank for FY 2018/2019.

NGOs and microcredit institutions started working in the later part of stage 1, gained momentum in stage 2, and strengthened in stage 3. The Microcredit Regulatory Authority (MRA) oversees microfinance activities in Bangladesh under the Microcredit Regulatory Authority Act of 2006. The goal of the Act is to provide an all-encompassing regulatory framework for microfinance within Bangladesh and improve transparency and accountability within the sector. The Act stipulates that all microfinance institutions (MFIs) must obtain a license before carrying out microfinance activities.

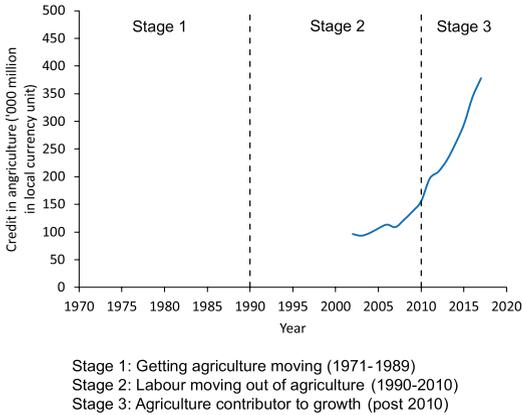
The microfinance sector is a key provider of small loans in rural Bangladesh. As of June 2017, the MRA had issued licenses to 783 microfinance institutions. In 2017, the average agriculture loan size of top 20 MFIs was around Taka 35,000. The MRA (2017) notes that loans for input supply, storage and small food processing activities are provided through micro-enterprise loan support, with loan amounts of more than Taka 50,000 (or Taka 71,000 in the case of ASA). As of 2017, Grameen Bank and other 19 large MFIs have disbursed about Taka 409 billion or 42 percent of the total loan disbursements to agriculture (Bangladesh Bank, 2019a, MRA). Therefore, non-agriculture rural loans make up a large share of the MFI operations.

In addition, value chain actors such as large and small traders regularly provide advance payments and credit to their suppliers, and some small traders also provide produce on credit to their buyers. Farmers also borrow regularly from family or village savings groups.

The Bangladesh Central Bank has introduced several policies to improve farmers' access to financial services. In order to include women entrepreneurs in CMSME (Cottage, Micro, Small and Medium Enterprises) credit facilities, the bank initiated a policy of group-based lending. Women in rural areas benefit from this initiative. It introduced agent banking, which has facilitated banks' outreach in rural areas. And, to achieve the prime objectives of the Sustainable Development Goals, it has published the annual Agricultural and Rural Credit Policy and Programme for FY 2018/2019.

With all the contributions from the public and private sectors, formal credit in agriculture has been sharply increasing during stage 3 (Figure 19).

Figure 19. the value of Agriculture credit in Bangladesh, 2002 to 2018



Data source: FAOSTAT (2020)

3.7 Agricultural value chain development

Input and output markets play a significant role in agricultural transformation. The efficient services of input and output markets help to achieve food sufficiency and food security. For example, timely supply and adequate quantities of quality seeds and fertilizers, and efficient irrigation management ensure higher productivity of crops. The Actionable Policy Brief (2006) suggests that crop production can be increased by 15 to 20 percent just by ensuring the timely supply of adequate amounts of quality seeds. Currently, the BADC, NGOs and the private sector are involved in the production and procurement of seeds and fertilizers, which are a major part of the value chain. After independence in 1971, most of the organized activities in the Bangladesh economy were carried out by the public sector. Then, in accordance with the free market economy, the important task of agricultural input distribution largely shifted to the private sector in the early 1990s (stage 2).

Table 11: Highlights of value chain development in the agricultural transformation in Bangladesh

Stage of transformation	Key policies and/or actions
Stage 1. <i>Getting agriculture moving</i> (1971 to 1989)	<ul style="list-style-type: none"> Public sector dominated inputs-outputs market
Stage 2. <i>Labour moving out of agriculture</i> (1990 to 2010)	<ul style="list-style-type: none"> Agricultural input distribution largely shifted to the private sector
Stage 2. <i>Agriculture as a contributor to growth</i> (post-2010)	<ul style="list-style-type: none"> Private sector bringing substantial change to the agrifood value chain by popularizing supermarkets

There has been immense scope for the private sector to invest in the agricultural sector and the accelerating agricultural transformation. The private sector is adding value to agricultural products; huge opportunities exist in food processing. With the growth of the middle class and working women, the food processing sector is rapidly expanding. According to the Bangladesh Agro Processor's Association (BAPA), exports of agro-processed products increased from US\$60 million in 2010/2011 to US\$224 million in 2014/2015 (Anon, 2016). At present, Bangladeshi firms export processed food to well over a hundred countries, including the US, Canada, UK, Saudi Arabia, UAE, China, Japan and Australia. The products include, among others, spices, fruit juice, fruit drinks, biscuits, processed nuts, potato chips, potato flakes and pickles. Many major business conglomerates in Bangladesh have invested in agro-processing and are expanding their operations. Their investment has spread across inter-related markets (agro-machinery and equipment, inputs, post-harvest infrastructure). There is increasing interest in foreign direct investment in agroprocessing. Thus, agroprocessing has been identified as one of the priority sectors by the government. In stage 3 of transformation, several policies such as the Industrial Policy 2016, the 7th Five-Year Plan and the Agriculture Policy 2013, were designed to create a flourishing agroprocessing sector. The government also provided tax holidays and cash incentives (20 percent for exports of agroprocessed products) for agroprocessors (Anon, 2016). Bangladeshi foods are now being sold in 130 countries. Locally manufactured spices, biscuits, juices and drinks are gaining ground abroad. The food processing sector in Bangladesh is a US\$2.2 billion industry that grew 7.7 percent on average per year between FY 2004/05 and 2010/11 (the latest accessible figures). There are 100 manufacturers engaging in exports and nearly 250 firms involved in food processing (Parvez, 2016).

The agrifood system, including value chain development, is expected to utilize surplus agricultural production, provide consumers with safe and affordable food, while also meeting objectives with respect to health and environmental sustainability. At the same time, the system provides income to a wide range of food and non-food chain actors such as large and small traders, and retailers. The Ministry of Agriculture is working on Action Track 5 (build resilience to vulnerabilities, shocks and stress) of the Global Food Summit 2021 to ensure the continued functionality of sustainable food systems that are prone to natural disasters. This track also aims to help people everywhere participate in food systems that, despite different shocks such as pandemics, deliver food security, nutrition, and equitable livelihoods.

During stage 3 of transformation, the private sector has also been bringing substantial change to the agrifood value chain by popularizing supermarkets. With rising incomes and changing lifestyles people now want to shop for all kinds of goods under one roof so that they can save time, money and energy. There are more than 200 supermarkets in operation, and supermarket turnover in food items is estimated at about 2 percent of food retailing. The current sales growth is a healthy 15 percent per year. This annual growth rate is expected to reach 30 percent by 2021, and the supermarket industry will be worth US\$2.39 billion (Hussain and Leishman, 2013). According to LightCastle (2020), the domestic market size for frozen food in 2018 was estimated at about US\$95 million. In the same year, the sector generated US\$ 371 million in revenue, which is expected to reach US\$420.48 million by 2024. (LightCastle Analytics Wing, 2020).

Plausible lucrative export destinations are the USA, Canada, Australia, the Middle East and Europe (LightCastle Research, 2015).

As the agricultural sector in Bangladesh is gradually moving towards commercialization, infrastructure is important for facilitating this transition. Well-organized storage and transportation facilities are essential to maintain a successful supply chain of perishable agricultural products. Unfortunately, the condition of storage and transportation facilities is very poor. However, the government has formulated some policies to develop a value chain in the agricultural sector. The Agriculture Policy 2013, Food and Nutrition Security Policy 2020, Country Investment Plans 1 and 2, and the 7th Five Year Plan all have a focus on value chain development. In this regard, the Government of Bangladesh (GoB) with support from its international partners is in the process of making significant investments to support value chain development and adaptation to climate change. Key investments include US\$ 101 million loan agreement with JICA and US\$ 180 million from the World Bank financing in 2020 for food value chain development. In addition, the GoB and IFAD are investing nearly US\$110 million to further develop value chains of high value crops and climate adaptation in 11 coastal districts.

To accelerate the growth of agribusiness in rural Bangladesh the private sector is gradually becoming confident to manufacture various agricultural machines and equipment and render repair and maintenance services. Rural entrepreneurs render services to smallholder farmers starting from ploughing to land preparation, transplanting, seeding, irrigation, weeding, spraying, harvesting, threshing and drying.

4. Important institutions and policy changes

Attaining and maintaining self-sufficiency in food, primarily rice, has been the primary goal of the country since its independence. Therefore, the agricultural policy context of Bangladesh has been centred on this goal. In line with that, a number of policies were developed or reformed for directly assisting farmers by enhancing the use of inputs, increasing credit facilities and guaranteeing support prices through public procurement.

In stage 1, until the 1980s, the agricultural and food policies were mainly state controlled, and this did not work as the country had low growth in technological progress (Selim, 2007). To overcome low growth in the economy where agriculture plays a major role, the government followed recommendations from the International Monetary Fund and the World Bank. It transformed many agricultural and food policies, including input and output policies, from publicly controlled mechanisms (parastatal) to market-oriented approaches (Salim and Hossain, 2006). A summary of the policies that evolved over time is presented in Table 12. In stage 1, market reform policies began in the early 1980s, but the pace increased in the 1990s and continued until the mid-1990s. In light of a failing system of input and output price support, the objectives of the policies were to accelerate production growth, and reorganize the public food-grain distribution system. All of the policy aims were designed to free up the domestic markets and encouraging imports of agricultural inputs and outputs by allowing the private sector to be involved in the market transformation process. As a result, the role of the parastatals, such as the Bangladesh Agricultural Development Corporation (BADC), was drastically reduced. The BADC was largely responsible for input procurement (seed, fertilizer and machinery) and distribution across the country. The government also lowered tariff and non-tariff barriers beginning in the early 1990s. It gradually eliminated subsidies and price supports for agricultural inputs (except fertilisers) and outputs, minimized public involvement, and created an enabling environment to encourage the private-sector leadership in the agriculture sector.

Table 12: Evolution of food and agricultural policy in Bangladesh

Period	Policy
Stage 1 (1971 to 1989)	<ul style="list-style-type: none"> - Huge input subsidy - Market quantity rationing - Eased and rationalised tariffs rates - Input distribution through government channel - Credit ceiling - Price control - Output price support
Stages 2 and 3 (1990 to 2019)	<ul style="list-style-type: none"> - Reduction in input subsidies, except for fertilisers - Reducing government control in agricultural input & output markets - Lowering tariffs & non-tariff barriers - Food grain importation by private sector - Moderate role for the public food grain distribution system - Price stabilization through open tender procurement policy - Permitting the private sector to procure fertilizers and irrigation equipment

Sources: Selim (2007); Salim and Hossain (2006); Alam (2011); Agriculture policy reviews

In 2010, during stage 3 of transformation, the government introduced the Agriculture Input Assistance Card programme. Through this programme, farmers are given a smart card that allows them to open a bank account through which they directly receive cash to buy inputs.

As recognized in the National Food Policy Plan of Action (2008 - 2015), the government has a long-standing policy of maintaining public food stocks. The policy serves two purposes: providing price and profit incentives to farmers, and providing food to underprivileged consumers. The 'Domestic Procurement Programme' has been operating since the late 1970s. Through this programme the government purchases grain (rice, paddy and wheat) from the open market in order to stabilize prices for farmers and provide them with income support. The total storage capacity of government warehouses and silos is around 2.1 million metric tonnes. The government plans to increase the storage capacity to 2.7 million metric tonnes by 2020 and around 3 million metric tonnes by 2025.

In order to improve the nutritional status of the people through ensuring availability of adequate and safe food as well as diversification in diet, the government formulated the National Nutrition Policy (NNP) in 2015, and the National Nutrition Plans of Action 1 and 2. In December 2020, the government drafted the National Food and Nutrition Security Policy 2020.

5. Summary and conclusions

Given that structural change is the essential component of long-term economic development, this study was undertaken to review agricultural transformation in Bangladesh. This case study deserves special attention because, once characterized as a ‘bottomless basket’ during the early 1970s, Bangladesh has turned itself into a ‘basket full of food’ (Kabir *et al.*, 2015). The country is projected to be among three of the world’s fastest growing economies in the years leading to 2050 (PwC, 2019).

The study followed the agricultural transformation framework highlighted in chapters 1 and 2 of this publication. Based on the historical outlook, the agricultural transformation process of Bangladesh fits into three of the six stages of that framework: (i) getting agriculture moving, (ii) labour moving out of agriculture, and (iii) agriculture as a contributor to growth. Table 13 summarizes the three transformation stages by linking them to the background environment in which they took place or are taking place, the structure and policy that drove or is driving them, and the major outcomes and concerns therein.

Getting agriculture moving (1971 to 1989): During stage 1, immediately after the ‘War of Liberation’ in 1972, Bangladesh faced the tremendous task of feeding its 75 million people. The war devastated the economy, and the country had to rely on food aid from overseas. To make the things worse, a famine broke out in 1974, and the country unfortunately descended into political turmoil. However, the seeds of agricultural research were planted and policies were formulated based on the knowledge that the country could not be built without developing and transforming agriculture. As a typical characteristic of initial agricultural transformation, the Bangladesh economy relied deeply on agriculture and passed through stages of labour-intensive activity and low labour productivity. The notable policies formulated were input distribution through government channels, rationalised tariff rates to protect domestic farmers from competition, and output price support. Bangladesh, towards the end of the stage, developed a ‘rainfed mega rice variety’ (BR11) for the monsoon season. This variety was adopted with tremendous success in the later stages of agricultural transformation. Low crop productivity (i.e., yields) had been a great concern in this stage.

Labour moving out of agriculture (1990 to 2010): During stage 2, Bangladesh’s political environment changed as democratically elected civilian politicians were empowered to govern. The country charted a new course in economic development as agriculture’s share in GDP fell substantially. Agriculture as a sector had to contend with decreasing net cropped area. The government began adopting different policies for agriculture and food. The government reduced its control of input and output markets, liberalized input markets, invested in irrigation, changed credit policies and agricultural price incentives, supported price stabilization through open tender procurement, permitted the private sector to procure fertilizers and irrigation equipment, and strengthened research, development and extension activities.

Stage 2 was marked by increasing adoption of modern varieties and rising input use. Two dry season mega-rice varieties, BRRI dhan28 and BRRI dhan29, were released early in this stage. Rice production rose, although self-sufficiency had not yet been achieved. The private sector entered agriculture through procurement of fertilizers and irrigation equipment. The seed system was gradually liberalized under the National Seed Policy of 1993 and a series of amendments to the Seeds Ordinance of 1977. These included the Seeds Amendment Acts of 1997, 2005 and 2007 and the Seed Rules of 1998, resulting in expansion, diversity and productivity improvements in vegetables and fruits. Non-crop sectors, such as fisheries and poultry, began to develop.

This stage was also characterized by increasing mechanization, especially in land preparation (i.e., permitting the private sector to procure machinery, spare parts, irrigation equipment). Agriculture's share of employment decreased while labour productivity improved. On the other hand, input costs and fluctuating farm-gate prices of agricultural commodities threatened farm productivity. Soil and environment degradation started raising questions about the sustainability of agriculture.

Agriculture as a contributor to growth (post-2010): Stage 3 of agricultural transformation has benefitted from stable government. Although a single party has held power, the bright side has been continuity in planning and implementing longer-term economic policies and development. The government is committed to achieving the SDGs and is aiming for Bangladesh to develop into a high-income country by 2041. To achieve those milestones, the government has crafted a series of major policies. The policies aimed at developing the agricultural sector include the national agricultural extension policy, the 7th Five-Year Plan 2016 to 2020, and the Bangladesh Country Programming Framework (CPF): Towards Sustainable Agriculture and Improved Food Security and Nutrition (CPF 2014 to 2018). The government established the Bangladesh Wheat and Maize Research Institute (BWMRI) to vitalize wheat and maize production. Agricultural research, development and extension activities continued to strengthen. A pre-monsoonal mega-rice variety, BRRI dhan48, was released adding to existing varieties for other seasons, and more varieties of cultured fish species were made available.

This is the stage when Bangladesh achieved rice self-sufficiency and maintained a production surplus of its staple food. It enjoyed rapid expansion and increased productivity of maize, which contributes to the feed industry. The productivity of non-rice crops increased, and cultivation of vegetables and fruit species gradually spread. The fish and poultry industries grew stronger. With rapid mechanization and labour productivity rising, agriculture's share of employment fell. Nonetheless, concerns began to arise during this stage about non-judicious input use, continued degradation of land and soil, and fluctuating farm-gate prices of crop commodities. The shrimp and prawn industry faced increasing international competition, especially because of low productivity. Due to lack of R&D, the country's dairy industry remains poorly developed.

Bangladesh has not reached the two advanced stages Laborde *et al.* (2018) formulated in their study on agricultural transformation: *agriculture integrated to the macroeconomy* and *industrialized economies*. To reach those stages, the path forward should sustain existing achievements and maintain the momentum for progress that has focused on agriculture, research and development, extension, and structural and policy drivers.

The future development of agriculture in Bangladesh will likely face challenges from two directions: demand and constraint. Quantity, i.e., more production stemming from projected population growth, will be the first challenge of demand. An increasing quantity of food will be required for both human consumption and non-human use, such as feed for the fisheries and livestock industries. In addition to quantity, demand will rise for quality food, in terms of both nutrition and safety.

On the constraint side, changes are expected in the natural production environment from climate change and other factors. Some changes would be ‘predictable,’ such as weather, abiotic stress and altered ecosystems. Some will be ‘unpredictable,’ such as climate, disaster and biotic stress. Decreasing or restricting resource use, such as land, water, soil and labour, would constrain future agriculture production and productivity.

Bangladesh is already experiencing unintended outcomes of the recent acceleration of agricultural growth, such as overuse of ground water, soil degradation, and imbalanced and excessive use of fertilizer and pesticides. Besides, fluctuating farm-gate prices could fuel calls for sustainability in the recent development trends in agriculture and is likely to have impacts in the near and remote future.

Taken all together, Bangladesh has made tremendous progress in agriculture development. However, it will likely encounter substantial challenges in the future for it to reach the final stages of agricultural transformation.

Table 13: Summary of the three agricultural transformation stages of Bangladesh with the links to stage-wise background environment, structure and policy drivers, major outcomes and concerns

Agricultural transformation stage	Features of development environment	Structural and policy drivers	Outcomes	Concerns
Stage 1 (1972 to 1989) <i>Getting agriculture moving</i>	<ul style="list-style-type: none"> ○ In the state of post-war economic devastation ○ An unwelcome famine in 1974 ○ Politics largely dominated, directly or indirectly, by military power ○ Agriculture dominated economy (with respect to GDP share) ○ Relatively high availability of net cropped land per capita 	<ul style="list-style-type: none"> ○ Kick start of BRRI; establishment BINA and CDB (1972), BARI (1976), FRI (1984) and BLRI (1976) Release of BR11, a 'mega-rice variety', at the later part of the stage ○ Huge input subsidy ○ Rationalised tariffs rates ○ Input distribution through government channel ○ Output price support 	<ul style="list-style-type: none"> ○ Chronic food shortage ○ Labour-intensive agriculture ○ Low labour productivity 	<ul style="list-style-type: none"> ○ Low crop productivity

Agricultural transformation stage	Features of development environment	Structural and policy drivers	Outcomes	Concerns
Stage 2 (1990 to 2010) <i>Labour moving out of agriculture</i>	<ul style="list-style-type: none"> ○ Politicians entering into government through democracy ○ Share of agriculture to GDP's share slipped half compared to Stage-1 ○ Reducing in net cropped land per capita 	<ul style="list-style-type: none"> ○ Strengthening agricultural research, development and extension ○ Release of BRRI dhan28 and BRRI dhan29, two 'mega-rice variety', at the early part of the stage ○ Release of modern non-rice crop varieties ○ Private sectors entering into agriculture ○ Modification of input subsidies ○ Reducing government control in agricultural input & output markets ○ Lowering tariffs & non-tariff barriers ○ Permitting the private sector in the procurement of fertilizers and irrigation equipment 	<ul style="list-style-type: none"> ○ Adoption of modern varieties increasing ○ Input use in agricultural production increasing ○ Production of staple food (rice) improved, but still not achieved self-sufficiency ○ Increasing mechanization, especially in land preparation ○ Agricultural share of employment decreasing ○ Labour productivity increasing ○ Rise of culture fish industry ○ Rice of poultry industry (meat and egg) 	<p><i>Crops</i></p> <ul style="list-style-type: none"> ○ Sustainability has started becoming an issue with increasing input costs, fluctuating farm-gate price, soil and environment degradation

Agricultural transformation stage	Features of development environment	Structural and policy drivers	Outcomes	Concerns
<p>Stage 3 (post 2010) <i>Agriculture as a contributor to growth</i></p>	<ul style="list-style-type: none"> ○ Stable government ○ Fully committed to achieve SDGs ○ Aiming to become high-income country by 2041 	<ul style="list-style-type: none"> ○ Continued strengthening agricultural research, development and extension ○ Establishment of BWMRI ○ Release of BRRI dhan48 and BRRI a ‘mega-rice variety’, in 2015 ○ Seventh Five Year Plan (FYYP, 2016–2020) focuses on promoting agricultural diversification and expanding horticultural crops ○ The National Livestock Extension Policy (2013) was framed to update the knowledge and skills of policy-makers and extension workers to provide demand-based extension services to livestock farmers in a non-formal participatory and decentralized manner. ○ Private sector engagement in the procurement of feed ingredients at minimal tariffs ○ Private sector to invest more in livestock. ○ The government has decided to provide a subsidy of Taka 30 billion to help farmers buy farm machinery at a cheaper price so that they can minimise cost of production. 	<ul style="list-style-type: none"> ○ Largely stable production surplus of staple food (rice) ○ Rapid expansion and productivity increase of maize ○ Steady increase in productivity of non-rice crops ○ Gradual spread of vegetable and fruit species ○ Strengthen fish and poultry industry ○ Continued decrease in agricultural share of employment ○ Rapid mechanization ○ Continued increase in labour productivity 	<p><i>Crops</i></p> <ul style="list-style-type: none"> ○ Sustainability is becoming a more serious issue with respect to overuse of ground water, unbalanced, overuse of fertilizers and pesticides, soil degradation, and fluctuating farm-gate price <p><i>Fisheries</i></p> <ul style="list-style-type: none"> ○ Increasing international completion – shrimp / prawn culture <p><i>Livestock</i></p> <ul style="list-style-type: none"> ○ Poor development of milk industry

BARI: Bangladesh Agricultural Research Institute; BINA: Bangladesh Institute of Nuclear Agriculture; BLRI: Bangladesh Livestock Research Institute; BWMRI: Bangladesh Wheat and Maize Research Institute; CDB: Cotton Development Board; FRI: Fisheries Research Institute

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