Smallholder or Family Farming in Transforming Economies of Asia and Latin America: Challenges, and Opportunities

Ganesh Thapa

---

1 Paper presented at the International Conference on Dynamics of Rural Transformation in Emerging Economies, April 14-16, 2010, New Delhi, India

2 Regional Economist, Asia and the Pacific Division, International Fund for Agricultural Development (IFAD), Rome
Smallholder or Family Farming in Transforming Economies of Asia and Latin America: Challenges, and Opportunities

I. Introduction

Small farms, also known as family farms, have been defined in a variety of ways. The most common measure is farm size: many sources define small farms as those with less than 2 hectares of crop land. Others describe small farms as those depending on household members for most of the labour or those with a subsistence orientation, where the primary aim of the farm is to produce the bulk of the household’s consumption of staple foods (Hazell et al., 2007). Yet others define small farms as those with limited resources including land, capital, skills and labour. In Latin America and the Caribbean region, family farms have been defined as those in which family members are primary suppliers of labour with limited employment of hired labour, where the family is directly responsible for farming (agriculture/livestock) activities and lives on site or nearby, and the production resources used are compatible with the family’s working capacity and the activities developed (Marquez and Ramos 2010).

It is estimated that about 87 per cent of the world’s 500 million small farms (less than 2 ha) are in Asia and the Pacific region (IFPRI, 2007). China and India alone account for 193 million and 93 million small farms, respectively. Three other Asian countries with a large number of small farms are Indonesia (17 million), Bangladesh (17 million) and Viet Nam (10 million). Agriculture in Asia is characterized by smallholders cultivating small plots of land. The average size of operational holdings (actual area cultivated) is only 0.5 hectares in Bangladesh, 0.8 hectares in Nepal and Sri Lanka, 1.4 hectares in India and 3.0 hectares in Pakistan. About 81 per cent of farms in India have land holdings of less than 2 hectares, whereas their share in total cultivated area is about 44 per cent (NCEUS, 2008). In China 95 per cent of farms are smaller than 2 hectares.

A recent study in six countries of Latin America and the Caribbean (Brazil, Chile, Colombia, Ecuador, Mexico and Nicaragua) estimates that there are 11 million family holdings that account for 30 percent and 60 percent of the total agricultural and forest area respectively, with a related population of about 50 million persons, or 14 percent of the total population (FAO/IDB 2007). There are 4.4 million family farms in Brazil, 0.27 million in Paraguay, 0.25 million in Argentina and Chile and 0.03 million in Uruguay (Marquez and Ramos 2010). These farms cover approximately 125 million hectares of land, with an average of 24 hectares per farm. However, there is considerable variation in average size of family farms among these countries: 8 hectares in Paraguay, 20-30 ha in Brazil and Chile, and over 100 ha in Argentina and Uruguay.

The overall trend in Asia has been that of declining farm size over time. For example, in China farm size decreased from 0.56 hectares in 1980 to 0.4 hectares in 1999 (Fan and Chan-Kang, 2003); in Pakistan it declined from 5.3 hectares in 1971-73 to 3.1 hectares in 2000; in the Philippines the average farm size fell from 3.6 hectares in 1971 to 2 hectares in 1991; and in India it declined from 2.2 hectares in 1950 to 1.8 hectares in 1980, to 1.4 hectares in 1995-96 and to 1.33 hectares in 2000-01 (Nagayets, 2005; Government of India, 2008).

An earlier version of the paper (Thapa 2010) was presented at the Roundtable on the role of smallholder agriculture and family farming in Asia and Latin America and options for South-South cooperation organized by the International Fund for Agricultural Development (IFAD) on 18 February 2010 in Rome.

Because of the highly skewed distribution of land in Latin America, the average figure does not provide an accurate view of small farms as a large majority of farms are well below that size.
Farm size is declining in some Latin American countries like Ecuador, Chile and Panama whereas it is increasing in countries like Brazil (Table 2). Brazil has a bimodal land distribution where most of the land is in large farms, while most farms are small. This pattern has been increasing over the last three decades, where the number of medium-sized farms declined while the numbers of both small and very large farms increased (World Bank 2007). Table 2 shows changes in land distribution in selected Latin American and Asian countries. The inequality in land distribution is much higher in Latin American countries than in Asian countries. Among Latin American countries, inequality in land distribution is increasing over time in Ecuador and Brazil whereas it is declining in Chile and Panama. In Asia, the Gini coefficient in land distribution is declining in India whereas it is increasing in other countries like Bangladesh, Pakistan and Thailand. In many countries of Latin America and Asia, unequal land access is perpetuated through social mechanisms, which leave many households belonging to indigenous peoples or ethnic minorities without access to land or with land plots too small to meet their needs.

The number of small farms and their share in total cultivated area has been increasing over time in some Asian countries. For example, in India, small farms accounted for almost 81 per cent of operational holdings in 2002-03 compared to about 62 per cent in 1960-61 (Table 3). Correspondingly, the area operated by small farms increased from about 19 per cent to 44 per cent during this period (NCEUS, 2008). The distribution of landownership in India has become less skewed. The share of land area owned by small farms increased from 20% in 1961-62 to 43.5% in 2003. Also, the trend toward landlessness also appears to have been arrested, with the percentage of landless between 1971-72 and 2003 remaining approximately at 10%. In India the distribution of operational holdings (actual area cultivated) closely mirrors the distribution of land owned.

Table 1 shows the main characteristics of family farming in Latin America and the Caribbean region. Their contribution to the national value of sectoral production (agriculture, livestock, fisheries and forestry) varies between 25 percent and 70 percent. It is estimated that they produce 65 percent of the food consumed in the region and their share in the gross value of agricultural production is about 35 percent. Their contribution is much higher in the production of livestock products, fruits and vegetables, cassava and beans. For example, in Brazil they produce 84 percent of cassava, 67 percent of beans, 60 percent of vegetables and 52 percent of dairy products. Likewise, they produce 94 percent of goats, 55 percent of cattle, 76 percent of honey, and 54 percent of vegetables in Chile.

Smallholders’ contribution to the total value of agricultural output is also significant in many countries of Asia. For example, in India their contribution to total farm output exceeds 50 per cent although they cultivate only 44 per cent of land. Many studies have also confirmed the inverse relationship between farm size and productivity per hectare. Small farmers are characterized by smaller applications of capital but higher use of labour and other family-owned inputs, and a generally higher index of cropping intensity and diversification. The inverse relationship between farms size and productivity is a powerful rationale for land reform policies, including land redistribution for both efficiency and equity gains. Family farms tend to grow a wide variety of cultivars, many of which are landraces. These landraces are genetically more heterogeneous than modern varieties, offer greater resilience against vulnerability and enhance harvest security in the midst of diseases, pests, droughts and other stresses (Clawson 1985).

Although family farming is an extensive and dynamic sector of strategic importance of national food security in Latin American countries, it has not been sufficiently acknowledged in public policy. Most family farms are considered to be non-viable and more attention is paid to those producers which have access to assets and public services and that can be easily
integrated into markets. Experience has shown that Asian countries such as India that promoted small farms were able to launch the Green Revolution. Countries like China started supporting smallholder farming after collective farms could not provide adequate incentives to increase production and productivity.

This paper assesses the challenges and opportunities faced by small or family farming in Asia, and Latin America regions in sustainable agricultural production and productivity enhancement, and in diversifying into high-value commodities. It first gives a brief account of the transformation of the agriculture sector in these two regions from the mid-1960s to the mid-1990s, which was characterized by a dramatic increase in agricultural production and productivity through major breakthroughs in technological innovations, and the more recent transformation, which is characterized by significant changes in diets brought about by increases in incomes, urbanization and globalisation, and the resulting changes in production of high-value commodities and major transformation in the agrifood industry. The paper then discusses the challenges faced by smallholders in addressing the problems related to sustainability of food production as well as agricultural diversification. Following this, the paper highlights some of the technological and institutional innovations that have been tested to address such challenges. It then discusses the policy and programme support provided by selected countries in Asia and Latin America to small or family farms in enhancing productivity and in benefiting from emerging markets in high-value commodities. Finally, it identifies some measures that the governments, the private sector and international development partners can take to support small farmers in dealing with emerging challenges and in sharing experiences and learning from one another.

II. Transformation of agriculture

This section briefly discusses two important transformations in the agriculture sector, which have profound impact on the small or family farms of the two regions. In the first one, small farms played an important role particularly in Asia in raising food production and incomes based on biological, chemical and mechanical innovations. The second transformation is more recent and presents considerable challenge as well as opportunity for these farmers to benefit from new agriculture.

The Green Revolution

The Green Revolution in Asia, which mainly comprised a dramatic increase in the production of three important cereal crops – rice, maize and wheat – between 1965 and 1990, was driven by rapid advances in the sciences and substantial public investments in and policy support for agriculture (Hazell, 2009). This represented the first major transformation of the agriculture sector in Asia in its modern history. Cereal production more than doubled in Asia between 1970 and 1995, from 313 to 650 million tons per year (Table 4). As a result, per capita calorie availability increased by about 30 per cent and real prices of wheat and rice decreased. Higher production of all three major cereal crops was realised mainly through yield growth. Between 1965 and 1982, average rice, maize and wheat yields increased by 2.54 per cent, 3.48 per cent and 4.07 per cent per year, respectively. During the same period, cultivated area expanded by only 0.7 per cent, 1.09 per cent and 1.3 per cent, respectively.

Modern varieties of wheat, maize and rice also spread rapidly in Latin American countries during the Green Revolution period. For example, by the mid-1980s, 82 percent of wheat area in Latin America was planted to modern varieties (Darlymple 1986). An adaptive rice breeding programme at CIAT, Colombia facilitated the spread of high-yielding semi-dwarf rice varieties from Asia to Latin America. In contrast to the new variety release pattern in

 Nonetheless, there are important exceptions in recent years (see for example Box 1).
Asia, where variety releases levelled off in the 1980s and 1990s, annual releases of new rice varieties continued to increase in Latin America (Evenson n.d.). The Green Revolution in rice in Latin America was genetic with little contribution from agronomy and its impact was approximately two additional tons per hectare (Jennings 2007).

The success of the Green Revolution in raising food production and productivity, broadening economic growth and reducing poverty has been impressive. Nevertheless, in recent years agricultural production has experienced a number of challenges that have cast doubts on the sustainability of past gains.

**Recent transformations in agriculture**

*Growth in consumption and production of high-value commodities*

Rapid economic and income growth, urbanization and globalization are leading to a significant shift in diet in Asia and the Pacific region, away from staples and increasingly towards livestock and dairy products, fruits and vegetables, and fats and oils. Rapid income growth is a key factor in the rising demand for high-value agricultural products. In most Asian countries urbanization is increasing rapidly and studies have shown that urban households spend more on meat, fish and sugar and less on rice than rural households, even after taking into account income and household characteristics (Minot et al., 2003).

Urbanisation, rapid growth in per capita incomes, and the increase in the opportunity cost of women’s time as a result of their entry into the workforce led to greater demand for non-staples, particularly perishables and processed foods in Latin American countries (Reardon et al. 2002). On the supply side, trade liberalisation since the early 1980s made it easier and cheaper to import food and non-food products.

Trade liberalization has also contributed to the growth of high-value agriculture. The reduction in import barriers in industrialized countries has favoured the growth of high-value exports such as fish and seafood products. Likewise, foreign direct investment has also facilitated the transformation of agricultural production in developing countries. It has facilitated the expansion of food processing, animal feed production, exports and food retailing. The entry of foreign companies into the agriculture sector has put competitive pressure on domestic agribusiness companies (Gulati et al., 2005).

A recent study by the International Food Policy Research Institute (IFPRI) analysed the growth of high-value agriculture in Asia and its implications on the restructuring of the agricultural supply chain, and on the role of small farmers (Gulati et al., 2006). These countries include the largest and most important transforming countries of Asia – Bangladesh, India and Pakistan in South Asia; Indonesia, the Philippines, Thailand and Viet Nam in Southeast Asia; and China in East Asia.

The study documented a clear shift in food consumption from grains and other starchy staple crops such as cassava and sweet potatoes to meat, milk, eggs, fish, fruits and vegetables mainly due to income increases (Table 5). In these countries, per capita grain consumption either increased very slowly or even decreased between 1990 and 2000. In contrast, per capita demand for vegetables, fruits, and animal products increased substantially in all countries.

In addition to rising domestic demand, these high-value commodities have also experienced high export demand. High-value products such as fruits, vegetables, livestock products and fish constitute a rapidly growing share of international trade in agricultural products. In these countries as a group, the share of high-value exports in total agricultural exports increased from 47 per cent to 53 per cent.
Due mainly to the high growth in domestic demand and, to some extent, an increase in exports, the production of high-value commodities in many Asian countries has grown more rapidly than that of food grains. The production of food grains in the eight countries under study increased by 1.3 per cent per year during the 1990s, slightly below the population growth rate of 1.5 per cent. In contrast, the production of high-value commodities grew much more rapidly during this period (Table 6). For example, fruit and vegetable production increased by 7.7 per cent in these eight countries. China, in particular, achieved a very high growth rate in the production of fruits and vegetables. Between 1980 and 2004, 58 per cent of the increase in global horticulture production came from China, 38 per cent from all other developing countries and the remaining 4 per cent from developed countries (Ali, 2006). India, Indonesia, Pakistan and Viet Nam also recorded an annual growth rate of more than 3 per cent in the production of fruits and vegetables in the 1990s.

The production of livestock products also increased impressively in many Asian countries during the 1990s. Milk production grew by 4.6 per cent per year in these eight countries during this period. Most countries also achieved high growth rates in the production of eggs, meat and fish.

*Transformation of agrifood industry*

The growth in domestic consumption and production of high-value agricultural commodities in Asia and Latin America was accompanied by a transformation of the agrifood industry, which includes processing, wholesale and retail. Governments contributed to this mainly through investment in municipal wholesale markets, parastatal processing firms and state-run retail chains. However, the main new developments are private-sector investment in and consolidation of processing and retail (Reardon et al., 2009).

An important element of this transformation is the restructuring of the wholesale sector, which started with the public investment phase in the 1970s-1980s in many parts of Asia and Latin America and in the 1990s in China. This phase was characterized by public investment in the expansion and upgrading of wholesale markets, and investment in market information systems to reduce transaction costs for small farmers to gain access to growing urban markets. In the 1990s and 2000s, more attention was paid to deregulation of wholesale markets to allow greater entry and competition.

The second element of this transformation is the restructuring of the processing sector. In the 1990s, private small and medium-sized processing companies grew due to liberalization in the processing sector. This growth was facilitated by a rapid increase in the consumption of processed foods spurred by rising incomes and urbanization, and a concomitant increase in the number of women working outside their homes.

The third element is the restructuring of the retail sector, which is mainly characterized by the supermarket revolution and a rapid spread of fast-food chains in many countries of Asia and Latin America. The growth in supermarkets, which started in the early to mid-1990s, was driven by a massive flow of foreign direct investment and competitive domestic private investment, privatization of retail parastatals, rising incomes and urbanization, and procurement system change (Reardon et al., 2009). The spread of modern retail took place in three waves, first in South America and East Asia outside China, then in Southeast Asia and finally in China, India and Viet Nam. Within a given country, supermarkets first sold processed products, then semi-processed and recently fresh produce.

III. Challenges faced by small/family farms
Farmers are facing a number of challenges in producing food in a sustainable manner as well as in diversifying from their dependence on cereal production to the production of high-value commodities. Although some of these challenges affect both large and small farms, there is evidence that they apply more strongly to small farms. For example, small farmers cannot take advantage of higher food prices by expanding production if they have difficulty in accessing services and credit. Similarly, when new technologies require higher capital inputs or mechanization, small farmers may be at a disadvantage unless they are helped in reducing their transaction costs to access inputs, credit and marketing facilities.

In recent years, productivity growth of major food crops has declined quite significantly. However, funding has shifted from public to private research, particularly in biotechnology. This change is reportedly disadvantageous to small farmers because private research companies lack incentives to address small farmers’ concerns (Pingali and Traxler, 2002). Also, the impacts of both environmental degradation and climate change are usually more severe for small farmers than for large farmers because small farmers have less access to human, social and financial capital and information than large farmers (Hazell et al., 2007).

**Declining productivity growth**

A number of studies have confirmed a slowdown in productivity growth in cereal crops such as rice and wheat in major irrigated areas of Asia such as the Indo-Gangetic plain and East Asia (Bhandari et al., 2003; Pingali et al., 1997). For example, rice yield growth in irrigated areas of Asia declined from 2.31 per cent per annum in 1970-90 to 0.79 per cent in 1990-2000 (Hossain, 2006). The major reasons for this decline in yield growth include: the displacement of cereals on better lands by more profitable crops; diminishing returns to modern varieties when irrigation and fertilizer use are already at high levels; and the recent low price of cereals relative to input costs, making additional intensification less profitable (Hazell, 2009). In intensive monocrop systems such as the rice-wheat system of the Indo-Gangetic plains, deteriorating soil and water quality is an important problem; degradation of soils and build up of toxins have been reported in intensive paddy systems in several Asian countries (Pingali et al., 1997; Ali and Byerlee, 2002).

Researchers have documented stagnating or even declining levels of total factor productivity in some of these production conditions (Janaiah et al., 2005). An analysis of data from long-term yield trials in several countries of South Asia found stagnating or declining yield trends in rice and wheat when input use was held constant (Ladha et al., 2003). One of the reasons for slow yield growth has been reported to be pest and disease resistance of modern varieties to chemical pesticides.

Within Latin America, grain productivity growth has been mixed over time across sub-regions. The grain yield growth in Central America declined from 2.16 percent per year during 1961-85 to 0.40 percent during 1986-08 where as it increased in South America from 1.63 percent to 3.15 percent during the same period (Piesse et al 2009). In the Caribbean, it also declined from 2.51 percent to 0.62 percent.

**Environmental problems**

Poor water management in many countries of Asia has resulted in land degradation in irrigated areas through salinization and waterlogging. It is estimated that almost 40 per cent of irrigated land in dry areas of Asia are affected by salinization (Millennium Ecosystem Assessment, 2005). In Mexico’s coastal aquifer of Hermosillo, withdrawals of groundwater three to four times the annual recharge rate led to a 30 meter drop in water tables and salt water intrusion, causing large agribusiness companies to relocate to other regions (Howe 2002).
Inappropriate use of fertilizers and pesticides has led to water pollution and damage to larger ecosystems, where excess nitrates from agriculture enter water systems. Fertilizer nutrient runoff from agriculture has become a major problem in intensive systems of Asia, causing algal bloom and destroying wetlands and wildlife habitats.

Serious soil and water degradation has taken place in the rice-wheat system of India and Pakistan due to intensive and continuous monoculture of rice in summer and wheat in winter (Ali and Byerlee, 2002). The effects of soil nutrient mining, salinization and declining organic matter have been exacerbated by depletion of groundwater aquifers and build-up of pest and weed populations and resistance to pesticides.

**Land and tenure security**

In many countries of Asia and Latin America, marginalization is linked to the lack of access to land and land-use rights. Improving poor people’s access to land is important to improve equity as well as production, as small farms tend to be more productive than large farms (Lipton, 1993). The political prospects for redistributive land reform are not bright for many developing countries. Also, land scarcity has become acute, and rapid urbanization is reducing the area available for agriculture (Cassman et al., 2003). Crop land per capita of agricultural population is only 0.23 hectares in East Asia and the Pacific and 0.27 hectares in South Asia, compared to 0.48 hectares in Sub-Saharan Africa, 0.74 hectares in Middle East and North Africa, 1.55 hectares in Latin America and the Caribbean, and 3.53 hectares in Europe and Central Asia.

Some aspects of land reform, such as the extension of tenurial security, may be less difficult to implement than other aspects, such as land ceilings. IFAD-supported tribal development projects in India provide examples illustrating the importance of security of tenure. For example, the Orissa Tribal Development Project in India provided titles to land above 10 degrees in slope to tribal groups. Land occupied by tribals became transferable to women in the form of inheritable land titles in perpetuity. Such land titling led to major improvements in natural resource management, with the incentives derived from clear property rights.

In socialist countries like China and Viet Nam, land tenure reform has led to significant increases in agricultural production and rural poverty reduction. In Viet Nam under the Doi Moi reform process, in 1988 agricultural collectives were converted to contract land to households for 15 years for annual crops and 40 years for perennial crops (Kirk and Nguyen, 2009). This reform together with the relaxation of price controls and the opening up of domestic and international trade promoted entrepreneurship and productivity. Viet Nam passed a Land Law in 1993 that extended land tenure to 20 years for annual crops and 50 years for perennial crops. These reforms generated strong incentives to invest in agriculture, which led to greater food security and better nutrition. Land transactions increased greatly as a result of tenure reforms. There is an active land market in the country, with the percentage of households participating in land transactions increasing from 3.8 per cent in 1993 to 15.5 per cent in 1998. Although land sales are not allowed, with more secure land rights many farmers have diversified their production into aquaculture, livestock and perennial crops such as coffee and cashew. In China land rentals have contributed to rural diversification and income growth. In contrast, Deininger, Jin and Nagarajan (2006) have shown that tenancy restrictions have reduced productivity and equity in India.

**Water shortages**

In much of Asia and some countries of Latin America, the demand for water for both agricultural and non-agricultural uses is rising and water scarcity is becoming acute, thus limiting the future expansion of irrigation. Irrigated food production in large areas of China and South Asia is being maintained through unsustainable extraction of water from rivers or
the ground (UNDP, 2006). The expansion of tubewell irrigation in South Asia has resulted in serious overdrawling of groundwater and falling water tables. In the agriculturally advanced states of India – Haryana, Punjab, Rajasthan and Tamil Nadu – more than one fifth of groundwater aquifers are overexploited (World Bank, 2007). As a result, water pumping has become difficult and too costly. The most affected are small farmers, who have little access to expensive pumps and often have insecure water rights.

Diversification

Small farmers have the potential to raise their incomes by switching from grain-based production systems to high-value agriculture. Although the production of high-value agriculture is labour-intensive and thus more suitable for smallholders, they face a number of constraints. Since high-value agricultural commodities are perishable and their markets are fragmented, there is high volatility in their prices, and thus high market risk. In addition, small farmers have low volumes of marketable surplus and the land they cultivate is mostly located in remote areas with poorly developed infrastructure. As a result, smallholders face high transaction costs and risks in production and marketing of such commodities. They also face poor access to credit, and stringent food safety and quality standards.

Impact of climate change

Researchers have predicted that climate change will have serious consequences for agriculture, particularly for smallholders in poor developing countries. In tropical countries even moderate warming (1 degree C for wheat and maize, 2 degrees C for rice) can reduce yields significantly because many crops are already at the limit of their heat tolerance (World Bank, 2007). In parts of Asia and Central America wheat and maize yields could decrease by 20 to 40 per cent as the temperature rises by 3 to 4 degrees, even if farm-level adjustments are made to accommodate higher average temperatures, such as changing the date of seeding or planting drought-resistant varieties (Long et al, 2007). Rice yields would also decline, although less than wheat and maize yields.

In low-lying areas agriculture will be adversely affected by flooding and salinization due to sea level rise and salt water intrusion in groundwater aquifers. Water scarcity will increase in areas such as Nepal, and parts of China and India due to decreasing snow cover over time, where glacial melt is an important source of irrigation water.

Risk and vulnerability

Smallholders face a number of individual risks such as disease, injury and death of animals, as well as common or aggregate risks such as drought, epidemic and economy-wide shocks, affecting everyone in the locality. The consequences of these risks can be extremely severe, potentially leading to malnutrition, disease, starvation or even death. As a result, managing and coping with risks are an integral part of the daily lives of poor rural people.

In addition, there has been a concern that the recent successes of market-oriented policy reforms (e.g. in India and China) or the advance of globalization may have further increased the degree of potential income fluctuations, thereby exacerbating the already precarious position of poor rural people, comprising principally landless and small farmers (Dercon, 2005). Evidence points to high vulnerability of small farmers in the semi-arid region of south India to crop shocks. What is worse, occasionally they are subject to a series of such shocks, making it harder for them to escape persistent poverty (Gaiha and Imai, 2004).

---

6 Some researchers point to the fact that the projections of crop yield losses made by different climate change models may be overestimated, as they tend to be based on cereal mono-crops with high rates of chemical fertilizer use.
evidence comes from case studies of the Philippines and Bangladesh confirming significant effects of natural hazards (e.g. El Nino in the Philippines and floods in Bangladesh) on various indices of poverty and anthropometric measures of under-nutrition. Disasters often disrupt food production, resulting in loss of livelihoods and higher food prices. Finally, not only do poor rural people lose assets, but they also lack access to risk-sharing mechanisms such as insurance. It is therefore not surprising that disasters substantially increase poverty levels (e.g. 50 per cent of the increase in the incidence of poverty in the Philippines during the 1998 crisis was due to El Nino). Although the devastation is seldom confined to the poorer segments – including small farmers – in the absence of easy access to credit and insurance they find it harder to recover their previous standard of living (Jalan and Ravallion, 2001).

IV. Opportunities for higher productivity, higher incomes and sustainability

This section discusses technological as well as institutional innovations that can enable small or family farms to sustainably raise agricultural productivity and to increase incomes by accessing emerging markets for high-value commodities.

Technological innovations to address environmental problems and yield growth

To address the concerns about the sustainability of Green Revolution technologies and their ability to benefit poor farmers, particularly in less favoured areas, many are advocating new technological approaches (e.g. Pender, 2008). These include low external input and sustainable agriculture approaches based on ecological principles of farming; organic agriculture based on a similar set of agro-ecological principles but without the use of artificial chemical fertilizers, pesticides or genetically modified organisms; and biotechnology. Although biotechnology and agro-ecological approaches seem to be in opposition to one another, both approaches focus on biologically based rather than chemically based technologies, and there may be potential for realizing complementarities between these approaches. In fact, it has been argued that a combination of ecological and biotechnology approaches is needed to bring about a “Doubly Green Revolution” (Conway, 1997). Others have argued that integrated agricultural and natural resource management innovations are needed that combine improved germ plasm (using both conventional methods and biotechnology) and improved and integrated management of soils, water, biodiversity and other natural resources (CGIAR, 2005).

Conservation agriculture/zero tillage

To address the declining productivity growth of the rice-wheat system in the Indo-Gangetic plain, zero tillage has been promoted by the Rice-Wheat Consortium, a partnership of the Consultative Group on International Agricultural Research centres and national agricultural research and extension system and with the support of IFAD and other development partners. This technology involves planting wheat immediately after rice, without tillage, so that wheat seedlings germinate using the residual soil moisture from the previous rice crop. Zero tillage has been reported to have many advantages over conventional tillage in the rice-wheat system. It saves labour, fertilizer and energy, minimizes planting delays between crops, conserves soil, reduces irrigation water needs, increases tolerance to drought, and reduces greenhouse gas emissions (Erenstein et al., 2007).

South America is the leader in the adoption of zero tillage: 47 percent of the area cultivated using this technology in the world is in South America, mainly Brazil, Argentina and Paraguay (Esteves 2007). Brazil’s large farms pioneered this technology, which was used on some 25.5 million hectares or more than 60 percent of the country’s cultivated land in 2005. However, small farmers used it only on 600,000 hectares mainly due to the high cost of specialised machines for planting and spreading the fertilizer on cover crops. Because of the
availability of cheaper seeding machines and efforts of farmer organisations in recent years, this technology is spreading rapidly among small farmers. In the steep hillsides of the Chiapas region in Mexico, the combination of conservation tillage and crop mulching has increased net returns on land and labour (Erenstein 1999).

**Organic agriculture**

Organic agriculture is a specific type of low external input whose requirements are more restrictive – no use of chemicals or genetically modified organisms. Based on certification, price premiums of 10 to 50 per cent are common for developing country exports of organic products (IFAD, 2005). Organic farming has increased rapidly in many Asian countries in the last few years. In 2000-02, there were about 60,000 farms producing certified organic products on about 600,000 hectares. This increased to more than 90,000 farms on more than 3.8 million hectares in 2005-06 (Pender, 2008). China, India and Indonesia are the major organic producers in Asia.

In 2006 total organic land area in Latin American countries was 4.9 million hectares belonging to 223,000 farmers and represented 0.68 percent of total agricultural land (IFOAM 2008). The major organic producers are Argentina (2.2 million ha), Uruguay (0.93 million ha), Brazil (0.88 million ha) and Mexico (0.40 million ha).

Several studies have shown favourable impacts of organic agriculture on the costs of production and yields (IFAD, 2005; Reunglertpanyakul, 2001). However, there are several constraints to the adoption of organic farming. Profit margins usually diminish due to increased competition, and organic producers may face greater market risks as the sector grows. Perhaps the most important concern among smallholder farmers relates to the costs of certification and assuring compliance with organic standards. These problems can be addressed by developing farmer organizations at the local level and through efforts by outside agencies to develop local capacities and facilitate linkages to markets.

**Biotechnology**

Broadly defined, biotechnology includes a wide variety of techniques, from traditional methods such as conventional plant and animal breeding to more modern techniques such as tissue culture, embryo transfer, cloning, breeding using marker-assisted selection, genetic engineering of plants or animals, and genomics (ADB, 2001). In current literature, the term biotechnology is used to refer to modern agricultural biotechnology and it is also used synonymously with genetic engineering. Biotechnology is reported to have the potential of incorporating many traits in crop varieties that can address problems faced by smallholders, such as drought resistance, disease and pest resistance, yield improvement and quality improvement.

Since 1996, there has been a rapid adoption of a few genetically modified (GM) crops globally. Among Asian countries, an estimated 6.4 million small farmers in China (on an average area of 0.5 hectares) and 1 million small farmers in India (on an average area of 1.3 hectares) were growing Bt cotton by 2005, while more than 50,000 farmers in the Philippines (on an average area of 2 hectares) were growing Bt maize (Pender, 2008). Studies have shown that Bt cotton has contributed to increasing yields, reducing costs of production, increasing farmer incomes and reducing negative health and environmental effects of high pesticide use, particularly in China (Smale et al., 2006; Huang et al., 2002). Other studies conducted in India have also reported reduced pesticide use and increased yields (Bennett et al., 2006; Qaim et al., 2006).

The cultivated area with GM crops has increased rapidly in Latin America reaching 32 million hectares in 2006 (Falck-Zepeda et al 2009). However, this expansion has happened
only in 3 crops (soybean, maize and cotton), 2 traits (herbicide and insect resistance or a combination of both) and 8 countries (Argentina, Bolivia, Brazil, Colombia, Honduras, Mexico, Paraguay and Uruguay).

Genetically modified cotton has been adopted by large numbers of smallholders in China and India, indicating that the technology can be adopted equally by large and small farmers. It further confirms the ability of smallholders to adopt new technologies, although there may be lags in adoption due to considerations of costs and risks. The dissemination of biotechnology to developing countries is inhibited by intellectual property rights issues, the lack of interest of multinational corporations in investing in the development of genetically modified crops in poor countries and less-favoured areas, difficulties in establishing public-private partnerships and the lack of investment and leadership in biotechnology by international agricultural research centres (Pender, 2008).

Institutional innovations for productivity enhancement and diversification

Although smallholders face formidable challenges, a number of innovative institutional models are emerging that can help small farmers benefit from the ‘new agriculture’ dominated by value chains. These include: the development of farmer/producer organizations for marketing; the promotion of contract farming; the development of supply chains for high-value exports through an appropriate mix of private- and public-sector initiatives; facilitating private-sector provision of market information through telecommunication; and directing fiscal stimulus to rural areas.

Farmer/producer organizations

To overcome challenges related to high transaction costs, small farmers in many countries have formed producer organizations. These organizations are of various kinds, including cooperatives, associations and societies. They support smallholders in gaining access to markets and public services, and for advocacy. One of the most well-known producer organizations in Asia is the Indian dairy cooperative, which in 2005 had a network of more than 100,000 village-level dairy cooperatives with 12.3 million members and which accounts for 22 per cent of milk produced in the country (National Dairy Development Board, 2006). Sixty per cent of members are landless or smallholders; women make up 25 per cent of the membership. This cooperative model was replicated with the brand name “Safal” for fruits and vegetables to meet the growing demand in the Indian capital Delhi.

The National Federation of Coffee Growers of Colombia, established in 1927 has 310 members, most of whom are smallholders owning less than 2 hectares (World Bank 2007). It provides production and marketing services to 500,000 coffee growers and uses its revenues to contribute to the National Coffee Fund, which finances research and extension and invests in services like education and health as well as in basic infrastructure such as rural roads and electrification for coffee-growing communities.

Contract farming

Contract farming has been promoted in many Asian and Latin American countries as a potential means to incorporate small farmers into growing markets for high-value commodities. Since contracts often include the provision of seed, fertilizer and technical assistance for accessing credit and a guaranteed price at harvest, this form of ‘vertical coordination’ has the potential to address many constraints to small-farm productivity. In this sense, it has been viewed as an institutional solution to the problems of market failure for credit, insurance and information.
Several studies have assessed to what degree smallholder farmers have participated in contract farming in Asia, and the evidence has been mixed. A recent study of contract and non-contract growers of apples and green onions in Shandong province of China found no bias toward large farmers in contract farming schemes (Miyata et al., 2009). In contrast, another study found that small farmers were less likely to participate in contract farming than larger farmers (Guo et al., 2005). Singh (2002) identifies several problems associated with contract vegetable production in Punjab state of India – imbalanced power between farmers and companies, violation of the terms of the agreements, social differentiation, and environmental unsustainability.

Most studies indicate positive impacts of contract farming on incomes. For example, Birthal et al (2005) found that the gross margins for contract dairy farmers in India were almost double those of independent dairy farmers, largely because contract farmers had lower production and marketing costs. Miyata et al (2009) also found that contract farmers earned more than non-contract farmers even after controlling for household labour availability, education, farm size, share of land irrigated, and proximity to the village leader. Major factors for this difference included higher yields obtained by contract growers due to the technical assistance and specialized inputs provided by the packers, and higher prices received.

Supply chains and supermarkets

Several researchers have argued that smallholders enjoy several advantages over large commercial farmers in supplying to supermarkets. The first advantage is linked to production technologies and the associated labour requirements. Thai Fresh United, for example, has a portfolio of 140 herbs, spices, vegetables and fruits, each of which has stringent quality requirements (Gaiha and Thapa, 2007). Smallholders, especially women, are able to give the careful attention that such crops require. Small producers supplying Hortico, for example, had lower rejection rates for certain non-traditional vegetables relative to large farmers. Second, the traditional agro-economic and production practices of smallholders are more amenable to the requirements of supermarkets. For example, in Thailand, Tops has found that smallholders adapt more easily to organic production through crop rotation and selection among resistant varieties.

However, smallholders need support for intermediation and internalization to be able to integrate into the supply chains (Gaiha and Thapa, 2007; Lipton, 2006; Swinnen 2006). Intermediation can take different forms involving the cooperation of public and private agencies. For example, food safety standards might be laid down by national governments, and private agencies might help smallholders implement them; rural infrastructure might be strengthened by the public sector through private financing; suppliers might help finance the provision of inputs and provide extension. Internalization involves organizations of producers, especially small producers, who negotiate production and marketing arrangements with supermarkets or their suppliers.

A study sponsored by IFAD found the prospects for the expansion of supermarkets to be promising in most Asian countries (Gaiha and Thapa, 2007). It also saw good potential for the integration of smallholders in a rapidly transforming food and agricultural sector provided they receive adequate support from the public and private sectors.

Fiscal stimulus

Although the contagion of the financial crisis did not dampen growth in the Asia and the Pacific region as much as initially feared, the projected reductions in growth rates are 2 per cent or more in 2009. This is largely due to the resilience of China and to a lesser extent India (ADB, 2009a). In anticipation of such losses, and to minimize them, fiscal stimulus was undertaken by many countries in the region, ranging from 0.5 per cent of gross domestic
product to more than 5 per cent (ADB, 2009b). A study undertaken by IFAD’s Asia and the Pacific Division (Gaiha et al., 2009) demonstrates the potential of fiscal stimulus in accelerating overall growth through agricultural growth. If mechanisms are put in place to direct the fiscal stimulus to rural areas where both physical and social infrastructure are inadequate to sustain the growth impulse, substantial increases in yields and revenues from agriculture are likely. Various studies have confirmed the vital role of rural roads, transportation and market access in enabling small farmers and others to reap greater benefits from higher prices (Fan and Rao, 2008; Gaiha et al., 2009). Of particular significance are the findings of a study by Shilpi and Deininger (2008), focusing not only on distance to a market in the Indian state of Tamil Nadu, but also on the facilities available in that market. Their analysis shows that additional investments in market facilities are indeed pro-poor, since the sales by poorer farmers increase more than those by wealthy farmers. In other words, while the wealthier farmers capture the benefits of existing facilities better than the poorer farmers, the marginal benefit from an improvement of market facilities is substantially greater for small (poorer) farmers.

V. Enabling policy and programme support to small or family farms—Selected Examples from Asia and Latin America

There are powerful efficiency and equity reasons to support small or family farms in Asia and Latin America. They are economically more efficient relative to large farms, can create large amounts of productive employment, reduce rural poverty and food insecurity, support a more vibrant rural nonfarm economy, and help to contain rural-urban migration (Hazell 2003). The Green Revolution experience showed strong commitment of both Asian and Latin American governments to agriculture, which led to significant investments in technologies and rural infrastructure as well as major policy and institutional reforms in support of agriculture. However, there was one major difference between the two regions. In Asian countries such as China and India, public interventions such as land policies, agricultural marketing and support services and agricultural research and extension benefited commercially oriented small farms. In China, small farms were supported after collective farms could not provide adequate incentives to increase production and productivity. In contrast, small farms in Latin America did not receive the same attention as in Asia during the Green Revolution period, although there was significant public commitment to agriculture. However, in recent years Latin American countries are providing strong policy and programme support to family farms (Box 1). Box 2 provides the highlights of the current programme of the Chinese government in support of small farmers.
Box 1. Policy support to family farms in MERCOSUR countries in Latin America

MERCOSUR stands for Mercado Comun del Sur or the Common Market of the South and includes seven countries—Argentina, Brazil, Paraguay, Uruguay, Bolivia, Chile, and Venezuela. It was created by the Treaty of Asuncion in March 1992 to coordinate macroeconomic and sectoral policies across member states. Its Common Market Group (CMG) Resolution passed in 2004 created the Specialized Meeting on Family Farm (REAF) to strengthen public policies to support family farms, and to promote trade of the region’s family farm products. REAF provides a forum to promote political dialogue between governments and organizations that represent MERCOSUR family farms, for the harmonization and design of different policies to reduce asymmetries that prevent family farms from harnessing the potential benefits of regional integration. Under REAF, member states of MERCOSUR have designed and implemented a number of policies related to access to land, resource allocation, agricultural insurance, and cooperative development to support family farms.

To improve family farmers’ access to land, MERCOSUR countries have implemented several policies. For example, Brazil has provided fund to purchase land through the National Programme for Farming Credit. This includes the development of basic productive infrastructure in areas where land purchase and distribution is not possible. Uruguay has implemented a programme to promote access to land for collective use through leasing or renting out private or public land. These programmes are accompanied by complementary infrastructure development including construction of rural roads, housing, storage facilities, access to power grid, and supply of agricultural credit for purchase of inputs and machinery.

MERCOSUR countries have also instituted policies to provide financial services to family farms with various forms of subsidies. The National Programme to Enhance Family Farm—Programa Nacional de Fortalecimiento da Agricultura Familiar (PRONAF) in Brazil provides funding to family farms with capital discounts as a reward for timely payments and interest bonuses, benefits that are covered by the public budget. Chile’s National Institute for Agriculture and Livestock Development or Instituto Nacional de Desarrollo Agropecuario (INDAP) uses three financial instruments to help family farms: subsidies on production capital, non-bank credit specifically designed for family farms, and credit to cover the incremental transaction costs incurred by new, small-scale companies.

Several MERCOSUR countries have also provided financial support to family farms to benefit from insurance schemes. Under agriculture insurance pilot plans, national and provincial governments have provided partial subsidy on insurance policy to family farms growing fruits and vegetables. Additional funds are also available to respond to emergency situations. In Brazil the Guaranteed Harvest or Garantia Zafra-Cosecha programme is aimed at family farmers in the semi-arid region, who receive special protection in the event of harvest losses (cotton, maize, bean, rice and cassava) of over 50 percent due to drought. In such cases, they receive a minimum monthly wage of about US$50 for five months. The Low-Water Fund also run by the same ministry is an emergency fund to compensate for damages suffered by rural producers who suffer losses exceeding 50 percent of their harvests.

These countries have also implemented policies to help family farmers’ organizations for their integration into markets. In Brazil, financial and legal support is provided to the cooperative system to streamline the supply of quality products to public institutional procurement. The state also creates new marketing programmes such as the Programme for Food Procurement, the Programme for Biodiesel Production, and the Organics Programme—to benefit the cooperative systems of family farmers. In Chile, cooperatives receive assistance through Programme for Productive Alliances and the Labelling Programme, etc. to help family farms meet requirements related to volume and quality of products, and timeliness of delivery for different marketing channels—retailers, wholesalers, supermarkets and exporters.

Source: Marquez and Ramos 2010.
Box 2. Policy support to small farmers in China

The reform of the rural economic system in 1978 laid an institutional foundation for rural development and poverty reduction in China. The main element of the reform was to change the agricultural production model from centralized planning to household contract farming. This reform significantly boosted farmers’ incentives to produce more and promoted agricultural development.

In recent years the government has implemented a series of policies to strengthen agriculture sector and to benefit small farmers. First, the government has significantly improved resource allocation to agriculture to benefit small farmers in rural areas: from RMB 432 billion in 2007 to RMB 596 billion in 2008 and to RMB 716 billion in 2009. Second, since 2006 the government has abolished agricultural tax and other taxes and fees, which has changed the age-old distribution relationship between the state and farmers. Third, the government has implemented the policy of minimum procurement price for grains to protect farmers’ interest and national food security. Fourth, more resources have been allocated to build rural infrastructure and to improve rural production and living conditions. Fifth, since 2007 China has exempted tuition and fees for students in rural elementary and secondary schools, which has benefited over 148 million rural children. The government has also established a new rural cooperative medical system covering 815 million farmers.

Although smallholder farming has contributed significantly to enhance agricultural production and to reduce rural poverty during the past thirty years, it is experiencing new challenges due to globalization and trade liberalization. These include the inability to achieve economies of scale, ineffectiveness in the dissemination of new technologies, and difficulties in risk prevention and control. The government has taken a number of steps to deal with the challenge of declining farm size. Although farmers had land-use contracts for 15 years, administrative reallocation was regularly practiced in response to population growth or to make land available for non-agricultural purposes. With the rapid rise in rural-urban migration, decentralized land rentals have complemented and eventually replaced administrative reallocations. Such land rentals have been reported to have had favourable impacts on land productivity, occupational structures, and welfare (World Bank 2007). Net revenue on rented land increased by about 60 percent, as land was transferred from those with low ability or interest in agriculture to better farmers. Net income increased both for renters and landlords by 25 percent and 45 percent, respectively. Land rentals also transformed the occupational structure in rural areas. Almost 60 percent of farmers, who rented out their land, depended on agriculture as their main source of income before entering land rental markets. Their number declined to 17 percent following land rentals, with 55 percent migrating and 29 percent engaging in local nonfarm activity. This shows that, in a context of strong non-farm growth and migration, a well functioning land rental market can contribute to productivity growth as well as welfare. However, there is a need to continue efforts to strengthen farmers’ property rights and to reduce the discretionary powers of officials.
VI. Concluding remarks

Small or family farms have proved resilient over time and they continue to contribute significantly to agricultural production, food security, rural poverty reduction, and biodiversity conservation in Asia and Latin America despite the challenges they continue to face with respect to the access to productive resources and service delivery. They are now facing new challenges on integration into new agriculture dominated by value chains, adaptation to climate change, and management of market volatility and other risks and vulnerability.

However, they have also shown their ability to integrate into the emerging value chains, if they are provided support through intermediation and internalization. Intermediation may take a variety of forms whereby public and private agencies cooperate (e.g. food safety standards might be laid down by governments, and private agencies might help smallholders implement them; rural infrastructure might be strengthened by the public sector through private financing; suppliers might help finance the provision of inputs and provide extension). Internalization involves organizations of producers, especially small producers that negotiate production and marketing arrangements with supermarkets or their suppliers.

Historically, Asian governments have provided stronger support to smallholders than their Latin American counterparts. However, as the above discussion on MERCOSUR shows Latin American countries have in recent years paid greater attention to support family farms through new policies and programmes. In some Asian countries like India, which has provided strong support to smallholders to adopt the Green Revolution technologies, there has been strong opposition to cutting back subsidy support, although many studies have shown that reorienting public expenditure away from subsidies toward expenditures on important public goods like agricultural research and rural roads would have a greater impact on agricultural growth and rural poverty reduction. Many governments face similar political economy challenges which need to be addressed for optimal outcomes.

Institutional innovations can play an important role in the provision of inputs and services to small or family farmers when there are market failures. In some cases, the private sector has adequate incentives to innovate (as discussed above in the sections on contract farming and supermarkets). However, in many cases the government should play an active role in coordinating the delivery of input, financial, technical and output marketing services to small farms. Support will also be needed to enable small farmers to face emerging challenges related to climate change impacts and market volatility.
Table 1. Main characteristics of family farming in selected countries of Latin America and the Caribbean Region

<table>
<thead>
<tr>
<th>Sectoral importance</th>
<th>Brazil</th>
<th>Chile</th>
<th>Colombia</th>
<th>Ecuador</th>
<th>Mexico</th>
<th>Nicaragua</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of sectoral production (%)</td>
<td>38</td>
<td>27</td>
<td>41</td>
<td>45</td>
<td>39</td>
<td>67</td>
</tr>
<tr>
<td>Share of sectoral importance (%)</td>
<td>77</td>
<td>57</td>
<td>57</td>
<td>-</td>
<td>70</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of agri holdings (000)</td>
</tr>
<tr>
<td>Share of total holdings (%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave size of family farms (ha)</td>
</tr>
<tr>
<td>Ave size of units not under family farming (ha)</td>
</tr>
</tbody>
</table>


Table 2. Changes in farm size and land distribution in selected Asian and Latin American countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Land distribution (Gini)</th>
<th>Average farm size (hectares)</th>
<th>Change in total number of farms (%)</th>
<th>Change in total area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
<td>Start</td>
<td>End</td>
<td></td>
</tr>
<tr>
<td>Smaller farm size, more inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1977-96</td>
<td>43.1</td>
<td>48.3</td>
<td>1.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1990-00</td>
<td>53.5</td>
<td>54.0</td>
<td>3.8</td>
<td>3.1</td>
</tr>
<tr>
<td>Thailand</td>
<td>1978-93</td>
<td>43.5</td>
<td>46.7</td>
<td>3.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1974-00</td>
<td>69.3</td>
<td>71.2</td>
<td>15.4</td>
<td>14.7</td>
</tr>
<tr>
<td>Smaller farm size, less inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>1990-95</td>
<td>46.6</td>
<td>44.8</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Chile</td>
<td>1975-97</td>
<td>60.7</td>
<td>58.2</td>
<td>10.7</td>
<td>7.0</td>
</tr>
<tr>
<td>Panama</td>
<td>1990-01</td>
<td>77.1</td>
<td>74.5</td>
<td>13.8</td>
<td>11.7</td>
</tr>
<tr>
<td>Larger farm size, more inequality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1985-96</td>
<td>76.5</td>
<td>76.6</td>
<td>64.6</td>
<td>72.8</td>
</tr>
</tbody>
</table>

Table 3. Changes in Percentage Distribution of Operated Area by Size of Operational Holdings in India, 1960-61 to 2002-03

<table>
<thead>
<tr>
<th>Land class</th>
<th>% distribution of operational holdings</th>
<th>% distribution of operated area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60-61</td>
<td>81-82</td>
</tr>
<tr>
<td>Small</td>
<td>61.7</td>
<td>68.2</td>
</tr>
<tr>
<td>Medium</td>
<td>33.8</td>
<td>28.8</td>
</tr>
<tr>
<td>Large</td>
<td>4.5</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Small: < 2 ha, medium: 2-10 ha, large: >10 ha

Table 4. Changes in cereal yield and production in Asia, 1970 and 1995

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>Other S. Asia</th>
<th>China</th>
<th>SE Asia</th>
<th>Developing Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal yield (mt/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>0.93</td>
<td>1.20</td>
<td>1.77</td>
<td>1.35</td>
<td>1.32</td>
</tr>
<tr>
<td>1995</td>
<td>1.74</td>
<td>1.85</td>
<td>4.01</td>
<td>2.24</td>
<td>2.63</td>
</tr>
<tr>
<td>% change</td>
<td>88.4</td>
<td>54.2</td>
<td>126.5</td>
<td>65.6</td>
<td>99.5</td>
</tr>
<tr>
<td>Cereal production (million mt)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>92.8</td>
<td>25.4</td>
<td>161.1</td>
<td>33.8</td>
<td>313.2</td>
</tr>
<tr>
<td>1995</td>
<td>174.6</td>
<td>48.1</td>
<td>353.3</td>
<td>73.6</td>
<td>649.6</td>
</tr>
<tr>
<td>% change</td>
<td>88.1</td>
<td>89.3</td>
<td>119.3</td>
<td>119.3</td>
<td>107.4</td>
</tr>
</tbody>
</table>

Source: Hazell 2009.

Table 5. Average annual percentage growth in per capita consumption of selected foods in selected Asian countries, 1990-2000

<table>
<thead>
<tr>
<th></th>
<th>B’desh</th>
<th>India</th>
<th>Pak</th>
<th>Indo</th>
<th>Phil</th>
<th>Thai</th>
<th>Viet</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>0.2</td>
<td>-0.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>1.2</td>
<td>-1.3</td>
</tr>
<tr>
<td>Veg</td>
<td>0.2</td>
<td>2.1</td>
<td>2.2</td>
<td>3.3</td>
<td>0.0</td>
<td>0.5</td>
<td>4.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Fruits</td>
<td>-1.5</td>
<td>2.9</td>
<td>0.5</td>
<td>1.9</td>
<td>0.2</td>
<td>0.3</td>
<td>1.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Milk</td>
<td>0.2</td>
<td>1.9</td>
<td>3.0</td>
<td>5.9</td>
<td>1.5</td>
<td>5.0</td>
<td>13.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Meat</td>
<td>1.0</td>
<td>0.9</td>
<td>0.2</td>
<td>0.4</td>
<td>4.7</td>
<td>1.5</td>
<td>4.3</td>
<td>6.8</td>
</tr>
<tr>
<td>Eggs</td>
<td>4.6</td>
<td>1.9</td>
<td>1.9</td>
<td>3.7</td>
<td>1.6</td>
<td>0.4</td>
<td>5.8</td>
<td>9.7</td>
</tr>
<tr>
<td>Fish</td>
<td>4.7</td>
<td>2.0</td>
<td>1.6</td>
<td>3.2</td>
<td>-1.4</td>
<td>3.9</td>
<td>3.7</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Source: Gulati et al 2006 (based on FAO Food Balance Database)

Table 6. Average annual percentage growth in production of food grains and high value commodities in selected Asian countries, 1990-2000

<table>
<thead>
<tr>
<th></th>
<th>B’desh</th>
<th>India</th>
<th>Pak</th>
<th>Indo</th>
<th>Phil</th>
<th>Thai</th>
<th>Viet</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>3.6</td>
<td>1.9</td>
<td>3.8</td>
<td>3.8</td>
<td>1.7</td>
<td>1.4</td>
<td>3.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Fruits &amp; Veg</td>
<td>1.7</td>
<td>4.3</td>
<td>3.8</td>
<td>3.8</td>
<td>4.1</td>
<td>2.1</td>
<td>2.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Milk</td>
<td>3.0</td>
<td>4.2</td>
<td>5.7</td>
<td>5.7</td>
<td>2.8</td>
<td>-6.5</td>
<td>14.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Eggs</td>
<td>6.4</td>
<td>4.2</td>
<td>4.6</td>
<td>4.6</td>
<td>4.9</td>
<td>3.4</td>
<td>1.1</td>
<td>6.7</td>
</tr>
<tr>
<td>Meat</td>
<td>3.4</td>
<td>3.0</td>
<td>2.8</td>
<td>2.8</td>
<td>1.6</td>
<td>5.6</td>
<td>3.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Fish</td>
<td>7.0</td>
<td>4.0</td>
<td>2.7</td>
<td>5.0</td>
<td>0.4</td>
<td>3.0</td>
<td>7.6</td>
<td>11.3</td>
</tr>
</tbody>
</table>

Source: Gulati et al 2006 (based on FAO Agricultural and Fisheries Production Databases)
References


