RAP PUBLICATION 2014/04

The State of
Food and Agriculture in Asia and the Pacific

2014

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Contents

Foreword

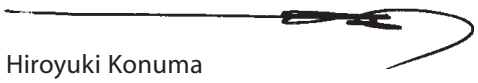
I am pleased to announce the third issue of The State of Food and Agriculture in Asia and the Pacific. This publication aims to discuss past trends and provide a forward-looking regional analysis of the many issues facing food and agriculture in this very dynamic and populous part of the world.

The world now produces enough food to feed everyone. In 2011–2013, however, FAO estimated that a total of 842 million people did not have access to a sufficient supply of dietary energy to live a healthy life, with 553 million, nearly two-thirds of the global total, living in the Asia-Pacific region. This constitutes a great improvement since 1990, and the region as a whole is on track to reach the MDG target. But even if the target is achieved, that will mean that about 12 percent of the region's population in 2015, more than 500 million people, will be undernourished. These disadvantaged people live at the bottom of society, suffering daily extreme hardship. Until hunger is completely eradicated, social equity and sustainable development will not have been achieved. FAO is therefore focused on helping these hundreds of millions through the Zero Hunger Challenge.

Our food producers face shortages of land, water and labour, and these shortages are likely to become worse in the coming decades. Rapid income growth in the region is crucial for alleviating poverty, but it will lead to a profound transformation of diets that will place increasing stress on our production capacity, and possibly our health as well. Add to this a number of uncertainties surrounding future crude oil prices, food price volatility, the negative impact of climate change and natural disasters, and biofuel developments, and it is obvious that it will be a tremendous challenge to meet the food and nutrition demands of a growing, wealthier and increasingly urbanized population. Aside from the deficits in dietary energy that must be overcome, the negative health consequences of micronutrient deficiencies continue to affect around 2 billion people (many of them in this region), and there is also a rapidly increasing population suffering from overnutrition.

This challenge can be met only if all stakeholders work together. Governments need to provide public goods in sufficient quantity and quality, as well as a fair and inclusive enabling environment for private investment that respects the rights of the poor. We need private and public agricultural research, extension and institutional innovation to promote sustainable intensification that helps farmers manage risk and meets food demand at affordable prices while also protecting the numerous services provided by our natural environment. And, we must not forget the remaining 12 percent undernourished that will still remain even if we reach the MDG hunger target. These people, the most vulnerable in our society, will require systems of social protection and targeted support. Sustainable consumption, reducing postharvest loss and waste, and improving food safety and quality are equally important.

In conclusion, everyone should have a right to access food. Food is essential for our survival, stability, peace and world security. FAO is therefore committed to working together with its partners around the region and the globe in order to eradicate hunger and ensure many future generations of well-nourished and prosperous farmers and consumers.



Hiroyuki Konuma
Assistant Director-General and Regional Representative
for Asia and the Pacific

Acknowledgements

This publication is the end result of contributions from many different people. Guidance and supervision from Hiroyuki Konuma, Assistant Director-General and Regional Representative for Asia and the Pacific, and Vili Fuavao, Deputy Regional Representative, were instrumental in developing the overall structure of the report, while David Dawe of the Agricultural Development Economics Division (ESA), based in the Regional Office for Asia and the Pacific (RAP), was in charge of coordinating technical inputs to the report. Ramesh Sharma, Kevin Gallagher, Sumiter Broca, Nanae Yabuki and Seevalingum Ramasawmy of the Economic, Social and Policy Assistance group (ESP) and Vinod Ahuja of the Agriculture and Food Systems group (AFS) at RAP provided many helpful inputs through comments and discussions in the office. Patrick Durst, Simon Funge-Smith, Wiriya Khim, Weimin Miao and Chung Te Tzou of the Natural Resources and Environment group (NRE) at RAP drafted the sections of the report on natural resource management and Shashi Shareen of the AFS group drafted the sections on food safety and quality. Chotika NaChiangMai provided excellent administrative support to make sure the work was published, and Su-Arjar Lewchalermvongs provided research assistance in organizing much of the data behind this report. Last, but not least, the report was skillfully edited by Bill Hardy.

SOUTHEAST ASIA


Brunei Darussalam (BRN)


Cambodia (KHM)


Indonesia (IDN)


Lao PDR (LAO)


Malaysia (MYS)


Myanmar (MMR)


Philippines (PHL)


Singapore (SGP)


Thailand (THA)


Timor-Leste (TLS)


Viet Nam (VNM)

SOUTH AND SOUTHWEST ASIA


Afghanistan (AFG)


Bangladesh (BGD)


Bhutan (BTN)


India (IND)


Iran (IRN)


Maldives (MDV)


Nepal (NPL)


Pakistan (PAK)


Sri Lanka (LKA)

NORTH AND CENTRAL ASIA


Kazakhstan (KAZ)


Russian Federation (RUS)


Uzbekistan (UZB)

EAST ASIA


China (CHN)


DPR Korea (PRK)


Mongolia (MNG)


Republic of Korea (KOR)

PACIFIC ISLANDS


Cook Islands (COK)


Fiji Islands (FJI)


Kiribati (KIR)


Marshall Islands (MHL)


Micronesia, Fed. States of (FSM)


Nauru (NRU)


Niue (NIU)


Palau (PLW)


Papua New Guinea (PNG)


Samoa (WSM)


Solomon Islands (SLB)


Tonga (TON)


Tuvalu (TUV)

Vanuatu (VUT)

DEVELOPED COUNTRIES

Australia (AUS)

Japan (JPN)

New Zealand (NZL)

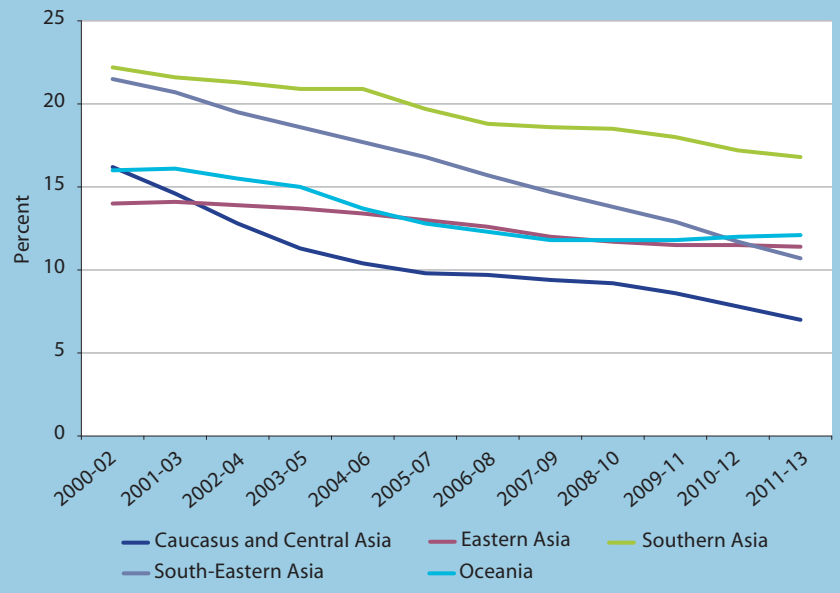
I. Trends in food security and nutrition

Undernourishment is declining but has not been eradicated

The most recent estimate of the number of undernourished people (those who obtain insufficient dietary energy to lead an active and healthy life) in the world is 842 million in 2011–2013, which represents a decline from 957 million in 2000–2002 (FAO, IFAD and WFP 2013). Nearly all of the global decline of 115 million has taken place in the Asia and the Pacific region (110 million).

The largest percentage declines in the number of undernourished since the beginning of this century (2000–2002) have taken place in (i) the Caucasus and Central Asia (-53 percent)[1] and (ii) South-Eastern Asia (-43 percent), but the number of undernourished also declined in Eastern Asia and Southern Asia (it remained unchanged in Oceania at 1.2 million). Because population has grown in all of these subregions, the prevalence of undernourished has declined in all subregions (Figure 1), with a decline from 18.3 to 13.5 percent for Asia and a decline from 16.0 to 12.1 percent for Oceania (18.2 to 13.4 percent for the region as a whole). Given a prevalence for the region of 24.0 percent in 1990–1992, the pace of decline is almost exactly on pace to meet the Millennium Development Goal (MDG) target. But despite this progress, Asia and the Pacific remains home to 553 million undernourished people, nearly two-thirds of the world's total (Figure 2).

Figure 1. The prevalence of undernourishment in subregions

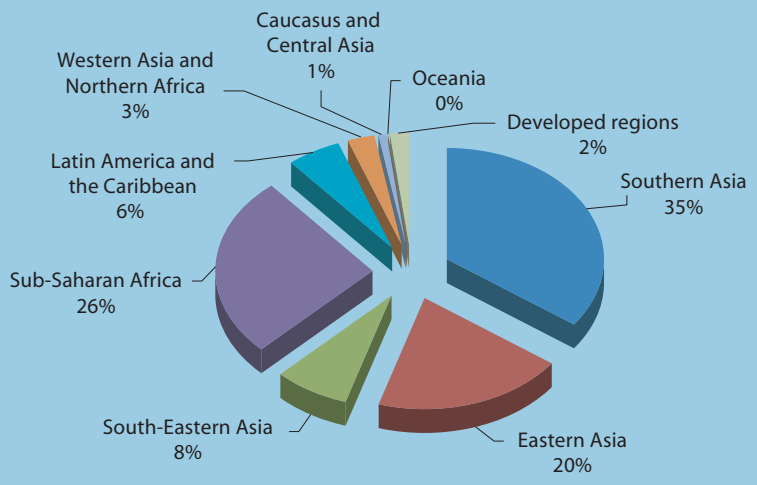


Source: FAO, IFAD and WFP (2013).

Some other indicators of food security and nutrition show similar trends over time. For example, there have also been rapid reductions in the percentage of children under five years of age who are stunted (low height for age). In East Asia and the Pacific, the percentage declined from 42 percent in 1990 to 12 percent in 2012, and in South Asia it declined from 61 to 38 percent over the same period (World Bank 2014). These rates

[1] This publication uses analyses from many different sources, as well as some original analysis. When using analysis from other publications, this report uses the names for regions and subregions that were used in the source material. This results in different names being used for similar groupings (e.g. Caucasus and Central Asia vs. Central Asia; Pacific Island countries vs. Oceania). When not reporting the results from other publications, the groupings used are found on page vii.

Figure 2. Share of global undernourished by region



Source: FAO, IFAD and WFP (2013).

of decline are more rapid than those for the proportion who get insufficient dietary energy.

There has been less progress in reducing micronutrient deficiencies, however (FAO 2013). Vitamin A deficiency in the region declined from about 37 percent in 1990 to just 32 percent in 2007, a very slow rate of decline. Progress has also been quite slow in reducing the incidence of anaemia and low iodine (UNSCN 2010).

Access to food has improved, but many are still poor

Much of the improvement in the various measures of food security is due to improvements in the availability of, and access to, food (these are two of the key pillars of food security). The availability of food has increased tremendously due primarily to increased production per capita, as discussed in section II, but also because of increased trade (discussed in section III).

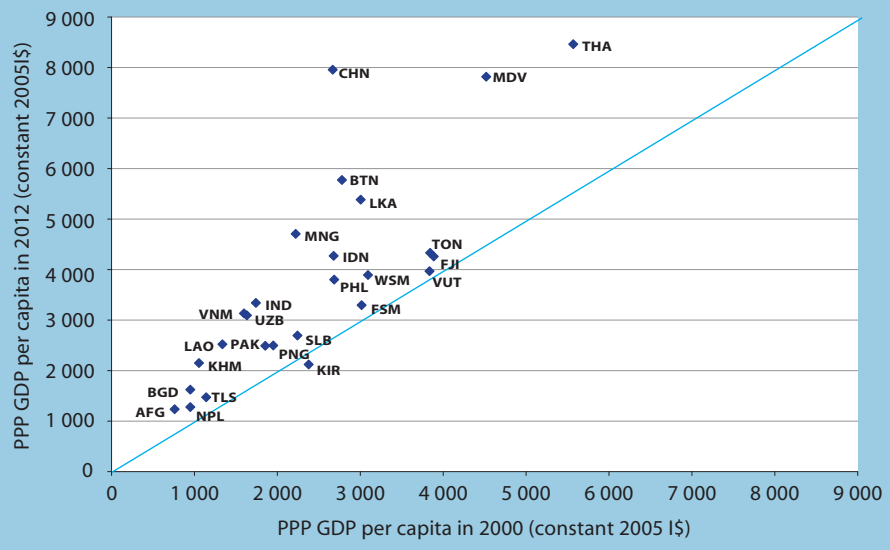
Access to food has also improved, in the first instance due to higher income. In nearly all countries of the region, GDP per capita has improved since 2000, as shown by the fact that nearly all countries are above the 45 degree line in Figure 3 (Kiribati, where income has declined very slightly, is the only exception). Economic growth has consistently been more rapid in the countries of Central, East, Southeast and South Asia than in the Pacific Island countries (PIC) and developed countries.

But, higher average GDP per capita does not necessarily improve access to food – some of the increased income must accrue to the poor so that they can buy more food. If all of the income goes to the better off, then there might not be any improvement in undernourishment due to increases in GDP per capita.

The trends in the share of income accruing to the bottom 20 percent of the population show no distinct patterns across countries – it has risen in some countries, but declined in others. Excluding the developed countries, the current (based on the most recent data available) share ranges from 4.5 percent in Malaysia to 9.6 percent in Pakistan, both of which are well below 20 percent (the percentage they would earn if income were distributed equally).[2] Fortunately, among the countries in the region where undernourishment is a problem, there are no cases where the percentage decline in

[2] For comparison, the share of income accruing to the bottom 20 percent of the income distribution, according to the most recent World Bank (2014) data, is 10.6 percent in Japan (in 1993) and 5.4 percent in the United States of America (in 2000).

Figure 3. PPP GDP per capita, developing countries in the region, 2000 and 2012



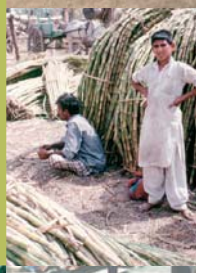
Source of raw data: World Bank (2014). Data for Afghanistan refer to 2002 and 2011 and data for Maldives refer to 2001 and 2012. Countries with PPP GDP per capita of more than 10 000 in constant (2005) international dollars in 2012 are not shown (Australia, Brunei, Iran, Japan, Kazakhstan, Malaysia, New Zealand, Palau, Republic of Korea, Russian Federation, Singapore). Symbols for countries are given on page vii.

the share of income accruing to the bottom 20 percent has been greater than the percentage growth in GDP per capita over the past decade or so. This means that the absolute income of the bottom 20 percent has increased in all countries of the region for which there are data, which in turn means that the poor have more income with which to buy food than they did in the past. This is roughly confirmed by data on poverty – the share of the population living below the poverty line has declined in nearly all countries in the region over the past 10–15 years for which there are data (it has risen slightly in the Philippines and substantially in Timor-Leste).

Although poverty is declining and the poor have more money with which to buy food, inequality remains an important concern. Even when the poor's share of national income is constant, this still means that they are receiving a small proportion of the overall increase in income. With income increasing rapidly in many countries, this implies that the absolute (as opposed to percentage) increases in the income of the poor are lagging far behind the absolute increases in the income of the well-to-do.

Income is the most important determinant of access to food, but food prices also make a difference. This is particularly true for rice and wheat, because these are the most important expenditure items for most of Asia's poor. Rice and wheat are now the dominant sources of dietary energy in most of the PIC as well, even though these are not the traditional staple foods in that subregion. Over the past few decades, domestic rice prices have declined in most Asian developing countries after adjusting for inflation (Dawe et al 2010). But, more recently, domestic prices increased sharply in many countries during the world food price crisis of 2007–2008. Through the use of trade controls, the largest countries were able to insulate themselves from the crisis – rice and wheat prices were quite stable during the crisis in China and India, and rice prices were stable in Indonesia (Fang 2010; Gulati and Dutta 2010; Saifullah 2010). But, these trade controls exacerbated the price spike on world markets (Anderson 2012), and many countries were not able to insulate themselves from the crisis.

Since the crisis, prices on world markets have declined once again. Nevertheless, comparing 2013 with 2006 (before the crisis), world market maize and wheat prices in US dollars (adjusted for inflation) were up by 107 and 44 percent, respectively. Soy and

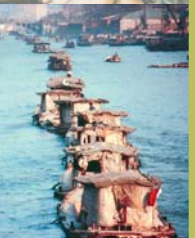











palm oil prices rose 67 and 64 percent, while rice prices (Viet Nam 5 percent brokens) increased just 28 percent. Some of the impact of these price increases for countries in the region has been offset by appreciation of their real exchange rate against the US dollar: most countries in the region saw their real exchange rate appreciate by 15 to 30 percent between 2006 and 2012.[3]

But, because of government trade policies, staple food prices on domestic markets are not always well connected with international prices. And, in terms of food security, domestic prices are arguably more important, as the income received by farmers and the purchasing power available to consumers depend on domestic prices.

Since the price crisis on world markets in 2007–2008, domestic rice prices have behaved differently in different countries. For most countries in the region where rice is the staple food, domestic rice prices, after adjusting for inflation, are now higher than they were before the crisis. Comparing 2013 with 2007, the biggest increases in real prices have occurred in China (up 37 percent), India (up 24 percent) and Thailand (up 22 percent). These increases are often due to government policies to support farm prices, not because of higher world market prices. High prices give farmers additional income (especially those with large surpluses to sell), but make it more difficult for poor consumers to maintain expenditures on other items, including foods such as meat, dairy products and vegetables that provide important micronutrients. Although rice prices have increased since the crisis in most countries of the region, real rice prices have declined in some countries (compared with 2007), including Viet Nam (down 15 percent), Nepal (down 13 percent) and Lao PDR (down 9 percent).

The picture is more mixed in the case of wheat and wheat products (e.g. wheat flour). Prices adjusted for inflation have increased since 2007 in China (up 30 percent), Pakistan (up 25 percent) and Sri Lanka (up 20 percent), among others, while they have fallen in Bangladesh (down 25 percent), Nepal (down 19 percent) and India (down 5 percent).

To summarize, access to food is improving due to income growth, but higher staple food prices since the world food price crisis have eroded some of those gains.

Diets are diversifying

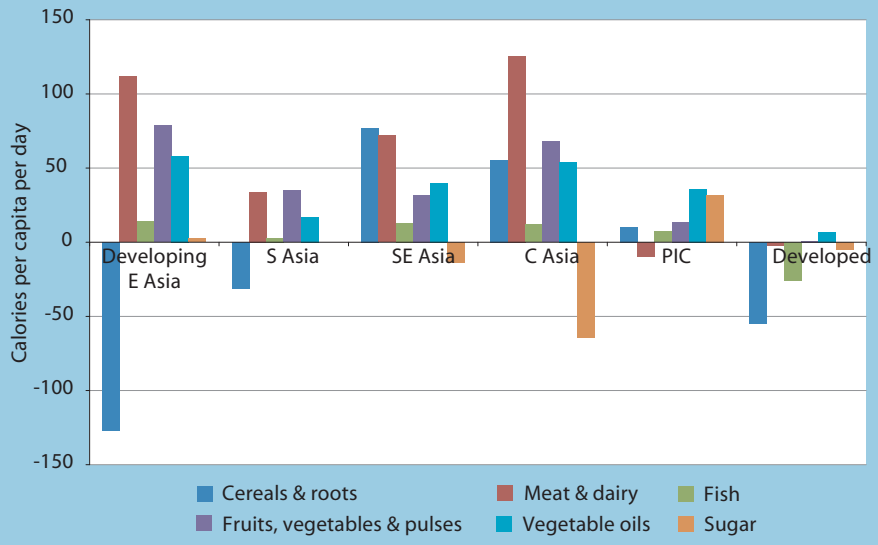
For most of the Asia-Pacific region (East, South, Southeast and Central Asia), the largest increases in dietary energy supply since 2000 have generally come from three food groups: fruits, vegetables and pulses (FVP); meat and dairy products; and vegetable oils (Figure 4). This is not surprising, given that these subregions have experienced the most rapid economic growth. The dietary energy supply from cereals and roots and tubers has declined in East and South Asia, although it may have increased in Southeast and Central Asia.[4] The dietary energy supply from fish has increased slightly, while that from sugar has declined.

The trends are different in the PIC and the developed countries, however. In the PIC, most of the increased dietary energy supply in roughly the past decade has come from vegetable oils and sugar. This trend does not bode well for health in the coming years. In the developed countries group, the dietary energy supply declined between 2000 and 2009, although this trend was mainly due to events in Japan; the dietary energy supply increased substantially in Australia. Relative to developing countries in Asia, the different patterns in the PIC were probably due to slower economic growth in this subregion, while in the developed countries the different pattern is probably because of the high per capita income.

[3] Full data for 2013 were not available at the time of writing.

[4] Data from household surveys for some Southeast Asian countries indicate that the dietary energy supply from rice has declined in recent years, just as it did years earlier in countries such as Japan and the Republic of Korea (Timmer et al 2010). But, the data from food balance sheets, on which Figure 4 is based, are inconsistent with the household survey data. This is an important discrepancy that needs to be resolved.

Figure 4. Change in dietary energy supply by food category, 2000–2009



Source of raw data: FAO (2014).

Sanitation has improved, but major problems remain

Improved sanitation is important for good nutrition because it reduces the incidence of disease, thereby allowing the human body to better use the nutrients that are consumed (food utilization is also a key pillar of food security). Access to sanitation facilities has generally improved across the region, although several countries in the Pacific are an exception. Despite the improvements, there are still a number of countries, many of them in South Asia, where less than half of the population has access to good sanitation facilities. To some extent, families will invest in better sanitation facilities as they grow wealthier, but not all people appreciate the importance of improving hygienic practices and using sanitation facilities, so there is an important role for governments to play, especially in education.

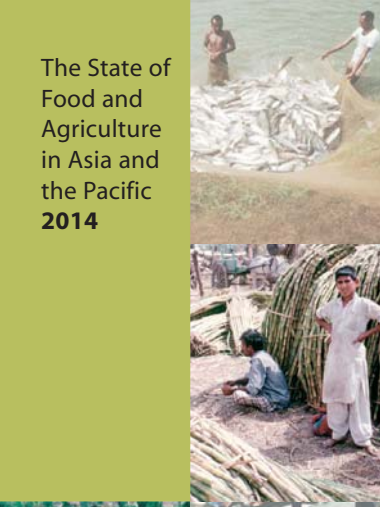
Food safety and quality

WHO estimates that foodborne and waterborne diarrhoeal diseases cause about 2.2 million deaths annually worldwide, of which 1.9 million are children. But, a lack of data prevents a complete quantification of the burden of unsafe food in Asia. Better policies and infrastructure related to food safety would provide many benefits such as fewer foodborne illnesses, a reduction in food losses and waste, increased market access and reduced public health costs.

Emerging nutrition problems

Over the long term, income gains, declines in food prices and improved sanitation facilities, among other factors, have helped to reduce undernourishment in the region, although, as noted earlier, the downward trend in food prices has been reversed in the past few years. But, higher income and lower prices, combined with urbanization and changes in work habits due to the structural transformation of the economy away from agriculture and toward sectors with more sedentary employment, have created new nutrition problems.

Overweight (body mass index, or BMI, greater than 25) and obesity (BMI greater than 30) are emerging problems in the Asia-Pacific region, as they lead to an increased incidence of non-communicable diseases such as heart disease and diabetes that, in turn, lead to increased health care costs and premature mortality. There are wide disparities across different subregions in the incidence and impact of these problems. Between 1990 and 2010, the total disability-adjusted life years (DALYs) lost to these two



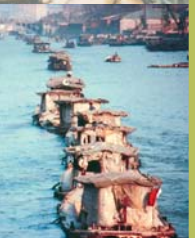












factors in Asia more than doubled, while in Oceania it quadrupled. As a result, the DALYs lost per thousand people due to overweight and obesity are now higher in Oceania (67) than in any other developing region of the world. On the other hand, the DALYs lost per thousand people in Southern Asia are just 11, the lowest figure for any developing region (FAO 2013).

The increased magnitude of these problems is undeniably important, but it should not obscure the continued importance of underweight and micronutrient deficiencies in the region. The total DALYs lost to these latter two factors for mothers and children alone are more than double the total lost to overweight and obesity for all adults aged 25 and older (FAO 2013). In Asia as a whole, the population-adjusted DALYs lost to underweight alone are more than five times as large as for obesity and overweight. Even in Oceania, where the overweight problem is the worst, population-adjusted DALYs are greater for underweight children than for obesity and overweight. In addition, undernutrition in childhood also increases the risks of obesity later in life. Thus, although obesity is an increasing problem that needs attention, it is important not to lose focus on eradicating undernutrition and micronutrient deficiencies.

II. Agricultural growth and trends in production for crops, livestock and fish

Economic and agricultural growth has been rapid, especially in East and Southeast Asia

As noted above, economic growth has been rapid in Asia and the Pacific for several decades. Despite the Asian economic crisis in the late 1990s and the global food, fuel and financial crises in the late 2000s, rapid economic growth has generally continued. In nearly all cases, most of this growth is due to growth in the industrial and service sectors of the economy, which tend to grow more rapidly than the agricultural sector (although this tendency can be reversed for brief periods of time, especially if the terms of trade tilt in favour of agriculture). As a result, the share of agriculture in the overall economy tends to decline as GDP per capita increases.

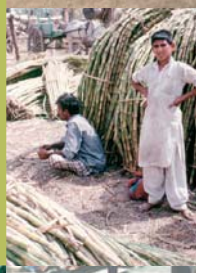
Although agricultural sector growth has been lower than that in the industrial and service sectors, growth in this sector has still been robust in recent years. The annual average growth of agricultural value added (VA) per worker from 2000 to 2011 exceeded 2.4 percent per annum in all developing countries in Central, East and Southeast Asia other than Brunei Darussalam and Lao PDR. But, in other regions, agricultural growth per worker was almost uniformly lower. Other than the Solomon Islands (5.7 percent per annum), Iran (4.2 percent; data available only until 2007) and Bangladesh (3.6 percent per annum), developing countries in South and Southwest Asia and in the Pacific grew at rates of 2.2 percent per annum or less (see Table 1).

Interestingly, some of the most rapid growth in agricultural VA per worker since 2000 took place in Japan and the Republic of Korea although these countries had some of the lowest growth rates of agricultural VA (indeed, Japan's agricultural sector had negative VA growth during this period). The explanation for the difference in growth of agricultural VA and agricultural VA per worker was the rapid decline of the agricultural labour force in these two countries, which led to increased productivity for those left behind. This also led to the share of agriculture in total employment declining more rapidly than the share of agriculture in GDP, thus leading to a narrowing of the agricultural employment-income gap. A number of other countries have also seen a higher growth rate of agricultural VA per worker than agricultural VA due to a decline in the agricultural labour force. These countries are China, Kazakhstan, Malaysia, Mongolia, the Russian Federation, Samoa, Singapore, Thailand and Tonga. These countries tend to have higher GDP per capita than other countries in the region. As countries become richer, the decline in the agricultural labour force lifts the productivity of the remaining workers in the agricultural sector, thus helping to raise the living standards of those employed in agriculture.

In most of the developing and transition economies in the region, growth in agricultural output during the past decade has not been primarily due to increased input use, but rather due to growth in total factor productivity (Fuglie 2012).[5] For most East and Southeast Asian countries during the period 2001–2009, more than 70 percent of the growth in gross output was due to growth in TFP. The share was slightly lower in the rest of the region, but still usually 50 percent or above. These shares of TFP in total growth are higher than in earlier decades, particularly the 1960s, 1970s and 1980s. In addition, percentage growth in the use of inputs has slowed down compared with earlier decades. This is consistent with FAO's "Save and Grow" approach, which focuses on continued agricultural growth but with less use of inputs. Most of the reduction in input use has been due to labour, but not necessarily a reduction in the use of material inputs such as fertilizer and pesticides.

At least two key factors have been responsible for the growth in agricultural TFP: agricultural R&D and a reduced pricing bias against agriculture.

[5] Growth in total factor productivity (TFP) is growth in outputs minus growth in inputs.









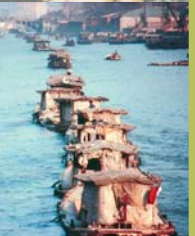



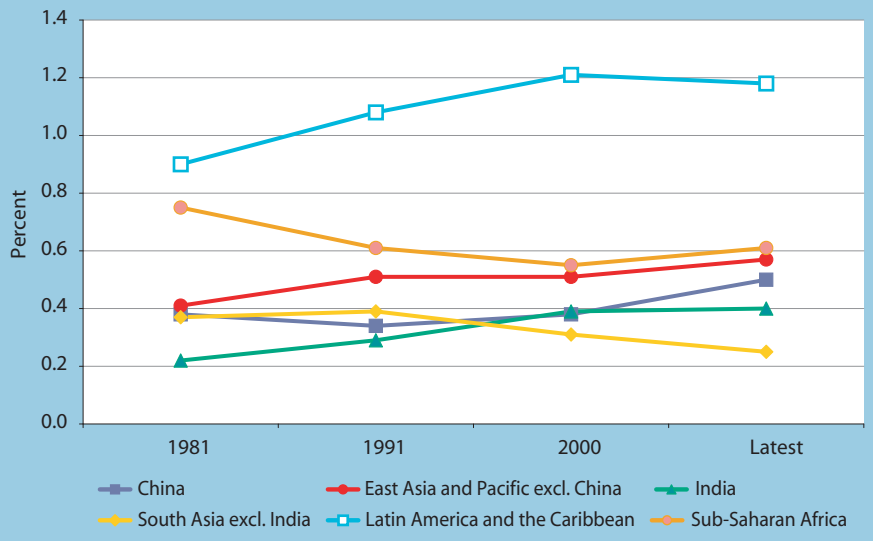
Table 1. Growth in agricultural value added (VA) and agricultural VA per worker, percent per annum

Region/country	*Agricultural value added*		*Agricultural value added per worker*	
	1990–1999	*2000–2011*	*1990–1999*	*2000–2011*
East Asia				
China	4.2	4.4	3.7	4.5
Korea, Rep. of	1.6	1.7	6.2	7.5
Mongolia	0.9	3.9	1.2	4.7
Southeast Asia				
Brunei Darussalam	3.7	1.8	13.3	1.8
Cambodia	4.2	5.5	1.5	3.5
Indonesia	2.2	3.5	0.9	3.2
Lao PDR	4.7	3.5	2.4	1.0
Malaysia	0.1	3.3	0.7	4.8
Philippines	1.7	3.0	0.1	2.4
Singapore	-2.8	-1.9	4.4	2.6
Thailand	0.7	2.2	1.3	2.7
Viet Nam	4.2	3.7	2.7	2.4
South and Southwest Asia				
Afghanistan	–	2.4	–	-0.4
Bangladesh	2.5	3.6	2.3	3.6
Bhutan	1.4	1.8	2.3	-4.0
India	3.3	3.2	2.0	2.0
Iran	3.4	5.9	2.2	4.2
Maldives	–	-0.1	–	-0.7
Nepal	2.4	3.2	-0.3	-0.1
Pakistan	4.4	3.3	2.5	0.4
Sri Lanka	1.8	3.3	1.4	2.2
North and Central Asia				
Kazakhstan	-8.9	4.2	-8.1	5.2
Russian Federation	-6.2	1.8	-2.7	3.9
Uzbekistan	0.0	6.4	0.6	6.1
Pacific Islands				
Fiji	0.5	-0.5	-0.4	-0.6
Kiribati	-3.5	1.0	-3.5	-0.3
Palau	–	0.7	–	0.7
Samoa	0.1	-2.2	1.5	-0.4
Solomon Islands	4.4	8.3	1.6	5.7
Tonga	1.4	-1.1	0.6	-0.1
Tuvalu	0.6	1.6	0.6	1.6
Vanuatu	2.6	2.8	1.8	1.1
Developed countries				
Australia	3.0	1.8	3.6	1.4
Japan	-0.7	-1.2	4.6	5.4
New Zealand	3.0	2.0	2.5	1.2

Source of raw data: World Bank (2014). "–" indicates that no data are available for that period.
Note: Growth rates are calculated using linear regression of the log of VA versus time.

Public expenditures on agricultural R&D as a percentage of agricultural GDP have been increasing in China, the rest of the East Asia and the Pacific region, and India, although they have unfortunately been declining in the rest of South Asia (Figure 5). It is well known that agricultural R&D has exhibited high rates of return in the past, in terms of both agricultural production and poverty reduction (FAO 2012a; Fuglie 2012; Fan et al 2000, 2004, 2008a, 2008b), as well as high financial rates of return (Pardey and Beintema 2001). These positive trends in most of the region have contributed to robust agricultural sector growth, and will continue to provide benefits into the future. It is important that these trends continue; although expenditures on agricultural R&D have been increasing, they are still below the recommended level of 1 percent of agricultural GDP for developing countries (Beintema and Elliott 2011), and are also below the levels in sub-Saharan Africa and Latin America and the Caribbean.

Figure 5. Expenditures on agricultural research and development as a percentage of agricultural GDP



Source: FAO (2012) using data from IFPRI ASTI database (available at www.asti.cgiar.org/data/) and World Bank.

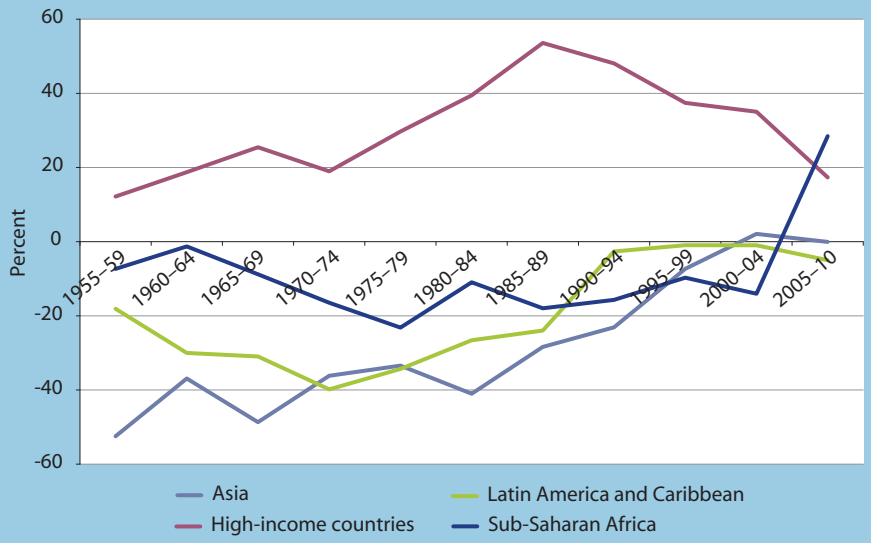
Note: Latest data are 2002 for East Asia and Pacific excl. China, 2006 for Latin America and the Caribbean, 2008 for Sub-Saharan Africa and China, 2009 for India and South Asia excl. India.

Although government spending on public goods such as agricultural research is crucial, it is also important to realize that private domestic investment dwarfs the magnitude of government investment, foreign direct investment (FDI) and overseas development assistance (ODA) (FAO 2012a). Thus, it is important that government policies create an enabling environment for private sector investment because such investment is a key driver of job creation and economic growth. In addition to a strong enabling environment, public–private partnerships are also crucial for future agricultural sector growth.

In terms of agricultural prices, the relative rate of assistance to agriculture (RRAA)[6] in Asian developing countries has been steadily improving since the 1950s (Figure 6). In 1955–1959, the RRAA was about -50 percent, which implies a strong bias against agriculture. As late as the first half of the 1980s, it was still -40 percent. But, since that time, it has been steadily increasing and, for the periods 2000–2004 and 2005–2010, it

[6] The RRAA measures the extent to which government policies affect farm prices relative to other sectors and provides an indication of the degree to which a country's overall policy regime is biased for or against agriculture. A positive RRAA implies that agriculture is favoured or subsidized relative to other sectors, while a negative RRAA indicates that agriculture is penalized or taxed (Anderson and Valenzuela 2008).

Figure 6. Relative rate of assistance to agriculture



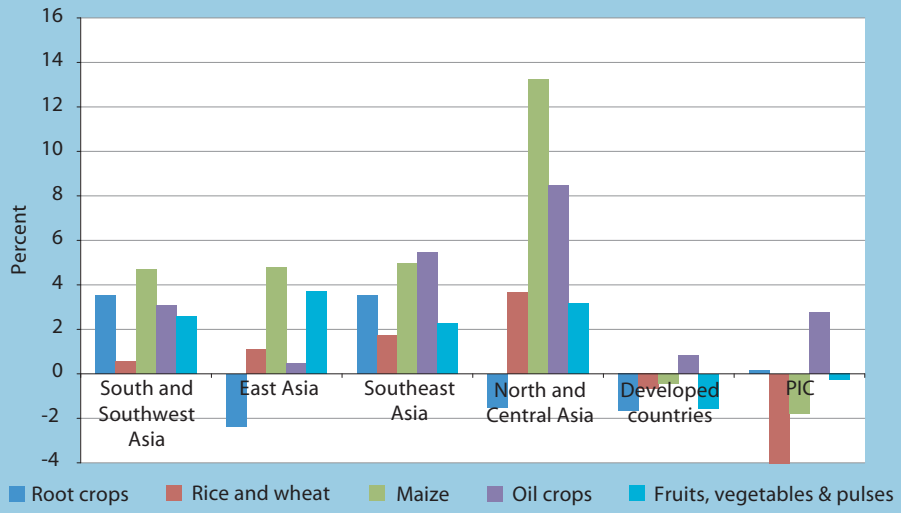
Source: Figure 17 in FAO (2012a), using data from Anderson and Nelgen (2012).

reached zero, which means that the agricultural sector is neither favoured nor discriminated against (relative to other sectors of the economy) in terms of pricing policies. There are of course some differences across countries, but the RRAA improved substantially in all 10 of the Asian countries included in the analysis.[7] The enhanced incentives almost certainly played some role in more rapid TFP growth.

Production patterns are diversifying to meet demand

The growth rates of output differ markedly across different commodities. Among the crops, per capita growth rates of production from 2000 to 2011 were generally low for traditional staple foods such as rice, wheat and root crops (see Figure 7). This is because demand per person for these staple foods is not growing rapidly, as people prefer to eat other foods. This is a universal phenomenon that has been witnessed in all countries around the globe.

Figure 7. Annual growth rates of per capita production for different crops by subregion, 2000–2011

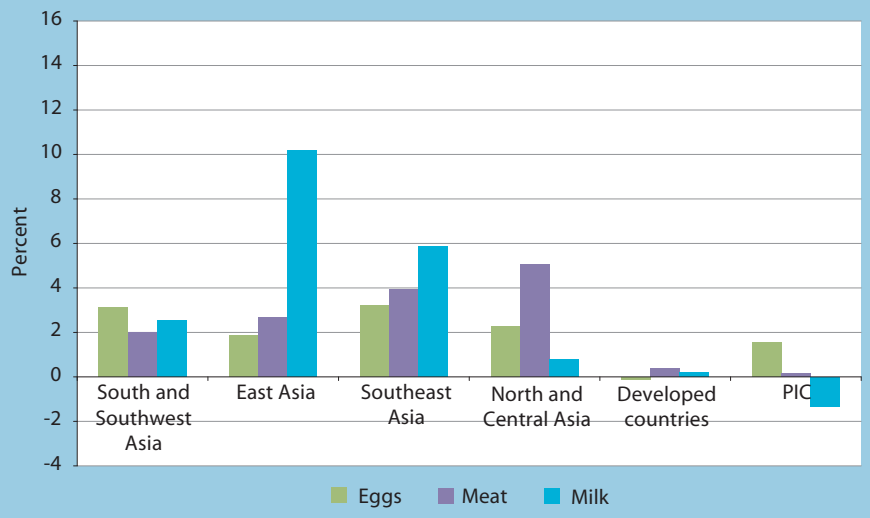


Source of raw data: FAO (2014).

[7] China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam in East and Southeast Asia, and Bangladesh, India, Pakistan and Sri Lanka in South Asia.

Production growth rates (again in per capita terms) were higher for non-staple crops, primarily maize; fruits, vegetables and pulses; and oilcrops (Figure 7). The rapid growth in production of these crops has been driven by the fact that most people want to eat more of these foods as their income increases. Increased production of maize is driven not by demand for direct human consumption per se, but because maize is a key ingredient in animal feed, and people are demanding more animal products such as meat, milk and eggs. The production of meat, milk and eggs has also expanded rapidly in most countries during the past decade (Figure 8). Thus, in response to income growth and shifts in demand patterns, production is diversifying in most countries of the region, away from staple crops and toward a variety of other products.

Figure 8. Annual growth rates of per capita production for eggs, meat and milk by subregion, 2000–2011



Source of raw data: FAO (2014).

Although the production growth rates for non-staple foods were consistently high in most developing and transition economies, growth has been consistently lower in the developed countries of the region and in the Pacific Island countries. Indeed, this pattern has held for both staple foods and non-staple foods.

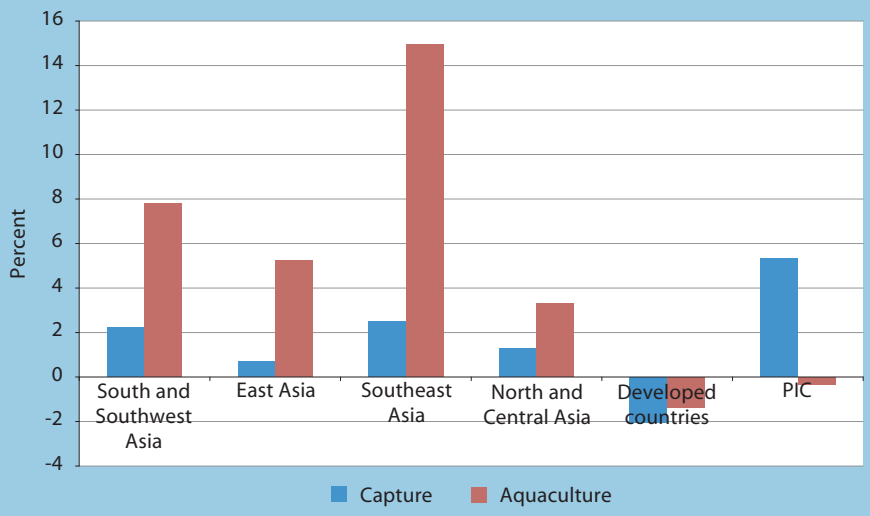
Fish production has grown especially rapidly in most developing and transition countries, especially for aquaculture (Figure 9). In East, Southeast and South Asia, aquaculture production grew at annual average rates exceeding 5 percent from 2000 to 2011. Growth in Southeast Asia has been especially rapid, with the volume of production more than quadrupling during the period. The total volume of aquaculture production in East Asia far exceeds that from capture fisheries, and, given its recent rapid growth, the volume of aquaculture production is now approaching that from capture fisheries in Southeast and South Asia.

In the other subregions (Central Asia, Pacific Island countries, developed countries), however, volumes from capture fisheries far exceed those from aquaculture. Capture fisheries expanded rapidly in the Pacific Island countries during 1990–2005, but they have since been declining. Production from capture fisheries in developed countries has been steadily declining for at least the past 20 years.

Labour and land are becoming scarcer

Economic growth in much of the region is creating additional demand for labour, and data on agricultural wages generally tend to confirm these trends. China, India, Bangladesh and Viet Nam have all seen strong increases in rural wages over the past decade or so, although this has not occurred in the Philippines. Higher wages cause

Figure 9. Annual growth rates of per capita fish production by subregion, capture fisheries and aquaculture, 2000–2011



Source of raw data: FAO (2014).

farm producers to substitute capital for labour, and tractors and combine-harvesters are becoming increasingly common sights in many of the region's middle-income countries.

At the national level, farm sizes are still declining in most countries, as the agricultural labor force is still increasing (albeit slowly) and competing for a relatively fixed amount of land. Some countries have pockets where farm sizes are starting to increase, however. Even in these areas, though, the increases in farm size have not been large in quantitative terms. This need not hinder further mechanization, however, as in most cases vibrant machinery rental markets help even small farmers deal with labour shortages.

It will be of crucial importance to increase labour productivity in rural areas in order to meet farmers' aspirations for a higher standard of living. Mechanization, rural outmigration and increased growth of nonfarm activities in rural areas all offer key pathways to higher labour productivity. These developments will eventually lead to larger farm sizes, although it is not clear how large farms will become in the next two to three decades.

Fertilizer use is still growing, but less rapidly than in the past

Fertilizer use was still increasing in most countries in the region between 2002/04 and 2009/11, although at growth rates lower than what took place in the 1960s, 1970s and 1980s. Nitrogen (N) rates per hectare have declined since 2002/04 in a few countries, however, including relatively high-income countries such as Japan, Australia, New Zealand and Republic of Korea as well as some other countries such as Fiji, the Philippines and Viet Nam. This decline could be due to more environmental awareness and regulation, as well as having reached high N use in earlier years.

The rates of increase in the use of phosphorus (P) and potassium (K) fertilizers have tended to be slower than for N, and in fact use declined in many countries between 2002/04 and 2009/11. The lower growth and/or decline was possibly due to the very large fertilizer price spikes during 2007–2009, which probably caused farmers to cut back to some extent on P and K more than on N, because N is more important in the short term, whereas P and K are investments that are more important over the long term. If this imbalance continues, however, it will eventually lead to excessive soil mining of P and K.

The highest fertilizer use per hectare tends to occur in East Asian countries such as China, Japan and Republic of Korea, as well as in Pakistan and Uzbekistan.

III. Trends in international trade

Consumer demand drives market economies. But, agricultural production in any given country or locality is not necessarily driven exclusively by local consumer demand – it is also influenced by factors such as rainfall, groundwater, temperature, sunlight, the slope of land, and others. Thus, some countries or regions are more suited for producing certain foods than others. When local consumer demand and the local agricultural supply do not match, trade (both domestic and international) can make up the difference.

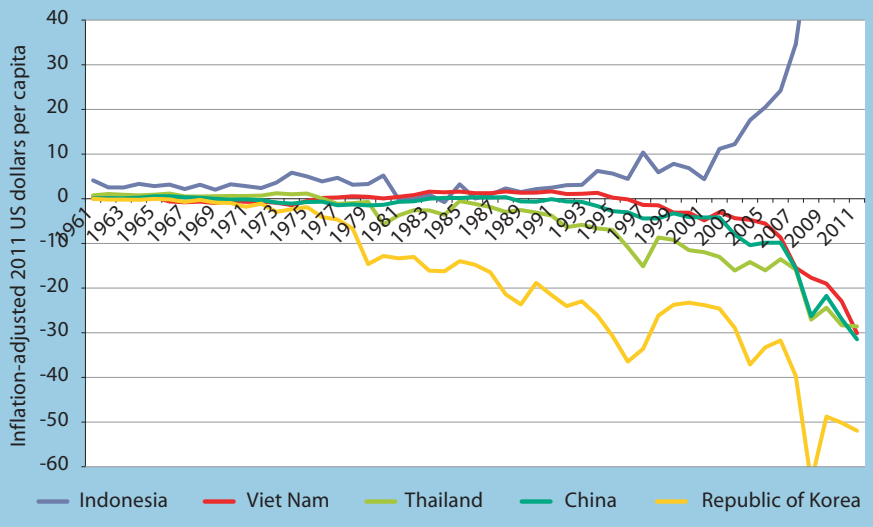
The balancing role of international trade can be hindered by high costs of communication and transportation, but these costs have been declining substantially over the past decade or two. Mobile telephones have become ubiquitous in urban areas, and have spread rapidly to rural areas as well. The density and quality of roads are also increasing in most parts of the region. The spread of the Internet has dramatically lowered the costs of acquiring information and data.

As a result of these developments, international food trade has been increasing rapidly in importance in recent years. This has been especially true for the "newer" commodities in people's diets, that is, vegetable oils (and oilseeds), fruits and vegetables (plus pulses) and meat and dairy products, and particularly in some of the faster growing economies in East and Southeast Asia (Figures 10, 11, 12). Such a change in recent years is generally less evident in the PIC, although many of these countries strongly depend on imports (and have done so for some time).

Trade would grow even more rapidly if importing countries were to adopt uniform rules based on Codex standards, as stipulated in the WTO SPS Agreement, and exporting countries were to pay greater attention to ensuring food safety. Many consignments are rejected at the border of importing countries, leading to more uncertainty and greater transaction costs.

It is in the nature of international trade that some countries are exporters and others are importers (and some have essentially zero net trade; see Table 2). One common feature of international food trade is that, for any given commodity or commodity

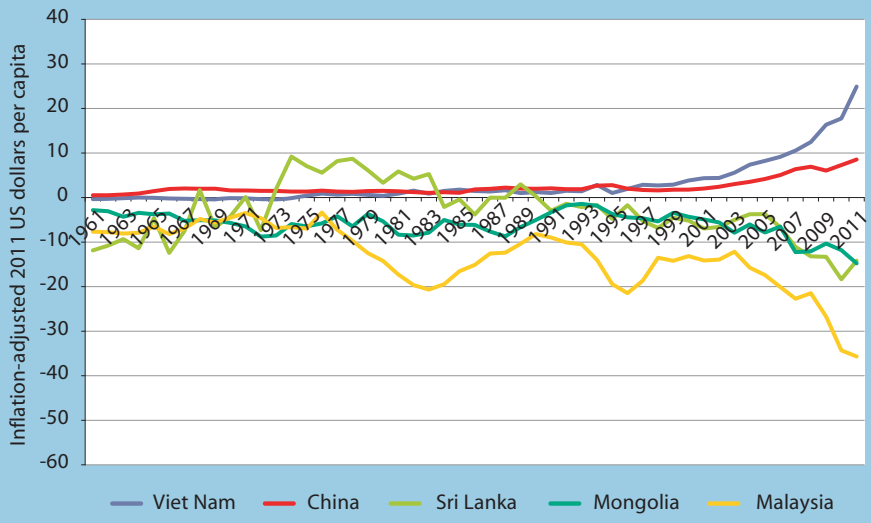
Figure 10. Net exports (+) or imports (-) of vegetable oils and oilseeds, selected countries



Source of raw data: FAO (2014) and IMF (2014).

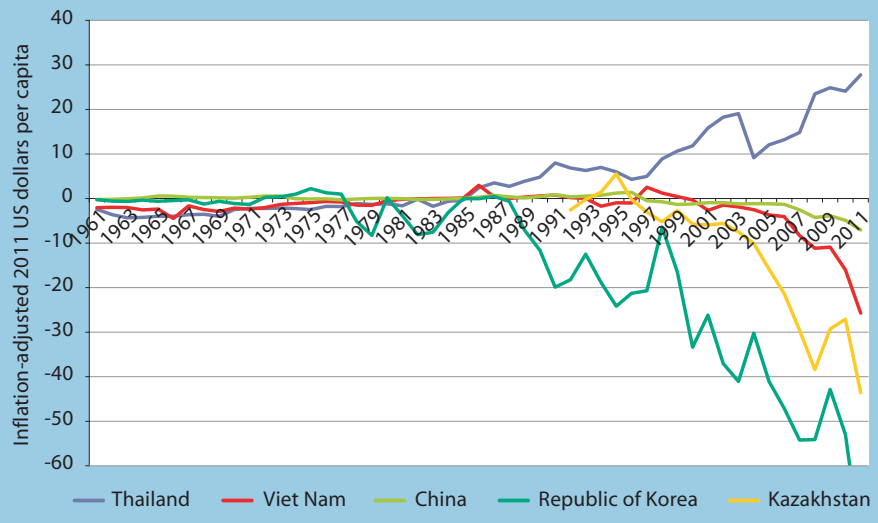
Note: Exports for Indonesia reached $74 per person per capita in 2011, but the vertical axis is truncated at $40 in order to show the patterns of other countries more clearly.

Figure 11. Net exports (+) or imports (-) of fruits, vegetables and pulses, selected countries



Source of raw data: FAO (2014) and IMF (2014).

Figure 12. Net exports (+) or imports (-) of meat and dairy products, selected countries



Source of raw data: FAO (2014) and IMF (2014).

Note: Imports for Republic of Korea reached $77 per person per capita in 2011, but the vertical axis is truncated at -$60 in order to show the patterns of other countries more clearly.

group, there are typically a small number of exporters and a much larger number of importers. This is true for all of the eight commodity groups shown in Table 2.

Exporting countries also tend to cluster geographically. For example, Thailand and Viet Nam, both on mainland Southeast Asia, are the two largest rice exporters (in dollars of net exports per capita). The countries that are exporters of vegetable oils are islands (or peninsulas): Malaysia, Indonesia and the Philippines in Southeast Asia, and the Solomon Islands, Papua New Guinea, Vanuatu, Kiribati and Samoa in the Pacific. In addition, Kazakhstan and Russia are two of the three biggest wheat exporters. Such geographic concentration tends to occur within countries as well – all countries have certain states or provinces that are well known for particular types of food.

No country is an exporter of everything. Indeed, only six countries are exporters of two or more commodity groups: Australia and Thailand (five groups), New Zealand and Viet Nam (three), and the Philippines and Vanuatu (two). Even Thailand is a large importer of vegetable oils and a small importer of wheat. Indeed, there are tradeoffs in becoming an exporter (or having zero net trade) in one commodity, because that means that less land, research and inputs are available for the production of other commodities. In essence, because resources are scarce, being an exporter in one commodity makes a country more likely to be an importer of another commodity.

Another important pattern is that, over time, countries tend to remain in the same category (exporter, zero net trade or importer) for extended periods of time, with little switching back and forth. There are several exceptions, but they are just that, exceptions. The norm is for a country to consistently remain either an exporter or an importer. Most likely, this is because of climatic, soil and geographic factors that make certain parts of the world more suitable for the production of particular crops compared with other parts of the world. In this regard, it should be noted that India has zero net trade for all eight commodity groups and China has zero net trade for all groups save three (and its trade position is relatively small for two of the latter three groups). At least part of the reason for this pattern is that these two countries are geographically large and thus have a great diversity of ecosystems that permits the production of many different foods. Of course, the level of economic development and wage rates also play a key role in determining comparative advantage along with geophysical factors – the former are more subject to change over time than the latter.

Table 2. Trade status of countries in the Asia-Pacific region by major commodity group

	Rice	*Wheat*	*Maize*	*Roots & tubers*	*Fruits, vegetables & pulses*	*Vegetable oils*	*Meat & dairy*	*Sugar*
Exporters	Thailand Viet Nam Pakistan	Australia Kazakhstan Russian Fed.	Lao PDR	Thailand New Zealand Viet Nam	New Zealand Thailand Niue Myanmar Iran, Islamic Rep. of Australia Viet Nam Uzbekistan Vanuatu Philippines China Tonga Afghanistan	Malaysia Solomon Is Papua New Guinea Indonesia Vanuatu Kiribati Australia Philippines Samoa	New Zealand Australia Thailand	Fiji Australia Thailand
Zero net trade	India Cambodia Myanmar Kazakhstan China Uzbekistan Russian Fed. Afghanistan Tonga Nepal Sri Lanka Bangladesh Lao PDR DPR Korea Indonesia	Nepal India Pakistan Lao PDR Cambodia China Myanmar	Thailand Cambodia India Myanmar Russian Fed. Australia New Zealand Pakistan Kazakhstan Nauru Tuvalu Niue Uzbekistan Kiribati Afghanistan	Tonga Iran, Islamic Rep. of Pakistan Afghanistan Cambodia India Myanmar Lao PDR DPR Korea Bangladesh Indonesia Uzbekistan Timor-Leste Solomon Is Philippines	DPR Korea Nepal Cambodia Lao PDR India Indonesia Papua New Guinea Pakistan	Cambodia Lao PDR Niue Nauru India	India Pakistan Mongolia DPR Korea Nepal Uzbekistan Cambodia Bangladesh Myanmar Lao PDR Afghanistan	Philippines India Nepal Myanmar Pakistan China Papua New Guinea Viet Nam DPR Korea

Table 2. Trade status of countries in the Asia-Pacific region by major commodity group *(continued)*

	Rice	*Wheat*	*Maize*	*Roots & tubers*	*Fruits, vegetables & pulses*	*Vegetable oils*	*Meat & dairy*	*Sugar*
Zero net trade *(continued)*			Papua New Guinea Samoa Mongolia Fiji Solomon Is Tonga Vanuatu Sri Lanka Cook Islands Philippines Nepal Bangladesh Timor-Leste China DPR Korea Indonesia	Papua New Guinea Nepal China Mongolia Nauru Kiribati Sri Lanka Kazakhstan Samoa Australia Republic of Korea Vanuatu				
Small importers	Mongolia Australia Timor-Leste Japan Republic of Korea Tuvalu Cook Islands	DPR Korea Timor-Leste Bangladesh Iran, Islamic Rep. of Viet Nam Papua New Guinea Thailand Indonesia Philippines Nauru Solomon Is	Viet Nam	Russian Fed. Japan Malaysia Bangladesh Niue	Solomon Is Samoa Timor-Leste Kazakhstan	Myanmar Tuvalu DPR Korea Kazakhstan Afghanistan Uzbekistan Tonga Sri Lanka Mongolia Russian Fed. Nepal Timor-Leste	Indonesia China Philippines Mongolia	Afghanistan Timor-Leste Lao PDR Mongolia Bangladesh Indonesia Japan Uzbekistan Iran, Islamic Rep. of Vanuatu Russian Fed. Solomon Is

Table 2. Trade status of countries in the Asia-Pacific region by major commodity group *(continued)*

	Rice	*Wheat*	*Maize*	*Roots & tubers*	*Fruits, vegetables & pulses*	*Vegetable oils*	*Meat & dairy*	*Sugar*
Large importers	New Zealand Nauru Philippines Iran, Islamic Rep. of Papua New Guinea Malaysia Niue Fiji Vanuatu Solomon Is Kiribati Samoa	Sri Lanka Uzbekistan Afghanistan Tuvalu Mongolia Japan Malaysia Vanuatu Samoa Tonga Niue New Zealand Republic of Korea Cook Islands Kiribati Fiji	Iran, Islamic Rep. of Malaysia Japan Republic of Korea	Fiji Cook Islands	Mongolia Sri Lanka Nauru Kiribati Tuvalu Fiji Kazakhstan Republic of Korea Malaysia Russian Fed. Japan Cook Islands	Bangladesh Cook Islands Pakistan Fiji Viet Nam China Thailand Iran, Islamic Rep. of Japan Republic of Korea New Zealand	Timor-Leste Iran, Islamic Rep. of Sri Lanka Viet Nam Solomon Is Papua New Guinea Vanuatu Malaysia Kazakhstan Nauru Russian Fed. Kiribati Republic of Korea Fiji Japan Samoa Tuvalu Tonga Niue Cook Islands	Cambodia Republic of Korea Nauru Niue Tonga Sri Lanka Kazakhstan Cook Islands Malaysia New Zealand Samoa Kiribati Tuvalu

Trade status is defined according to the value of net trade (VNT, exports minus imports) per capita in 2009–2011 as follows: Exporter (VNT > $3 per person); Zero net trade (-$3 per person < VNT < $3 per person); Small importer (-$10 per person < VNT < -$3 per person); Large importer (VNT < -$10 per person). Within each column, countries are listed in descending order of VNT. Source of raw data is FAO (2014).

IV. Trends in natural resource management

Forests and forestry

The area of land in the Asia-Pacific region covered by forests is about 784 million ha, accounting for 19.5 percent of the world's forests (FAO 2010). Within the region, forests occupy 19.9 percent of land area. The region as a whole has been able to reverse deforestation trends and it showed positive gains in net forest area over the last ten years, primarily due to the large-scale afforestation programme in China. Forest area has also increased in Bhutan, Fiji, India, the Philippines, Sri Lanka, Thailand and Viet Nam, where increased investments in national reforestation programmes have been observed. Efforts to eliminate deforestation and tackle illegal logging, such as through Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreements, (FLEGT-VPAs), forest certification and Reducing Emissions from Deforestation and Forest Degradation (REDD+), have shown positive results; however, deforestation rates remain high in many countries.

Industrial roundwood production (i.e. timber that is harvested for industrial use in manufacturing wood products, paper, etc., but not including wood harvested for fuel) in the region remained relatively stable between 1980 and 2000, increasing from about 260 to 293 million m^3. However, the last decade saw a significant increase in production to 370 million m^3 in 2010 and further to 385 million m^3 in 2012. This surge in production has allowed the Asia-Pacific region, led by China and Viet Nam, to emerge as a major producer and exporter of wooden furniture. The value of wooden furniture exported from the region increased from just US$1.56 billion in 1990 to US$17.7 billion in 2007, and is believed to be much higher now.

Non-wood forest products (NWFPs) such as rattan, medicinal plants, fruits, honey, sago, resins, mushroom, sandalwood oil and gums continue to play important roles in the economic and social well-being of many people in the region. Most NWFPs are consumed for subsistence or sold in local markets, but increasing quantities are now being traded in national, regional and global markets. More than 150 different types of NWFPs from the region are traded internationally (in variable quantities).

The importance of ecosystem services provided by forests has gained substantially greater attention in recent years. Conservation of biological diversity, protection of watersheds, combating desertification and land degradation, and climate change mitigation and adaptation are key ecosystem services provided by forests. Trees and forests also play a major role in preventing and mitigating the impacts of natural disasters such as floods, droughts, tsunamis, landslides and typhoons. In some countries, such services have become more important than the production of wood and NWFPs. The establishment of large tracts of protected areas and conservation forests, allied with changes in management objectives, including in some cases total bans on logging, reflects changes in society's priorities with respect to forest management.

With population growth and increased demand for wood and non-wood forest products and other services, the region's forests will undoubtedly continue to face intense pressure. One response has been the planting of human-made forests (i.e. forest plantations) with intensive wood production as a primary management objective. Although forest plantations now account for about 16 percent of the total forests in the region, they supply well over half of all industrial wood that is harvested in the Asia-Pacific region, and this trend is expected to continue in the future.

As decentralization and empowerment of local people gain momentum, the region will continue to witness increased demand for participatory approaches in forestry decision making. At the same time, efforts to revitalize forestry institutions to respond to the contemporary needs of modern forest management will continue to be boosted. The

current and expected future changes will require adjustment in forest policies and legislation. What is also evident is that challenges in the forestry sector cannot be solved in isolation due to the close linkages between forests and many other sectors. Therefore, future forest management will likely increasingly adopt landscape management philosophies and approaches.

Water and irrigation

Total water withdrawal in 2009 for Asia was 1 981 km^3, just 4.5 percent above that a decade earlier (FAO 2012b). Most of these withdrawals (82 percent) were destined for agriculture, but that share is declining over time with urbanization and industrialization. This sectorial reallocation has advanced most rapidly in East Asia, where municipalities and industry now account for 35 percent of water withdrawals, reflecting the rapid economic development in this subregion. In order to manage these competing demands (which include hydropower and ecosystem services), numerous countries in the region are increasingly adopting an integrated approach to water resource management that incorporates various sectors in the planning and development of water resources. Water quality degradation from the misuse of agro-chemicals and higher concentrations of livestock, together with increased urban sewage discharge, are an increasing problem.

In South Asia, groundwater withdrawal skyrocketed from 10–20 km^3 per year before 1950 to 240–260 km^3 per year by 2000, and rapid declines in groundwater tables in China have taken place as well. Both shallow alluvial and deep groundwater aquifers have been critically overdrawn, often helped by government subsidies for well installations, pumps and energy. Increased efforts at groundwater recharge and conjunctive management of surface water and groundwater will need to be implemented as mitigation measures, although the high cost of energy is often a constraint to effective conjunctive management. Saltwater intrusion due to groundwater overexploitation and lowering of water tables has occurred in many areas, for example, Gujarat in India and West Java in Indonesia, where some aquifers have been salinized permanently. Deltas in India, Myanmar, Bangladesh and Viet Nam are also adversely affected by saltwater intrusion and some areas are shrinking due to silting up of upstream reservoirs that reduce sediment deposit downstream.

Investments in large-scale irrigation systems experienced a sharp rise between the mid-1970s and mid-1980s, resulting in increased agricultural productivity and poverty reduction. Because of years of neglect, however, the performance of many of these systems has deteriorated, particularly in South Asia, where rapid growth in groundwater pumping has occurred as a result. Consequently, lands irrigated by large-scale surface irrigation schemes have been decreasing since the 1990s. From 1994 to 2002, India and Pakistan together lost more than 5.5 million ha of canal-irrigated lands despite continued investments in new systems and rehabilitation of old ones – some of these areas were abandoned due to high irrigation-induced soil salinity and waterlogging due to poor drainage.

As the agricultural sector diversifies because of the changing dietary patterns noted earlier, and non-agricultural uses increase in importance, irrigation systems need to provide flexible and reliable services and facilitate multiple uses of water. System performance must be improved through service-oriented modernization supported by sound water accounting, not just by the rehabilitation of physical infrastructure. An assessment methodology and tool developed by FAO known as Mapping System and Services for Canal Operation Techniques (MASSCOTE) has been used successfully in many countries to evaluate and develop system modernization plans. Irrigation modernization has high investment costs and will require extensive capacity building, governance restructuring and training for operational sustainability. Institutional reforms in irrigation service management and operations are an integral part of the modernization process. The current approach is to look beyond participatory irrigation

management, which has not been as effective as anticipated, to other alternatives that would be more economically viable and compatible with the service-oriented approach of irrigation modernization. Alternatives such as public-private partnership (PPP) will need to be organized using a business model approach through a financial and management framework that facilitates cost recovery.

Fisheries

Fish and fishery products make an enormous contribution to the nutrition and well-being of the peoples of the Asia-Pacific region. The quantities produced and the sheer diversity of species and products from inland and marine waters that exist in the region are clear testimony to a deep-rooted tradition of fish consumption and its importance in the diet and culture of the peoples of Asia. Both capture fisheries and aquaculture are of great importance in the region, although aquaculture is of much less importance (relative to capture fisheries) in North and Central Asia, the PIC and the developed countries.

Aquaculture production has experienced the most rapid growth in recent years, with that growth being concentrated in East, Southeast, South and Southwest Asia. The rapid growth of aquaculture is challenging management systems and environmental carrying capacity in some areas. In addition, feed costs are increasing, and land and water are becoming increasingly scarce. The combination of these factors points to a slowing down in overall growth rates in the future. Nevertheless, the prospects of aquaculture remain bright provided that the necessary mechanisms to sustainably intensify aquaculture are put in place. These mechanisms include aquatic animal health management, efficient water use, farm zoning and control of effluents.

Capture fisheries from marine waters have also shown growth in recent years, although at much lower rates than experienced in aquaculture (see Figure 9; the PIC are an exception). These increases in capture fishery production can be attributed to increased fishing effort, expansion of the geographic range of fishing activities and the increased overall biomass of fisheries by fishing-down effects (i.e. removing larger, longer-lived species, thus allowing a higher biomass of shorter-lived, small and fast-recruiting species). The growth in marine capture fisheries may give the appearance that there are still plenty of resources to exploit and that significant potential remains for further expansion, but the data hide the reality that many stocks are seriously overfished and that fisheries are increasingly catching lower-value fish. For example, marine capture fishery production has been declining for many years in Japan and Republic of Korea and now shows signs of leveling off, as their long-distance fleets have declined and these countries now focus more on trading.

Capture fishery production from inland waters in the region also continues to increase, and the region now contributes 68 percent of global production from inland waters. The increase in inland fisheries is unlikely to be due to massive increases in productivity per fisher, although undoubtedly increasing interest and effort are being applied. Good data do not exist, but the fact that the rural population is still increasing in many countries suggests that there are increasing numbers of inland fishers, especially in the developing countries of Southeast, South and Southwest Asia.

Land and land use

The total land area in the Asia-Pacific region amounts to 3 942 million hectares or 30.3 percent of the global land area. Land use is divided among several categories: arable and permanent crops (15 percent), permanent pasture (37 percent), forest land (20 percent) and other land, including urban areas, barren land and some other types of land (28 percent). The region's agricultural population has an average of 0.28 hectare of land per person in comparison with a global figure of 0.58 hectare. The difference is indicative of the severe pressure on land resources in the Asia-Pacific region.

Over past decades, the region has seen a rapid increase in the area of land under arable and permanent cropping while steep declines in forest area have taken place. Land resources are under increasing stress due to overexploitation, conflicts over use and ownership rights and anthropogenically induced environmental change.

Approximately 25 percent of all land in the region is degraded, with 13 percent classified as seriously degraded. It has been estimated that only 14 percent of the total land area in the region has no major constraints for agricultural use. Adverse soil, climatic and topographic factors affect different proportions of the region's land area, including cold (2 percent), dryness (19 percent), steep slopes (27 percent), shallow soils (4 percent), wetness (6 percent), adverse soil textures (13 percent) and chemical problems (14 percent).

Land degradation and desertification constitute serious ecological and economic issues for most countries in the region. In environmentally fragile areas, such as upland and mountain regions, deforestation, overgrazing and intensified cultivation have led to soil erosion and fertility losses and increased flash floods, landslides and mud flows. The region's poor, and particularly the politically and socially marginalized minorities, are often the most severely affected by disasters and difficulties partially or wholly attributable to land degradation.

V. Outlook and challenges to 2050

Population growth is slowing; Asia will continue to become wealthier and more urbanized

The main drivers of future food demand (in terms of quantity and the types of food) are population growth, urbanization and income growth. Globally, the 2012 UN medium variant scenario projects that total population will be 9.55 billion in 2050 (UN 2014), of which slightly more than half will be in countries that are members of FAO's Regional Office for Asia and the Pacific (RAP). There is more uncertainty in these estimates than most people realize, however – the UN low variant projection is for 8.34 billion people in 2050 and the high variant projection is for 10.87 billion.

Population growth is slowing down throughout the region. Indeed, the population in 2050 is projected to be smaller in each of Eastern Asia, Central Asia (Kazakhstan, Russia and Uzbekistan) and the developed countries (Australia, Japan and New Zealand) than in 2014.[8] Peak total population is projected to be reached in the latter two subregions around 2020, and in 2030 in Eastern Asia. In the developed countries, the projected decline in Japan's population (where the population has already peaked) will more than offset the projected continued increase in Australia and New Zealand.

In Southern and Southeastern Asia, population growth will continually slow down compared with present rates, but will remain positive, and the population will not peak until sometime after 2050. Between 2010 and 2050, annual average population growth is projected to be less than 1 percent, with rates of 0.80 and 0.69 percent per annum, respectively, in the two subregions. Because of the more rapid population growth in Southern Asia in general, and India in particular, India is projected to overtake China as the world's most populous country slightly before 2030.

In the Pacific Island countries, population growth will also continue to slow, but rates will remain much higher than elsewhere in the region. Between 2010 and 2050, annual average population growth is projected to be 1.42 percent, a relatively high rate of increase.

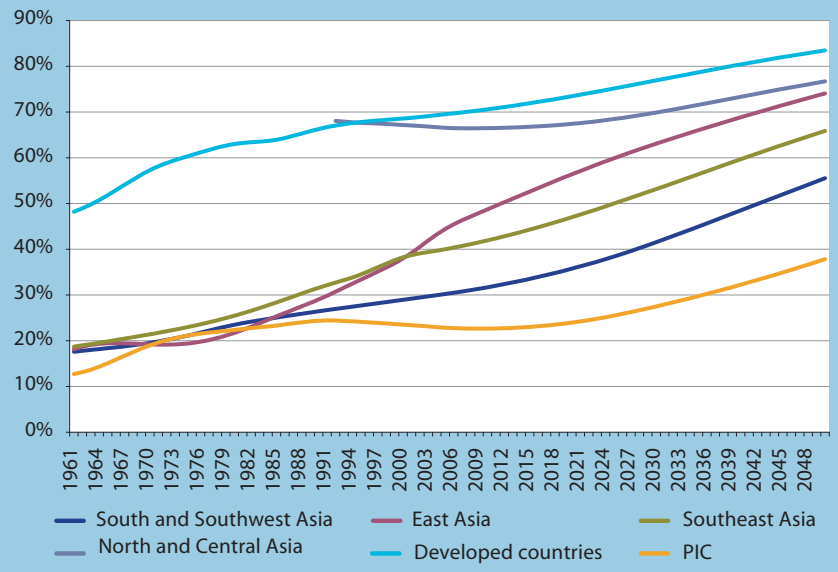
Urbanization is also increasing throughout the region (Figure 13). These changes will affect dietary preferences, as urban dwellers are typically busier (and have a higher opportunity cost of time due to higher wages) and thus prefer more highly processed food. If this food is higher in fats and sugars, as is often the case, there will be important implications for nutritional status. By 2050, all subregions except one will have more people living in urban areas than in rural areas, with urbanization rates of 56, 66, 74, 77 and 83 percent in Southern Asia, Southeastern Asia, Eastern Asia, Central Asia and the developed countries, respectively. The PIC are the exception, where the urbanization rate is projected to reach only 38 percent by 2050.

Projections of future income growth are highly speculative, but most experts agree that the Asia and Pacific region will grow more rapidly than other regions in per capita terms between now and 2050. East Asia (which includes Southeast Asia and PIC) is projected to have the most rapid growth, somewhere in the range of 3.5–4.0 percent per annum, while South Asian growth is projected in the range of 3.0–3.5 percent per annum.[9] These rates are higher than the projected growth rates in all other regions of the world, and, if they hold true, they imply that food demand will undergo more rapid changes in the Asia-Pacific region than elsewhere.

[8] This projection refers to the medium variant, as do all of the numbers in this paragraph and the two succeeding ones.

[9] The projected growth rates given in the text are those used in the FAO long-term projections (Alexandratos and Bruinsma 2012). Separate estimates for the PIC are not available. Note that PIC countries have grown much more slowly than the Asian countries during the past two decades.

Figure 13. Historical and projected urbanization rates by subregion, 1961–2050



Source of raw data: FAO (2014). Based on 2010 revision of World Population Prospects from the UN Population Division.

Changes in agricultural production to 2050[10]

In order to meet the demand imposed by population growth, income growth and urbanization, FAO projects that, globally, the value of agricultural production must increase by 60 percent between 2005/07 and 2050. In percentage terms, this increase is much less than what was experienced between 1961/63 and 2005/07,[11] during which time the value of production increased by 170 percent. But, to a large extent, the lower percentage growth is simply because the base upon which the change is calculated has increased. For example, the absolute increase in cereal production to 2050 is projected to be 941 million tonnes, compared with 1 225 million tonnes between 1961/63 and 2005/07. For meat production, the projected increase to 2050 is 197 million tonnes, compared with 186 million tonnes in the earlier period. Thus, the projected increases in demand to 2050 are indeed substantial.

Consistent with the trends in dietary diversification noted earlier, cereal production is anticipated to grow more slowly than the production of fruits and vegetables, vegetable oils and meat. In the Asia-Pacific region as a whole, rice production in particular is projected to grow just 22 percent by 2050, less than both wheat (37 percent) and maize (60 percent). The slower growth for rice is not necessarily because of constraints on the supply side, but rather because consumers want to diversify their diets to non-cereals, and, within the category of cereals, they want to diversify in favour of wheat. Despite this diversification, rice will remain the single most important source of calories in the region for many decades to come. Of the three major cereals, maize production is projected to grow most rapidly because it is used primarily as animal feed, and consumers will probably want to eat more meat as their income allows them to do so. Production growth for all of these cereals is generally projected to be more rapid in South and Southeast Asia than in East Asia.

Most other crops will see more rapid growth than that for cereals, driven by consumer demand for diversified diets. Palm oil production is projected to nearly double

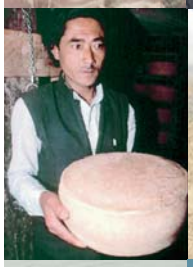
[10] This section draws heavily on Alexandratos and Bruinsma (2012).

[11] Note that 1961/63 to 2005/07 is 44 years (using the midpoints of 1962 and 2006), the same length of time as 2005/07 to 2050 (using the midpoint of 2006).













(95 percent growth) and coconut oil production is projected to increase by 73 percent (industrial uses are also important for both of these vegetable oils). Fruit production is projected to increase by 67 percent and sugar production is projected to rise by 84 percent. Finally, meat production is projected to increase by 192 percent in South Asia (where levels are currently relatively low) and by 80 percent in East Asia (which includes the PIC and Southeast Asia).

Many factors may constrain these projections from being realized, however: scarcity of land and water, climate change, biofuels, high oil prices and food price volatility.

New land is limited

There is a fair amount of uncertainty over how much land is potentially available for agricultural uses in the future. This is not surprising, given that land use depends on many factors such as infrastructure, the development of new technologies, the level of commodity prices and government policies, among others. Although some areas in Southeast Asia may still see substantial future expansion in agricultural land use (especially for oil palm), most experts agree that the overall scope for additional land coming into cultivation in Asia and the Pacific is fairly limited (Latin America and Africa have the most potential for future land expansion). It should be noted that further clearing of land for oil palm will come at the expense of important environmental services such as carbon storage and biodiversity.

At the macro level, FAO projects that arable land expansion will account for just 6 percent of increased production between 2005/07 and 2050 in South Asia and make no contribution at all in East Asia. Increased cropping intensity is projected to account for 2 percent of the increase in total crop production in South Asia and 15 percent in East Asia. Thus, yield increases will need to account for the vast bulk of the growth in production by 2050 (92 percent in South Asia and 85 percent in East Asia). If these projections are to be realized, the countries in the region will need to invest heavily in raising productivity per unit of land. The challenge will be even more difficult to meet because of the decline in land quality noted earlier (in section IV).

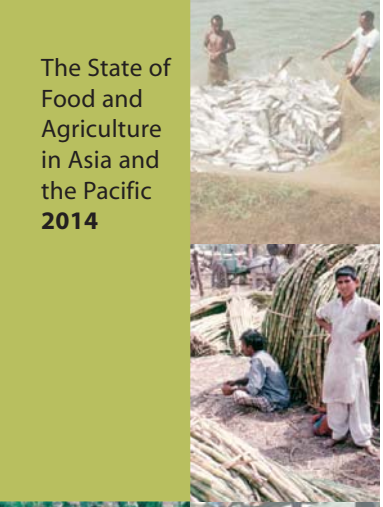
Water is increasingly scarce

Water has a key role to play in all of the paths to higher production: increases in arable land, increases in cropping intensity and higher yield. When new land is brought under cultivation, it is often important to provide that land with modern irrigation systems. Irrigation also helps to increase cropping intensity by allowing farmers to grow multiple crops in the same year. And, irrigation alleviates water stress on plants, leading to higher and more stable yield.

The demand for water to produce food is tremendous. One person requires 2 to 5 litres of drinking water per day, while the production of 1 kilogram of wheat requires 1 500 litres of water and 1 kilogram of meat requires 15 000 litres of water. Altogether, one person requires 3 000 litres of water daily to meet food needs.

But, agriculture already uses about 70 percent of the water resources of the planet, and demand is increasing for that water from households, for environmental purposes and from the industrial sector. Because of this increasing demand and because the best land for irrigation has already been developed, FAO projects that only a small amount of additional land will be equipped for irrigation by 2050 (compared with 2005/07) – another 8 million hectares in East Asia and another 3 million hectares in South Asia. These increases are very small compared with those in the past – between 1961/63 and 2005/07, an additional 48 and 53 million hectares of irrigated area were added in East and South Asia, respectively.

Groundwater now accounts for 64 percent of irrigation in India and 74 percent in Bangladesh, but it is becoming very scarce in certain areas, such as northern India and



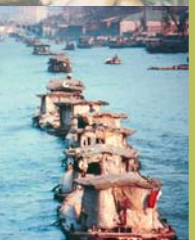












northern China. Continued groundwater mining is not sustainable, and eventually cropping patterns will need to be adjusted to the increased scarcity, either through the adoption of different crops or through the conversion of land to non-agricultural uses.

Climate change creates more uncertainty

Climate change is expected to have at least two major effects: a gradual increase in global temperature and an increased frequency of extreme climate events such as typhoons, floods and droughts. The first decade of the twenty-first century was the warmest on record, and the World Bank (2012) has cautioned that the globe could warm by 4°C. Although the precise magnitude of future temperature increases is not known with certainty, temperature is one of the key climatic variables affecting food production, and there is a very real risk of large changes in growing conditions for different crops as well as livestock and fisheries. Certainly, there will be ample scope for adaptation by producers (e.g. shifting to new crops, different varieties of the same crop), but it is not clear *ex ante* how easy or costly it will be to make these adjustments. Different studies come to different conclusions in this regard, but there is no denying that all estimates entail high uncertainty. Given the importance of the food economy to the lives of the poor, such uncertainty is worrying.

The Asia-Pacific region is already subject to a large number of disasters, and climate change will impose further costs in this regard, in terms of both mitigation measures and damage after the fact. The region has made progress in disaster preparedness, but it is never feasible to prepare fully, and damages are likely to increase further in the future (also because economic growth is leading to more wealth that can be destroyed).

Biofuels might add to crop demand

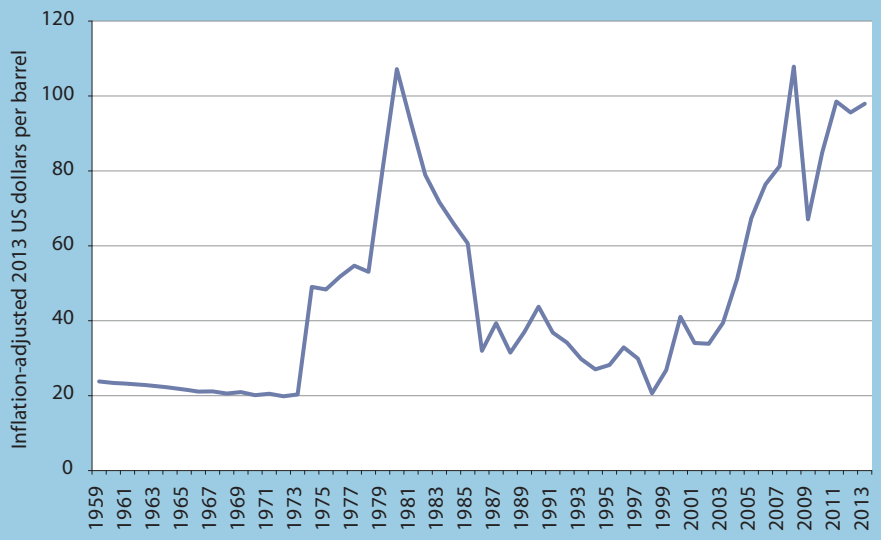
In addition to income growth and population growth, biofuels are another potentially key source of demand in the future that can lead to upward pressure on food prices. But, the magnitude of their impact is far from certain – it will depend to some extent on political decisions made in the United States and Europe, both of which are reconsidering the growth of biofuel mandates. Biofuel demand will also depend on the level of oil prices, since biofuels are a substitute for petroleum products.

Several countries in the region, including China, India, Indonesia, Malaysia, Thailand and the Philippines, have instituted policies that aim to increase the use of biofuels, primarily for automotive fuel through blending with conventional gasoline. But China has restricted the use of maize and wheat as feedstock for biofuel production, preferring to promote cassava instead because it is less important for food (industrial plants using maize or wheat as feedstock that were established before the regulations were allowed to continue production, but new plants are not allowed to be established). Biofuels have not taken off on the domestic market in Indonesia and Malaysia because retail fossil fuel prices are subsidized while biofuel prices are not, thus decreasing incentives for blending. All Asian countries are struggling to meet their biofuel production targets (Maltsoglou et al, 2013). Thus, the impact of biofuels on future food prices is unclear.

Oil and food prices will remain volatile and difficult to predict

Crude oil prices have experienced many ups and downs over the past 50 years (Figure 14), and it is not clear how they will behave in the medium term. During the past few years, they have been relatively high. These high prices have increased the production and marketing cost of foods through higher prices for chemical fertilizers, higher transportation costs of farm produce (and farm inputs) and the higher cost of diesel for irrigation, among others. Higher oil prices have also resulted in a high price for bio-ethanol, which in turn led to higher prices for maize, which is a key staple food for humans and is also used as animal feed, which in turn led to price increases for meat, milk and associated products.

Figure 14. Crude oil prices adjusted for inflation, 1959–2013



Source of raw data: IMF (2014).

It is still very uncertain what the future trend of crude oil prices will be, as they are often influenced by the political and social stability of oil-producing countries. The recent increase in the exploitation of oil and gas through hydraulic fracturing ("fracking") may help to constrain further price increases. Although such forecasts are far from certain, the International Monetary Fund (IMF) forecasts that spot crude petroleum prices will decline by 17 percent between 2013 and 2018. If this happens, oil prices will remain relatively high in historical terms.

Just as fluctuations in energy prices affect farm profits, so do fluctuations in food prices. In addition to affecting farm profits, food price movements also affect access to food, thus impacting all of the poor in developing countries, both consumers and producers. Although food prices are not as volatile as energy prices, they still undergo substantial variation, and these fluctuations can reduce farm-level investment, throw poor consumers and farmers into poverty traps and cause political and macroeconomic instability in developing countries (Dawe and Timmer 2012).

It is important to realize, however, that not all fluctuations in food prices are bad. Given that production is concentrated in particular seasons, consumption occurs year round and storage costs money, seasonal price changes are essential in order to encourage farmers and traders to store some of their production (and encourage consumers to economize at certain times of the year). Predictable price changes such as these pose fewer problems than large unpredictable swings that may arise in the future due to climate change, erratic trade policies and shifting exchange rates. Mitigating and dealing with such volatility will pose a challenge for governments, farmers and consumers in the years ahead.

VI. Policy challenges and the way forward

The provision of public goods, in both quantity and quality[12]

In order to eradicate hunger, progress needs to be made on many fronts. One of the key challenges revolves around providing the proper environment that will generate sufficient amounts of high-quality investment in the agricultural sector.

In the wake of the food price crisis of 2007–2008, many Asian governments increased public spending on agricultural programs. But, increased agricultural spending, while important, does not in and of itself guarantee higher growth, lower poverty or the eradication of hunger. A large body of research shows that these outcomes will be determined by the quality of those expenditures as well as by the quantity.

At least two key features determine the quality of public spending. The first is fiscal sustainability – if higher agricultural spending leads to large budget deficits, this may lead to higher interest rates that will make investment throughout the economy less profitable. Large budget deficits can also lead to macroeconomic instability, which slows down growth in the non-agricultural sector and thus leads to reduced demand for farm products.

The second key feature of agricultural public spending is whether the spending is for public goods or private subsidies. Expenditures on public goods such as agricultural research, extension services, education and rural infrastructure are indispensable for agricultural growth, competitiveness and poverty reduction. Much research has shown that these types of expenditures bring about the highest economic and social returns (Fan et al 2000, 2004, 2008a, 2008b). For example, many farmers are constrained by a lack of all-weather roads that can bring in cheaper inputs and make it easier to sell farm produce to people outside the village. On the other hand, subsidies provide fewer benefits, as they usually do not increase productivity – they tend to be just a transfer of financial resources from one group of people to another. Given limited public financial resources, these subsidies can make it difficult to invest in the public goods that are essential for growth, competitiveness and poverty reduction.

Input subsidies can make sense, although only in certain limited situations. If farmers need to learn about new inputs, then a subsidy can encourage adoption and accelerate the learning process. Subsidies can also compensate for poorly functioning credit markets. In these cases, subsidies can be a wise investment. This was likely the case in the early years of the Green Revolution. But, once farmers know about the new inputs, subsidies become much less beneficial. In fact, they can even be detrimental, as farmers over-apply fertilizer, leading in many cases to lower yield and less production and in nearly all cases to more environmental degradation. Pesticide subsidies have similar problems, especially in rice, for which brown planthopper populations are increased by pesticide use and have been a major threat to production levels in recent years. Because most farmers in Asia and the Pacific today are well aware of the costs and benefits of fertilizers and pesticides, subsidies for these inputs are not likely to be beneficial.

Input subsidies also often require large quantities of government funds, leaving less money for spending on items such as agricultural research that can have a real impact on production and productivity. Finally, general input subsidies also tend to disproportionately benefit larger and richer farmers, because they use more inputs. If it is desirable to increase farmer income, it is preferable to use targeted and limited cash transfers that have maximum upper limits for individual farmers and are not tied to input use (see below for more discussion in the context of social protection).

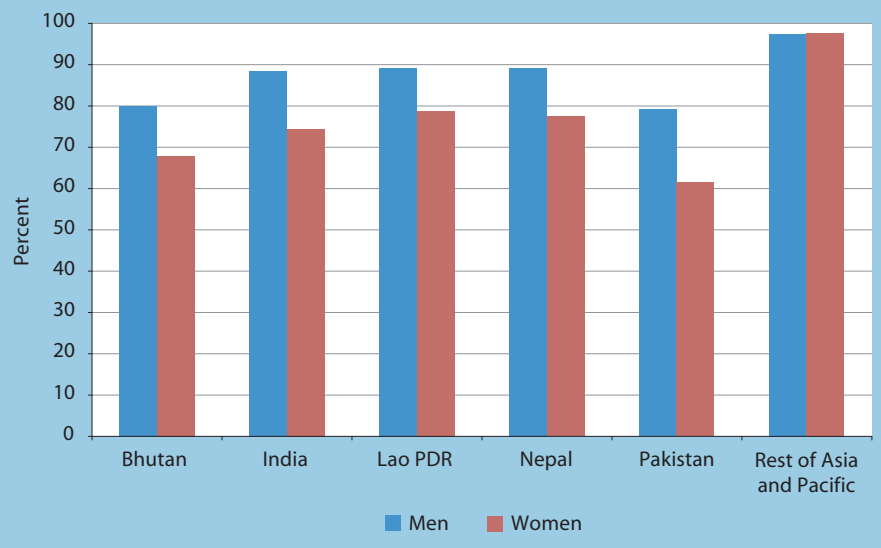
[12] This section is largely based on Zorya (2013).

Creation of a fair and inclusive enabling environment for private investment[13]

Although public spending is important, the vast bulk of investment in the agricultural sector comes from the private sector, and most of that investment comes from domestic investors, not foreign investors. In order for this private spending to be as productive as possible, a good general investment climate (as well as an adequate supply of public goods) is essential to create a strong enabling environment for the private sector. The key elements of such a climate are good governance, macroeconomic stability, equal treatment for men and women, transparent and stable trade policies, fair and well-functioning markets and respect for property rights, especially the rights of poor smallholders.

An important part of creating a fair and inclusive enabling environment for private investment is reducing discrimination against women, who make essential contributions to agriculture in the Asia-Pacific region. They constitute somewhere between 40 and 50 percent of the agricultural labour force in all subregions except the PIC, where they account for 52 percent. But, depending on the specific country and state/province, they have less access than men to productive resources (including human capital) and opportunities. For example, youth (ages 15–24) literacy rates for women in some countries are substantially lower than for men (Figure 15). Because women often act as farm managers, and farm management is becoming more knowledge-intensive, lower literacy acts as a drag on agricultural sector growth. If such inequities persist, the drag will become increasingly important in the future with male outmigration and the feminization of agriculture. To overcome this problem and make the agricultural sector as dynamic as possible, key areas for reform include eliminating discrimination against women in access to education, extension, financial services and key inputs, and investing in productivity-enhancing technologies and infrastructure to free women's time for activities that are more productive and involve less drudgery.

Figure 15. Youth (ages 15–24) literacy rates for men and women, selected countries



Source of raw data: World Bank (2014).

Note: Countries shown are all those for which the differential literacy rate between the sexes is 10 percentage points or greater. "Rest of Asia and Pacific" includes all developing countries in the region except the five countries shown separately in the Figure.

[13] This section draws heavily on FAO (2011a) and FAO (2012).

Although an enabling environment should facilitate private investment, this is not the same as allowing the private sector to operate without any constraints – the environment should also be fair and inclusive. For example, there must be strong governance structures in place that can guide private investment appropriately so that it does not lead to environmental degradation or override the rights of existing land users. Options to be considered are the use of instruments such as the Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources and the Voluntary Guidelines for the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, both of which offer possible frameworks in this regard. Alternative and more inclusive business models for large-scale investors that offer opportunities for greater direct involvement of small local farmers in agricultural value chains should also be promoted.

Sustainable intensification[14]

Some people argue that production doesn't need to increase because there is already enough food in the world to go around or because large quantities of food are lost or wasted. Upon closer inspection, however, these arguments do not imply that we can ignore efforts to increase production. First, although there is enough food to eradicate hunger if it were distributed equally, there is no existing mechanism to distribute food equally or nearly equally among all people in the world. Second, although food losses and waste are undeniably important (see below), a high degree of uncertainty surrounds the precise magnitude of these losses and waste. Furthermore, much of the loss and waste may not be able to be recovered in a cost-effective manner or recovery may rely on behavioural changes that are difficult to bring about. Thus, to feed a growing world population, it would be a mistake to rely on a "silver bullet" – there is no option but to intensify crop production as part of a multi-pronged approach that also reduces losses and waste along the value chain.

Although there are many opportunities to increase production, it is important to do so in a sustainable manner. Environmental considerations are becoming more important than in the past because people are getting richer (and thus demand more environmental services) and because the population is still growing, which puts increasing pressure on a finite planet. Thus, FAO promotes a "Save and Grow" approach of sustainable crop production intensification (SCPI), which produces more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services.

Such an approach often combines traditional knowledge with modern technologies that are adapted to the needs of small-scale producers. It provides farmers with a genetically diverse portfolio of improved crop varieties that are suited to a range of agro-ecosystems and farming practices, and resilient to climate change. It encourages the use of conservation agriculture, which boosts yield while restoring soil health. It controls insect pests by protecting their natural enemies rather than by spraying crops indiscriminately with pesticides. Through a judicious use of mineral fertilizer, it avoids "collateral damage" to water quality. Through modernization of irrigation systems, it delivers the right amount of water when and where it is needed. The Save and Grow approach is also fully consistent with the principles of climate-smart agriculture – it builds resilience to climate change and reduces greenhouse gas emissions through, for example, increased sequestration of carbon in the soil. For such a holistic approach to be adopted, environmental virtue alone is not enough: farmers must see tangible advantages in terms of higher income, reduced costs and sustainable livelihoods, as well as compensation for the environmental benefits they generate. Such production systems are also knowledge-intensive. Thus, policies for SCPI should build capacity through extension approaches such as farmer field schools, while also using private sector extension when appropriate.

[14] This section draws heavily on FAO (2011b).

Reducing food losses and waste[15]

Food is lost or wasted throughout the supply chain, from initial agricultural production down to final household consumption. In low-income countries, food is lost mostly during the early and middle stages of the food supply chain; much less food is wasted at the consumer level. The causes of food losses and waste in low-income countries are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems. To reduce these losses, food supply chains in developing countries need to be strengthened by, inter alia, investments in infrastructure, transportation and food and packaging industries. Both the public and private sector have a role to play in making these investments.

More research into the magnitude of food losses and waste, and the scope for cost-effective methods to reduce them, is also urgently needed. A recent major FAO study revealed that major data gaps surround our knowledge of these issues (FAO 2011c).

Improving food safety and quality

Food safety is a key emerging issue in many parts of the region. Because hazards may arise at different stages of the food chain, it is important to use a systematic risk-based preventive approach that promotes good agricultural and hygienic practices throughout the food chain in addition to inspecting finished products.[16] Even the best preventive system will sometimes fail, however, and, to be ready for such cases, food safety emergency management and recall systems need to be strengthened.

More and better data on food safety and quality need to be collected, and there needs to be more training and education to increase awareness for the entire range of stakeholders, including farmers, processors, handlers, retailers and consumers. Certifications and accreditation should exist not only for products but also for service providers such as laboratories. Implementing such a comprehensive approach will require improved food safety strategies, policies, legislation and governance, including coordination mechanisms across ministries and between countries.

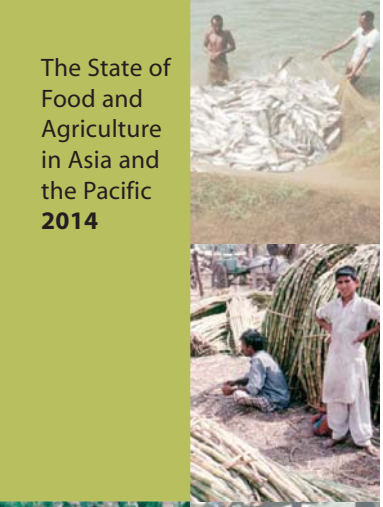
Building a dynamic non-agricultural economy and a system of social protection[17]

Economic growth is a necessary, if not sufficient, condition for the eradication of hunger. The increased income generated by growth improves economic, social and physical access to food and allows undernourished people to afford more, and more nutritious, food.

As people become richer, they naturally want to diversify their consumption patterns beyond food to nicer clothing and housing, better health care and education, automobiles, consumer electronics and a wide range of other items. This implies that the agricultural sector, even if it is growing, shrinks in relative terms and has less capacity to be an engine of growth for the economy as countries move to middle-income status and beyond. In turn, this implies that the non-agricultural sectors also have a key role to play in improving access to food. Thus, a dynamic non-agricultural economy is crucial for the eradication of hunger.

But, economic growth is only necessary, not sufficient, to eradicate hunger. For those left behind (e.g. for reasons of inadequate access to land, education and health care), a system of social protection will also have a key role to play. Social protection is not

[15] This section draws heavily on FAO (2011c).
[16] An example of this approach is hazard analysis and critical control points (HACCP).
[17] Parts of this section draw on Davis (2013) and Tirivayi et al (2013).



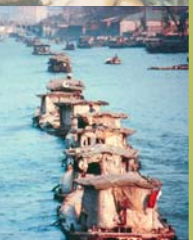












a panacea, and it cannot replace a coherent development strategy for the agricultural sector, but it is becoming increasingly important in many developing countries. Because many social protection schemes operate in rural areas, they can affect smallholder farmers. Often, however, such programs miss opportunities for better linkages with the agricultural sector. It is therefore important for policymakers to foster such linkages and maximize the opportunities for synergies between the two types of policies.

Social protection is related to agriculture in several ways. First, it can improve human capital by improving nutritional status, health status and educational attainment. These factors can make for smarter and stronger farmers. Second, it can facilitate changes in productive activities by relaxing credit constraints. Thus, it can allow for the accumulation of productive assets or help farmers to adopt new crops and new technologies. Third, it gives households a better ability to deal with risks and shocks by providing insurance. This helps smallholders to avoid distress sales of productive assets and premature sale of farm output, and can also permit diversification into new crops, livestock or aquaculture. Taken together, these factors can lead to increased resilience for households and a more dynamic and productive agricultural sector. Thus, it is important that policymakers involved in social protection coordinate with those involved in agricultural development, and vice versa, in order to maximize the synergies.

Helping farmers to manage risk and uncertainty

Because of its dependence on the weather, agricultural production is inherently risky, and farmers have been forced to deal with that risk for millennia. This is one key feature that distinguishes agricultural production from many other economic activities. And, even if some progress is made on mitigation, climate change is likely to test the adaptability of farmers even further in the coming decades.

Because of the inherent risks in agriculture, many farmers avoid new technologies or new crops because they are afraid of taking on even more risk. Such attitudes, although rational, can reduce the potential profits that farmers can make. Thus, farmers need support from research and institutional innovation in order to manage risks in a way that facilitates entrepreneurial behaviour and an escape from hunger and poverty, while also making sure that food stays affordable and accessible for poor consumers. Basic and applied agricultural research and development is a key part of providing farmers with more options, for example, crops that are adaptable to a wider range of growing conditions. Recent advances in this area include rice varieties that are submergence tolerant, drought tolerant and able to grow well in degraded soils.

Innovations in insurance markets such as index insurance may also help farmers to better manage risk without putting undue burdens on government budgets. Finally, governments can also help by making trade policies more predictable. Sudden changes in export and import policies were a major driver of the world food price crisis in 2007–2008, which created uncertainty and hardship not only for consumers but also for farmers, who benefited from higher prices but also had to deal with greater uncertainty. Finally, farmers throughout the region are diversifying their income sources to include more non-agricultural income whenever possible. For many farmers, this diversification will be a key way to manage the risks of fluctuating agricultural income.

Structural transformation of the economy and agricultural transition: Are large farms the way of the future?

Many countries in the region have achieved rapid economic growth over a sustained period of time. This growth creates a dilemma. If the people employed in agriculture are to achieve income parity with those employed outside of agriculture at the same time that agriculture is shrinking in relative size, it is essential that farmers collectively obtain an ever-larger share of their income from outside of agriculture. There is simply no other alternative, unless they are willing to subsist on much lower income than other citizens in the economy.

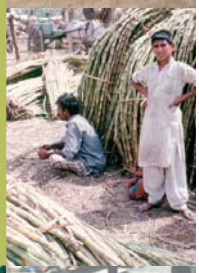
Income parity can be achieved through at least two paths. One option is for farmers to leave agriculture entirely, either through migration to urban areas or through earning non-agricultural income in rural areas. The other option is for farmers and their household members to keep working on their farms, while at the same time taking part-time employment outside agriculture. Both of these options will involve substantial mechanization of agricultural work – even if people remain on the farm and do not migrate, they still need to free up time for non-agricultural work. However, the implications of these two options for farm size are potentially different.

To the extent that farming households leave agriculture entirely, farm sizes are likely to increase – the alternative is that formerly productive land will be abandoned. On the other hand, if farmers remain on the land while diversifying their income sources to non-agricultural occupations, farm sizes could remain the same. This is the trend in parts of many countries in the region (for example, Japan, Republic of Korea and Thailand): farm sizes have increased, but the increases have been quite small. Depending on the types of technologies and markets that are developed and commercialized in the future, farm size may have implications for agricultural growth and the overall productivity of the sector.

Historically, one of the crucial factors behind the higher productivity of small farms has been a more intensive use of labour. But, as wages increase, this may not be possible because production will become less labour-intensive. In the future, with the rise of knowledge-intensive and specialized technologies noted above, large farms could become more productive (in terms of labour, land or both) than small farms, because large farms will have more ability and incentives to adopt knowledge-intensive technologies that require substantial investment in learning and education. Such investment might not be profitable for a 1-hectare farm, but it could be profitable if applied to a 30- or 50-hectare farm.

If large farms do become more productive (and this is by no means a foregone conclusion), one way to manage such a transition would be land sales or leases that lead to larger farms through land consolidation. But land sales are not the only way for such a transition to occur. Cooperatives provide an alternative vision, with different cooperative members specializing in different areas such as marketing, soil and nutrient management or information technology applications. For example, in Viet Nam, some farmers are joining forces in a "big field, small farmer" cooperative approach whereby a number of small farmers all grow the same varieties using the same technology. Such an approach is more likely to succeed if farmers take an active role in managing the cooperative, and this in turn is more likely if farmers have access to educational and training opportunities.

The specific institutional form that prevails in any given locality should depend on the choices of farmers themselves, as well as each society's collective socio-cultural vision of the future. It will be important for the government to provide a space for public debate and an enabling environment in which such institutional innovation and a diversity of solutions can take place.

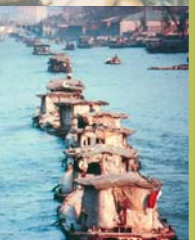











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