



Agriculture and Structural Transformation in Developing Asia: Review and Outlook

Roehlano Briones and Jesus Felipe

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ABSTRACT

Relative to other developing regions, developing Asia has experienced a slower decline in employment share in agriculture, compared to its output share; a rapid growth in labor and land productivity; and a shift from agricultural output from traditional to high-value products. The most successful Asian economies have pursued an agricultural development-led industrialization pathway. Nevertheless, agriculture remains the largest employer in many large Asian countries, hence future structural transformation must take into account agricultural transformation. Extrapolating from past trends, and taking to account emerging conditions, many countries of developing Asia will be expected to move on to the next phase of agricultural development; however even in the long term, agriculture's employment share will continue to be sizable relative with the output share. To expedite transformation, many Asian countries will still need to promote long term productivity growth in agriculture and facilitate upgrading of their farms and agroenterprises within the global value chain.

Keywords: economic growth, structural transformation, agricultural development, agricultural productivity, global value chain

JEL classification: O13, Q19

EXECUTIVE SUMMARY

Overview. Agriculture has played an important role in the development of Asian economies. Whether it will continue to do so is an open question. This paper presents an outlook for the future evolution of the agricultural sector in developing Asia, within the context of overall economic transformation.

Asian experience. The most prominent stylized fact of modern development is a secular decline in the share of agriculture in both output and gross domestic product (GDP), with the consequent increase in the combined shares of industry and services. The experience of developing Asia is no exception. However in Asia, five aspects of agriculture and structural transformation stand out. First, agriculture's output share is declining faster than that of employment. Today, agriculture is the largest employer in developing Asia but not the largest sector in any Asian country by GDP. Second, agricultural labor productivity in Asia has grown faster than in other developing regions. Third, land productivity in Asia has grown faster than in other developing regions. Fourth, technological change in agriculture since the 1960s led to significant improvements in yields of traditional crops. Fifth, the composition of agricultural output of developing Asia has shifted from traditional to high-value products.

The newly industrialized economies in East Asia (Japan; the Republic of Korea; and Taipei,China), followed an agriculture development-led industrialization pathway. The fast-growing transition economies (the People's Republic of China and Viet Nam), seem to be traversing a similar one. Agricultural growth has also been a prominent feature in the rest of developing Asia, particularly Indonesia, Malaysia, and Thailand. However, growth in agriculture has lagged in Bangladesh, India, Pakistan, and the Philippines; in these countries, the period of rapid sustainable growth came late or has yet to materialize.

The contemporary view recognizes the evolving role of agriculture in development, roughly definable in four phases: (i) Beginning phase—agricultural labor productivity starts to increase; (ii) Agricultural surplus—agricultural productivity growth generates surplus towards the development of the nonagricultural sector; (iii) Integration—agriculture becomes increasingly linked to the rest of the economy through improved infrastructure and development of markets; (iv) Industrialized—integration is successful and the role of agriculture diminishes to just one of numerous major sectors of the economy. These phases can be used to classify Asian countries in 1980 and 2010. Over this period, most of the countries advanced by one phase; three (Armenia, the Republic of Korea, and Viet Nam) advanced by two phases; a few (the Philippines and Thailand) remained in the same phase.

Does agriculture matter? Given that agriculture remains the largest employer in many large Asian countries, discussion of structural transformation cannot neglect this sector. Agricultural transformation in Asia will likely proceed according to past trends, though the pace and direction of change will be punctuated by emerging challenges and opportunities related to environmental stress (e.g., climate change), market instability, future technological breakthroughs, and the rise of global value chains. Over the next 2 decades many countries of developing Asia will move on to the next phase of agricultural development. However, the reduction in agriculture's employment share will continue to lag, relative to the decline in its output share. By 2040, if current trends continue, agriculture's employment share will remain sizable (over 20% for most of Asia), compared to the output share (under 20% for most countries, and under 5% for majority of these). Even 30 years hence, the transformation of employment structure of the economy in many Asian countries will remain incomplete.

Implications. A strategy that pays greater attention to the role of agriculture in development can help the poor trace pathways out of poverty, through improved livelihoods in agriculture, market access for smallholders, increase in skilled employment in rural areas, and establishment of efficient value chains. These pathways entail investments in effective research and development and technology transfer, human resource development, transport infrastructure and contract enforcement, other public goods and rural infrastructure, and a functional and equitable system of land rights. These elements appear fairly obvious, except that many governments have not prioritized these elements in practice. Investments have been skewed by urban bias, while agriculture support takes the form of distortionary price policies and subsidies. Governments may continue to implement price policies and subsidies, but should shift their focus from supplanting market forces, aiming rather at protection of poor households, ensuring predictability of agricultural investments, upgrading along the agriculture value chain, and addressing blockages, externalities, and coordination failures in private and public investments. In short, the rationale for industrial policy, often applied to manufacturing can similarly be extended towards farm and agribusiness support.

I. OVERVIEW

Following Asia's rapid economic transformation over the past several decades, there is a heightened interest in its future development. Within the next few decades a global economic transition is anticipated, in which Asia becomes the world's largest regional economy, eclipsing Europe and North America. Economywide factors are seen to be key for sustained development of Asia, e.g., entrepreneurship, technology, and the environment (ADB 2011); and investment, finance, and institutions (Hill and Gochoco-Bautista 2013). Others that do highlight the structural aspects of Asia's future development do so with emphasis on manufacturing (ADB 2013), or services (ADB 2012). Agriculture does not feature prominently in these prognostications. The fact that agriculture now has the smallest output share in Asia, and that its growth has lagged behind the other sectors, accounts for this omission.

This paper seeks to reevaluate the role of agriculture in future economic transformation in developing Asia. The evaluation is based on the development pathways of Asian countries during the period of their modernization. It argues that development of agriculture was a key element of structural transformation in Asia, and that agriculture will continue to play an important role in future transformation. However, future patterns of change may vary from those observed in the history of economic development, owing to marked differences in underlying global drivers, e.g., demographics, natural resources, technological progress, and global value chains (GVCs).

The rest of this paper is organized as follows: Section II examines past patterns of agriculture and economic transformation in developing Asia. Section III explains these patterns within a framework relating agriculture to economic transformation. Section IV discusses emerging global drivers of future agricultural growth, together with the outlook for agriculture and economic transformation in developing Asia. Section V concludes.

II. AGRICULTURAL TRANSFORMATION: THE ASIAN EXPERIENCE

A. Patterns of Agricultural Transformation in Asia

The most prominent stylized fact of modern development is a secular decline in the share of agriculture in both output and gross domestic product (GDP), with the consequent increase in the combined share of industry and services. The experience of developing Asia is no exception. However in Asia, five features of agriculture and structural transformation stand out.

Agriculture's output share is declining faster than that of employment. While the output share has declined since the 1970s at about 2.51% per annum (faster than the world's average), the employment share has declined at about 1.71% per annum (slower than the world's average). Table 1 shows the annual rate of decrease in the share of agriculture in both output and employment for selected Asian countries. The fastest declines in both shares were registered by the Republic of Korea, about 5%–6% per annum. The speed at which the shares are declining in other countries, especially that of employment, is much slower, e.g., in Bangladesh and Pakistan annual rates of decline are less than 1%. The estimated elasticities of the shares of agricultural output and employment with respect to income per capita (in constant US dollars of 2000) vary with the level of income per capita, but in all cases the output elasticity is larger than the employment elasticity (Box 1).

Table 1: Agriculture Output and Employment Shares in Asia: Speed of Reduction

Country	Period Covered (OS - Longest Available)	OS Start; End (%)	Speed of Reduction OS (% per annum)	Period Covered (Same for OS and ES)	OS Start; End (%)	Speed of Reduction OS (% per annum)	ES Start; End (%)	Speed of Reduction ES (% per annum)
Korea, Rep. of	1965–2010	39.4; 2.6	5.74	1980–2010	16.2; 2.6	5.73	34; 6.6	5.15
Japan	1970–2009	6; 1.4	3.57	1980–2009	3.6; 1.4	3.10	10.4; 3.7	3.39
Viet Nam	1985–2010	40.2; 20.6	2.54	1996–2006	27.8; 20.4	2.77	70; 51.7	2.72
Malaysia	1960–2010	34.3; 10.6	2.28	1980–2009	22.6; 9.5	2.85	37.2; 13.5	3.32
Thailand	1960–2010	36.4; 12.4	2.09	1980–2009	23.2; 11.5	2.31	70.8; 41.5	1.76
Indonesia	1960–2010	51.5; 15.3	2.35	1985–2010	23.2; 15.3	1.59	54.7; 38.3	1.36
PRC	1961–2010	35.5; 10.1	2.48	1980–2008	30.2; 10.7	3.51	68.7; 39.6	1.88
Bangladesh	1980–2010	31.6; 18.6	1.70	1984–2005	32.3; 20.1	2.13	58.8; 48.1	0.91
India	1960–2010	42.8; 19	1.58	1994–2010	28.5; 19	2.36	61.9; 51.1	1.12
Philippines	1960–2010	26.9; 12.3	1.52	1980–2009	25.1; 13.1	2.14	51.8; 35.2	1.28
Nepal	1965–2010	65.5; 36.1	1.29	1991–2001	47.2; 37.6	2.05	81.2; 65.7	1.91
Sri Lanka	1960–2010	31.7; 12.8	1.76	1981–2009	27.7; 12.7	2.65	45.9; 32.6	1.17
Pakistan	1960–2010	46.2; 21.2	1.52	1980–2008	29.5; 20.3	1.28	52.7; 44.7	0.57

ES = stands for agriculture's employment share, OS = stands for agriculture's output share, PRC = People's Republic of China.

Source: Authors calculations based on data from the World Development Indicators.

Box 1: Elasticities of Output and Employment Shares

Elasticities are estimated from logarithmic regressions of the share of agriculture (in GDP and in total employment) on GDP per capita and GDP per capita square and both time and country fixed effects. Results are:

$$\begin{aligned} \ln(\text{output share}) &= 1.39 + 1.20 \cdot \ln(\text{GDP per capita}) - 0.13 \cdot [\ln(\text{GDP per capita})]^2 + \sum_i^N \hat{\alpha}_i D_i + \sum_t^M \hat{\beta}_t D_t, \text{ where } D_i \text{ and } D_t \text{ are country and time dummies, respectively. } N = 5,076; R^2 = 0.76 \\ \ln(\text{employment share}) &= -3.26 + 2.27 \cdot \ln(\text{GDP per capita}) - 0.18 \cdot [\ln(\text{GDP per capita})]^2 + \sum_i^N \hat{\alpha}_i D_i + \sum_j^M \hat{\beta}_j D_j, + \sum_i^N \hat{\alpha}_i D_i + \sum_t^M \hat{\beta}_t D_t, \text{ where } D_i \text{ and } D_t \text{ are country and time dummies, respectively. } N = 2,403; R^2 = 0.50. \end{aligned}$$

This way the elasticities vary with the level of income per capita. The output elasticities vary from -0.19 for Nepal to -0.93 for Malaysia. For employment, they vary from about -0.10 for countries like Bangladesh, India, the Kyrgyz Republic, or Nepal, to -0.69 for Malaysia.

Hence this sector is still the largest employer in developing Asia, but not the largest sector in any country by GDP. Agriculture is the largest employer in 17 economies for which data is available, including Bangladesh, Bhutan, the People's Republic of China (PRC), India, Pakistan, Thailand, and Viet Nam. In Bhutan, Cambodia, Myanmar, Nepal, Papua New Guinea (PNG), Tajikistan, or Viet Nam, agriculture's share in total employment is above 50%. Moreover, in some countries the absolute number of people employed in agriculture is still rising (e.g., India).

The key explanation of the lag in the speed of decline between the employment and output shares is that agriculture is a sink for surplus labor. In most Asian developing countries, the Lewis “turning point,” where the shift from surplus labor in agriculture to labor shortage is reflected in a rising agriculture wage, is yet to be reached.¹ The faster rate of population growth in developing Asia, compared to the industrialized countries at a comparable stage of development, heightens the labor absorption problem. Maddison (2006) reports that the annual population growth of Western European industrializing countries ranged from 0.3% (France) to 0.9% (United Kingdom) over 1820–1913 (their industrialization period). Meanwhile in developing Asia, following modern advances in medical technology and public health, annual population growth averaged 2.5% since the 1960s.²

Agricultural labor productivity in Asia has grown faster than in other developing regions. Agricultural output per worker has risen fast in developing Asia (Table 2); average growth in Asia was 2.2% per year during 1980–2010, while in Sub-Saharan Africa it was only 0.6%, and in Latin America and the Caribbean it was 1.8%. Latin American countries tend to start out with highest baseline agricultural productivity, followed by Asian countries; however omitting outliers Japan, the Republic of Korea, and Malaysia, Sub-Saharan countries were not much worse off than Asian countries in the 1980s. Within Asia, agricultural output per worker grew most rapidly in the PRC, Japan, the Republic of Korea, and Malaysia. The laggards in the region are the Bhutan, Nepal, and the Philippines, where labor productivity in agriculture has grown at Sub-Saharan Africa rates, or worse.

Land productivity in Asia has grown faster than in other developing regions. Over the past few decades, the scope for expansion in farmland worldwide has narrowed considerably, and the land constraint is most acute in developing Asia: the annualized growth rate of agricultural land area was 0.49% since 1980, lower than of Latin America (0.61%), and that of Sub-Saharan Africa (0.89%). Columns (a) and (b) in Table 3 decompose agricultural growth into growth in land area and growth in land productivity. In developing Asia, annualized growth in land productivity was 2.24% on average, compared to 1.51% in Sub-Saharan Africa, and to 1.84% in Latin America. The share of land productivity growth in agricultural output growth, or the ratio (b)/(c), is 82% in Asia, only 62% in Sub-Saharan Africa, and 75% in Latin America. Within developing Asia, only Indonesia, the Lao People’s Democratic Republic (Lao PDR), and Malaysia benefited from expansion of the land frontier over the period. The implications of land productivity growth (and the related trend on yield growth, discussed below) for the future of Asian agriculture is discussed in Section IV, C.

¹ Ranis (2012) dates Japan’s turning point around 1956, and that of the Netherlands during the late 19th century. Indonesia had not reached the turning point during the 1990s; India and Bangladesh are in the same situation; the Republic of Korea reached it during the late 1970s; Taipei, China during 1961–1968; and the PRC around 2000. Several studies using wage trends argue that PRC has passed the Lewis turning point, but other studies using other information (production functions, employment data) or applying more controls (e.g., worker characteristics) indicate that the Lewis turning point is yet to be reached. Institutional restrictions on rural–urban migration are imposing local scarcities, which account for recent wage increases. Nevertheless, the critics concur that the turning point is fast approaching.

² Bairoch (1975) had estimated the average level of agricultural labor productivity in African and Asian countries in the 1970s to be 45% below that of developed countries at the start of the Industrial Revolution.

Table 2: Gross Value-added per Agricultural Worker, in Constant 2000 \$ and Annualized Growth, Developing Countries, 1980–2010

	Starting Value	Ending Value	Annual Growth (%)
Asia			2.2
Bangladesh	269	507	2.1
Bhutan	437	437	0.0
China, People's Republic of	179	545	3.8
Indonesia	450	730	1.6
India	308	507	1.7
Japan	11,358	40,385	4.3
Korea, Rep. of	2,538	19,807	7.1
Lao People's Democratic Republic	296	465	1.8
Malaysia	2,633	6,680	3.2
Mongolia	1,084	1,524	1.2
Nepal	193	240	0.7
Pakistan	585	947	1.6
Philippines	916	1,119	0.7
Sri Lanka	590	966	1.7
Thailand	384	706	2.0
Viet Nam	218	367	2.1
Latin America and the Caribbean			1.8
Argentina	6,555	12,957	2.3
Bolivia	716	716	0.0
Brazil	1,090	4,182	4.6
Chile	2,443	6,377	3.3
Colombia	2,283	2,874	0.8
Cuba	2,875	3,903	1.0
Dominican Republic	2,087	5,083	3.0
Ecuador	1,588	2,040	0.8
El Salvador	2,084	2,746	0.9
Guatemala	2,424	2,780	0.5
Honduras	939	2,041	2.6
Jamaica	1,620	2,758	1.8
Mexico	2,135	3,302	1.5
Panama	2,230	3,559	1.6
Paraguay	1,310	2,710	2.5
Peru	922	1,607	1.9
Uruguay	5,407	8,625	1.7
Venezuela, RB	4,122	7,667	2.1
Sub-Saharan Africa			0.6
Angola	227	202	-0.6
Benin	402	684	2.2
Botswana	648	534	-0.6
Burkina Faso	107	163	1.8
Burundi	163	84	-2.2
Cameroon	402	743	2.3
Cape Verde	1,525	3,335	3.3
Central African Republic	346	418	0.7
Chad	234	225	-0.2
Comoros	486	551	0.4
Congo, Dem. Republic	208	173	-0.6
Cote d'Ivoire	812	1,056	0.9
Gabon	1,180	1,825	1.5
Gambia, The	535	440	-0.6

Continued

Table 2: continued

	Starting Value	Ending Value	Annual Growth (%)
Guinea	159	242	1.8
Kenya	396	351	-0.4
Lesotho	253	215	-0.5
Madagascar	218	187	-0.5
Malawi	104	169	1.6
Mali	376	462	0.8
Mauritania	1,056	813	-0.9
Mauritius	1,767	5,692	4.0
Mozambique	95	234	3.5
Namibia	1,263	881	-1.2
Niger	273	245	-0.5
Rwanda	218	214	-0.1
Senegal	275	271	-0.1
Seychelles	834	701	-0.6
South Africa	1,914	3,951	2.4
Sudan	453	929	2.4
Swaziland	1,056	1,213	0.5
Tanzania	219	289	1.4
Togo	315	531	1.8
Uganda	196	200	0.1
Zambia	250	214	-0.5
Zimbabwe	270	161	-1.7

Notes:

Growth rate is computed on annualized basis between starting and ending years. For regions the growth rate is a simple average. Countries with intervals shorter than 20 years were omitted from the tabulation.

Source: World Development Indicators.

Table 3: Annualized Growth Rates of GDP, Agricultural GDP, Land Productivity and Area, Developing Countries, 1970–2009 (%)

	Area (a)	Land productivity (b)	Agricultural GDP = (a) + (b)
Asia	0.49	2.24	2.72
Bangladesh	-0.16	2.29	2.13
Bhutan	-1.34	4.53	3.19
China, People's Republic of	0.50	3.54	4.04
Indonesia	1.27	2.14	3.41
India	0.07	2.51	2.58
Japan	-0.59	0.22	-0.36
Korea, Rep. of	-0.63	2.64	2.01
Lao People's Democratic Republic	2.00	2.29	4.29
Malaysia	1.39	1.55	2.94
Mongolia	0.66	1.02	1.68
Nepal	0.62	1.96	2.58
Pakistan	0.25	3.18	3.43
Philippines	0.86	1.71	2.57
Sri Lanka	0.35	2.06	2.41
Thailand	0.82	2.17	2.99
Viet Nam	1.70	2.00	3.70
Latin America and the Caribbean	0.61	1.84	2.45
Argentina	0.44	1.41	1.85
Bolivia	2.19	0.64	2.83
Brazil	1.31	2.23	3.54

Continued

Table 3: *continued*

	Area (a)	Land productivity (b)	Agricultural GDP = (a) + (b)
Chile	-2.19	5.72	3.53
Colombia	-1.03	2.83	1.79
Costa Rica	0.04	3.13	3.17
Ecuador	-0.01	1.55	1.54
El Salvador	0.96	0.11	1.07
Guatemala	1.17	1.76	2.93
Guyana	0.46	0.49	0.95
Honduras	-0.19	2.93	2.74
Mexico	0.47	1.43	1.91
Panama	0.63	2.47	3.11
Paraguay	3.78	0.23	4.01
Peru	1.18	1.36	2.54
Uruguay	1.27	0.39	1.66
Venezuela	-0.08	2.62	2.54
Sub-Saharan Africa	0.89	1.51	2.40
Angola	1.67	2.63	4.30
Benin	1.97	2.03	4.00
Botswana	-1.18	3.56	2.37
Burkina Faso	2.55	0.96	3.51
Burundi	0.10	0.60	0.70
Cameroon	0.54	3.09	3.62
Cape Verde	1.58	0.85	2.42
Central African Rep.	0.16	1.90	2.06
Chad	1.03	0.82	1.85
Comoros	1.35	1.65	3.00
Congo, Dem. Rep.	0.07	1.49	1.56
Côte d'Ivoire	2.06	0.26	2.33
Gabon	0.17	1.31	1.49
Gambia	2.96	-0.28	2.68
Guinea	0.16	3.82	3.98
Kenya	1.10	2.05	3.15
Lesotho	-0.24	1.05	0.81
Madagascar	1.04	0.76	1.80
Malawi	1.78	2.22	4.00
Mali	3.36	-0.12	3.25
Mauritania	0.90	-0.29	0.61
Mauritius	-0.37	0.58	0.22
Mozambique	1.82	3.50	5.32
Namibia	0.56	1.64	2.19
Niger	0.75	0.00	0.75
Rwanda	2.09	1.57	3.66
Senegal	0.54	1.03	1.57
South Africa	0.38	1.64	2.02
Sudan (former)	1.42	1.79	3.22
Swaziland	0.59	-0.12	0.47
Togo	0.61	1.93	2.54
Uganda	1.55	1.31	2.87
Zambia	0.51	1.75	2.26
Zimbabwe	1.47	-1.39	0.08

Notes:

Agricultural output pertains to GVA in agriculture (2000 \$). Area pertains arable land and permanent crops, in hectares. Land productivity is agricultural output per hectare.

Growth is annualized over the available interval from 1970 to 2009; countries with intervals below 20 years with areas below 100,000 ha were omitted.

Sources: World Development Indicators for agricultural GDP; FAOStat for area.

Technological change in agriculture since the 1960s led to significant improvements in yields of traditional crops. Table 4 shows the yield improvement in the most important cereal staple for a selected sample of Asian countries. The fastest yield growth since the 1970s was registered in Bangladesh, the Lao PDR, Pakistan, and Viet Nam, which started out from a relatively low base. The PRC and the Republic of Korea, already having good yield levels in 1970, attained sustained improvement and reached 6.5 tons per hectare (t/ha) or better—among the highest yields worldwide—followed by Indonesia and Viet Nam at 5 t/ha or more.

Table 4: Yield and Yield Growth of Main Cereal in Developing Asia, 1970–2010

	Share of Cereals in Agricultural Output, 1970	Yield (t/ha)			Annualized Yield Growth (%)			
		1970	2010	1970s	1980s	1990s	2000s	1970–2000
Bangladesh	55	1.7	4.3	1.8	2.4	3.1	2.2	2.4
Bhutan	50	2.0	3.1	0.0	0.5	-2.1	6.3	1.1
Cambodia	47	1.6	3.0	-2.8	1.2	4.6	3.4	1.6
China, People's Republic of	45	3.4	6.5	1.9	3.3	0.9	0.4	1.6
India	38	1.7	3.4	1.7	2.7	0.9	1.7	1.7
Indonesia	40	2.4	5.0	3.3	2.7	0.2	1.3	1.9
Japan	36	5.6	5.2	-0.9	2.1	0.6	-2.5	-0.2
Korea, Rep. of	63	4.6	6.9	-0.6	3.7	0.8	0.2	1.0
Lao PDR	38	1.4	3.6	0.6	4.8	2.9	1.6	2.5
Malaysia	6	2.4	3.6	1.8	-0.3	1.0	1.7	1.1
Philippines	22	1.7	3.6	2.4	3.0	0.3	1.7	1.8
Nepal	47	1.9	2.7	-0.1	2.2	1.2	0.1	0.8
Pakistan	29	1.2	2.6	3.0	1.5	3.2	0.2	2.0
Sri Lanka	19	2.2	4.1	1.4	1.7	1.2	1.7	1.5
Thailand	34	2.0	2.9	-0.7	0.4	2.9	1.2	0.9
Viet Nam	62	2.2	5.3	-0.3	4.3	2.9	2.3	2.3

Lao PDR = Lao People's Democratic Republic.

Notes:

In computing the share of cereals in agricultural output, the latter is measured in constant \$ 2000.

The primary cereal is paddy rice, except for Pakistan where the primary cereal is wheat.

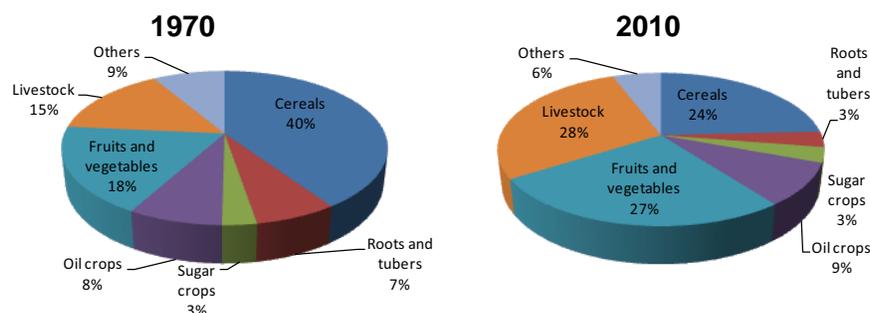
Source: FAOStat.

Yield growth for cereals was achieved through the “Green Revolution,” i.e., breeding and adoption of modern varieties, which exhibit greater yield response to inputs (chemical fertilizer and water) compared with traditional varieties. Improved wheat and rice varieties were pioneered at research institutions in Mexico and the Philippines in the 1950s, and disseminated in the 1960s and 1970s in Asia. By the 1980s, the adoption of modern varieties in Asia had reached about 60% for rice and 80% for wheat (Evenson and Gollin 2003).

The composition of agricultural output of developing Asia has shifted from traditional to high-value products. Increasing yields in traditional crops, especially cereals, is critical but not sufficient, and continued growth in agriculture has been achieved in part by structural change within the sector. In developing Asia, rapidly growing agriculture is increasingly being driven by expanding demand for livestock products and other high-value crops, which are also more labor-intensive (World Bank 2009). The divergence in value per hectare between high-value agricultural products and traditional staples can be dramatic; tobacco and oranges earn about ten times as much per hectare as rice; while the ratio is over thirty-fold for bananas.

Since 1970, the composition of agricultural output in developing Asia has shifted dramatically (Figure 1), albeit with country-specific differences. Increasing global trade is a key driver behind these trends. The share of developing Asia in global agricultural exports has increased from 12% to 17% since 1970. The composition of export trade has changed, away from traditional tropical products (coffee, cocoa, tea, sugar, spices and nuts) towards products such as horticulture and seafood, as well as toward processed products (Humphrey and Memedovic 2006; Jongwanich 2009). Developing countries are typically net exporters of oilseeds and products, coffee and cocoa, sugar, and fruits and vegetables, and net importers of dairy products and cereals (Diaz-Bonilla and Reca 2000).

Figure 1: Composition of Agricultural Output (constant \$), Developing Asian Countries, 1970 and 2010 (%)



Source: FAOStat.

The change in agricultural output composition has occurred within a broader diversification, known as the agribusiness transition, involving input providers (farm equipment producers, logistics firms, and other business service providers) as well as agro-processors, distribution companies, and retailers (World Bank, 2009). The share of agribusiness in GDP is substantially higher than that of agriculture, and the ratio of the share of agribusiness to that of primary agriculture is typically higher the greater the per capita income of the country. World Bank (2009) reports shares of agribusiness in GDP for Indonesia and Thailand of 33% and 43%, respectively. And Balisacan et al. (2011) indicates that the share of agribusiness in GDP in the Philippines is 15%.³ Agricultural transformation thus involves a parallel development of industry (agro-processing) and services (finance, logistics, marketing, etc.).

³ Other countries reported are (World Bank 2003): Cameroon (17%), Cote d'Ivoire (26%), Ethiopia (30%); Ghana (19%), Kenya (23%), Nigeria (16%), Tanzania (21%), Uganda (23%), Zimbabwe (21%), Brazil (30%), Argentina (29%), Chile (34%), Mexico (27%), South Africa (16%), the United States (13%). "Agribusiness" covers manufacturing activities closely related to agriculture (e.g., food and beverage, cotton ginning, tobacco processing, leather processing, wood-working, fertilizer manufacture, agro-chemical production, and agri-machinery production), as well as the imputed food-related component of trade and transport/logistical services. The component is estimated based on (i) the share of food in household expenditure in the case of trade; (ii) the average of the food expenditure share and the share of agriculture/food in total exports in the case of transport/logistical services. Data were obtained from the Food and Agriculture Organization of the United Nations, World Bank, and UNIDO databases. Balisacan et al.'s (2011) definition is not identical with World Bank (2003); the initial list of agribusiness subsectors was obtained from the official 240-sector input-output table; this list was narrowed down by eliminating subsectors below a cut-off, based on a composite indicator equal to a weighted average of the subsector's input-output coefficient, its employment share, and its share in gross value added. Agribusiness subsectors include: milling industries, food preservation, processing of agricultural raw materials, wood industries, other rubber products manufacture, wood carvings, restaurants, and wholesale and retail trade. Sample weights from a contemporaneous survey of business establishments conducted by the National Statistical Office were used to aggregate the value added of the final list of subsectors; disaggregated information from the same survey was also used to estimate the agri-related component of wholesale and retail trade.

Table 5: Shares in Agricultural Output by Country, Developing Asia, 1970 and 2010

	Cambodia		PRC		Japan		Korea, Republic of	
	1970	2010	1970	2010	1970	2010	1970	2010
Cereals	47.3	36.3	45.1	20.8	35.7	28.5	63.0	34.0
Roots and tubers	1.0	33.0	9.1	3.0	8.6	5.2	7.3	1.1
Sugar crops	0.8	0.2	3.7	4.1	0.8	0.9	0.0	0.0
Oil crops	4.7	3.7	13.4	7.8	0.9	0.8	5.6	1.9
Fruits and vegetables	25.2	9.9	9.6	31.0	29.8	26.3	13.7	27.6
Livestock	16.8	14.0	12.4	29.9	18.6	35.1	7.6	33.8
Others	4.2	2.9	6.6	3.4	5.6	3.3	2.8	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Lao PDR		Indonesia		Malaysia		Philippines	
	1970	2010	1970	2010	1970	2010	1970	2010
Cereals	37.7	32.0	39.6	30.2	5.9	2.7	22.4	23.2
Roots and tubers	3.6	3.5	9.9	4.3	1.3	0.5	2.7	1.8
Sugar crops	0.3	5.5	2.1	1.0	0.1	0.2	23.8	9.6
Oil crops	2.6	1.7	12.3	26.2	9.2	54.2	11.8	11.1
Fruits and vegetables	33.8	43.9	15.2	15.2	5.5	3.1	16.7	20.0
Livestock	12.1	9.1	14.0	16.4	7.8	21.2	19.0	32.1
Others	9.8	4.3	6.9	6.7	70.3	18.1	3.6	2.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Thailand		Viet Nam		Bangladesh		Bhutan	
	1970	2010	1970	2010	1970	2010	1970	2010
Cereals	33.6	24.8	61.5	43.1	54.6	60.6	50.4	31.7
Roots and tubers	1.7	3.0	7.5	4.8	4.0	8.4	8.4	9.3
Sugar crops	0.9	3.8	1.1	2.8	5.6	1.4	0.0	0.4
Oil crops	2.3	5.8	0.0	0.0	1.8	1.2	1.7	0.9
Fruits and vegetables	34.2	21.4	5.7	7.1	9.6	10.0	15.1	27.8
Livestock	18.3	20.6	18.9	27.7	11.0	12.3	20.2	18.5
Others	9.0	20.7	5.2	14.5	13.4	6.1	4.2	11.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	India		Nepal		Pakistan		Sri Lanka	
	1970	2010	1970	2010	1970	2010	1970	2010
Cereals	37.6	27.2	46.7	28.3	29.5	22.2	19.0	31.6
Roots and tubers	1.6	2.8	4.6	10.7	0.5	2.4	5.6	3.3
Sugar crops	3.9	2.6	0.4	1.3	3.8	1.9	0.2	0.5
Oil crops	9.4	10.6	3.0	2.1	7.7	6.7	24.2	14.0
Fruits and vegetables	20.4	23.5	6.1	25.0	11.7	10.5	12.1	16.7
Livestock	12.7	22.4	31.2	24.8	38.6	51.1	8.6	13.2
Others	14.4	10.8	7.9	7.7	8.2	5.2	30.3	20.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Note: Agricultural output is measured in constant 2000 \$.

Source of basic data: FAOStat.

B. Key Historical Trajectories by Subregion

1. The Newly Industrialized Countries

For Japan, the period 1880–1920 was one of rapid agricultural growth. Output of the six major crops grew by nearly 77%, compared to just 44% growth of population. From 1885 to 1915, labor productivity in agriculture doubled, though agriculture remained labor-intensive; productivity growth appears to have been driven by development of new varieties and application of fertilizers. Owing to stagnant real wages, growth in agriculture led to a surplus that was channeled towards industrial development, which accelerated from the 1920s onward. A large share of this surplus was extracted by a system of agricultural taxation; savings were also mobilized for industrial development by some landowners, largely in rural-based industry such as textiles and food processing (Johnston 1951; Tsakok, 2011).

Ranis (1995) discusses Taipei, China's experience together with the case of the Republic of Korea. In the 1950s, both countries began their economic growth process with some initial advantages, i.e., rural infrastructure (more so for Taipei, China), relatively high literacy rates, an active agricultural research system, and an early “green revolution” in rice. They also have undergone an effective land reform program which expropriated landed interests. Output growth in agriculture was rapid and sustained in Taipei, China in the 1950s, and the Republic of Korea in the 1960s, before slowing down in both countries by the 1980s.

For Taipei, China, growth in agriculture can be largely attributed to technological change, driven by research and technology diffusion activities, mostly focused on new crops—cotton, fruits, and vegetables. Over the period 1960–1988, the share of rice in agricultural output fell from 57% to 27.1%, while that of nontraditional crops rose from 27.3% to 51%. Moreover in Taipei, China, rapid growth was achieved without massive foreign debt and significant inequalities. Even the smallest farmers participated actively in labor-intensive industrial and service activities in rural areas, led initially by agro-processing. In contrast, the nonagricultural sector in the Republic of Korea was more large-scale and capital intensive; rapid growth was achieved but with higher levels of foreign debt and income inequality. Nevertheless, Ramachandran (1995, p. 367) argues that the Korean case is “not an anomaly but an interesting and somewhat unique example of agricultural development preceding rapid industrial expansion.”

2. Successful Transition Economies

The PRC initially embarked on import substitution industrialization based on central planning. A new strategy was implemented in the late 1970s. The production team system in agriculture gave way to a “household responsibility system”; the restoration of individual economic incentive was a key factor in the ensuing acceleration of agricultural growth. Another institutional reform was the township and village enterprise, which served as the vanguard of rural industrialization. Prices were deregulated gradually. In 1985, dual-track pricing was introduced, in which the output within the planning targets were priced by government, whereas output above the target were priced under market conditions. With rapid growth, output soon outgrew (modest) planning targets. By the mid-1990s, 80% of agricultural output was sold outside the administrative quota. Pricing reforms were also introduced with respect to foreign exchange and the interest rate (Lin, Cai, and Li 2003).

Rapid growth during the reform period benefited from investments already in place prior to reform. The PRC grain production had been rising 2.8% annually in 1970–1978, owing to new technologies generated by an active agricultural research system, together with massive investments in water infrastructure. Growth of grain output accelerated to 5.8% annually in the early years of reform (1978–1985) but decelerated in the following years.

In the 1990s and 2000s, the PRC's agriculture evolved from a grain-centered economy to one oriented towards high-valued cash crops, horticulture, livestock, and aquaculture products. Orchards now occupy over 5% of cultivated area, double the share in other countries with large agricultural sectors. Between 1990 and 2004, vegetable production was growing by the equivalent of California's vegetable industry every 2 years. Agriculture is now also heavily export-oriented, and specialized towards labor-intensive products. Imports are also large and skewed towards land-intensive products such as grains, oilseeds, and sugar crops (Huang, Otsuka, and Rozelle 2008).

Compared with the PRC, a unified Viet Nam was characterized by a weaker state apparatus, a briefer stint in central planning, and a more extensive informal sector effectively outside the planning system. Reforms, which began in the early 1980s with decollectivization of farming, accelerated under *Doi Moi*, as follows: (i) openness to private sector investment, and commercialization of state enterprises; (ii) phased deregulation of prices and consumer subsidies, as well as liberalization of the foreign exchange market; (iii) recognition of usufruct rights of farmers, culminating in formal recognition of transferability of land rights. Most land is now under farmer cultivation (state farms account for just 4% of agricultural land). Government also engaged in significant investments in irrigation and transport infrastructure, as well as strategic support for selected crops (e.g., coffee in the Central Highlands).

Market reforms were followed by sustained high agricultural growth in the late 1980s and 1990s. By 1995, agriculture accounted for 46% of exports. In the rice sector, growth eased food security concerns, and eventually propelled Viet Nam to its status as the world's second leading rice exporter. Agricultural exports are nonetheless diversified, with significant shares from coffee, tea, cashews, pepper, cinnamon, rubber, fruits and vegetables, and aquaculture (Arkady and Mallion 2003).

3. South Asia

India embarked on an import substitution industrialization path upon its independence beginning from its First Five-Year Plan (1951–1956). Successive droughts in 1965–1966 drove the country to seek self-sufficiency in wheat (Srinivasan 1996). The program called for widespread dissemination of new, high-yielding varieties, together with public investments and farm support, ushering in a “green revolution.” The specter of famine retreated and India became a net food exporter in the 1990s. Reforms in the 1980s and early 1990s radically altered the investment climate and led to above-average growth, though only in the last 2 decades. Within agriculture, benefits of modernization remain uneven and unbalanced, no thanks to piecemeal land reforms and regressive subsidy policies. Across states for instance, Punjab has experienced substantial poverty reduction together with higher agricultural growth rates. On the other hand, Bihar and Orissa, with stagnant agricultural sectors, suffer from among the worst levels of poverty in the country (Tsakok 2011).

Similarly, Pakistan (then both West and East) started out with an interventionist regime economy, with bias against exports, as well as various distortions in the agricultural sector. In the 1960s and 1970s, government implemented a price support system for wheat, rice, cotton,

sugarcane, maize, potato, onion, gram, and oilseeds. A public procurement system; as well as restrictions on transporting and exports of various crops. A decade after independence in the 1970s, Bangladesh embarked on a reform program. Similarly, Pakistan embarked on trade policy liberalization in the late 1980s. Reforms were also implemented in agriculture; in Bangladesh, for example, rice importation is significantly liberalized (Ahmad et al. 2010; Chowdhury, Farid, and Roy 2010). Numerous distortions and structural bottlenecks remain. For instance, in rural Pakistan (where two-thirds of the population reside), one in five villages remain inaccessible by an all-weather passable road (Tsakok 2011).

4. ASEAN-4

Among the large Association of Southeast Asian Nations (ASEAN) member countries, the highest per capita income currently belongs to Malaysia, whose development strategy has prioritized agriculture especially in the early phase of development. Funds from extractive industries were combined with large government investments heavily in smallholder agriculture. From 1971 to 1995, the share of agriculture and rural development in total public spending averaged 17%. Investments went to FELDA (the land administration and development authority), price support, and farm subsidies. In 1984, the New Agricultural Policy was formulated, aiming at developing agro-industry, through research, market development, and diversification from rice. In 1986, the Industrial Master Plan promoted downstream agro-processing, focusing on rubber, palm oil, food, timber, other resource-based industry (Tsakok 2011).

Thailand, the leading rice exporter for most of the 20th century was preoccupied with maintaining independence and political stability. In the 1970s, farmers and students pushed successfully for democratic reforms which led to a more pro-agricultural policy. Rapid increases in farm productivity ensued, based on high-value products (e.g., fragrant rice, rubber, processed food); then came a wave of industrialization beginning from the mid-1980s (Leturque and Wiggins 2011).

Colonial and postcolonial experience made Indonesia the byword of dual development and agricultural involution. Prominent experts (e.g., Gunnar Myrdal and Clifford Geertz) were skeptical of the country's long term growth prospects. Following military takeover in 1966, the New Order regime aimed for rice self-sufficiency, based on strong government support for new technologies and price stabilization. This kicked off a green revolution, paving the way for Indonesia's rapid industrialization in the 1970s and 1980s. Agricultural growth was by no means limited to rice. There was also rapid expansion of cash crops, especially in Sulawesi, Sumatra, and Kalimantan (Hill 2000).

The Philippines under colonial rule, an oligarchic class emerged from a cash economy (led by sugar) organized as a hacienda system. This class perpetuated itself by combining economic and political power. The structure persisted and thrived under postwar democracy. An authoritarian regime (1972–1986) did implement agrarian reform and promoted a Green Revolution at the same time, recurrent balance of payments crises, and distortionary policies biased against agriculture, excluded the country from the club of high performing economies in Southeast Asia. With return of democracy and resurgence of organized farmer groups, much of the bias against agriculture has been dismantled, but weak governance and elite disinterest in a globally competitive industrial base has mired the economy in erratic and mediocre growth.

III. AGRICULTURE AND STRUCTURAL TRANSFORMATION: A FRAMEWORK

A. The Role of Agriculture in Development

The role of agriculture in development is often dismissed in the face of the stylized fact of structural change. Dual economy models (e.g., Lewis 1954, Jorgenson 1967), which posit capital accumulation as a result of growth of the manufacturing sector, further reinforced the notion of backwardness and limited potential of agriculture. In fact, postwar development strategies in many developing countries aimed at rapid industrialization with a strong “urban bias” (Lipton 1977, Bezemer and Headey 2007).

On the contrary, in the most successful Asian economies, apart from the cities of Singapore and Hong Kong, China, agriculture played an important role in launching the period of high growth. In these economies, the link between agricultural development and poverty alleviation indicated the positive interaction between the political economy of rapid growth and a development strategy that emphasized the role of the rural economy. Indonesia after 1966, the PRC after 1978, and Viet Nam after 1989, tilted investment priorities toward rural growth, while the transformation of agriculture in other Asian countries, e.g., India or Pakistan, has been slow.

Johnston and Mellor (1961) provided the classic explanation of the role of agriculture in development. Agriculture is a source of: (i) food, (ii) foreign exchange, (iii) labor, (iv) savings for capital formation, and (v) purchasing power to generate demand for manufactures. Growth in agriculture supports the subsequent growth of industry. As an economy develops, the relative contribution of agriculture to output and employment must decline. This pathway was to be elaborated further as agricultural development-led industrialization (Adelman 1984).

In recent years a number of critics of “agricultural fundamentalism” (Hasan and Quibria 2004) favored nonagricultural (i.e., urban-based) pathways to development, particularly in light of domestic and global conditions inimical to smallholder agriculture (e.g., Collier 2008, Ellis 2005). Even advocates of agriculture-led development do recognize that the role of agriculture depends on the degree of economic integration within the domestic economy, and between the domestic and world economy. For instance, if food can be imported, labor can directly flow from agriculture to manufacturing with manufactured export earnings used to fund food import (Dercon 2009). However, such a trade-based approach is limited to developing countries with small economies and high openness to trade. In fact, many developing countries still host large populations in remote areas, and must therefore continue to rely on domestic production for much of its food supply (Gollin 2010).

B. The Evolving Role of Agriculture

The best way to resolve the agriculture-versus-industry debate is to simply recognize the evolving role of agricultural development. At the nascent stage of economic development, agriculture accounts for a large bulk of output, and about half or more of employment (Johnston and Mellor 1961). Much of the “circular flow” of economic activity is confined to rural areas; i.e., output of farm households is consumed as subsistence, or is exchange for food and materials produced by other farm households. The reason is that at this stage, agriculture generates little surplus with which to trade with urban households or with foreigners. Moreover, markets are fragmented, and interaction across space and economic sectors is constrained by high transaction costs.

Economic transformation is triggered when agriculture realizes enough surplus in the form of food and materials, product and factor markets begin to integrate across space, and workers begin to move out of agriculture to meet the demands of a growing industrial sector. With continued productivity growth and economic integration, other sectors as well as other countries increasingly provide food, raw materials, foreign exchange and savings, and enlarge the market for manufactures (and services). Domestic agriculture continues to decline in terms of share in output and employment, owing to the Engel relation (Buera and Kaboski 2009), as well as capital deepening and the allocation of resources towards capital-intensive sectors (Sonobe and Otsuka 2001, Acemoglu and Guerrieri 2008). The role of agriculture shifts from being the lead sector, to one that promotes convergence of living standards. The key to convergence is increased productivity (i.e., value added) of the farming population, and diversification, both in terms of product variety and range of activities linked to manufacturing and services (World Bank 2008).

A specific outline of the changing degree of agricultural transformation is that of Timmer's (1988, pp. 280–281) four phases. In the beginning phase, agricultural labor productivity starts to increase. Eventually productivity rises to a sufficiently high level, leading to the second phase of agricultural surplus. The surplus enables growth of the nonagricultural sectors by mobilizing labor, savings, and tax revenues from the agricultural sector. In the integration phase, the nonagricultural sectors become increasingly significant. Agricultural development depends on its being progressively linked to the rest of the economy through improved infrastructure and the development of markets. When integration is successful, then the economy is deemed Industrialized. At this phase, the role of agriculture is little different from that of any other sector in the economy.

Table 6 shows where countries in developing Asia were in these four phases in 1980 and 2010. These phases are defined based on per capita income and agricultural output per worker, based on the qualitative description of Timmer's phases, and the cross-section profile of developing countries. Owing to the protracted duration of the integration phase, the classification differentiates between early, middle, and late integration. The demarcation of phases is described in the Note to the Table.

Table 6: Stages of Agricultural Development for Countries in Developing Asia and the Pacific

		Countries in 1980	Description	Countries in 2010
Beginning		Bangladesh, Cambodia, Nepal, Viet Nam	Low income country; agricultural labor productivity only \$240. Agriculture's output share is 37%, and employment share is 66%.	Nepal
Agricultural surplus		Bhutan, India, Indonesia, Kyrgyz Republic, Lao PDR, Pakistan, PNG, PRC, Sri Lanka, Samoa, Uzbekistan	Low income countries; agriculture output share ranges from 19% (Bangladesh) to 36% (Cambodia); employment share from 33% (Kyrgyz Republic) to 85% (Lao PDR). Agricultural labor productivity ranges from \$434 (Cambodia) to \$947 (Pakistan).	Bangladesh, Cambodia, Kyrgyz Republic, Lao PDR, Pakistan, PNG, Tajikistan
Integration	Early	Armenia, Philippines, Tajikistan, Thailand, Vanuatu	Middle income countries. Agriculture's labor share ranges from 33% (Sri Lanka) to 52% (Viet Nam); output share ranges from 10% (PRC) to 21% (Viet Nam). Agricultural labor productivity as low as \$367 (Viet Nam), up to \$1,100 (Philippines).	India, Indonesia, PRC, Philippines, Thailand, Sri Lanka, Viet Nam
	Middle	Georgia, Malaysia, Rep. of Korea	Middle income country. Agricultural labor productivity is \$2,800; output share is 20%; employment share is 38%.	Georgia, Samoa, Uzbekistan, Vanuatu
	Late		Middle income country. Agricultural labor productivity approaching \$7,000; employment share of agriculture is 14%; output share is 10%.	Armenia, Malaysia
Industrialized		Japan	High income countries. Agricultural labor productivity ranges \$6,423–\$76,830 (median of \$33,450). Output share ranges 0%–3.9% (median of 1.9%); employment share ranges 1.0%–10.9% (median of 2.9%).	Rep. of Korea, Japan

Lao PDR = Lao People's Democratic Republic, PNG = Papua New Guinea, PRC = People's Republic of China.

Notes:

Output per worker is measured in constant 2000 dollars; per capita income is measured in constant 2005 PPP-adjusted dollars. 2010 represents either 2010 or the final year for which data is available; 1980 represents 1980 or the earliest year for which data is available. For details see Appendix Table A.1.

High income: GDP per capita above \$20,000; *Middle income:* \$2,500–\$20,000 GDP per capita; Low income: below Middle income. Middle income can be demarcated further as Upper middle (U), at GDP per capita above \$6,125. (In 1980 no country in Asia was in the Upper middle income level.) The sub-stages under the Integration stage are demarcated as follows:

Middle income countries with labor productivity of \$1,750 or below are in the Early integration phase; between \$1,750 and \$3,300 are in the Middle integration phase; and above \$3,300 are in the Late integration phase.

Source: World Development Indicators.

In 1980, only Japan had reached the industrialized phase. But over the next 30 years most countries progressed. The most striking advances were made by the Republic of Korea (which reached the industrialized phase), Viet Nam, and Armenia. However, the PRC, India, Indonesia, and Thailand are still in the early integration stage. Nepal, the Philippines, Thailand, and several others remain in the same phase after 30 years. The reason is that labor productivity in these economies has not seen a significant increase commensurate with their income per capita.⁴

⁴ A least squares regression indicates that output per agricultural worker in Thailand is only 21% of what is expected given its level of per capita income. That of the PRC is only 19%, and those of India and Indonesia only 50%. In contrast, Malaysia is close to its predicted level of output per agricultural worker (97%); and so is the Philippines (92%). These countries started with relatively high agricultural output per worker in 1980 (\$2,633 and \$916, respectively).

IV. FUTURE PATTERNS OF GROWTH AND STRUCTURAL CHANGE

A. Does Agriculture Matter?

As discussed previously, agriculture is still the largest employer in many Asian countries, including Bangladesh, Cambodia, the PRC, India, Pakistan, PNG, Thailand, and Viet Nam. Moreover, the bulk of the poor are still found in rural areas where the primary source of employment is agriculture. Thus, discussion of developing Asia's future structural transformation cannot neglect this sector. This is obvious for countries where the process of structural transformation remains shallow (e.g., in Bhutan, Cambodia, Myanmar, and Nepal, where the share of agriculture in employment remains over 60%). In the rest of developing Asia, even though the output and employment shares of agriculture have declined over time, the reduction in the employment share lags behind that in the output share, implying relatively low levels of labor productivity in agriculture. None of these countries can therefore afford to neglect the transformation of agriculture.

Moreover, except in a few countries, there is little prospect that expansion of manufacturing industries and productive services will be high enough to absorb quickly the growing labor force. Therefore, at least in the short- to medium-term, a large part of the additional employment opportunities has to be generated within agriculture. The scope for transfers of agricultural workers into other sectors is, at least initially, limited, as low-skilled rural-based workers find it difficult to find occupations outside the farm. Hence, productivity growth must be driven by growth within agriculture. In the long run, the resulting income boost will allow farm households to increase their investment in human capital, enabling family members to find employment outside the farm (Otsuka and Yamano 2006).

The past directions of structural transformation will likely continue over the next few decades. As per capita incomes in developing Asia continue to rise, the share of agriculture in GDP will continue to fall. The share of agriculture in total employment will also decline, but at a slower pace. Only at a mature stage of development will the employment share catch up with the output share, and this will be accompanied by an acceleration of agricultural labor productivity growth (as seen in the experiences of Japan and the Republic of Korea). The pace of agricultural transformation will also be determined by underlying global drivers, discussed in the following.

B. Resource Depletion, Environmental Stress, and Market Instability

The capacity of agriculture to deliver rapid increases in production in the presence of scarce natural resources, especially land, has been questioned since the time of Malthus. In the 1970s, coinciding with food price surges, the ecological movement warned of overpopulation and widespread famines (Ehrlich 1968). On the contrary, over the next 2 decades real commodity prices declined (FAO 2004). In the 2000s, the specter of Malthus returned, with the alarm of global famine again being sounded (e.g., Cribb 2010). Long term challenges facing future growth include the following (MacIntyre et al. 2009):

- Land degradation currently affects 38% of all cropland, while nutrient deficiency affected 85%–90% of cultivated soils worldwide in 2000.
- Agriculture accounts for about 86% of world freshwater consumption. Already 1.2 billion people reside in areas where water is scarce. By 2050, this number may double, and the

proportion of water available for agriculture will decrease slightly. In many water-scarce areas, the current level of per capita water consumption is unsustainable.

- Climate change worldwide is amplifying the frequency and intensity of extreme events such as floods, cyclones, and droughts. Global warming and climate change, with accompanying water shortages is perhaps the single most important long-term challenge facing humankind this century and beyond (ADB 2011).

In addition to meeting food requirements, agriculture also needs to address increasing non-food demand. Over the past decade, the rising cost of fossil fuels has improved the financial viability of crops as an alternative energy source. Bioenergy demand for farmed products is rising along with global energy demand, intensifying competition with food production for scarce land and other resources.

Resource constraints are beginning to be felt in commodity markets. The 2000s heralded a reversal of the long term decline of commodity prices in real terms (FAO 2004). The reversal culminated in the commodity boom of the late 2000s, with food prices escalating to crisis proportions in 2007–2008. Whether commodity markets have moved into a permanently higher and more volatile price regime is unsettled (Box 2). What is likely though is the recurrence of price crisis episodes, similar to those of the early 1970s and late 2000s, as climate change increases the frequency of extreme weather events large enough to damage crop production on a global scale (Willenbockel 2012).

Box 2: Has Volatility in World Food Prices Increased?

In the 1980s and 1990s, commodity prices were in long term decline in real terms (FAO 2004). In the late 2000s however, commodity prices erupted, leading to a boom (from the viewpoint of farmers) and a food crisis (from the viewpoint of consumers). From levels of about \$200 for rice (and half of that for wheat), price more than tripled in real terms for wheat in late 2007 and for rice by mid-2008. Overall, the FAO food price index more than doubled. This was followed by a rapid collapse in late 2008; however prices remained elevated (far above levels in the early 2000s) and moved erratically, with another surge of wheat prices in 2011.

Overall, supply-side factors (such as rising fuel and fertilizer prices, decline in stocks, and biofuel demand) have been implicated in the price surge. However, factors unrelated to market fundamentals likely contributed to the crisis, namely: trade policies, such as export restrictions and government procurement through imports; producers and traders holding on to supplies together with consumers advancing their purchases as prices soar and panic escalates; and increased demand on commodity futures markets as a result of both speculation and portfolio diversification. The first two factors are probably more important in the case of rice, while financial factors may have been important for commodities with an actively traded futures, such as wheat and corn (Prakash and Gilbert 2012, Dawe and Slayton 2012).

While the recent volatility episode is extreme, it is not by any means unprecedented. Commodities are characterized by lengthy periods of relatively stable prices, punctuated by sudden episodes of sharp volatility (Cashin, MacDermott, and Scott 2002). Balcombe (2011) examines monthly series for several agricultural commodities including rice, wheat, maize, soybean oil, poultry, pigmeat, beef, and sugar. He identifies the major drivers of commodity price volatility to be oil price volatility, exchange rate volatility, and stock levels; only if there are changes in these underlying drivers (e.g., increases in oil price volatility) can it be supposed that commodity price volatility increase.

What is the outlook for agriculture in the face of these challenges? A review of several global projections suggests the following:

First, over the next several decades, agricultural production will continue to keep pace with demands of a growing world population. By 2040, Asia's population will reach 5.1 billion, while the world population will reach 9.0 billion (UN 2013). Bruinsma (2011) projects that by 2050, the world's food requirements will increase by 70% from today's levels. About four-fifths of this increase needs to come from increases in productivity.

Climate change is the biggest source of uncertainty in these projections. On the one hand, the World Development Report (2010, p. 145) expects that climate change "will increase yields in some countries but lower them in most of the developing world, reducing global average yield." On the other hand, MacIntyre et al. (2009, p. 286) claims that "the preponderance of global agricultural studies... shows that climate change is not likely to diminish global agricultural production by more than a few percent, if at all, by 2050." Almost certainly, the impact of climate change will be uneven: Gains are even be expected in temperate climates of Europe and North America as warming opens up new areas for cultivation and prolongs the growing season. However, climate change may inflict mostly negative impacts on Asian and African agriculture. This is consistent with other simulations, i.e., MacIntyre et al. (2009) projects Asia's rice production to fall by nearly 4% to 2100. For the PRC and India in particular, yields may decline while rainfed areas will tend to shrink.

Second, yield growth of major crops worldwide will undergo a slowdown. Global projections by Nelson et al. (2010) do not indicate absolute decline in yields of major crops worldwide; however, yield growth will experience a slowdown on average. According to Bruinsma (2011), global average annual growth rate over the projection period (2005–2050) is 0.8%, compared to 1.7% from 1961 to 2007. This slowdown has already been underway for some time. In countries with highly productive farming (usually but not always the developed countries), land and labor productivity are already close to scientific and technical frontiers. For Asia, a major contributor to yield growth slowdown is climate change. Again there will be area-specific differences; relative to the 2000s, major improvements are still possible in developing countries such as Cambodia, India, or the Lao PDR, where land and labor productivity are still well below the frontier.

Owing to government policies and long term trends in energy prices, assessments point to major increases in biofuel production. Government support, research and development (R&D), and perhaps even biofuel mandates are expected to persist as countries seek to boost the share of indigenous and renewable energy sources. Moreover, fossil fuel prices are expected to continue their upward trend drawing in more agricultural production to replace fossil fuel. Competition with land for food production may however be tempered by breakthroughs in "second generation" technologies based on cellulosic feedstocks, that can be grown on marginal lands.

Third, food prices will trend upward over the first few decades of this century. The reference point for this is the pre-surge baseline in 2003–2005. The most optimistic projections actually point to similar levels of food prices in 2050 and the baseline; a more likely scenario though is that prices will converge to somewhere above the baseline but far below the price peaks reached in 2007–2008 (Alexandratos 2011). As supply keeps pace with demand despite diminishing yield growth, food prices will increase in real terms over the next few decades, relative to the mid-2000s (Nelson et al. 2010; Hertel, Burke, and Lobell 2010). Even with the upward trend, prices in the 2030s will remain well below the crisis levels observed in 2007–2008

(Bruinsma 2009). Price increases that are driven by rising demand (for food and bioenergy) will be beneficial for developing country farmers. However, higher food prices will be harmful to future generations of poor net food consumers in developing Asia.

C. Forthcoming Technological Breakthroughs

What can be the role of today's frontier technologies in transforming agriculture? In the past, yield growth was driven by primarily high yielding varieties from selective breeding. Conventional breeding will still be an important source of productivity growth, especially for less favorable farm areas, which need continuous adaptive plant breeding and research in sustainable management practices. In favorable areas however, yield growth will increasingly involve new discoveries in frontier technologies such as biotechnology based on molecular genetics (Huang, Pray, and Rozelle 2002), vertical farming, and nanotechnologies.

Genetically modified (GM) crops are already being widely sown in countries such as Argentina, Brazil, the PRC, Canada, India, and the US. Current implanted traits mainly cover pest resistance and herbicide tolerance; genomics and molecular techniques are now being applied to accelerate even conventional breeding programs. Within this decade, GM crops are expected to disseminate more widely throughout Asia and Africa, with currently high regulatory costs expected to fall (Fischer, Byerlee, and Edmeades 2009).

The information revolution has now reached the level of the individual farmer. Market information is being disseminated via electronic or mobile networks, reducing transaction costs throughout the supply chain, e.g., in the management of contract growers, and allowing farmers to match their output with demand and fetch the best price. Intra-field variations in pest and disease vulnerability, soil properties, terrain, etc., can now be pinpointed using global positioning system, towards targeted application of inputs under precision agriculture. Nanotechnologies, already beginning to be applied in the form of nanomaterials and nanosensors, in the next few decades promise to revolutionize precision agriculture and controlled environment systems (Gruere 2012). Around urban centers, food companies will pioneer the "hyper-niche" of high-tech urban production, e.g., vertical farming using hydroponics (US Grains Council 2011). Similarly in fisheries, farming systems will also expand to take over today's capture systems in the form of marine fish farming and seaweed plantation.

D. The Rise of Global Value Chains in Agriculture

Agriculture and related agribusiness activities are being increasingly organized in GVCs. Supply chains link production, processing, and distribution centers, often driven by direct foreign investments in the food and retail sectors of developing countries. GVCs favor production and distribution systems that meet volume requirements and address quality and safety standards. Hence, organized supply chains are displacing traditional arrangements such as spot markets and integrated plantations (Box 3). Small farmers in developing Asia can potentially realize dramatic increases in income by joining these supply chains, if they can upgrading their farming and postharvest practices.

Box 3: Country Cases of GVCs in Agriculture

The exploitation of many tropical export crops is changing from large, vertically integrated plantations into smallholder systems. Examples are tea and coffee in Kenya, rubber in India, sugarcane in Guyana, and oil palm and rubber in Indonesia.

In Sri Lanka, independent tea producers increased their output share from 11% in the 1960s to 60% by 2004. Small farmers sell green leaves to collectors or directly to processors. Green leaves are processed into black tea, most of which is sold in the world's largest tea auction, located in Colombo. Global tea trade is dominated by global brands such as Unilever—Lipton and Tata—Tetley which pack and distribute the tea worldwide in ready-to-consume form such as tea bags. Production is labor-intensive and subject to minimal scale economies, but given a prolonged gestation period, investment in tea plantations was historically unattractive to smallholders. Since the 1980s, unionization of plantation labor together with the government's price stabilization policy boosted the smallholder sector

In the PRC, by contrast, vegetable production never passed through a period of capitalist consolidation, but before 1979 it was farmed in collectives. The shift to the household responsibility system enabled rapid agricultural growth. From 1991 to 2003, vegetable production quadrupled as land resources move towards products with high domestic demand, reflecting the PRC's comparative advantage in labor-intensive and land-scarce activities. Export buyers determine vegetable varieties, production practices, and processing requirements. In Laiyang county in Shandong province, up to half of output may be exported; owing to fragmentation of household parcels, village authorities consolidate farmers' parcels for lease to processors (the *fanzu daobao* system), and production may follow a "growership" scheme in which the processor provides inputs and imposes delivery, quality and management standards, while farmers supply labor. Larger buyers tend to be foreign-owned or foreign-domestic joint ventures, and the main export destinations are the European Union, Japan, the Republic of Korea, and the United States. Harvest from small farms go to processors for sorting, cleaning, and packing (in the case of fresh produce), which are then distributed to supermarket outlets such as Wal-Mart and Carrefour.

Sources: van der Waal (2008); Herath and Weersink (2009); Stringer, Sang, and Croppenstedt (2009).

The key drivers of the agricultural GVC are international trade arrangements (including bringing agriculture into the World Trade Organization since 1995), as well as domestic market liberalization. The fundamental driver though is the transition in demand towards high quality processed or packed foods (Reardon and Timmer 2005). As incomes rise, food preferences shift towards products with higher income elasticities of demand. Middle- and upper-income class consumers are willing to pay more for products compliant with sanitary and phytosanitary standards, and meeting expectations regarding taste, packaging, and appearance. The demand transition is also being driven by urbanization and increased female labor participation, placing a premium on easy-to-prepare "convenience foods."

In the 20th century, these trends were largely limited to the old industrial countries but 21st century economic growth is creating a vast "global middle class," i.e., households with daily per capita expenditure of between 10 and 100 purchasing power parity (PPP)-adjusted dollars. In 2009, 1.8 billion consumers were in the middle class, having an annual purchasing power of \$21.3 trillion. By 2030, the global middle class may number 4.9 billion people spending \$55.7 trillion annually, and Asia will account for two-thirds of the number and three-fifths of their spending (Kharas 2010).

GVCs have penetrated even to the retail level, as in the “supermarket revolution” which swept through developing Asia in the 2000s. In the PRC, India and Viet Nam, the annual growth of supermarket retail sales averaged 28%–50% over the decade (Reardon, Timmer, and Berdegue 2004). Meanwhile, new technologies have drastically reduced processing costs, logistics, communications, and information management. They have also introduced greater capital requirements, intensifying economies of scale along the chain. Large buyers or suppliers, typically operating as global companies, occupy key nodes of GVCs (Reardon and Timmer 2005).

Agricultural GVCs have pros and cons. For self-employed farmers within a low-wage, labor-surplus setting, GVCs access premium export markets and hasten innovation, promoting agro-industrial modernization. On the other hand, consolidation of chains around a few players renders small farmers vulnerable to the demands of big buyers, while offering neither security nor an equitable sharing of value created along the chain. Unlike in many manufacturing GVCs, in agribusiness GVCs, the lowest value-added often accrues at the earliest stages, unless farmers have a unique niche based on soil, climate, or other special natural conditions or capabilities. Nevertheless, the growth of agricultural output per worker will increasingly depend on linking farmers to expanding GVCs, with farmers meeting the requirements specified by agro-processors and modern retail outlets (e.g., quality, volume, and timing). Over the course of the agribusiness transition, numerous bottlenecks to growth are inevitable. States must embrace their role as facilitators, making the necessary complementary investments in public goods, providing a stable environment for investment.

E. Projected Agricultural Output and Employment Shares

Table 7 presents the outlook for agricultural transformation for countries in developing Asia, in terms of Timmer’s phases (discussed in Section III.B.) as well as projections for output and employment shares of agriculture. Over the 3-decade span considered, countries will (with a few exceptions) move to the next phase of agricultural transformation.

Given the estimated elasticities of the shares of agriculture with respect to income per capita, agricultural output shares in many Asian countries will fall to below 5% during the next 30 years, similar to the developed countries today. However, employment shares will remain significantly higher. This is particularly true for the largest developing economies in the region, namely the PRC and India, where agriculture will still account for between one-fifth and one-third of total employment, respectively. In other countries where agriculture is currently the largest employer, e.g., Bangladesh, Pakistan, and Viet Nam, employment shares are still projected to remain over one-third. And in some countries, agriculture will still be the largest employer by 2040, e.g., Cambodia, the Lao PDR, and PNG. The exception is Thailand, where both output and employment shares decline below 5%.

Table 7: Projections of Agricultural Output and Employment Shares for 2040

	Projected G of Income per Capita (%)	Timmer's Agricultural Phases, 2040	Share Elasticities with Respect to Income per Capita		Output Shares (%)		Employment Shares (%)	
			Output	Employ- ment	Latest	Projected 2040	Latest	Projected 2040
East Asia								
PRC	4.3	Middle integration	-0.55	-0.17	10.1	<5	39.6	22.8
Central and West Asia								
Armenia	2.9	Late integration	-0.57	-0.19	19.6	<5	44.2	32.7
Georgia	2.7	Late integration	-0.70	-0.36	8.4	<5	53.4	30.2
Kyrgyz Republic	0.7	Early integration	-0.34	-0.10	20.7	19.1	34.0	33.2
Tajikistan	0.8	Agricultural surplus	-0.26	-0.10	21.3	19.8	55.5	53.9
Uzbekistan	1.8	Late integration	-0.51	-0.10	19.5	12.3	38.5	35.6
South Asia								
Bangladesh	4.5	Middle integration	-0.33	-0.10	18.6	<5	48.1	34.9
Bhutan	4.2	Early integration	-0.52	-0.11	17.5	<5	59.5	43.0
India	5.0	Middle integration	-0.38	-0.10	19.0	<5	51.1	33.5
Nepal	4.1	Early integration	-0.19	-0.10	36.5	20.1	65.7	49.9
Pakistan	4.2	Middle integration	-0.43	-0.10	21.2	<5	44.7	33.6
Sri Lanka	1.6	Early integration	-0.54	-0.14	12.8	8.6	32.7	29.9
Southeast Asia								
Cambodia	3.1	Early integration	-0.35	-0.10	36.0	17.1	72.2	61.1
Indonesia	4.8	Middle integration	-0.52	-0.12	15.3	<5	38.3	24.2
Lao PDR	1.8	Early integration	-0.32	-0.10	33.0	25.5	85.4	79.2
Malaysia	3.0	Industrialized	-0.93	-0.69	10.4	<5	13.3	<5
Philippines	4.7	Late integration	-0.64	-0.29	12.3	<5	35.2	5.7
Thailand	4.2	Middle integration	-0.75	-0.44	12.4	<5	38.2	<5
Viet Nam	4.7	Early integration	-0.37	-0.10	20.6	<5	51.7	36.3
Pacific								
PNG	3.1	Early integration	-0.51	-0.10	35.8	7.6	72.3	61.0
Samoa	3.3	Late integration	-0.70	-0.38	9.7	<5	39.9	14.7
Vanuatu	1.2	Middle integration	-0.70	-0.37	19.7	13.8	60.5	50.8

Lao PDR = Lao People's Democratic Republic, PNG = Papua New Guinea, PRC = People's Republic of China.

Notes:

Growth projections are based on Felipe, Kumar, and Abdon (2012), except for Bhutan and Samoa, which are obtained by extrapolating past GDP growth trends.

Labor productivity is projected to grow at the same rate as per capita income growth.

Projected shares of agricultural output and employment are obtained using elasticities from the regressions of the shares of

$$s_{2040}^c - s_{2010}^c = \varepsilon^c \left(\frac{y_{2040}^c - y_{2010}^c}{y_{2010}^c} \right) s_{2010}^c$$

agricultural output and employment shown in Section 2, and then applying the formula:

where c indexes the country, and ε^c denotes the elasticity (i.e., derivative of the log of the share with respect of to the log of income per capita of the estimated regressions shown in Section 2). Output and employment elasticities are evaluated at the average of the per capita income distribution of each country.

The lag in decline between output and employment shares implies a relatively slow increase in labor productivity; none of the developing Asian economies, except Malaysia, will achieve the industrialized agriculture status during the next 3 decades. By 2040, if current trends continue, agriculture's employment share will remain sizable (over 20% for most of Asia), compared to the output share (under 20% for most countries, and under 5% for majority of these). Even 30 years hence, the transformation of employment structure of the economy in many Asian countries will remain incomplete. Compared with the high income countries today (see Table 6), the disproportionately large employment share and low labor productivity in

agriculture is unprecedented, being the legacy of the protracted delay in structural transformation, even during the period of fairly rapid economic growth over the past few decades.

In conclusion, even an extended time span (3 decades) will not be enough to complete the process of agricultural transformation in developing Asia. To expedite this process, many Asian countries will still need to dedicate significant sums of money to improve their basic agricultural infrastructure. Simultaneously, they will need to both adopt new technologies and conduct R&D. And to move up in the value chain, countries will need to support the agribusiness transition and enable farmers to produce the types of products demanded by GVCs in terms of quality and standards.

V. CONCLUSION

The modern understanding of agricultural transformation takes into account the evolving role of agriculture, whose phases depend on the level of agricultural development as well as the degree of integration of agriculture with the rest of the economy. The experience of developing Asia seems to exemplify this modern understanding.

Agricultural development in Asia will likely proceed according to past trends, though the pace and direction of change will be punctuated by emerging challenges and opportunities related to environmental stress (e.g., climate change), market instability, future technological breakthroughs, and the rise of global value chains. Over the next 3 decades many countries of developing Asia will move on to the next level of overall development. However, the reduction in agriculture's employment share will continue to be slow, relative to the decline in its output share. Disparities in output and employment shares for developing Asia will be more pronounced than what is observed currently among middle- and high-income countries. Developing Asia must continue to pay attention to accelerating growth of output and labor productivity in agriculture, as well as job creation in nonagricultural sectors.

What difference does this enduring importance of agriculture make for designing policy? The World Bank (2009) outlines an agriculture-for-development approach based on: improved livelihoods in subsistence agriculture. Development of smallholder competitiveness and entry into markets, the generation of more employment in agriculture based on skilled labor, and the establishment of efficient value chains. This approach entails investments in effective R&D and technology transfer, in human resource development, transport infrastructure and contract enforcement (to open up access to markets), other public goods and rural infrastructure (e.g., irrigation), and in a functional and equitable system of land rights (Tsakok 2011).

These elements appear fairly obvious, except that many governments have not prioritized these elements in practice. Rather than invest in public goods, many developing countries (e.g., India and Indonesia) have opted to focus on subsidies for private goods—an approach that, in Latin America at least, has had unfortunate consequences for rural poverty (Lopez and Galinato 2007). Price policies are implemented to prop up producer prices using border measures (e.g., the Philippines) and government procurement (e.g., Thailand), raising prices for consumers and bloating public outlays for agriculture.

An agricultural transformation agenda should not, however entirely, dispense with price policies and subsidies. Price policies should aim for some degree of market stability to offer protection for poor households and predictability for agricultural investments (Dawe and Timmer

2012). Subsidies and other promotional policies should be designed strategically, towards upgrading along the agriculture value chain, addressing blockages, externalities, and coordination failures in private and public investments. In short, the rationale for industrial policy, (e.g., Rodrik 2007, Felipe 2009), often applied to manufacturing, can similarly be extended towards agribusiness support.

A deeper characterization of a policy agenda for agricultural transformation belongs to another study. Rather, it is worth reiterating the need for renewed attention to the role of agriculture in the continued structural transformation of developing Asia. Discussions on development strategy must move forward from sterile debates about agriculture versus industry or agriculture versus services, towards a more balanced view of the potential contributions of all the sectors.

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Agriculture and Structural Transformation in Developing Asia: Review and Outlook

Past assessments of development and structural transformation in developing Asia have focused on industry and services. This paper renews the focus on agriculture, showing that agriculture still matters in economic transformation, given that it is still the largest employer for many large developing economies in Asia. In the long term, agriculture's employment share will continue to be sizable relative with the output share; to expedite transformation, many Asian countries will still need to promote long term productivity growth in agriculture and facilitate upgrading of their farms and agroenterprises within the global value chain.

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