RAP PUBLICATION 2008/03

The state of food and agriculture in Asia and the Pacific region

2008

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Preface

I am happy to present this second issue of FAO's regional publication devoted to the state of food and agriculture in Asia and the Pacific. This is a time of great challenges to food security in the region, but also a time of great opportunities for the region's food and agriculture sectors and both challenges and opportunities are highlighted in this publication.

The first part of the publication examines hunger and poverty in the region, changes in dietary patterns, agricultural commodity trends, and the outlook for the future, including the major challenges that need to be addressed. The second part provides a special focus on the new "gold rush": biofuels development in Asia and the Pacific. As biofuels are likely to have a major influence on agricultural commodity prices and rural incomes for some time to come, the status of biofuels development in the region is assessed. The main focus of the analysis is on the potential effects of the demand for biofuels on regional household food security.

The writing of *The state of food and agriculture in Asia and the Pacific region 2008* was co-ordinated by Kinlay Dorjee, Economist. It benefited from the contributions and comments of the multidisciplinary staff of the FAO regional office in Bangkok as well as of headquarters, Rome. The support of Keith Wiebe, Chief, Comparative Agricultural Development Service, and his encouragement to link this regional publication to the global *State of food and agriculture* are gratefully acknowledged. The special feature on biofuels was contributed by David Dawe, Senior Economist, Agriculture Sector in Economic Development Service. His continued inputs to and interest in the region are greatly appreciated. The graphs depicting the subregional differences in intake of various types of food were prepared by Kristian Jakobsen, Economist, Food Security and Agricultural Projects Analysis Service.

Finally, I wish to thank all those involved in this publication and invite feedback from all readers.

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The state of food and agriculture in Asia and the Pacific region

Developments and trends in food and agriculture

Poverty

Over the past decade, Asia and the Pacific region has dramatically reduced the incidence of poverty (UNESCAP, 2007). By 2004 the average income poverty rate in the region, based on the US$1 a day standard, was reduced by 17 percent. The region as a whole is on track to achieving the Millennium Development Goal (MDG) of halving the prevalence of extreme poverty by 2015. Nevertheless, more than 641 million people, half of the world's extreme poor, live in the region.

Both China and India are well on track to achieving the MDG of halving the prevalence of extreme poverty and hunger, as are 17 other countries. In general terms, accelerating growth in India has put South Asia on track to meet the goal, and East Asia has experienced a sustained period of economic growth, led by China. However, a few countries in the region are continuing to face difficulties in reducing hunger sufficiently to meet the MDG and World Food Summit targets.

According to the World Bank, a decade after the financial crisis which devastated East Asia in mid-1997, the region is much wealthier, has fewer poor people, and plays a more important global role than ever before (World Bank, 2007). But it warns that with this success comes a new wave of challenges for countries trying to avoid the "middle-income trap" — the strategies that allow countries to evolve from the status of low-income to middle-income countries are not the same as the strategies needed to propel them into the category of high-income countries. The report also notes that growth in emerging East Asia reached 8.1 percent in 2006 — the strongest in the past ten years — and it is likely to slow to 7.3 percent in 2007. Per capita incomes in former crisis-affected economies have significantly exceeded their pre-crisis levels and are growing steadily almost everywhere. In China and low-income countries such as Cambodia, Lao People's Democratic Republic and Viet Nam, incomes have grown at "exceptional rates". The past ten years have seen a doubling in the value of regional output levels, a halving in poverty rates, a jump in global and regional integration and accumulation of over US$2 trillion in foreign reserves.

Undernourishment

South Asia has the highest level of underweight prevalence in the world, with almost half (46 percent) of all children under-five being underweight. Three countries in this region drive these high levels — Bangladesh, India and Pakistan — and alone account for half the world's total number of underweight children.[1] Large disparities exist for underweight prevalence among urban and rural children. On average, underweight prevalence among children in rural areas is almost double that of children in urban areas in the developing world.

Malaysia has the fastest rate of improvement, with underweight prevalence declining more than one half between 1990 and 2003. Indonesia, Singapore and Viet Nam are also on track. Singapore now has the lowest under-five mortality rate in the world — lower than all industrialized countries with the exception of Iceland.

[1] These three countries are home to just 29 percent of the developing world's under-five population.

Progress is also being made in the Lao People's Democratic Republic, Myanmar and the Philippines, though still insufficient to meet the target of halving under-five mortality. Timor-Leste has the highest proportion of underweight children in the region and fully half of its children are stunted, although data are insufficient to assess progress since independence.

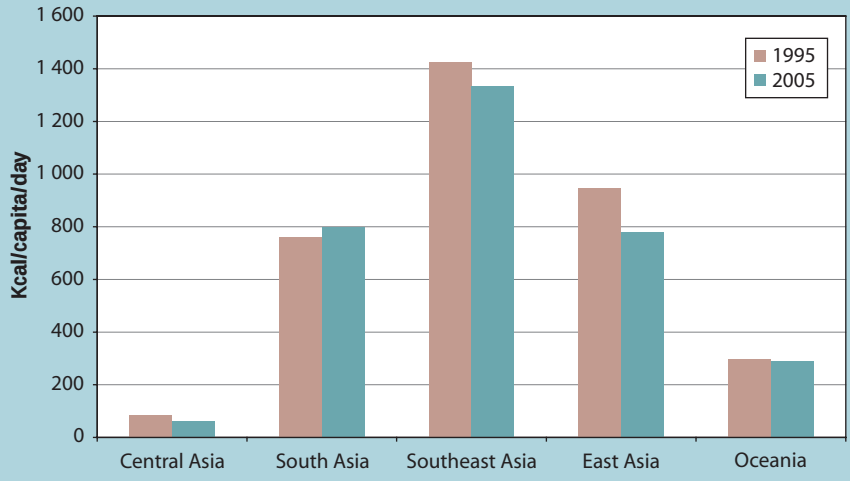
A survey conducted in early 2005, in Aceh, Indonesia showed an average wasting level of 11 percent among children under-five displaced by the tsunami (GOI, 2005). This was nearly the same as among children not affected by the disaster, thus highlighting the fact that poor nutrition is a chronic problem related to poverty, poor nutritional knowledge and practices, and inadequate sanitation.

Dramatic changes in dietary patterns

Asia and the Pacific region has undergone a dramatic shift in its dietary patterns in recent years (Pingali, 2007). This has been driven by rapid income growth, urbanization, and changes in lifestyles induced by globalization. The trend is towards the consumption of more processed foods with shorter preparation time as more women enter the workforce. Smaller urban families make it affordable to eat out more often. There is also a stronger preference for meat[2] or fish, dairy products,[3] fruits such as apples[4] and highly processed convenience food and drinks, all of which are readily available in emerging super (and hyper) markets and fast food outlets at competitive prices as a result of economies of scale.

Relative to traditional carbohydrate-dominated Asian diets the evolving diets are distinctly higher in fat and protein content. The traditional food supply chain is unable to satisfy the demand for dietary diversity and there is a growing severance of the links between diets and local availability because of trade liberalization and the increasingly reduced costs of transport and communications. Modernization of the food retail sector, as has already occurred in Latin America, through vertical integration of food supply chains, is likely to gain momentum. Although this would bring about significant benefits in terms of efficiency gains and lower prices, it would also entail some costs to certain groups in terms of unemployment and concentration of food supply chains.

Figure 1. Consumption of rice



[2] Meat consumption more than doubled in the last 20 years.

[3] Milk consumption increased by 50 percent in India in the last 20 years.

[4] There has been a fourfold increase in the consumption of apples in China in the last 20 years and Thailand has experienced a tenfold increase in potato consumption in the same period.

Figure 2. Consumption of wheat

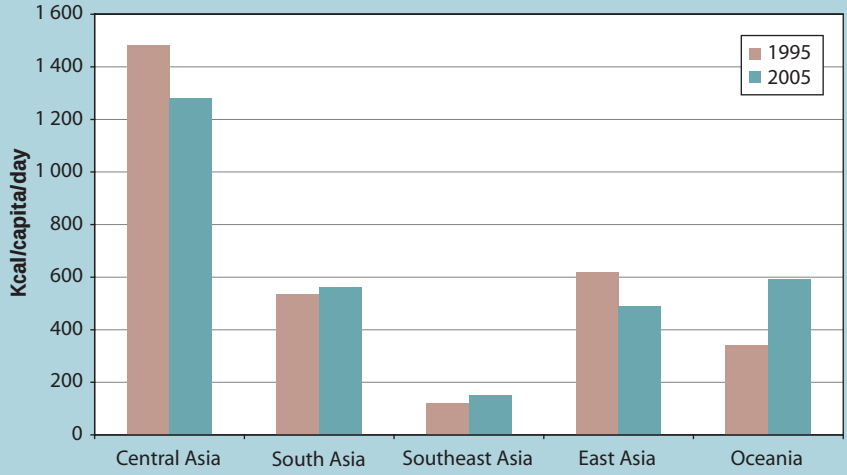


Figure 3. Consumption of maize

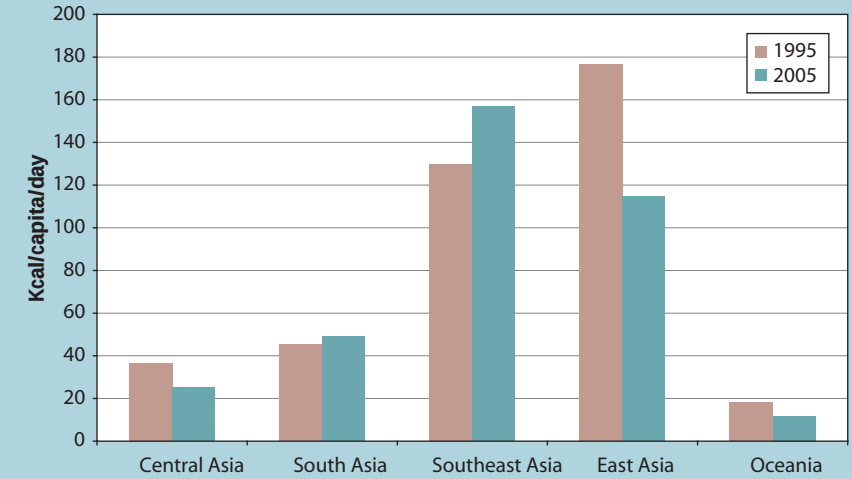


Figure 4. Consumption of potatoes

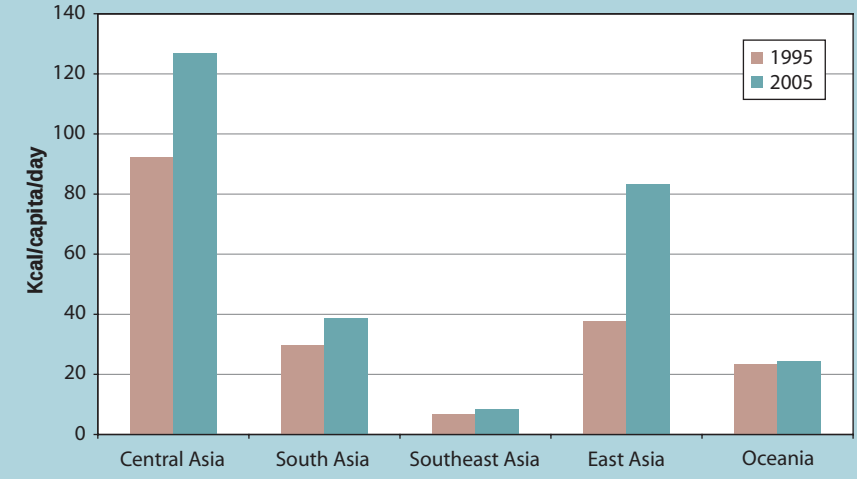


Figure 5. Consumption of fish

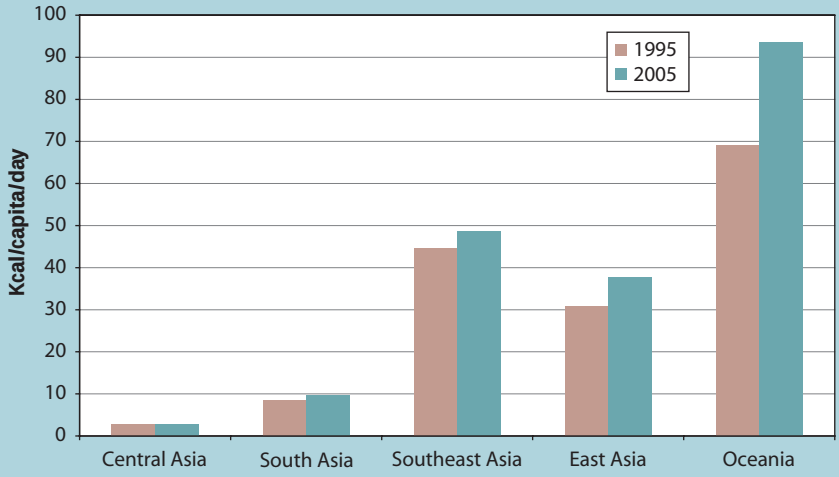


Figure 6. Consumption of chicken

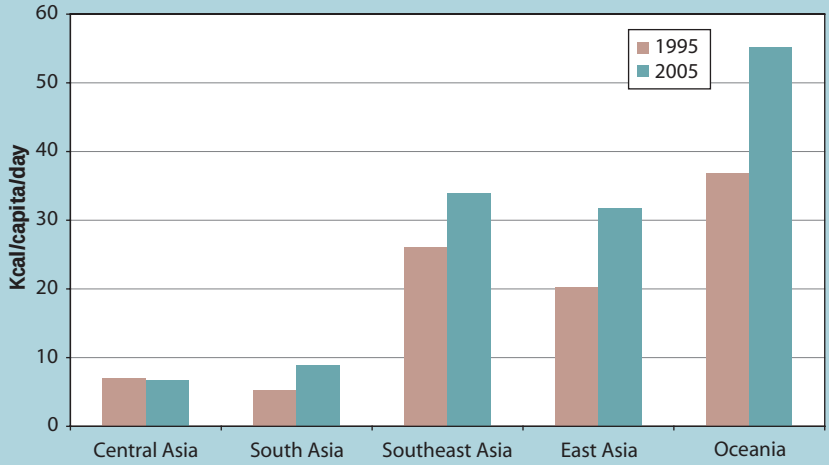


Figure 7. Consumption of bovine meat

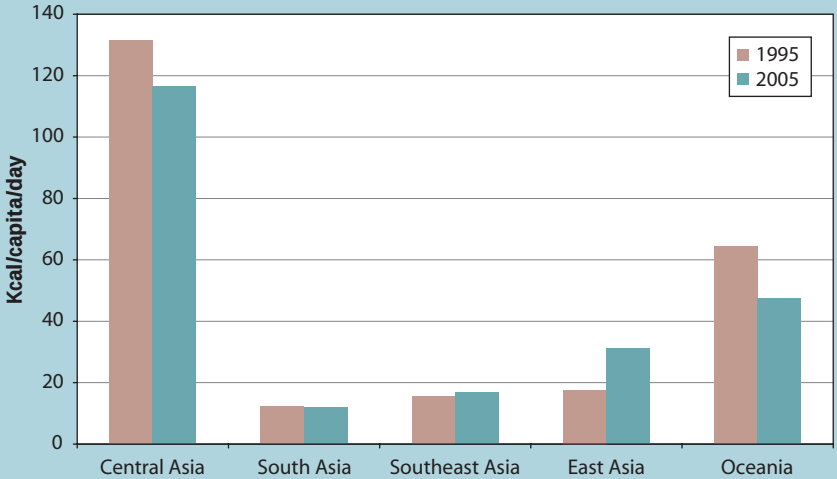


Figure 8. Consumption of pork

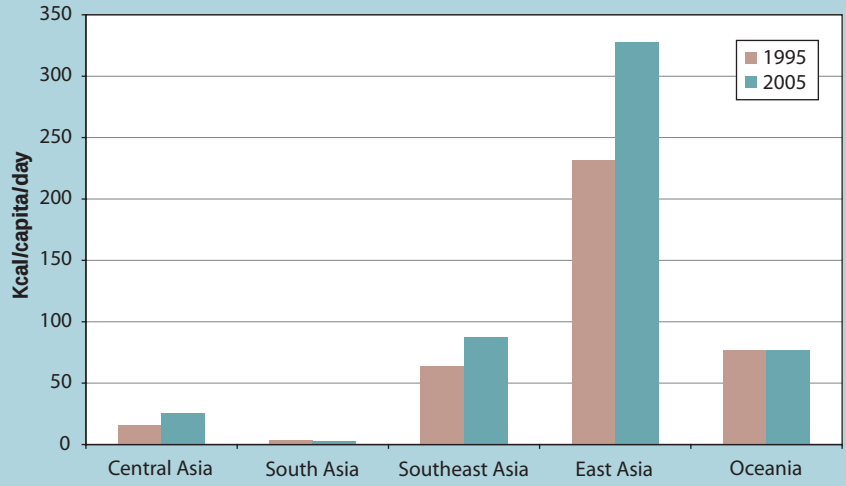
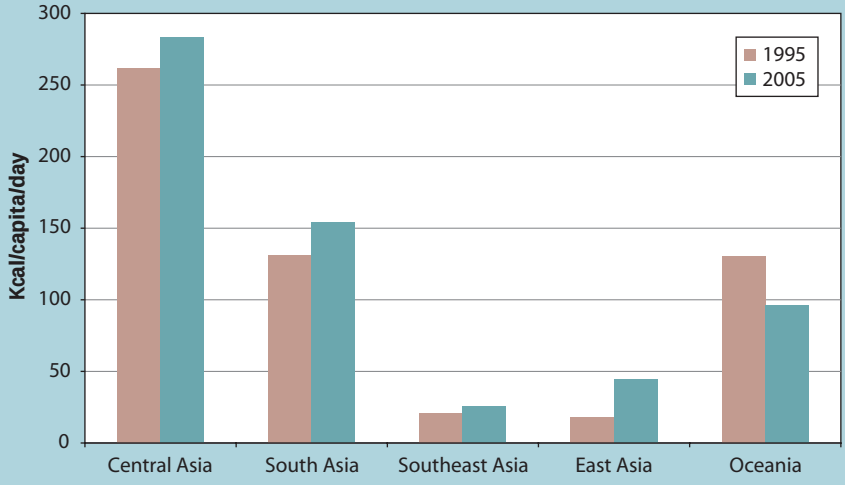


Figure 9. Consumption of milk



Asian agriculture is becoming increasingly commercialized and diversified in contrast to the former pre-occupation with cereal crop production, especially rice. With burgeoning cities, most of which are located on the coast, food imports can sometimes be cheaper than food supplies from the hinterlands, especially where the national communications and infrastructure links are poor. All these developments are adding to the surge in food imports,[5] which is raising the concerns of governments at a time when food prices are finally on an upward swing. Although the process of "supermarketization" in East Asia began between five and seven years after the process began in Latin America, the rate of growth is picking up. A recent study projects that the share of supermarkets in China will double to 23 percent by 2015. But in South Asia the high shares of supermarkets are not expected for some time because of low incomes and the persistence of highly rural economies (Traill, 2006).

[5] According to FAO (2006a), self-sufficiency ratio (production/total demand) is projected to decline from 97 percent to about 90 to 95 percent in East Asia and South Asia respectively.

Role of agriculture in poverty alleviation

It is now widely acknowledged by most stakeholders that the role of agriculture and the rural economy is fundamental for securing sustainable gains in the fight against poverty. There is much greater appreciation now for the fact that agriculture has strong links with other sectors. A productivity-induced agricultural expansion can "pull" other sectors with it and increase economic activity and employment opportunities in rural areas (Anriquez and Stamoulis, 2007). The recent research results of Davis et al. (2007) show that despite income diversification by rural households, households in the lowest expenditure categories still derive a larger share of their total income from agriculture when compared to households in higher income groups. This suggests the need to accord continued attention and increased resource allocation to the agriculture sector over the long term.

The role of agriculture in the structure of the economy will normally decline in the process of development. However, an analysis of the available data on agricultural transformation clearly indicates that the labour share of agriculture declines much more slowly than the share of agriculture in national GDP. Unless policies and investments are put in place to foster agricultural productivity, there is a danger that the decline of agriculture will be accompanied by increased rural poverty, some of which will find its way into the urban areas. At the same time, policies and programmes which increase the human capital of the rural poor and allow them to enter more remunerative labour markets are powerful tools to ensure a smooth transition of people out of agriculture without increasing poverty.

The international development community is finally beginning to place the necessary emphasis on the role of agriculture and rural development in alleviating hunger and poverty in developing countries. There has been an increase in official development assistance to agriculture and rural development in recent years. The emergence of private donors and foundations (such as the Gates Foundation) demonstrating a heightened interest in transferring resources to agriculture is encouraging. Major multilateral donors (such as the World Bank) are also looking at agriculture as an engine for poverty reduction for most developing countries and regions and as a fundamental component of a growth and poverty reduction strategy for the poorest, agriculture-based economies.[6] At the same time, there seems to be increased interest by domestic and foreign firms (including multinational agro-industrial firms) for investments (upstream and downstream) in agriculture. The potential of agriculture as a source of bio-energy has added attractiveness to the sector given its perceived ability to address global food and energy needs simultaneously.

In sum, there can be no doubt about the critical role of agriculture and rural development in the attainment of the MDG goal of halving extreme hunger and poverty by 2015. The most recent session of the Committee on World Food Security called on all parties to "enhance investments in agriculture and rural development and all related institutions".[7]

[6] In this context, it is instructive to see that the World Bank's World Development Report 2008 is titled *Agriculture for development.*

[7] FAO (2007a, para 13).

Food and agriculture outlook

World agricultural commodity market trends

In general, prices of agricultural commodities have increased substantially in recent years. After adjusting for inflation, annual world market prices of sugar, rice and palm oil have increased more than 50 percent since 2001. Annual prices of wheat and soybean oil have increased by more than 30 percent during the same time. Between September 2006 and March 2007, corn prices surged more than 40 percent. According to OECD-FAO (2007), the current strength in the world market prices for many agricultural commodities in international trade is, in large measure, a result of temporary factors such as drought-related supply shortfalls, low stocks and high oil prices.

But structural changes such as an increased demand for biofuels production for feedstock and the reduction of surpluses because of past policy reforms may keep prices above historic equilibrium levels during the next ten years. Higher commodity prices are a particular concern for net food importing developing countries as well as the urban poor and the rural landless (who are net buyers of food and are typically the poorest of the poor) and will fuel the ongoing debate on the food versus fuel issue. Furthermore, although higher biofuel feedstock prices support incomes of producers of these products, they imply higher costs and lower incomes for producers that use the same feedstock in the form of animal feed.

Exchange rates, in particular the weakening of the US dollar, have added to the pressure on agricultural commodity prices. Since most commodities are priced in US dollars on international markets, the strength of currencies other than the US dollar makes it easier for these countries to afford more imports at the same time that it puts pressure on farmers by reducing the amount of local currency they receive for their output, thus reducing their incentives to increase supplies. This is similar to the second half of the 1980s, when the falling US dollar also contributed to higher commodity prices.

Livestock

There has been a dramatic shift in the region from diets that were formerly predominantly vegetable-based to diets based on animal protein. This has resulted in an ongoing transformation of the livestock sector in the region, with subsequent implications for the feed resources and other inputs. These shifts raise a number of new and evolving concerns, particularly regarding environmental issues,[8] the provision of marketing opportunities and the need to balance feed production with demand. Total annual meat consumption in the region varies between 5 and more than 50 kg per capita, depending on the particular country's level of development and affluence. Beef is mainly consumed in the most developed countries, such as Australia and Japan, whereas mutton and goat meat are generally less important, with the exception of countries in the Pacific region. Pork is the predominant meat consumed in East Asia — 30 kg per capita per annum. Poultry meat is particularly important in the region with China being the largest importer of poultry products in the world and India registering double digit annual growth rates in poultry production.

Two important structural changes are taking place across production systems: i) a general growth in scale; and ii) a trend away from horizontal to vertical integration. Levels of livestock production and processing are increasing in

[8] For a summary of the main issues related to the environment, see FAO (2007b).

response to technological development, market requirements and insufficient returns to labour in traditional systems. Where alternative employment opportunities exist, such as in the rapidly industrializing countries of the region, traditional subsistence-oriented livestock farming is often abandoned, thereby opening up markets and expanding opportunities for other farmers or commercial entrepreneurs.

Poultry production in particular has developed from a simple farm operation to a complex vertical operation of related industries and enterprises, including grain production for animal feeds, feed mills, slaughterhouses and processing plants, food chain stores and wholesale enterprises. Further structural changes relate to the changing importance of different production systems. The growth potential for extensive grazing and roughage production is limited. In response to increased population pressure, the good pasture land is being converted to cropland, leaving increasingly poorer land for grazing and mixed farming. Industrial production of pigs and poultry is therefore going to increase relative to production from grazing and mixed farming systems. Pork and broiler production will increase relative to ruminant meat production as a direct result of the technological improvements in the sector.

During the 1990s production of pigs and poultry almost doubled in China, Thailand and Viet Nam (FAO, 2006b). By 2001 these three countries alone accounted for more than half the pigs and one-third of the chickens in the entire world. Pig and poultry operations concentrated in the coastal areas of China and Viet Nam are emerging as the major source of nutrient pollution of the South China Sea. The related booms in production and pollution have resulted in the Livestock Waste Management in East Asia Project (LWMEAP), which has been prepared with the governments of China, Thailand and Viet Nam by FAO and the inter-institutional Livestock, Environment and Development (LEAD) initiative under a grant from the Global Environment Facility. The project will address environmental threats by developing policies to balance the location of livestock production operations with land resources and to encourage the use of manure and other nutrients by crop farmers.

Milk production has grown more rapidly in Asia than anywhere else in the world. Two broad types of dairy industries exist. In some countries, such as India and Pakistan, where there has been a strong dairy tradition, markets remain largely insulated from international price variations, although some market opening has started. For these countries, output growth has remained firm, sustained by increases in domestic demand fuelled by economic and demographic growth. In the case of India, rapid domestic income growth, exceeding 6 percent, pushed milk prices higher in 2006 and 2007. Total milk output is expected to grow 3 percent in 2007. The tendency for prices to rise was accentuated by the country's recent entrance onto the world skimmed milk powder market, and high milk powder prices, which led the government to impose a six-month ban on milk powder exports in January 2007. As for Pakistan, the world's fifth largest dairy producing country, the domestic sector is largely disconnected from world markets, but investments in milk processing are occurring at a fast pace, with milk output expected to rise by about 4 percent in 2007.

Although accounting for only 4 percent of world production, Oceania is the largest milk product exporting region, with a market share of over 35 percent. Successive droughts and policy reform (2000) in Australia have contained that country's milk production to levels below those of ten years ago.

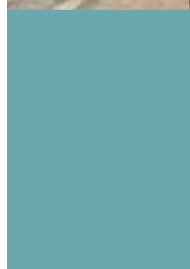













Fisheries

Asia and the Pacific region continues to be the world's largest producer of fish. In 2004, this amounted to 87.1 million tonnes — 46.7 million tonnes from capture fisheries and 40.4 million tonnes from aquaculture (calculated as total aquaculture production minus aquatic plants). This represents 49 percent and 89 percent of the global production, respectively. When aquatic plants are included in the total aquaculture figures, aquaculture production outstrips that of capture fisheries for the first time (total aquaculture production of 54.3 million tonnes and 91 percent of the world's production) (FAO, 2006c). Of the top ten producers of capture fish, five are from the Asia and the Pacific region (China (1st), Indonesia (5th), Japan (6th), India (7th) and Thailand (9th). For aquaculture, the top ten aquaculture producer states by quantity (excluding aquatic plants) in 2004 were China, India, Viet Nam, Thailand, Indonesia, Bangladesh, Japan, Chile, Norway and USA. Asian states hold the top seven positions. By value, China, Japan, India, Chile, Viet Nam, Indonesia, Norway, Thailand, Bangladesh and Myanmar comprise the top ten producer states. China alone is reported to have produced 70 percent of the world's aquaculture production (about four times the total fisheries production of Peru, the number two fishery producer worldwide).

Both capture fisheries and aquaculture sectors continue to be of fundamental importance to Asia and the Pacific region in terms of food security, revenue generation and employment. In many of the countries, catching or farming aquatic resources forms a vital part of rural people's livelihoods. Fisheries and aquaculture also have a deep cultural significance and are more than just a source of income or food supply; traditional fishery products such as fish sauce and fish-based condiments have always been important ingredients of people's daily diet and are not easily substituted. All sizes and types of fish are utilized in a wide variety of ways and there is very little discarded or wasted. The role that fish play in both the food security and nutritional security of many rural and coastal populations has often been underestimated in the past. It is also now recognized that fisheries and aquaculture are important contributors to the national economies in the region.

Fish products are also the most heavily traded natural food commodity in the world and trade issues involving fish are becoming increasingly important. Estimates of the capture production value indicate that the contribution of capture fisheries to GDP accounts for more than one percent in many states in the region. The fisheries sector plays a critical role in the national economies of small island developing states. The economic contribution of fisheries production tends to be less in Southeast Asian and South Asian states in general, yet fisheries still contribute more than one percent of the GDPs of eight of these states. It is also worth noting that these figures for fisheries value are probably underestimated and do not adequately value the artisanal part of the sector. Aquaculture also makes an important contribution to GDP in the Asian region and it is increasing.

Forestry

The role of forests in Asia and the Pacific region is being increasingly recognized, especially in the face of emerging important new issues including mitigation of climate change, demand for bio-energy, water issues, natural disasters, the contributions of forests in poverty reduction, and the potential role of coastal forests in mitigating the impacts of tsunami events. In the region as a whole there has been a net increase in forest area of about 633 000 ha annually during the 2000–2005 period, in contrast to the region's net loss of forest cover during the 1990s (FAO, 2007c). The improvement was largely the result of an increase of more

than 4 million hectares per year in China as well as efforts of other countries such as Bhutan, India and Viet Nam, which have all been investing in afforestation and forest rehabilitation in recent years.

However, many other countries experienced a net loss. As a subregion, Southeast Asia experienced the largest decline in forest area with an annual net loss of more than 2.8 million hectares per year, about the same rate as occurred during the 1990s. The greatest forest loss occurred in Indonesia, almost 1.9 million hectares per year, followed by Myanmar, Cambodia, the Philippines, Malaysia and the Democratic People's Republic of Korea.

The area designated for protection has been increasing for the region as a whole, resulting mainly from increases exceeding 4 percent per year in East Asia. However, the moist forests of Southeast Asia are increasingly being burned, resulting in huge losses of timber as well as problems such as air pollution and lost opportunities in trade and tourism.

Economic development creates problems as well as opportunities. In order to control and ensure sustainable commercial harvesting, several Asian countries are implementing regional and national codes of forest harvesting practices. Nevertheless, challenges abound as many of these codes were formulated without wide stakeholder consultations, and enforcement and monitoring practices are not sufficiently ensured as many codes are not legally binding.

The forestry sector in the region is witnessing a trend towards a more participatory approach to forest stewardship involving rural communities. The political commitment to sustainable forest management has never been stronger, and most countries have a relatively sound policy and legislative foundation for implementing it. However, central and local government capacity in policy analysis and enforcement is a challenge for most countries in the region. There are broad trends towards private sector participation in forest management, increased clarity of forest resources tenure, and decentralized management, departing from the traditional technocratic and hierarchical approaches of providing forest concessions under national forestry agencies.

Agricultural trade

Since the establishment of the World Trade Organization and the occurrence of the Asian financial crisis in 1997, the region has experienced substantial growth in agricultural trade. However, intraregional agricultural trade has not grown as expected and net imports have increased only slightly. The countries in the region have rapidly embraced bilateral and other trade arrangements that very quickly produced a situation of entangled and overlapping preferential rules that informally have been named "Asian noodles".[9] Total trade of Economic and Social Commission for Asia and the Pacific (ESCAP) members has increased in absolute terms and today accounts for almost 30 percent of world exports and imports. Most of the agreements, however, focus on reducing or eliminating tariffs and other barriers to industrial goods or manufactures. In contrast, agriculture does not feature prominently on the agenda for full and/or quick liberalization through Preferential Trade Agreements. This is mainly because many countries consider the sector to be special, sensitive and risky to liberalize.

[9] Mikic (2007).

Because of the sheer size of China and India, the region's trade performance is often dominated by these two countries. Both countries are projected to be close to self-sufficient in cereal grains in the medium term and therefore do not pose a serious threat to global food security.[10] Although India will continue to be a net exporter of rice, it is projected that both China and India will be major importers of oilseeds, plant-based fibre and forestry products. China is moving out of land-intensive crops such as food, feedgrains and sugar and towards the export of labour-intensive, high value horticultural, livestock and aquaculture products. Significant increases are predicted for agriculture and food trade between the two Asian giants.

Asian agricultural imports exceeded $165 billion in 2005, more than double that of 1990. Asian agricultural imports now account for 26 percent of global trade, with developed countries accounting for more than three-quarters of that amount. Cereals dominate imports, but growth has been driven by increased imports of oilcrops, fruits, vegetables and meats. On the whole, there is still significant potential for harnessing welfare gains for all from improving intraregional trade.

Long-term income and population dynamics

The recent increases in world agricultural prices come against a background of prices that are quite low in historical terms. During the past fifty years, growth in food production has outpaced population growth, thus lowering food prices. Coupled with the effects of rising incomes, millions of the poor have been lifted out of poverty and have vastly expanded access to food.

Among the group of 17 major rice producers in Asia, paddy production per person was less than 120 kilograms in 1951. By 1999, it had reached a peak of 166 kilograms per person, despite the fact that population more than doubled during this period. This represents a 40 percent increase in less than fifty years. Because of the rapid growth in food production, rice prices on the world market, after adjusting for inflation, declined by about 80 percent in US dollar terms between 1980 and 2000. This remarkable achievement was made possible by good policies and investments in research, technology, and infrastructure. At the same time, higher yields cushioned farmers against the effects of falling prices.

However, the challenges ahead are even greater. In 1950, there were only 1.4 billion people in Asia. Today there are about 4 billion, and these people have much higher incomes than before. More people with higher incomes mean substantially more pressure on the natural resource base. At the same time, there are still more than half a billion people in Asia who are undernourished. Furthermore, population is still growing. Despite the slowdown in population growth rates in percentage terms, the Asian population is growing more rapidly today (46 million more people per year) than it was in the early 1960s in absolute terms. This annual increase is only slightly less than the peak of 57 million people that were being added every year in the region during the second half of the 1980s. The UN medium variant projection is that the Asian population will continue to increase until at least 2050, when it will exceed 5.25 billion people.

Outlook for the future

The OECD-FAO's *Agricultural Outlook 2007–2016* projects that prices will rise only slightly during the next ten years, at a rate that is less than the rate of inflation. On the other hand, there are many factors that suggest food prices could increase at

[10] FAO (2006d).

rates faster than inflation. First, grain yields are still increasing, but the rate of increase has slowed to a trickle. For example, rice yield growth is now slower than population growth, despite the fact that population growth is declining, suggesting that technological progress may be slowing down. Growth in adoption of modern rice varieties, for example, has inevitably slowed as adoption rates reach plateaus of 75 to 90 percent in many countries. Unfortunately, continued expansion of area planted is not a solution either, as more land is needed for housing, roads and other crops that are being demanded by consumers. The Asian population is still increasing by more than 100 000 persons every day, and a way must be found to feed them.

The problem of slower yield growth is exacerbated by the changing composition of Asian diets, as increasingly wealthy consumers demand more meat and dairy products. Since it takes several kilograms of grain to produce one kilogram of meat, this will make it even more difficult for farmers to keep pace with food demand.

Besides increasing population, higher incomes, slower yield growth and the changing composition of diets, water scarcity is another source of concern for agricultural commodity markets. Water demand from the industrial and household sectors is increasing rapidly whereas groundwater tables are falling in many parts of China and India, putting pressure on farm production costs. Some of the water scarcity is caused by economic growth, but sometimes it is caused by government policies. For example, widespread electricity subsidies in India encourage excessive and wasteful use of water, harming the environment and thus reducing future production prospects. Given increased water scarcity in the future, the implications for food prices are potentially severe if water management is not improved.

Climate change adds another layer of uncertainty. A recent study on Indonesia by Naylor, Battisti et al. (2007a) found that the increased variability of the El Niño Southern Oscillation phenomenon in the future will lead to an increased probability of delayed monsoon onset and reduced rainfall that will lead to more variable production with important effects on food security. Furthermore, the region is prone to a high frequency of meteorological disasters such as droughts, floods, and cyclones that often have severe impacts on food production.

Challenges for the future

The growing importance of biofuels is a major challenge and an opportunity for the sector. Biofuels production has grown from 1 million hectares seven years ago to 25 million hectares today. FAO recently reviewed the situation of biofuel strategies for the Mekong delta region to assess their likely impact on poverty reduction.[11] If petroleum prices remain high and more ethanol plants are built, demand for sugar and maize will increase, leading to higher prices of these crops unless technology can lower crop production costs per tonne. Even if petroleum prices fall, the demand for corn from ethanol plants may remain high, as these plants have already incurred the fixed costs of construction and will continue to operate as long as they can cover their marginal costs of production. The problem is exacerbated by large subsidies and tax credits in the United States and other developed countries. If this additional demand for corn and sugar is met by farmers shifting land from other crops, then prices of other foods will also increase.

[11] Planning Workshop on Strategies and Options for Integrating Biofuels and Rural Renewable Energy for Poverty Reduction, 11–12 June 2007, FAO Regional Office for Asia and the Pacific, Bangkok.

Even if most of the biofuels are produced outside of Asia, the impact on Asia will be profound because of the globalized and integrated nature of world commodity markets. For example, farmers in northern Bangladesh are now shifting out of wheat into corn as world corn prices soar, making imports more expensive and making corn production more profitable. Thus, factory construction in the American Midwest is affecting the decisions of farmers in one of the world's poorest countries.

Higher prices will of course help farmers, but there are other effects to consider. One study by Senauer and Sur (2001) estimated that a 20 percent increase in food prices would increase the number of undernourished in Asia by 158 million people; thus, the impact of biofuels demand is worrisome indeed. And this does not even take into account the environmental destruction that will occur if more forests are cleared for oilseed production in Asia and Brazil.

Given these developments and trends, there exist enormous challenges in achieving a sound environment and ensuring that affordable food reaches the poor. More investment is needed in agriculture, especially agricultural research, which has been shown to be one of the most cost-efficient ways for governments to reduce poverty. And governments must focus the scarce resources that they have on increasing productivity, and not on subsidies that are often biased against the poor and encourage wasteful use of natural resources. But the challenges are so large that the public sector will be unable to do it alone; active participation by the private sector will be essential. The world desperately needs the research capacities and extension skills that are available in the private sector.

Biotechnology is one particularly promising way to improve agricultural productivity, and the private sector has played a major role in this area. Genetically modified organisms, or GMO crops, have received quite a large amount of publicity, and farmer adoption of GMO crops has grown extremely rapidly over the past decade in some countries. Most of this growth has occurred outside Asia, but Bt cotton has proved to be a favourite with farmers in China and India, and adoption has been exceedingly rapid. Insecticide use on cotton has traditionally been very high, so this innovation has reduced insecticide levels substantially, contributed to improved human health and a cleaner environment, and raised farmers' profits. This is truly a major achievement, although it will be a challenge to manage the development of insect resistance.

We need more success stories like this in the future. Some promising possibilities include golden rice, which could reduce vitamin A deficiency among the poor, and C4 rice, which holds out the promise of higher yields, lower production costs per tonne, increased water use efficiency, and reduced nitrogen loads into the environment. But these innovations are still not ready to be tried by farmers. Bt maize will hopefully make a big impact in the Philippines and elsewhere. Bt rice has also made progress, but it has still not been approved for commercial release in China. This points to the need for a comprehensive biosecurity framework that supports the introduction of safe new varieties with the potential for increasing the productivity of farmers and the well-being of consumers.

In addition, there are also many possibilities for using the tools of biotechnology that do not involve GMOs. For example, the development of submergence tolerant rice will help many poor farmers who are forced to make a living in harsh environments. This has been developed with modern technology, but without introducing genes from foreign organisms.













Crop production and livestock production have a profound effect on the wider environment. They are the main source of water pollution by nitrates, phosphates and pesticides. They are also the major anthropogenic source of the greenhouse gases methane and nitrous oxide, and contribute on a massive scale to other types of air and water pollution. Agriculture can also lead to land degradation, salinization, the overextraction of water and the reduction of genetic diversity in crops and livestock, problems which jeapordize its own future. However, the long-term consequences of these problems are difficult to quantify.

More sustainable production methods must be devised so that the negative impacts of agriculture on the environment can be attenuated. Agriculture can in fact play an important role in reversing the trends, for example by storing carbon in soils, enhancing the infiltration of water and preserving rural landscapes and biodiversity.

Ultimately, it is in the agricultural sector that problems such as non-sustainable production, poor fuel use, natural resource depletion and habitat exploitation must be addressed. Governments will need to seek agreements and plan adjustments to policies that correctly value the services provided by the sector, in order to face the challenge of climate change to food security. The true value of the role of agriculture and rural development in poverty alleviation and the provision of environmental services needs to be duly recognized.

Much of the discussion regarding biodiversity, climate change and bio-energy is currently taking place without the effective and full participation of the agricultural sector and ministries. This suggests that the window of opportunity in which the sector can still act as a driver of change, and thus integrate these various objectives successfully, is limited. To be an effective partner to the environment and trade sectors, agriculture planning needs to draw on its current competitive advantages, which result from the centrality of the agricultural nexus in the debate, and put forward coherent policy options for governments to debate.

Integrated policy and planning, between line ministries and the private sector, and within and beyond national jurisdictions, requires first of all that the agricultural sector becomes aware of its own environmental externalities as well as of the impact of environmental change on its economic and societal performance. This will allow the definition of appropriate policy objectives within the agricultural sector, based on negotiated strategic actions, including legal structures and resource allocation.

I. The new "gold rush": biofuels developments in Asia and the Pacific region

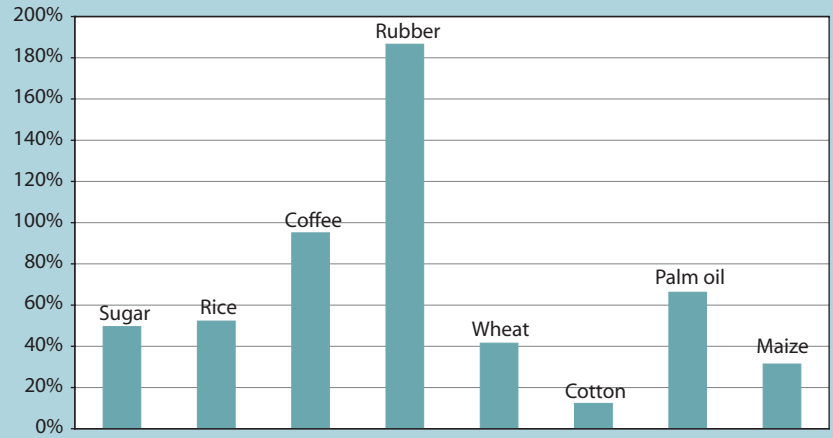
Looking into the medium-term future, the biofuels "gold rush" could be one of the major factors affecting agricultural commodity prices and rural incomes in Asia. This section discusses recent developments in the trends and stability of commodity prices; the status of biofuels development in the region; the possible effects of biofuels on national incomes, energy security and the environment; and whether and how biofuels production should be subsidized. The subsequent section examines the potential effects of biofuels demand on household food security in Asia.

Trends and stability of international commodity prices

Recent trends in commodity prices

Commodity prices have increased sharply during the past few years (see Figure 10). It is important to realize, however, that not all of the recent increases in commodity prices over the past few years are because of the demand for biofuels. First, higher oil prices lead to higher costs of food production (fertilizer and machinery), which in turn lead to higher food prices even in the absence of a demand for biofuels.

Figure 10. Percentage change in various commodity prices, 2001/02 to 2006/07 (adjusted for inflation)



Source of raw data: IMF (2008).

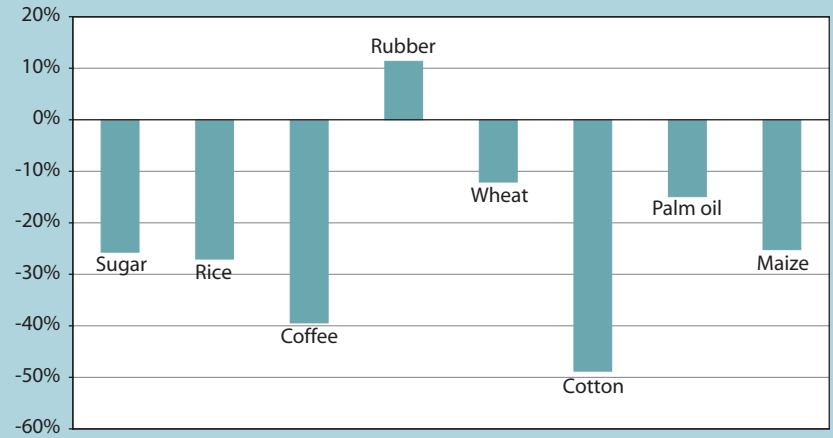
Second, demand for maize is increasing independently of its use as a feedstock for ethanol. As consumers in China, India and other rapidly developing countries gain more income, they shift diets away from cereals toward livestock products that use substantial quantities of maize as feed. Because it requires several calories of grain to produce just one calorie of meat, an increased demand for meat means a substantially increased demand for grain.

Third, some of the increases in commodity prices are a result of exchange rate movements, specifically the weakening of the US dollar. A weak US dollar leads to increased commodity demand (at any given US dollar price) from countries whose currencies have appreciated (e.g. the Indian rupee, the Thai baht), because it is cheaper in domestic currency terms to buy the commodity. A weak US dollar also leads to an inward shift of the supply curve as farmers in countries whose

currencies have appreciated now receive fewer units of domestic currency (again, at any given US dollar price) per unit produced. The shift in both demand and supply leads to higher commodity prices (as measured in US dollars). This theory is borne out by historical experience. For example, the weak US dollar in the mid to late 1980s led to increased commodity prices at that time.

Fourth, some of the recent increases in commodity prices are just the recovery from low prices in the past. Low prices in the first years of this decade discouraged farmers from planting, and this negative feedback on production has contributed to higher prices at present. Indeed, commodity prices in 2006/07, after adjusting for inflation, were still lower than they were during the previous peak in 1995/96 for most commodities (see Figure 11). In turn, the relatively high prices of the past few years have contributed to higher cereal production; FAO (2007c) estimated that world production of coarse grains and rice both hit record highs in 2007, although wheat production remained below the levels in 2004 and 2005.

Figure 11. Percentage change in various commodity prices, 1995/96 to 2006/07 (adjusted for inflation)



Source of raw data: IMF (2008).

Although the factors discussed above are medium to longer term in nature, some of the recent price increases may be a result of very short-term considerations. For example, despite the development of improved inventory management techniques during the past decade, the current low level of cereal stocks may create more uncertainty and make the markets more susceptible to very short-term supply shocks. This tendency may be exacerbated by increased participation of speculative investors (e.g. hedge funds) in commodity markets. Such trends should not lead to permanently higher prices, although they can lead to increased price volatility.

Finally, the demand for biofuels has also contributed to the upward pressure on commodity prices. More than half of the 2007 increase in world corn production, for example, will be utilized for higher ethanol production, limiting the ability of the increased supplies to help contain international prices (IMF, 2007). This leads to an obvious question: what will be the impact of increased biofuels production on international commodity prices in the future?

Future trends in commodity prices

Long-term projections are notoriously difficult to make. *Ex-post* validation often shows large deviations between projected prices and actual prices. Commodity

price variability from year to year complicates such validation; for example an incorrect projection for 2025 may be correct in 2035. Finally, those who make projections emphasize that projections are different from forecasts, and are simply estimates of what prices would be if the structure of their model is correct (a distinction often lost on many users of the projections). Despite these difficulties, such projections are still useful, and several research institutes make such projections.

The International Food Policy Research Institute (IFPRI, 2007), using its IMPACT model, has constructed two scenarios for possible future biofuel development. One scenario is based on the actual biofuel investment plans for countries that have such plans, as well as assuming that high-potential countries will also develop this sector in the near future. Under this scenario, maize prices are expected to be 26 percent higher in 2020 relative to a baseline scenario, whereas oilseed prices would be 18 percent higher. Under a more aggressive biofuel development scenario, where biofuels production levels are double those in the first scenario, maize prices would increase 72 percent relative to the baseline, whereas oilseed prices would increase 44 percent. Calorie consumption in Asia would be reduced by approximately 2 to 4 percent under the two scenarios and this would constitute a substantial reduction for the poor. Thus, biofuel development will have potentially large effects on food security (see the next section for more discussion).

Naylor, Liska et al. (2007) list several other long-term price projections, and note that the estimates from the various studies are quite variable. Projections for corn prices, for example, range from a 2.5 percent increase (by 2014) to a 65 percent increase (by 2016). The ultimate realization is very difficult to predict and will depend on many factors, including the development of technologies that can profitably use lignocellulosic feedstocks, the fate of Conservation Reserve Program (CRP) land in the USA and set-aside land in Europe, the time path of oil prices, and many other factors.

How will biofuels demand affect price stability on international markets?

As pointed out by Schmidhuber (2007), an increased demand for biofuels is likely to create closer integration between energy and food markets. If oil prices are relatively stable, then the links between these markets may create long-term stability in food markets. For example, if agricultural commodity prices rise, these rising feedstock prices will eventually make biofuels production unprofitable because feedstock costs are an important component of biofuels production costs. The contraction of demand for biofuels feedstock will then help to place a ceiling on agricultural prices. Conversely, if agricultural commodity prices decline, the rising profitability of biofuels production will increase demand and help to provide a price floor. This price corridor will narrow the range of volatility of agricultural commodity prices in the long term, although it will be less relevant in the short term because of transaction costs and time lags in expanding or contracting biofuels production capacity.

The scenario is quite different, however, if oil prices are themselves unstable. A look at the empirical evidence shows that oil prices have exhibited greater volatility than cereal prices at both monthly and annual frequencies (Table 1). The relative lack of integration between oil markets and agricultural commodity markets in years past meant that fluctuations in oil prices had relatively little effect on food price instability. Now, however, even if a demand for biofuels creates a price corridor for agricultural prices, this corridor will itself be fluctuating as oil prices fluctuate. In this case, the greater integration between oil prices and agricultural

Table 1. Volatility of real (inflation-adjusted) commodity prices, 1990 to 2007 (percent)

Commodity	Annual		Monthly	
	CV	DLMA	CV	DLMA
Petroleum	47	21	46	19
Sugar	29	20	33	19
Rice	24	14	25	11
Wheat	21	15	24	14
Maize	22	14	24	13
Palm oil	28	25	30	20
Soybean oil	21	16	22	14
Sunflower oil	24	21	24	17
Sorghum	19	13	22	13
Rubber	37	26	36	19

Note: CV is the coefficient of variation. DLMA is the average absolute value (over time) of the percentage change in the annual or monthly price from a two-year lagged moving average.

Source of raw data is IMF (2008).

commodity prices is likely to result in more pronounced price instability for cereal grains.

Status of biofuels development in the region

Over the last five years many Asian nations have started establishing national biofuels plans and strategies in order to provide a strategic and regulatory framework for the development of their biofuels industries. China and India, with their increasing influence on the international energy market, are in part responsible for driving the transformation of the global energy system by their sheer size and growing share in the fossil fuel trade. Based on current policies and trends, almost half of the growth in world energy needs from now until 2030 would be attributable to these two countries alone (IEA, 2007). Thus, biofuels developments in Asia could have an important impact on world energy and agricultural commodity markets.

China imports 45 percent of its crude oil from foreign sources, and it is expected to become the world's largest energy consumer after 2010. Its demand for transport fuel is expected to quadruple by 2030 as a result of an anticipated sevenfold expansion of the vehicle fleet (IEA, 2007). With this large demand in mind, China plans to produce about 6 million tonnes of ethanol by 2010 and 15 million tonnes by 2020, as well as 5 million tonnes of biodiesel (China Daily, 2007). But food security is also an important concern, and as of 2007 the government will not allow any expansion of ethanol production that uses staple grains such as maize. Sugarcane, sweet sorghum, cassava and rapeseed are being considered as alternative feedstocks. China is also looking at the possibility of investing in feedstock production in other countries in Southeast Asia, such as cassava in Lao PDR (Naylor, Liska et al., 2007).

India's net oil imports are projected to be as high as 6 million barrels per day in 2030, which would make it the world's third largest importer of oil (IEA, 2007). Concerned about this growing dependence on imported fuels, India's evolving strategy for the promotion and production of biofuel use is based on promoting the use of ethanol derived from sugar molasses for blending with petrol as well as the use of non-edible oils for blending with diesel. In 2006 the government mandated 5 percent blending of ethanol with petrol, subject to commercial viability, in 20 states and seven union territories. This would entail 550 million litres

of ethanol use. In the third phase, when the policy applies to all states, the blend ratio is set to be raised to 10 percent. Sugar mills are also able to get subsidized loans for the construction of ethanol plants (USDA, 2007a).

Biodiesel policy in India is based primarily on promoting plantations of jatropha on wastelands. The Planning Commission has earmarked 11.2 million hectares of wasteland to be planted with jatropha by 2012 in order to produce sufficient biodiesel to blend at 20 percent with petrodiesel. In 2005 the government announced a biodiesel purchase policy and price (currently Rs. 26.5 per litre); it is insufficient to cover the cost of production, however, and so has not attracted any sales yet. Even though the central government has exempted biodiesel from the central excise tax, the state governments do not provide any exemptions for biodiesel or biodiesel blends.

Indonesia adopted a National Energy Policy in 2006 that stipulates blending guidelines of 2 percent biofuel mix from 2005 to 2010, increasing to 5 percent by 2016. Some 3 million hectares of palm oil plantations and 1.5 million hectares each for jatropha and cassava have been allocated in support of the new policy (Kleffman Research Pacific, 2007). These plans are supported by incentives to develop biofuels from palm oil and by January 2007 as many as 59 corporations had concluded agreements for the manufacture of biofuels. However, food security is of concern, and sharp increases in cooking oil prices led the government to implement a progressive export tax on crude palm oil that can reach as high as 10 percent (Commodity Online, 2007). Plans are also being considered to reserve a minimum quantity for the domestic market (Naylor, Liska et al., 2007).

Malaysia, which has large oil palm resources, has adopted a National Biofuel Policy to promote the use of B5 (5 percent biofuel content) for the transport and industrial sectors. By August 2007, some 92 biodiesel plants had been licensed with a capacity of 10.29 million tonnes, but only seven plants were in operation because of increases in the price of crude palm oil. Some 120 000 tonnes of biodiesel were exported between August 2006 and July 2007, mainly to the European Union and the USA.

Thailand has also assigned priority to biofuels development because of its dependence on fossil fuel imports and its significant agricultural resources. It has mandated use of B2 in 2008 and is aiming for use of B5 by 2011, using palm oil as the source of biodiesel. The government has also reduced fuel taxes (and thus retail prices) for gasohol (E5, 5 percent ethanol content) in order to encourage consumers to substitute away from premium gasoline. Sugarcane, molasses and cassava are the feedstocks for ethanol production. As of the middle of 2007, there were seven ethanol plants in operation producing about 545 000 litres per day (operating at about 60 percent capacity utilization). Six of these plants use molasses as feedstock, with the other also using sugarcane. However, several plants using cassava as feedstock are now operational, or are expected to be so by the end of 2008 (USDA, 2007b). The Royal Thai Government is conducting research on improved cassava varieties that have higher starch content and/or shorter duration (so that cassava can fit into a rice-cassava rotation). The government is also supporting extension projects to help farmers learn more about the possibilities of growing cassava for ethanol production.

The Philippines' plans for biofuels are based on its major coconut plantations. The Biofuels Act of 2006 mandates a gradual increase in the use of biofuels from 1 percent in 2006 to 2 percent in 2008, rising to 5 percent in 2010 and 10 percent

from 2012 onwards. The government also plans to plant jatropha on 700 000 hectares, most of it in the poor Mindanao region. The recent opening by Ford of the first flexible fuel engine manufacturing plant in Southeast Asia may contribute to the use of biofuels in the country. However, a review of the Biofuels Act and its mandates is being undertaken in light of recent research casting doubt on the positive climate change contributions of biofuels (see below).

The key commodities affected by the biofuels movement in Asia are palm oil, maize, sugarcane, soybean, cassava and coconut oil, and it is clear that the Asian region has tremendous potential for increased biofuels production, especially biodiesel. It seems politically likely that biofuels production will continue to grow given the existing investments in plant and equipment.

Effects of biofuels

National incomes

Schmidhuber (2007) simulated the net trade status for energy and agriculture at various levels of the oil price and plotted the trade in US$ per capita on scatter diagrams. In that spirit, Figures 12a and 12b show the actual (not simulated) net trade status for energy and food in per capita terms using the most recent trade data available. Several countries in the region are net exporters of food and energy. Australia and Malaysia are large net exporters of both, whereas Indonesia, Papua New Guinea and Viet Nam are minor net exporters of both. These countries stand to benefit the most in terms of national income from the biofuels boom.

Half of the countries in the region are net importers of both food and energy, with Japan and the Republic of Korea having the largest import bills per capita. But these two countries are relatively wealthy, and will have an easier adjustment than many of the other countries that import both food and energy. Some of the region's poorest countries, such as Bangladesh, Cambodia, Nepal, and Pakistan, fall into this category. The remaining countries export either food or fuel, but not both. Whether they gain or lose will depend on the relative size of their food and energy trade balances.

Energy security

Perhaps the main motivation of many governments for pursuing biofuels production is the potential for enhanced energy security. Given the importance of oil in energy consumption, the fact that three-fourths of the world's proven oil reserves are in just seven countries, namely Iran, Iraq, Kuwait, Russia, Saudi Arabia, United Arab Emirates and Venezuela (Naylor, Liska et al., 2007), and the persistent volatility of world market oil prices, concerns over the reliability of future supplies are well founded.

Given the size of the world energy market, further development of biofuels is unlikely to make many energy importers self-sufficient in energy unless they are already close to self-sufficiency. For example, Rajagopal and Zilberman (2007) calculate that even if 25 percent of the world's current annual production of sugarcane, maize, wheat, sorghum, sugar beet and cassava was used for ethanol production, it would still account for just 21 percent of petrol demand (which is in turn just a fraction of total energy demand). Future energy self-sufficiency will be even more difficult to achieve because energy demand grows rapidly with income and is growing more rapidly than production of these major crops. It is also not clear that it would be politically feasible for many countries to shift such a large share of domestic food production into biofuels.

Figure 12a. Net trade balances for energy and food (various countries)

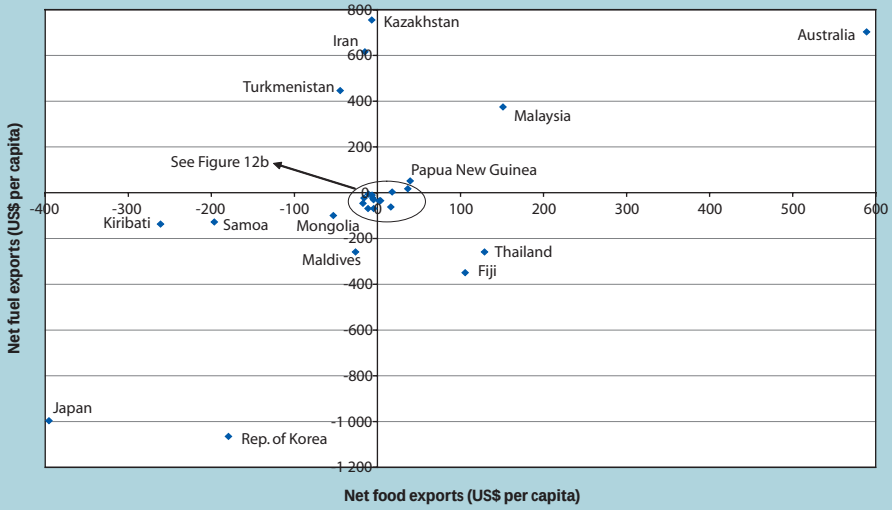
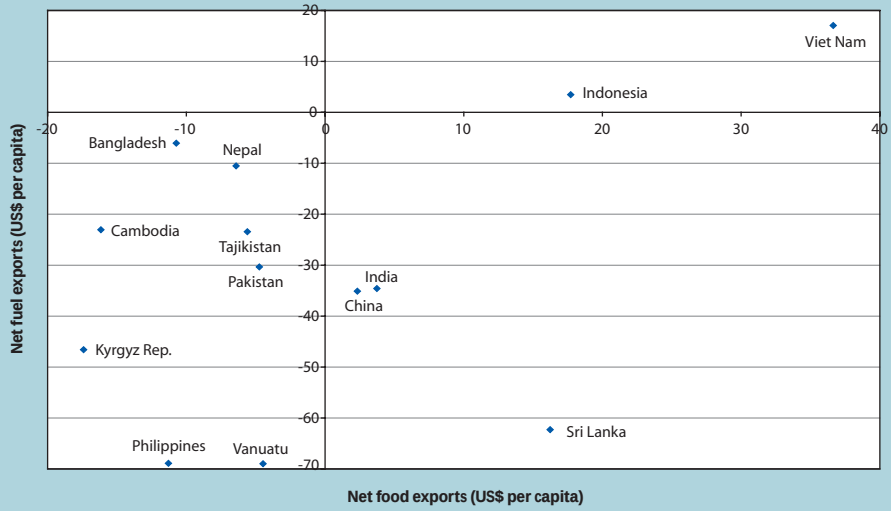


Figure 12b. Net trade balances for energy and food (various countries)



Notes to Figures 12a, 12b: Data are from 2005 or 2004 for most countries, although for some the most recent data available are for earlier years. Figure 12b is an expanded version of the central portion of Figure 12a so that country names can be noted more clearly. Thus, the scales for Figures 12a and 12b are different. New Zealand is not shown in either figure because of its large net exports of food, at $2 165 per capita (with net energy imports of US$686 per capita).

Source of raw data: World Bank (2008).

Increased energy security will be especially difficult to achieve for countries that are both net food importers and net energy importers. If a country is already importing food and diverts domestic food supplies to biofuels production, then it will simply be a matter of replacing oil imports with more food imports. This could be advantageous, however, to the extent that world food markets are more stable than world petroleum markets.

There is no denying however, that at the margin, increased biofuels production can improve energy security for many countries, and this is a goal worth pursuing. Even if energy self-sufficiency is not achieved, a diversification of energy sources will be helpful. There are, however, potential costs in terms of the environment and household food security that should be considered before pursuing improved energy security.

Environment

Initially, biofuels were widely seen as having the potential to reduce greenhouse gas (GHG) emissions relative to the combustion of fossil fuels. Given the concerns over global warming, this is an important benefit. Subsequent research, however, has cast doubt on the magnitude of these benefits. Life cycle analysis that considers not only the direct emissions from burning of the fuel but also the indirect emissions coming from the use of fertilizer, irrigation water and other inputs used in the production of the biofuel feedstock have found that the net reduction in CO_2 emissions is much less than previously thought. Furthermore, recent research suggests that the N_2O (a greenhouse gas that is more potent than CO_2) emissions from the cultivation of certain biofuel feedstock crops (e.g. bioethanol from maize, biodiesel from rapeseed) may contribute more to global warming than the cooling achieved by reduced combustion of fossil fuels (Crutzen et al., 2007). Thus, it is not clear whether biofuels will reduce or exacerbate global warming. What is clear is that different crops will have markedly different impacts.

However, changes in GHG emissions are not the only effect of biofuels on the environment. One of the most serious concerns in the Asian context is that biofuels production will lead to further deforestation, which will release sequestered carbon into the atmosphere and cause loss of biodiversity because of habitat destruction. Depletion of water resources will be of concern whenever new land uses increase evapotranspiration. Agrochemical pollution is a concern when biofuels feedstock is grown under input intensive conditions, as is often the case today. Even if production shifts to more marginal lands, there will still be potential problems with soil erosion, although in some cases cultivation on marginal lands might regenerate vegetative cover (e.g. jatropha). Finally, the burning of supposedly clean bioethanol may cause problems for human health (e.g. respiratory problems) even if GHG emissions are reduced (Rajagopal and Zilberman, 2007). Scharlemann and Laurence (2008) cite a recent Swiss study by Zah et al. which estimated that the total environmental impact of using almost any biofuel produced from crops was worse than the environmental impact of low sulphur petrol.

More research is clearly needed so that we can better understand the complex environmental effects of increased biofuels production. Unfortunately, much of this research will need to be location specific since agricultural production occurs within a very heterogeneous set of environments (e.g. irrigated versus rainfed, different intensities of fertilizer use). This fact will make the research agenda substantially more challenging.

Second-generation biofuels that use lignocellulosic feedstock seem likely to have much fewer adverse environmental impacts, but such technology seems unlikely to be in wide commercial use for at least the next ten years (Naylor, Liska et al., 2007).

Should production of biofuels be subsidized or protected?

Some Asian farmers, when first exposed to semi-dwarf modern rice varieties, were not convinced that higher yields would be forthcoming because the plants were so short. After all, they reasoned, how could a short plant yield more than a tall plant? (The farmers were unaware that the short stature of the plants was a structural advantage that enabled them to hold more grain without falling over). Other Asian farmers, when first introduced to nitrogen fertilizer, were happy to receive free fertilizer because they could put the free sack to good use (many of them simply discarded the urea inside). In situations like these, legitimate












arguments can be made for the temporary use of subsidies or price supports to overcome incomplete information. Furthermore, the very first modern rice varieties were quite susceptible to pests and diseases, entailing more risk for farmers who planted them (although these problems have been overcome and modern varieties now have more stable yields than traditional varieties). Again, there is a rationale for using subsidies when financial markets are imperfect, as was the case in nearly all Asian rural areas 40 years ago.

In terms of producing biofuels feedstock, however, it is hard to make similar arguments today because biofuels production from sugarcane, maize, cassava or palm oil does not depend on fundamentally new crops or varieties. One key exception might be jatropha, but even here many farmers are familiar with it as a fencing material, a source of lighting oil or as a medicinal plant. Even if it does make sense to distribute jatropha seeds widely and at low cost, it is important to note that providing such subsidies is only sensible if the costs of growing jatropha will eventually be less than the benefits when the subsidies are withdrawn, with the assessment being made in farmers' fields and not on experimental stations. If the costs will always be more than the benefits on the farm, then the money spent on subsidies could be better used elsewhere, e.g. for improving education or infrastructure. It is also difficult to argue for subsidies for large factories that produce biofuels since these investors should be well aware of relevant information and the risks involved.

There may be a role for government intervention in establishing the necessary infrastructure to transport biofuels from production points to retail distribution outlets, e.g. petrol stations. A recent study found that, in the USA it cost $0.13 to $0.18 to transport a gallon of ethanol fuel from refinery to service station, compared to just $0.03 to $0.05 per gallon of petroleum fuel (Kleffman Research Pacific, 2007). Construction of such infrastructure can arguably be left to the private sector, which is being increasingly relied upon for building roads and telecommunications networks. But there may be some role for government to set standards in terms of mandatory blending ratios to overcome coordination problems and help ensure that a viable market will exist in the future, thus providing incentives to the private sector to construct the required infrastructure. Again, however, the advisability of such interventions is contingent upon biofuels production being competitive and profitable at realistic levels of oil prices and feedstock prices.

Environmental benefits that are not priced in the market (externalities) also provide a potential rationale for government subsidies. However, once externalities other than GHG emissions are taken into consideration (e.g. deforestation, soil erosion), it is not clear that the net environmental benefits of biofuels are positive, so subsidies for environmental reasons may be difficult to justify at present. Energy security is also a potential rationale for subsidies or protection, although it is difficult to quantify this benefit.

Developing countries may want to consider postponing the use of subsidies in order to wait and learn more about developments in the commercial viability of biofuels production from lignocellulosic feedstock (second-generation biofuels), which could be substantially more efficient and will utilize different feedstocks such as switchgrass and miscanthus. Such a strategy could reduce the risks of getting locked into a technology that might soon be obsolete, or of producing a new crop such as jatropha that takes several years to mature but might then turn out not to be competitive as a source of energy.

However desirable biofuels may be in terms of energy security, consideration must be given to the adverse effects on food security for the poor (see the section below). The best way to avoid hurting the poor is to increase investment and productivity in agriculture in order to reduce production costs per tonne of food produced, thus lowering prices for consumers and increasing profits for farmers (Dawe, 2007). For example, government investments in agricultural research can create flood or drought resistant seeds that will buffer farmers against the risks inherent in unfavourable environments, helping to increase productivity. New seeds for favourable environments are also important, as it will be difficult to feed growing urban populations and the rural landless without increased productivity in these areas that provide most of Asia's food supply. Government investment in rural infrastructure can increase farmer access to key inputs such as land, water, fertilizer and credit, and simultaneously increase the opportunities for selling into new markets, again helping farmers to increase productivity. Rural education will help future generations of farmers to take advantage of new technologies and markets. These investments in public goods are more likely to reduce poverty and increase national income than are subsidies for biofuels production.

In some respects, poor consumers and the emerging biofuel industry are competitors, and the profits of the latter may come at the expense of food security for the former. Yet these two groups both have a vested interest in low food prices. Feedstock costs are one of the largest cost components of biofuels production and already the USA ethanol industry and the Malaysian biodiesel industry are under pressure from higher maize and palm oil prices. For many poor consumers, higher food prices are a matter of life and death. Thus, both of these groups will benefit from increased investment and productivity in agriculture. Such investment will create a win-win situation for all whereas the failure to fund such investment will hurt the most vulnerable members of society.

II. Biofuels and household food security

The consensus seems to be that the demand for biofuels will lead to higher commodity prices, although some commodities will be affected more than others. Higher commodity prices will affect farmers and consumers even in countries without biofuels production to the extent that these countries are linked to international markets. For example, higher maize prices driven by the increased demand for ethanol in the USA spill over into international markets, and, depending on domestic policies, often lead to higher domestic prices in both exporting and importing countries.

Higher commodity prices from biofuels development will help many farmers, and there is some potential for biofuels to create more jobs and employment. Despite the high hopes that some have for these developments to revitalize rural areas, biofuels are not likely to be the same engine for poverty alleviation as was the green revolution from the 1960s to the 1990s.

The green revolution, biofuels demand, and poverty reduction

The fundamental impact of the green revolution was to improve farmer productivity: output grew at a faster rate than input use, despite the increased use of water, fertilizers and pesticides. This lowered production costs per tonne of grain, leading to an outward shift of the supply curve. The outward shift of the supply curve helped to lower food prices, benefiting many poor people in both urban and rural areas (the rural landless) who were net consumers of food. At the same time, because farmers now had lower production costs per tonne, their profits increased. Many farmers used these increased profits to invest in education for their children, leading to benefits for future generations (Foster and Rosenzweig, 1996). Furthermore, the greater harvests led to increased labour demand, benefiting many landless labourers (often the poorest of the poor) throughout Asia by helping to increase wages. To summarize, the green revolution allowed society to gain on balance, because it entailed an increase in productivity. It also allowed many different groups of the poor to share in the benefits: farmers, agricultural labourers and poor urban consumers.[12]

The rush to biofuels is fundamentally different from the green revolution because it is being driven, not by increased productivity, but by an increase in oil prices, which in turn has led to higher agricultural commodity prices. Simply raising the price of a key commodity (oil) does not generate gains for the world economy; indeed, it shifts the economy's aggregate supply curve and raises costs of production throughout the economy, not just in the farm sector. It is true that some countries or groups (e.g. farmers with a surplus to sell) will gain from higher fuel and food prices, but these gains are merely transfers from consumers; they do not constitute new wealth for society. In fact, even the gains to farmers from higher commodity prices are to some extent offset by higher costs of production as a result of higher fertilizer and fuel prices. Livestock producers who must bear higher feed costs are another example of how agricultural producers can be harmed by higher commodity prices.

[12] Farmers with less favourable land may have lost as a result of the green revolution as these farmers were not able to increase their productivity. At the same time, increased productivity on other farms led to lower farm prices, which adversely affected farmers with poor quality land who were selling a surplus to markets (subsistence farmers not participating in markets would not be hurt by lower prices). All new technologies in human history have harmed at least some people.

Effects of biofuels on costs of production for food

Prices in food markets, despite many government interventions, are still influenced substantially by changes in market supply and demand. Furthermore, the market supply curve for food is strongly influenced by the prices and availability of various inputs: land, labour, water and fertilizer. If biofuels production does not compete for these resources with food crop producers, then the supply curve for food production will not be affected, and this should serve to mitigate food price increases. For example, if biofuel crops are grown on previously unused land, exploiting previously unused water supplies, without using any fertilizer and using previously idle labour, then there should be no effects on the marginal cost of food production. In some cases, these circumstances may be close to the truth; however, in many others, production of biofuels will seriously compete for these resources and affect the cost of food production.

To illustrate, despite the fact that jatropha *can grow* well in marginal environments, it generates larger quantities of oil (and thus more biodiesel) if it is grown with more water. Thus, biodiesel production from jatropha grown on marginal, previously unused land without any fertilizer may still have adverse impacts on food security if it competes for scarce water resources that are currently used by agriculture. Of course, it may be possible to grow jatropha without any irrigation water, but then it will be important to understand if it is possible to produce substantial quantities of biodiesel at competitive prices under these conditions.

In many other situations, biofuels production will compete seriously for key agricultural inputs. At present, most of the world's agricultural biofuels come from sugarcane in Brazil and corn in the USA, and both of these crops are grown with heavy use of inputs, including prime agricultural land, fertilizer and water. To summarize, an assessment of the impact of biofuels production on food security will need to consider in detail the inputs used in the biofuels production process, and how this use of inputs affects market supply curves for food production.

Biofuels and international food prices

Transmission of international prices to domestic prices

It is also important to note that biofuels will affect food security even in countries that do not produce biofuel. All countries participate in international agricultural trade, and depending on the trade policy pursued, changes in international prices will often affect the domestic prices paid by consumers and received by farmers.

However, households need not always be affected by price changes on international markets. First of all, much of the increase in commodity prices in US dollar terms has been neutralized by the weak US dollar, which in fact is one of the causes of the recent increases in commodity prices. For example, world rice prices increased by 48 percent in real (inflation adjusted) US dollar terms from 2003 to 2007. From the perspective of India, however, because of the rupee's appreciation the increase was just 21 percent during the same period in inflation-adjusted rupee terms. Trade policy may also dampen the transmission of international price movements to domestic prices, a case in point being Indonesia's variable export tax on palm oil.

Lack of infrastructure can have a similar effect on poor households living in remote rural areas, as it may be too costly in such circumstances to move food in or out of some villages because of high transportation costs. But the magnitude of this

effect may be less than is commonly supposed. For example, Chabot and Dorosh (2007) show that wheat prices in much of Afghanistan tracked movements in other markets such as Pakistan, despite the rudimentary infrastructure connecting the different parts of these countries. Furthermore, infrastructure continues to improve throughout Asia and the Pacific region.

How will higher food prices redistribute income?

To summarize, biofuels demand can lead to higher food prices either through increased competition for inputs such as land, water, fertilizer and labour, or through international trade. In order to understand the importance of these higher food prices for food security, it is first important to distinguish between net food producers and net food consumers. A net food producer is someone for whom total sales of food to the market exceed total purchases of food from the market, whereas for a net food consumer the reverse is true. This distinction is also usefully made at the level of individual commodities, as opposed to food in general.

Although nearly all urban dwellers are net food consumers, not all rural dwellers are net food producers. In fact, very small farmers and agricultural labourers are often net consumers of food, as they do not own enough land to produce enough food for their families.[13] These landless rural households are often the poorest of the poor. The importance of the rural landless varies greatly from country to country. In some countries, such as Bangladesh, India and Indonesia, among many others, the landless constitute a significant portion of the rural population. In others, such as land-abundant Thailand, they are much less important.

Generally speaking, with the exception noted in footnote 12, higher food prices can substantially hurt net food consumers. In order to appreciate this effect, one must realize that for the poor a very large share of expenditures goes to food. Indeed, in many countries food can account for 70 to 80 percent of expenditures by the poorest quarter of the population. In such circumstances, food price increases can have large effects on effective purchasing power, even if they do not directly affect nominal income *per se.* For example, Block et al. (2004) found that when rice prices increased in Indonesia in the late 1990s, mothers in poor families responded by reducing their caloric intake in order to feed their children better, leading to an increase in maternal wasting. Furthermore, purchases of more nutritious foods were reduced in order to afford the more expensive rice. This led to a measurable decline in blood haemoglobin levels in young children (and in their mothers), increasing the probability of developmental damage. A negative correlation between rice prices and nutritional status has also been observed in Bangladesh (Torlesse et al., 2003).

On the other hand, farmers who are net food producers are likely to benefit from higher prices, which, other things being equal, will tend to increase their incomes. Since many farmers are poor, higher prices could help to alleviate poverty and improve food security. However, it must also be kept in mind that farmers with more surplus production to sell will benefit more from high prices than farmers who have only a small surplus to sell. Furthermore, in many (but not all) contexts, farmers with more land tend to be better off than farmers with only a little land, so it may be that poorer farmers will not receive the bulk of the benefits from

[13] It is also true that whether a given household is a net food producer or consumer depends on market prices. Higher prices will discourage consumption, encourage more production, and possibly convert some households from net consumers to net producers. Lower prices could do the opposite.

higher food prices. But it should be noted that higher agricultural prices can affect domestic labour markets, potentially increasing the demand for hired labour on the farm, which would tend to benefit the poor.[14]

Taking these considerations into account, the effect of higher food prices on inequality will vary from country to country depending upon socio-economic structures and the national net trade position. In countries like Thailand, where land is relatively abundant, or in China, where land distribution is relatively equal as a result of the country's communist legacy, there are no large classes of poor landless agricultural labourers, and higher food prices may help to reduce poverty to some extent (Thailand is also a large net exporter of many commodities, reinforcing this positive effect of higher food prices). But in many other countries, such as Bangladesh, India, Indonesia and the Philippines, there are many landless agricultural labourers, and those at the bottom of the income distribution buy more food than they produce. In these cases, higher food prices are likely to have negative distributional impacts. Indeed, even in Viet Nam, where land distribution is relatively equal and the country is a substantial net rice exporter, higher rice prices were found to have only a very marginal benefit in terms of poverty reduction (Minot and Goletti, 2000). In importing countries (or in countries that export only a small percentage of production, such as India) where land distribution is much more unequal, the effects of higher food prices might worsen poverty, as appears to have happened in Indonesia when rice prices increased (Warr, 2005).

Although recognizing that outcomes will vary from country to country, on balance, for Asia and the Pacific region, the net effect of higher food prices on food security is likely to be negative, even for relatively small changes in prices. For example, Senauer and Sur (2001) estimated that if there is a 20 percent increase in food prices in 2025 relative to the baseline, the number of undernourished people in Asia would increase by 158 million.

Higher food prices and multiplier effects

It is possible that higher food prices will lead to multiplier effects and growth in the rural economy as farmers' higher incomes as a result of higher food prices create demand for other goods and services, much of it presumably produced locally. However, it must be kept in mind that if farmers' additional income is simply a transfer from the rural landless and urban poor, these new multiplier effects will come at the expense of the previous multiplier effects generated by the spending patterns of the poor, who will now have less money to spend on non-food items as their food bills increase. The point is that a change in relative prices because of changes in external market conditions (or, for that matter, government policy) does not create multiplier effects in the same manner as does a new technology that increases productivity, such as new seed varieties. The only way to assess the potential for net positive multiplier effects is to carefully measure the change in income distribution and compare the spending patterns of the winners and losers from the new set of relative prices. Although it is true that the (marginal) propensity to consume domestic products as opposed to imports decreases from the bottom to the top of the income distribution, it is also true that net food consumers often dominate both the bottom and the top of the income distribution. Thus, it is not clear that the propensity to consume domestic products is higher for net food producers than it is for net food consumers. In practice, it

[14] See "Trade liberalization, poverty and food security" in FAO (2006e).

seems that higher food prices are probably not likely to generate large net multiplier effects in either direction.

In the longer term, the potential for multiplier effects may be larger, but such a positive outcome will occur only if higher prices motivate governments and donors to increase public investment in rural areas. Such investment can spur gains in productivity that benefit both rural and urban areas. There are precedents for such an outcome; for example, the world food crisis in the 1970s motivated many Asian governments to increase investments in irrigation (Hayami and Kikuchi, 1978). But such an outcome is not a foregone conclusion.

Biofuels, employment generation and access to land

Employment generation

The production of biofuels will generate employment at both farm and factory levels, and this increase in employment will help to improve food security if it is targeted at the poor. But alternative uses of the land and capital necessary for biofuels production would have generated employment as well, and this alternative employment needs to be considered in assessing the impact of biofuels production on employment and food security. In other words, a critical issue in measuring the impact of biofuels production on employment and food security is the relative labour intensity of biofuels production.

Much of the employment that is likely to come with increased biofuels production, at least in developing countries, will be because of potentially increased labour use at the farm level to grow the feedstock. Here, it is crucial to understand the labour requirements of the biofuel feedstock per unit of area-time (e.g. per hectare per year) compared to the labour requirements of alternative land uses. If the land was previously unused, then clearly the planting of biofuel feedstock will create new employment. However, if the biofuel feedstock is less labour-intensive than the crops planted previously, then biofuels production will reduce employment on net at the farm level. The ultimate outcome will vary depending on what crop is used as feedstock and what crops were grown previously. Any increased employment in feedstock production will likely be biased toward unskilled labour, which will benefit the poorest of the poor.

In terms of fuel production from feedstock, small-scale bio-energy production seems likely to generate more employment for the poor than large-scale bio-energy production, which will probably be more capital intensive and less labour intensive. Indeed, current bioethanol and biodiesel factories in Brazil and the USA require huge investments of capital, often in the range of 100 to 200 million US dollars. Furthermore, the labour employed in these factories may favour relatively skilled workers (who are usually food secure).

Although small-scale bio-energy production may be better at creating employment, it is important to consider the ability of small-scale bio-energy production to compete with large-scale bio-energy production. Smaller plants may in general not be very competitive, and if they are not, then any increased employment is likely to be short-lived. However, if the bio-energy production is used to enhance access to energy in small villages with poor infrastructure, then competition with large-scale factories is probably not an important issue. Employment created at such small-scale processing plants is likely to have a positive impact on food security at the local level.

























Access to land for the poor

Many are concerned that biofuel production may adversely impact the access of the poor to land. The production of biofuels from feedstock is often quite capital intensive and has economies of scale, thus favouring large firms. These large firms may prefer to vertically integrate their operations for many reasons, including quality control of feedstock production. Such large firms can provide useful employment and other social benefits if they use the land more intensively, and this is an important benefit not to be overlooked. Yet it will also be important to insure that any previous users of the land are fairly compensated. For example, governments may reclassify some land as wasteland to facilitate its use for large-scale biofuel production even though it was serving productive functions for poor people.

Summary and conclusions

In general, the effect of the demand for biofuels will be to raise food prices, which will hurt the food security of many poor people in both rural and urban areas. However, the discussion above highlights the extent to which food production and consumption is heterogeneous across different countries, production environments and socio-economic structures. Biofuel production will increase employment in some cases, but reduce it in others. Higher food prices will benefit some poor households (if they are net sellers), but will harm many others (net buyers). On balance, across Asia, higher food prices will worsen food insecurity and poverty, because those in the poorest strata of society are net consumers of food.

One possibility for government intervention that can reduce the negative impacts on food security while still allowing the production of biofuels is to encourage the use of feedstock crops whose production is labour intensive. This might increase wage income in countries where there is a large class of poor landless labourers. Another possibility is to encourage the production of feedstock crops with land or water resources that were not previously utilized, but this option will often create strong tradeoffs with the land rights of the poor or environmental objectives. Blending mandates may make sense when energy security is the dominant objective, but it must be recognized that improved energy security will come at the cost of more food insecurity in countries where the poorest members of society are net food buyers. In countries such as Thailand, where the poorest are net food sellers, the tradeoff between household food security and national energy security will be less acute. In most other Asian countries, however, the tradeoff will be a matter for serious consideration.

In many cases, the best option may be to do nothing for the time being, i.e. offer no special incentives for first-generation biofuels production, and maintain the option to leapfrog to second-generation biofuels when and if that technology becomes commercially viable. In the absence of subsidies, much of the world's current biofuels production might not be competitive, given the high level of commodity prices that serve to increase biofuels production costs. In cases where biofuel production is competitive even without any government support, governments may want to intervene by regulating land use in order to reduce environmental impacts or improve the food security of the poor. Thus, for example, China has banned the use of grains for ethanol production.

Even if a country decides not to encourage the domestic development of biofuels, governments will be faced with higher and more variable prices on world food markets. Thus, consideration should be given to cost-effective trade policies

that serve to stabilize domestic prices in the face of large international price movements, as Indonesia has done with its variable export tax on palm oil and as Bangladesh does with variable tariffs on rice (Timmer and Dawe, 2007).

Most important is that governments renew their efforts to develop well-functioning markets and improve rural education, health services, infrastructure and agricultural research. These public goods are necessary to realize the full potential for higher productivity that can lead to sustainable poverty alleviation and counteract the negative effects of higher food prices on food security. If the current surge in international food prices serves to mobilize public investment in agriculture and rural areas, then historians will likely view the increase in the demand for biofuels in the early 21st century as a positive development. If, however, the increased prices do not lead to a renewal of rural development efforts, the demand for biofuels will be another obstacle to achieving food security for the poor.













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