



AVRDC

The World Vegetable Center

**High value agricultural products in Asia and the Pacific for
small-holder farmers:
Trends, opportunities and research priorities**

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1 Introduction

In many Asian countries the agricultural sector is undergoing transformation, with changes in the contribution of the different sub-sectors occurring. High value agricultural products (HVAP) are defined here as products that are typically perishable, that are of specific high-value, and that are sold through specialized markets (CGIAR, 2004). They can include livestock, dairy products, fish, fruit and vegetables; products that are growing in importance, albeit at varying degree.

Asia and the Pacific comprise countries of vast differences in climates, livelihood systems and economic development. For the purpose of this paper we will follow the FAO definition of country groups and distinguish among South Asia (SA)¹, East and South East Asia (ESEA)² and Oceania (developing)³. China, since it is such a large producer and consumer of HVAP, is considered separately. We will refer to the total of these countries as Asia and the Pacific.

While the importance of HVAP in Asia and the Pacific has grown both for domestic consumption and in exports, it is also true that many of the countries are low and middle-income countries, with large, often poor rural populations, with large numbers of marginal and small-scale farmers, as well as landless households.

Diversification into HVAP could benefit these poor farmers and landless laborers by increasing both production and employment. It could benefit the rural and urban poor through growth in the rural and urban non-farm economy and by making food available that is high in nutrients. Such diversification could also empower the poor by increasing their access to decision-making processes, by increasing their capacity for collective action, and reducing their vulnerability to shocks through asset accumulation.

Diversification into HVAP could thus play a significant role in poverty reduction, sustainable growth and food security in Asian developing countries.

¹ Including Pakistan, India, Bangladesh, Nepal, Sri Lanka, Bhutan and the Maldives.

² Including Brunei Darussalam, Myanmar, Indonesia, Cambodia, Democratic People's Republic of Korea, Republic of Korea, Lao PDR, Malaysia, Mongolia, Philippines, Timor-Leste, Singapore, Thailand, and Viet Nam.

³ Including, due to data availability, only Fiji islands, French Polynesia, Kiribati, New Caledonia, Samoa, Salomon Islands, and Vanuatu.

However, participation in markets for HVAP also requires a set of institutional changes to allow small-scale farmers and the landless to compete. The standards for participation in high value markets have increased, both in developed and developing countries and supply chains are increasingly complex, undergoing rapid changes and often based on strong vertical integration. Informed policies and a conducive regulatory environment will increase the incentives for agents in the supply chain to use the produce of small-scale farmers as inputs, and improve their capacity to meet the product attributes required in a rapidly modernizing agricultural marketplace.

This paper aims to (1) highlight the current and the future role of HVAP in agriculture and trade in Asia and the Pacific; (2) identify opportunities and constraints for small-holders participation in these markets and (3) highlight lessons learned from past research and development efforts in Asia and the Pacific.

This paper is organized as follows. The next section deals with developments in production, consumption and trade of HVAP in Asia and Pacific over the past thirty years. In chapter four we highlight opportunities and constraints for participation of small scale farmers in these markets, and focus on fruit and vegetable crops. In chapter five we summarize the results of a set of studies that have attempted to identify the reasons for success or failure of research and development projects in Asia and the Pacific that dealt with high value agricultural products, and in the last section we summarize and discuss the results.

2 Small-scale farmers in the Asian Pacific region

The majority of the world's poor are found in the Asia Pacific region, despite vast improvements over the past decades. Eight hundred million people in Asia and the Pacific live on less than a dollar per day, two-thirds of the global poor (IFAD, 2002). More than 40 percent alone are found in the South Asia (SA) region (Dixon *et al.*, 2001).

In spite of urbanization, the rural population continues to grow in many of the countries. The SA region's share of rural population is 72% and has the highest rural population density among all regions in the world. Approximately 751 million people depend on farming, fishing and pastoral occupations for their livelihood. The share of rural households is lower in East and South East Asia, about 63% and has a faster rate of urbanization⁴, but in this region also remain largely agrarian (Dixon *et al.*, 2001). Farms in the Asia Pacific region are dominantly smallholder-based with widespread occurrence of subsistence production systems.

Poverty in Asia and the Pacific is primarily a rural problem. With the exception of Mongolia, the majority of the poor in other countries live in rural areas. Poverty is most severe and acute in those farming systems practiced by the largest population, as Table 1 shows. The lowland rice systems that is the major farming system for 489 million people in South East Asia and the upland intensive mixed systems that are the base of livelihood for 316 million people in ESEA, as well as the rice (263 million people) and rice wheat systems (484 million people) in SA (Dixon *et al.*, 2001) are all characterized by prevalence of moderate to severe poverty. All of these systems are based on rice production, often coupled with livestock or horticultural products.

Socially, poverty is concentrated among small and marginal farmers, among the landless, and among women (IFAD, 2002). Female-headed households constitute a significant proportion of households in some countries, such as Cambodia (35%) and in parts of Nepal. Poverty is particularly severe among female-headed households. In Bangladesh, for example, 96% of female headed households are poor, and 33% are hard-core poor,

⁴ Urban population growth rate in ESEA is 3.44%, while the world growth rate is 2.52. Given this rate, a doubling of the population within the region is expected within the next 15 years.

meaning that it is often more difficult for women and their children to escape poverty. Reasons for higher levels of poverty among female headed households as compared to male headed households include lower assets, lower educational levels and more limited work opportunities. (IFAD, 2001)

The participation of these poor producers in dynamic markets for higher value crops and livestock products is a major challenge. For small farmers living in remote rural areas, transport opportunities and transport cost can both be limiting factors, especially if investment into rural infrastructure is not a high priority on a national level. Information may also be difficult to obtain in remote rural areas, as are credit facilities and other inputs.

Table 1. Overview on major farming systems in Asia and the Pacific

Farming system	Environment	Countries	Land area (million ha)	Population (million)	Principal livelihood	Incidence of poverty
Lowland Rice	Humid/ moist sub-humid tropical	Thailand, Vietnam, Myanmar, South and Central East China, Philippines, Indonesia	197	489	Rice, maize, pulses, sugarcane, oil seeds, vegetables, livestock, aquaculture	Extensive severe poverty
Tree Crop Mixed	Humid/ moist sub-humid tropical	Malaysia, Indonesia, Thailand, Cambodia, Philippines, Vietnam, southern China, Papua New Guinea	82	30	Rubber, oil palm, coconuts, coffee, tea, cocoa, spices, rice, livestock	Moderate poverty mainly of smallholders
Upland Intensive Mixed	Humid and sub-humid tropical, subtropical and temperate	Major areas in all countries of East and South East Asia	311	316	Rice, pulses, maize, sugarcane, oil seeds, fruits, vegetables, livestock	Extensive, moderate and severe poverty
Temperate mixed	Moist sub-humid subtropical and dry sub-humid temperate	Central northern China and Mongolia	95	161	Wheat maize, pulses, oil crops, livestock	Extensive moderate and severe poverty
Rice	Humid and moist sub-humid	Bangladesh, and West Bengal, Tamil Nadu and Kerala of India, and southern Sri Lanka	36	263	Rice (both seasons), vegetables, legumes, off-farm activities	Extensive severe poverty
Rice-Wheat	Semi-arid	Pakistan, northern India, southern Nepal, north-east Bangladesh	97	484	Rice, wheat, vegetables, livestock including dairy, off-farm activities	Extensive moderate and severe poverty
Highland Mixed		Upland areas of Afghanistan, Pakistan, India, Nepal, Bhutan, central Sri Lanka	65	82	Cereals, livestock, horticulture, seasonal migration	Moderate to severe poverty
Rainfed Mixed		Pakistan, Central, Southern and Western India, Sri Lanka	147	371	Cereals, legumes, fodder crops, livestock, off-farm activities	Extensive poverty, severity varies seasonally

Source: adapted from (Dixon *et al.*, 2001)

3 Overview on past developments in HVAP

Global food markets are changing and a variety of factors have contributed to this development. Incomes are increasing, especially of growing middle classes. Increasing urbanization requires large quantities of food being produced far away from where it is consumed, with effects on processing and value-added activities. Improvements in transportation and refrigeration have added to this development. Foreign direct investment from global retailers has had an impact on the structure of retailing. Trade liberalization has impacted on the increasing importance of exports, which are growing for high value crops and processed foods alike.

3.1 Production

Total production of HVAP in Asia and the Pacific has increased markedly over the past 30 years, but growth has been distributed unequally across regions and across products. Between 1972 and 2002, total meat production in Asia and the Pacific increased nearly sixfold from 15 million metric tons to 89 million MT. Fish production increased from 15 to 71 million MT, and milk production from 35 to 137 million MT. Growth in total meat and fish production was largely spurred by production increases in China since the 1990s, while milk production increased markedly in India (Figure 1). Among high value crops, vegetables have shown much larger growth than fruit, with an increase from 90 million MT to 514 million MT, again largely in China (Figure 2).

In Figure 3 we compare the share of cultivated area under fruit and vegetable cultivation for different regions worldwide. The graph shows an increasing importance of fruit and vegetable production on a global level where the share in area is now 6.7% (Weinberger and Lumpkin, 2005). The relative area allocated to cultivation of fruit and vegetables is high in East and South East Asia (around 10%), and in China (around 20%) but low in South Asia at 5%.

Figure 1. Production of animal products by region

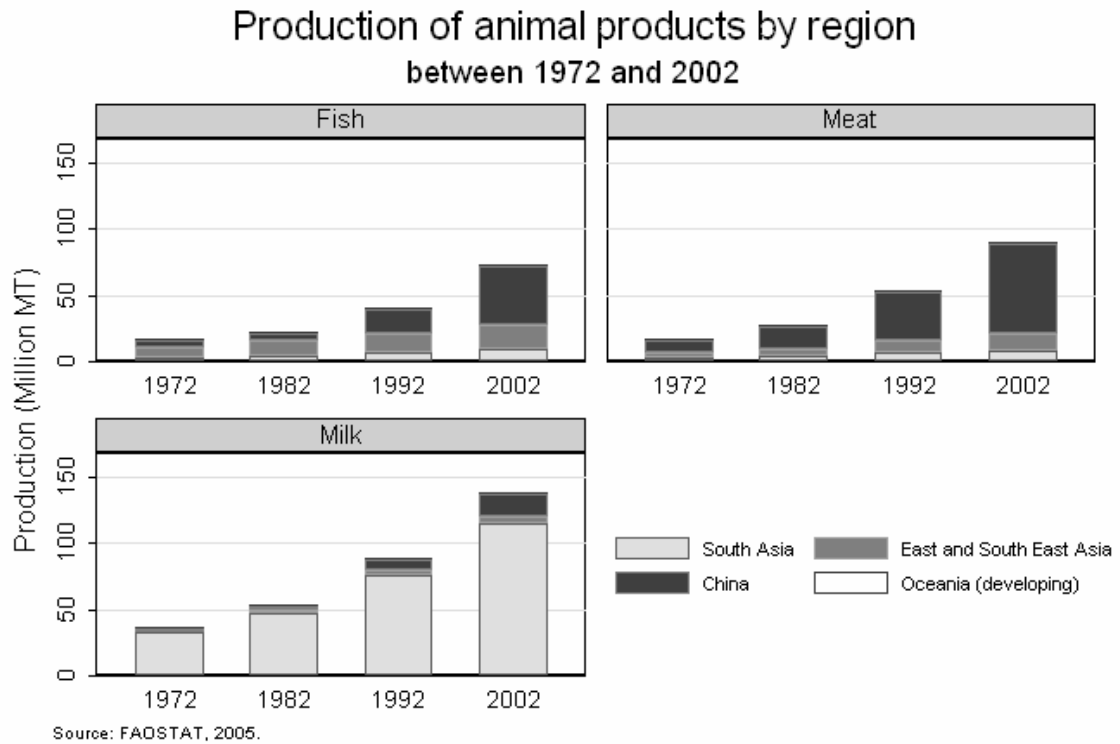


Figure 2. Production of high value crops

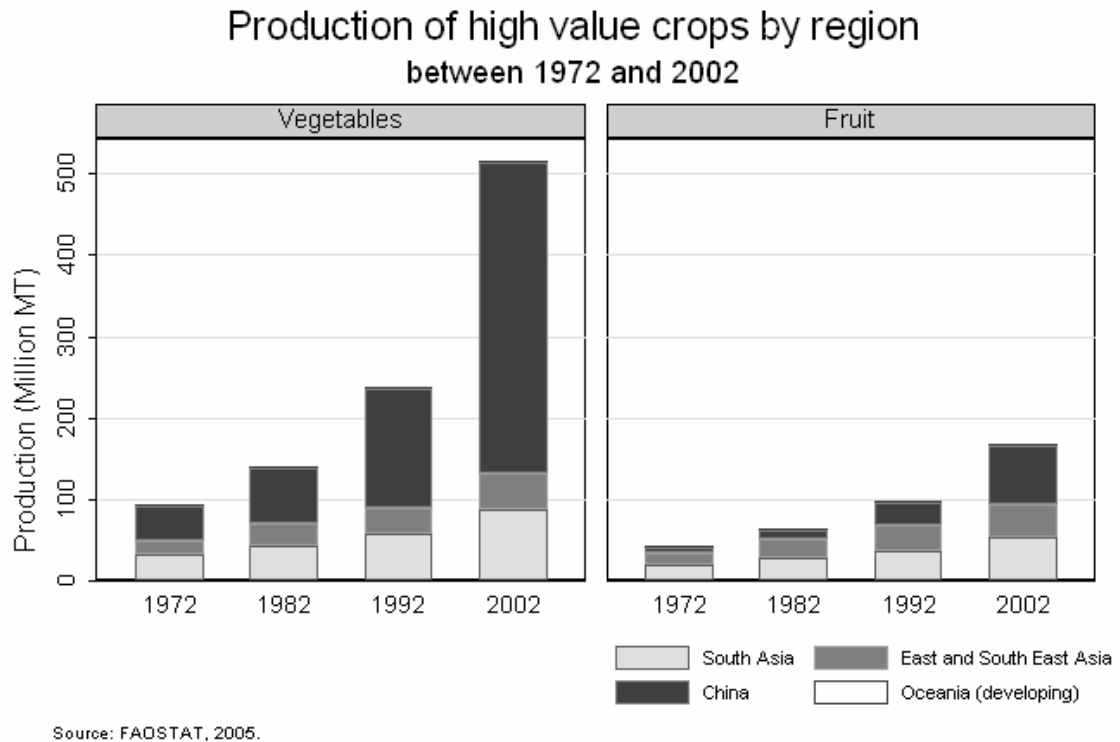
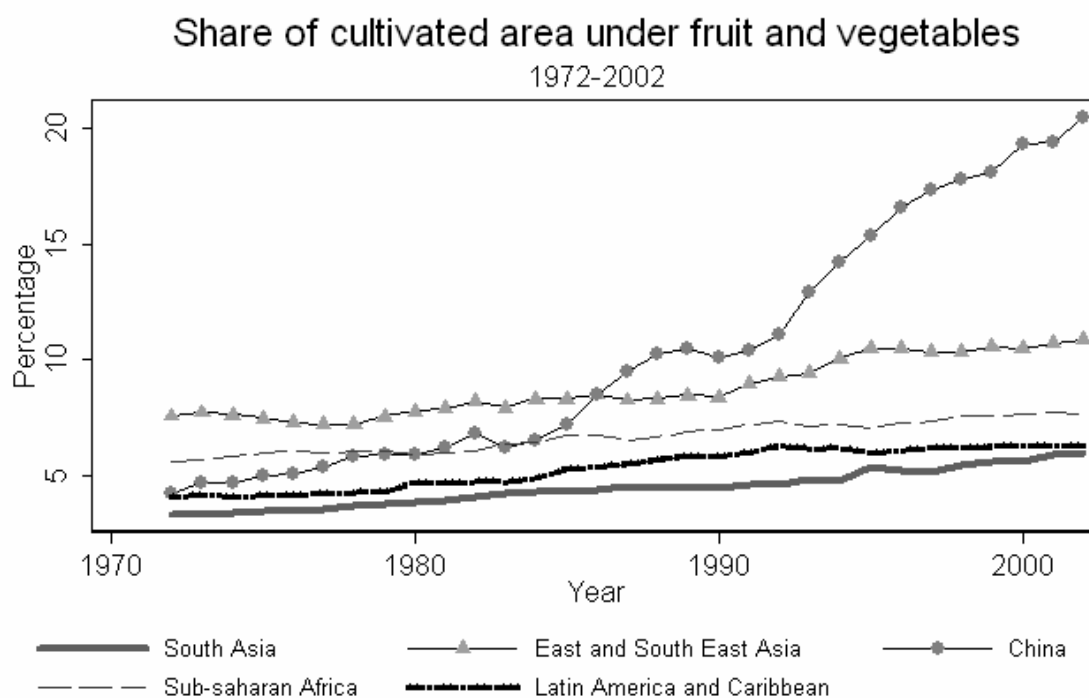


Figure 3. Share of cultivated area under fruit and vegetables



The production increases of horticultural products in China are particularly remarkable. These increases began in the 1980s after the government allocated land on a family basis and eliminated fixed procurement and retail prices for fruit, vegetables and some other agricultural products. As a result of the elimination of low procurement prices, farm profits for these products rose. Fruit and vegetables, which have higher labor requirements than grains, have a comparative advantage in China because of the low ratio of arable land per capita (Lu, 1998). China has always been a large contributor to world vegetable production, but currently produces nearly half of world supply (47%), up from 26% in 1961 (FAO, 2005).

Although area expansion has been largest in China, farmers in other regions of Asia and the Pacific have also found it profitable to expand production of horticultural produce at the expense of the cereal area, although yield increases in horticultural produce have been smaller than in cereal grains (Weinberger and Lumpkin, 2005). This increase in produce area has been fuelled by increasing domestic and international demand, which we will explore in the subsequent chapters.

3.2 Domestic consumption

In general, low-income countries have been found to be more responsive to income increases in terms of impact on their food habits than high-income countries (Seale *et al.*, 2003).

Per capita supply of HVAP has been increasing steadily (Figure 4). Total per capita supply of fish in Asia and the Pacific has increased from 7 kg to 17 kg per capita per annum, for meat from 8 kg to 27 kg, for milk from 16kg to 35 kg, for fruit from 18kg to 43kg and for vegetables from 41kg to 137 kg between 1972 and 2002. Much of the increase in supply has come from consumption changes in China. For instance, per capita consumption of vegetables in China (not included in Figure 4) has increased from 43 kg (1972) to 254 kg (2002). China has a traditional preference for vegetables and vegetables make up about 35 percent of per capita food consumption in China, a much higher share than world averages (Gale, 2002). However, there is a group of authors suggesting that vegetable consumption levels in China are actually much lower than those indicated by the supply data; and falling, instead of increasing (Du *et al.*, 2002, Du *et al.*, 2004, Popkin and Du, 2003)⁵.

Increasingly, consumers demand processed, ready-to-eat convenience foods, and this is true for developed and developing countries alike. Table 2 shows the growth in retail sales of processed food for selected Asian countries, which have exhibited very high growth rates over the past years. However, the food manufacturing sector remains underdeveloped in many of the countries and only a small share of value added is generated there as compared to the agriculture sector.

⁵ Incorrect data may be part of the explanation; the supply data for Oceania may also be incomplete..

Figure 4. Per capita supply of HVAP

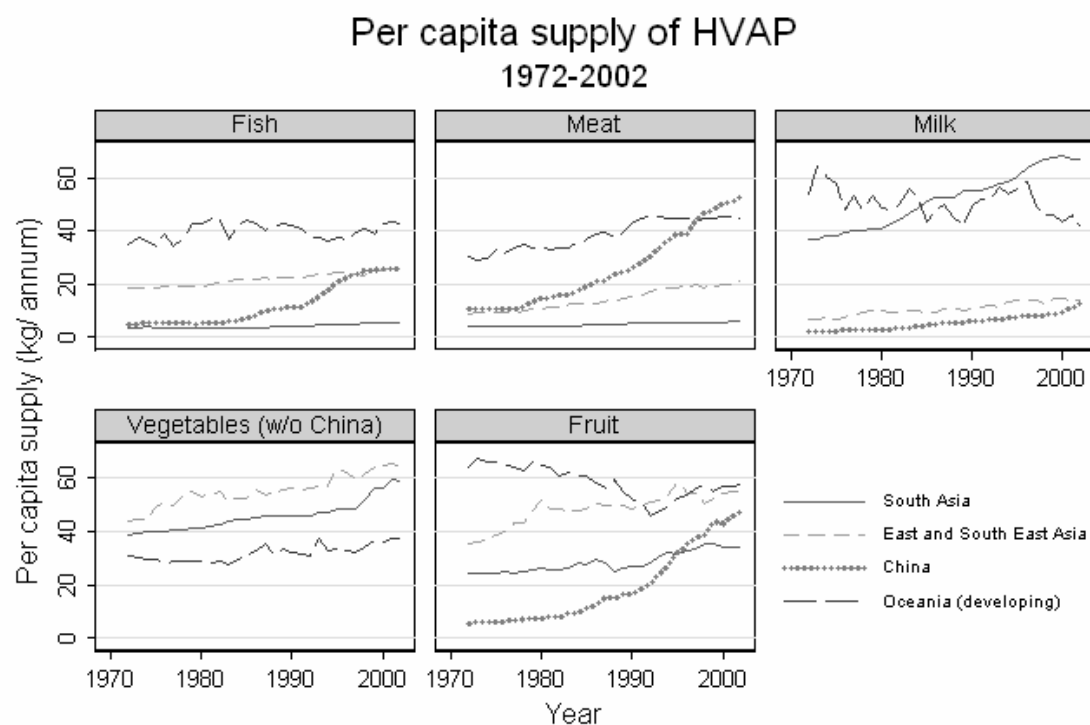
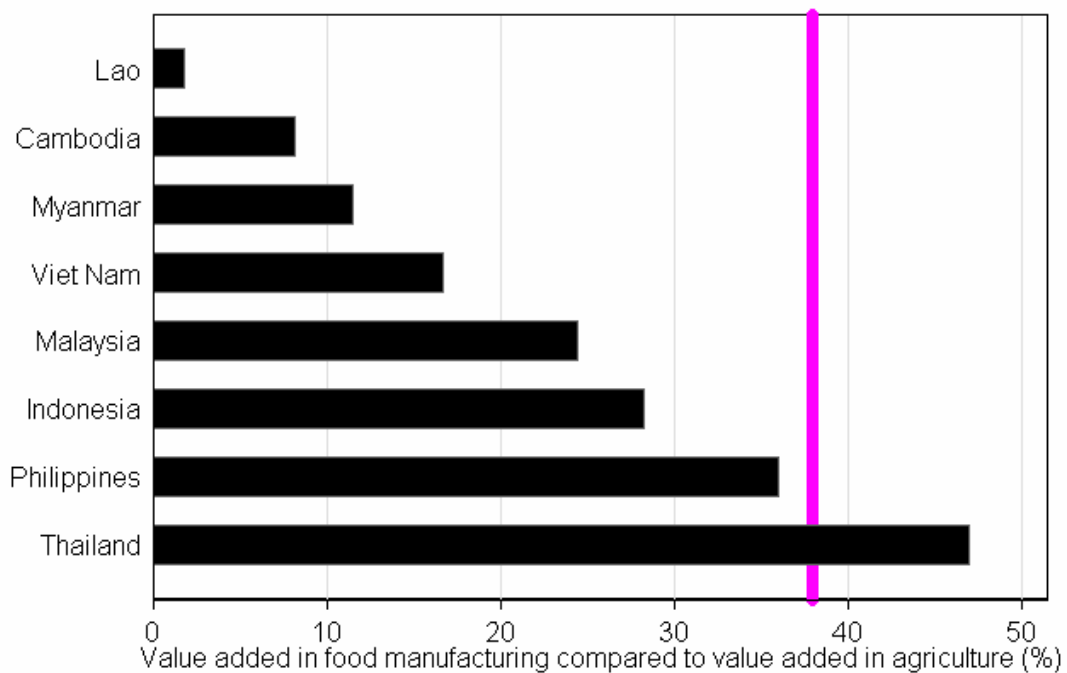


Table 2. Retail sales of processed food

	Percent growth 2001-2005	
	Per capita	Total retail
Vietnam	9.6	11.2
China	8.9	9.6
Indonesia	6.1	7.8
South Korea	5.7	6.8
Thailand	5.3	6.1
India	3.7	6.0
Philippines	2.8	5.1

Source: Regmi (2003)

Figure 5. Value added in food manufacturing compared to value added in agriculture in selected South East Asian countries



Source: Worldbank, 2004.

Note: Vertical line represents average for all developing countries. Average for developed countries is 128%.

Asian consumers increasingly purchase their food in convenience stores such as super and hypermarkets. The importance of supermarkets is growing especially fast in the South East Asia region. In Thailand, superstores on the Wal-Mart format, with sizes of 15-20,000 m² and prices 20-30% lower than supermarkets, are growing rapidly. Supermarkets, superstores and convenience stores threaten Thai traditional outlets, with shares rising from 32% in 1998 to an estimated 50% in 2003. Global retailers are strongly represented. Even in Vietnam, where modernization of food retailing is only about six years old, and wet markets are still the major source of food shopping, supermarkets' share of food products is expected to increase from around 0.5% in 2000 to around 40% in 2006. Metro has announced programs of assistance and consulting for 4,000 farmers and suppliers to help them in 'upgrading the quality, marketability, and competitiveness of their products.' In Indonesia, the local retail chain Ramayana, which positions itself to sell to people earning US\$40 a month, is growing at 25% a year. Carrefour has opened its eleventh store in Indonesia and is the leading hypermarket operator in the country. (Manalili and Tumlos, 2004)

China is also experiencing a very rapid restructuring of its agrifood system. Food retail sales in 2004 totaled US\$383 billion, of which US\$94 billion was through

'modern' distribution channels. Growth of modern retailing is spreading from the early growth areas of Guangzhou, Shanghai and Beijing to inner western regions. This is already having a profound effect on the way that food is produced in the country. According to USDA, China could support at least 9,100 hypermarkets. (Bi *et al.*, 2004)

In South Asia, the restructuring of the food system is not undergoing the same dramatic change as in South East Asia. The South Asian retail sectors are some of the least concentrated in the world with few major supermarket chains of note. Small traditional independent retailers, street markets, hawkers and roadside vendors dominate the sector. However, retailing is a high growth industry in India. Retail sales amounted to about 44% of GDP in 2002 and expanded at an average annual rate of 7% during the period 1999-2002.

The sales of fresh produce in supermarkets usually lags behind the sales of processed food items (Reardon *et al.*, 2003). However, even sales of fresh fruit and vegetables are rising fast in metropolitan areas of Asia, as Table 3 shows. Again, there are vast differences across the Asian regions.

Table 3. Share of fresh produce sold through supermarkets

Malaysia	Fruit: 60% Vegetables: 35%
Thailand (Bangkok)	Fruit: 40% Vegetables: 30%
Philippines (Manila)	Vegetables 15%
Korea	Fresh produce: 11%
China	Fresh produce: < 10%

Source: (Shepherd, 2005)

3.3 Trade

Bulk commodities such as grains and oilseeds now make up only one sixth of trade in agricultural products while trade in processed and high-value food products exceeds 80 per cent of global commerce. However, Asia and the Pacific contribute to only a minor share of the total export value of HVAP that are traded on a global level (Table 4). While more than half of global fruit and vegetable production and fish catch, and approximately one third of total meat production and primary crop production take place in Asia and the Pacific, only 12% of the total value of exported agricultural

products is generated in Asia and the Pacific. Thus, considering the large share that Asia and the Pacific has in global population, domestic markets and their requirements are likely to be more important in the near future than the attraction of export markets.

Table 4. Share of Asia and Pacific region in global production and traded value

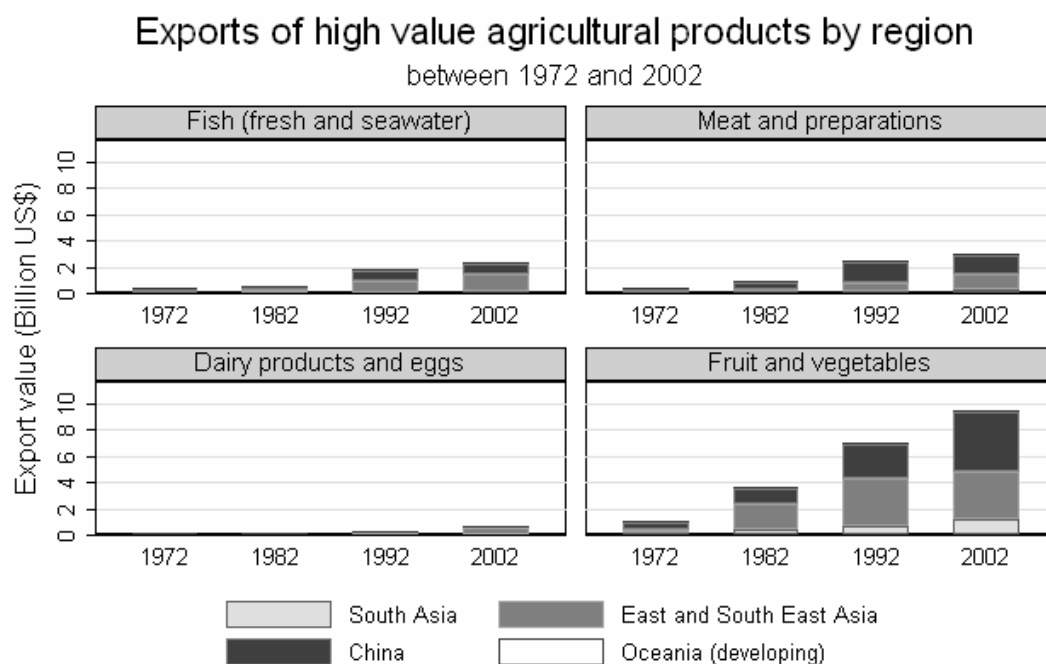
	Share of Asia and the Pacific	
	in global production	in global trade value
Total fish catch	58.1	22.7
Meat and meat preparations	37.5	5.7
Dairy products and eggs	27.5	2.1
Fruit and vegetables	54.0	11.8
Primary crops total	32.3	
Agricultural products total		11.9

Source: FAO, 2005

Most important for Asia and the Pacific is trade in fruit and vegetables, where total export value has increased to nearly US\$ 10 billion in 2002, up from less than US\$ 1 billion in 1972. Total export value for meat in the region is now US\$ 2.8 billion, and for fish US\$ 2.2 billion, while exports of milk and milk products are negligible at US\$ 500 million (Figure 6). Although the importance of fish traded is smaller than that of fruit and vegetables in absolute monetary terms, nearly one quarter of all fish traded globally originates from Asia and the Pacific, while only 12% of the global export value for fruit and vegetables originates here.

A look at individual trade data reveals that the group of largest net exporters has largely remained the same over the past 30 years, as has the group of net importers. China, Thailand and the Philippines were largest net exporters of fruit and vegetables in most years, and China, India and Thailand were largest net exporters of meat and meat preparations. Only India is a net exporter of dairy products and eggs, and has only been since 1996. Singapore, the Republic of Korea and Malaysia are the largest net importers both for fruit and vegetables, and for meat and meat preparations. In 2002, China, the Philippines and Malaysia were the largest net importers in Asia of dairy products and eggs (FAO, 2005).

Figure 6. Exports of high value agricultural products



Source: FAOSTAT, 2005.
Note: data for fish represents export value in 2001 instead of 2002.

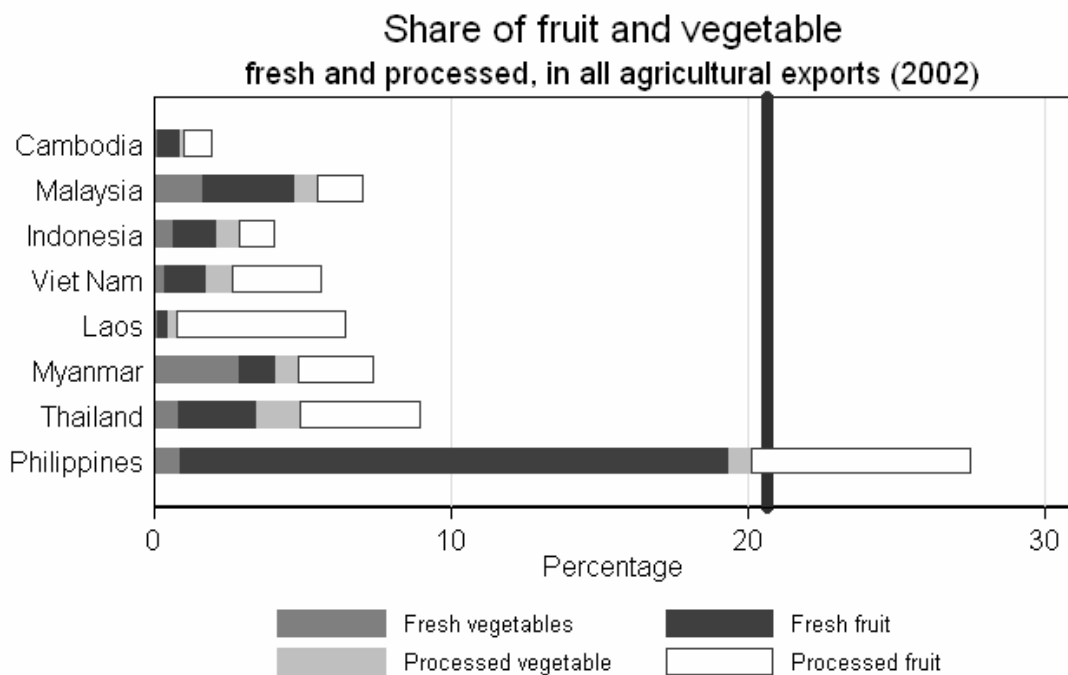
China's liberalization of trade practices has contributed to the increasing importance of horticultural products there, which have subsequently emerged as a leading class of food export products from China (Lu, 1998). For example, China now produces more than 40% of the world's apples and more than 70% of the world's garlic. Large areas in Shandong province have been converted from grain to vegetable production to supply inexpensive vegetables and other nongrain agricultural goods for consumers in nearby Japan. As a result, China has replaced the US as the number one supplier of fresh and frozen vegetables to Japan (USDA, 2002). Rising imports of inexpensive produce from China has forced Japan to impose temporary import protection against some Chinese agricultural products (Hsu and Gale, 2001).

The share of processed food in the value of total global agricultural trade has increased steadily over the past decades, to over 60 percent by 1995. The food processing industry has improved dramatically over the past 30 years, including transportation technology, sanitation packaging, storage and product and packaging appeal. Taken together, these changes have sharply increased the value-added share of processing and distribution within agribusiness, and of non-staple sub-sectors relative to staples, opening up new markets opportunities for developing countries (Reardon and Barrett, 2000). Exporters in developing country are taking

advantage of this trend, and over the past decade the increase of their processed food exports has exceeded that from the developed regions (Rae and Josling, 2003).

Within horticultural products, processed exports are important, as Figure 7 below shows for South East Asia. The graph shows exports of fruits and vegetables, fresh and processed, and their share in overall exports. Especially processed fruit items make up a large percentage share of export value. The graph also shows that on average fruit and vegetables exports are comparably less important than in other regions of the world. The vertical line represents the average share of fruit and vegetables in all developing countries.

Figure 7. Share of fruit and vegetables in all agricultural exports for selected South East Asian countries



Source: FAOSTAT data, 2004.

Note: vertical line represents average for all developing countries.

4 Opportunities and risk for small-scale farmer participation in markets for fruit and vegetables

The former chapter has shown that markets for HVAP are growing in the Asian Pacific region, although much of this development is due to increasing demand on domestic, rather than on international markets. Markets for HVAP are growing rapidly, and are becoming increasingly capital-intensive and vertically coordinated. The requirement is thus to identify critical areas for trade, marketing, capital market, and regulatory reforms that can facilitate the integration of small-scale and poor developing country farmers in rapidly growing global markets for high-value crop and animal products in a sustainable manner, and thus increase and diversify their incomes over the long-run. The following chapter will summarize opportunities and risk associated with the participation of smallholder farmers and will focus on high value markets for fruit and vegetable in Asia and the Pacific.

4.1 Gender aspects

In general, gender issues related to commercialization of agriculture have received less attention in research covering Asia and the Pacific as compared to other regions of the world. In a recent literature review of studies dealing with gender aspects in commercialisation (Spring, 2001) only seven of the studies cited deal with aspects of commercialization in Asia and the Pacific, out of 74 studies cited in total.

The increasing feminization of agriculture in Asia and the Pacific is well documented. Men move out of the sector more quickly than women, and women are becoming the preferred labor type by many employers (Gill, 2001, Singh, 2003). In a study conducted by Gill (2001) in Punjab, India during the mid-1990s, around three-quarters of all workers in the vegetable production sector were hired labor, and female hired labor accounted for 49%. In contrast, paddy had 25% female hired labor. Further, female labor in vegetable production accounted for 58% of total labor hours, compared with 34% in paddy. In tomato production alone, female labor accounted for almost 60% of the total labor hours. In contrast, hired vegetable-based labor in Bangladesh continues to be male-dominated, while post-harvest activities such as cleaning, washing and grading of harvested goods are dominated by women. Thus, there appears to be an employment-generating effect of modern vegetable

technologies that favors female labor employment to some extent, social and cultural circumstances permitting (Rahman, 2000, Weinberger and Genova, 2005).

Lack of access to and control over land in general, as well as appropriate land for commercial farming (in terms of soil fertility, location, slope, etc.) is a major constraint that women face in South Asia (Agarwal, 1994). Loss of access to land for women is also reported from China, where land is still owned collectively, marriage and divorce however lead to the condition that women do not gain access to land (Zhu and Jiang, 2001).

Although it is commonly assumed that the transformation from subsistence to commercial agriculture is detrimental to women, there are examples in the literature that argue that class relationship and poverty level may be more important than gender alone (Jefremovas, 2000, Spring, 2001, Weinberger, 2001). More studies are required to understand whether participation of women in markets for HVAP is limited as compared to men. It is expected that there would be regional differences and that participation of women is more limited in South Asia as compared to the remaining countries of Asia and the Pacific, where women have higher educational levels and higher rates of economic activity are reported (UNDP, 2005).

4.2 Production of fruit and vegetable

4.2.1 *Access to capital*

Capital and risk constraints are key factors that limit the adoption of high-value crops by small farmers because these crops generally are much more costly to produce per hectare than traditional crops (Ali, 2002, Ali and Hau, 2001, Key and Runsten, 1999), and most growers require credit to finance their production. While staple crops are usually cultivated using a level of input intensity appropriate to the financial resources available within a household, horticultural crops often require an intensive input regime and necessitate large labor inputs for harvest and planting that cannot be met with family labor alone (Weinberger and Genova, 2005). Horticultural crops also tend to be riskier than staple crops, since the higher costs associated with production impose a greater income risk. In addition, the profits of horticultural crops tend to be more variable because they have both more variable yields and more variable prices. From another perspective, prices for horticultural crops are more variable because the variability in yields increases the variability in market supply (Key and Runsten, 1999). In addition, governments usually do not regulate the price of horticultural

crops or even provide market information unlike for staples. Improving market information systems for horticultural crops, and facilitating farmers' access to credit are essential components of a strategy that seeks to strengthen smallholder participation in markets for high value crops.

4.2.2 Input markets

High value agricultural crops require more input use than other crops and access to inputs is often limited. In particular this relates to the seed market. A major limitation to fruit and vegetable production in the less developed countries of Asia and the Pacific is the availability of good quality seeds. The public sector in countries such as Cambodia and Lao PDR does not have sufficient capacity to supply adequate quantities of good quality seed and at present, there are few private sector seed companies adapting varieties to local environments, especially in poorer countries (exceptions are Thailand and India).

Farmers themselves often produce seeds of locally preferred or indigenous varieties, as the individual markets are too small to attract the interest of the private sector. Without proper seed production, processing technology, quality assurance, or management supervision, seeds are often contaminated by seed transmitted pests and diseases, and are genetically diverse. Lack of proper storage facilities and an effective monitoring mechanism often leads to low or uncertain seed viability and vigor. Moreover, low capital resources and poor market information discourage development of seed-related agribusiness.

4.2.3 Relative profitability

The relative profitability of horticultural crops compared to cereals has been shown to be a determining factor for crop diversification into horticultural production in India (Joshi *et al.*, 2003). Farmers engaged in the production of fruit and vegetables often earn higher net farm incomes than farmers that are engaged in the production of cereal crops only. Studies from South East and South Asia frequently show higher average net farm incomes per household member among horticultural producers (Weinberger and Lumpkin, 2005). The production of fruit and vegetables has a comparative advantage particularly under conditions where arable land is scarce, labor abundant and markets accessible. This is the prevailing situation in many countries of South and South East Asia, where the average size of landholding is among the lowest in the world and transportation infrastructure has seen dramatic

improvements. Vegetables have a lower comparative advantage than staple foods when labor and access to inputs are the limiting factors (Weinberger and Lumpkin, 2005).

4.2.4 Economies of scale

For the production of high value crops, the competitiveness of small scale farmers as compared to large farmers depends on a variety of factors. Size biases can be created by a range of factors, mostly working against small-scale producers. They include (1) the need to use large amounts of inputs; (2) the requirement for managerial skills; (3) certification and quantification requirements; (4) vertical coordination to deliver perishable products to markets or processing facilities in time; (5) “product gestation periods” are long for a number of fruits crops; (6) access to future markets or insurances to withstand the price and supply fluctuations associated with many high value crops; and (7) requirements for quality labor (Carter *et al.*, 1995).

While most of the above tend to work against small producers, since their access to capital, education and market institutions may be restricted, the last point, quality of labor may actually favour small scale producers (Collins, 1995). This refers to the fact that many high value crops “*are highly responsive to constant and careful monitoring of plant health; careful weeding, pruning and irrigation; harvesting based on assessments of when individual pieces of fruit and vegetables are ripe; and careful, efficient handling*” (Collins, 1995). Since many of these activities (i.e. pruning and trellising) cannot be mechanized, there may be very limited economies of scale in production of crops that require high quality labor. In addition, small scale farmers may have lower cost of production because they achieve higher yields and/ or are less capitalized (Boselie *et al.*, 2003). In fact, Boselie *et al.* find that for these reasons it can be of advantage for supermarket suppliers to rely on procurement from small producers for relatively small quantities of product that meet specific and exacting standards. Collins (1995) however argues that even though small scale farmers can produce at lower cost, there are significant postharvest transaction costs associated with many high value crops, and that large farms can possess an advantage in postharvest transactions that at least partially offsets their higher production cost.

4.2.5 *Employment opportunities*

Generation of additional employment opportunities in rural areas where labor is abundant is critical for achieving widespread and equitable growth. The production of horticultural products offers opportunities for poverty alleviation, because it is usually more labor intensive than the production of staple crops. Horticultural production requires twice as much, sometimes up to four times as much labor when compared to the production of cereal crops (Weinberger and Lumpkin, 2005). Often, additional labor requirements are met through hired labor, benefiting small farmers and landless laborers (McCulloch and Ota, 2002, Weinberger and Genova, 2005). Greater employment opportunities result in greater incomes for poor households. In Bangladesh for instance, total value added in wages is approximately US\$ 400 per ha, 7.5 times higher than valued added through hired labor in rice (Weinberger and Genova, 2005).

4.3 Value addition and processing

Poor postharvest management and lack of knowledge about required technologies, quality standards and food safety protocols severely limit producers' access to markets in Asia and the Pacific. Postharvest losses of vegetables vary greatly among commodities, production areas and seasons but it is estimated that between 20 to 50% of the crop is lost in the varied steps from farmer to consumer (Kader, 2003).

Small producers and firms often lack access to critical postharvest knowledge, technology and infrastructure. Where smallholder farmers and small-scale enterprises do not have access to the same technology, information and market outlets, they are subject to significant transaction costs as compared to large farmers. Since most high value agricultural products are characterized by a ratio of high value of transaction cost to final products, poor households find it more difficult than wealthier households to engage in the production of these products (Goletti, 1999).

Increased vertical coordination by linking supply chain actors through contracts, strategic alliances and other government modes can substantially reduce transaction costs and reduce risk as has been shown for the case of milk, broilers and vegetables in India (BIRTHAL *et al.*, 2005) and broilers in Indonesia (Patrick, 2004). Proponents of vertical coordination thus argue that it leads to increases in incomes and employment and puts local economies on a dynamic path of growth and development.

Small-scale processing and value-adding has potential as drivers of income enhancement through value addition (Gandhi *et al.*, 2001, Reardon and Barrett, 2000). However, it has also been reported that long-term commitment is required from all stakeholders to facilitate access to financial services, markets and the promotion of an enabling institutional environment, in order to reduce transaction cost of small and poor farmers and entrepreneurs (IFAD, 2003, Reardon and Barrett, 2000).

Research and development of appropriate postharvest technologies for small and medium sized producers, value-added processing techniques, food safety protocols and quality standards for vegetable commodities can help to reduce postharvest losses, improve food safety, and contribute to increased producer incomes and the subsequent development of rural economies.

4.4 Domestic markets

Domestic markets are expanding for high value crops, because of emerging educated middle classes with increasing incomes. China, India, Indonesia, which belong to the countries with the largest populations, have large emerging middle classes which impact the demand for high-value food crops (Senauer and Goetz, 2003). These markets are often influenced by younger, affluent urban population groups and farmers need to understand their demands. However, studies have shown that farmers have misperceptions about the nature of the demand for their products, reflecting the low farmers' awareness of their market's needs and thus putting these farmers at a disadvantage (Concepcion *et al.*, 2004). Enabling farmer access to information and capacity building to deal with the information is thus crucial for participation in markets for HVAP.

At least in the short run, domestic markets will probably continue to be more important for most producers in Asia and the Pacific than export markets. However, domestic markets are also undergoing a rapid transformation as a growing number of affluent urban consumers demand safe food products, reported for example from markets in Hanoi (Figuié, 2004). The standards for participation in high value markets are thus increasing both in developed and developing countries. The opening of access to world markets under globalization is raising the demand for storage, quality, convenience, and safety characteristics both of food products that are consumed in the growing formal food sector of cities and of exports. Meeting these new demands not only requires that the products meet the characteristics, but also that they can be

verifiably certified as such, which involves better organization of the supply chain from producer to consumer.

The growing importance of convenience outlets has implications of its own, coming from the methods of procurement used and the quality standards applied by supermarkets. The difficulties farmers can experience is reflected in fairly rapid declines in the numbers involved, as companies tend to de-list suppliers who do not meet expectations in terms of volume, quality and delivery. In Malaysia, for example, the Giant chain had 200 vegetable suppliers in 2001 but by 2003 this was down to just 30. In Thailand, similar changes have been seen following the introduction of a distribution center for the TOPS supermarket chain (Shepherd, 2005). For Indonesia, Chowdhury *et al.* (2005) report that smallholders are well integrated into modern value chains, but that this integration depends largely on the vendors who link the farmers to supermarkets. Small-scale farmers can find it difficult to produce and deliver according to standards dictated to them by the supermarket chains (Reardon *et al.*, 2003).

4.5 International markets

Rapid growth in mean per capita incomes in developed countries during the 1990s has enabled consumers to purchase a broader range of relatively expensive commodities such as off-season produce, exotic fruit and vegetables. Higher incomes have also raised the demand for other "quality attributes." Increasingly, consumers are concerned about quality and safety of their food, as well as the social and environmental conditions under which it is produced. This trend, in turn, has led to the increased importance of organic food and labeled brands (Reardon *et al.*, 1999, Yussefi and Willer, 2003). Organic trade from developing to developed countries is currently growing at over 20% per year (Raynolds, 2004).

The participation of small producers in global fruit and vegetable trade is also affected by the increasing attention that food quality and safety are receiving in food trade, coupled with an expansion in the number of non-tariff measures that developed countries apply to agricultural products (Henson and Loader, 2001). Fruit and vegetables belong to the class of food items most frequently affected by sanitary and phytosanitary measures (Unnevehr, 2000). Traceability, phytosanitary, infrastructure, and productivity issues will continue to be a barrier for participation in the fruit and vegetable trade for most of the developing world. Application of agricultural chemicals is often poorly regulated and industrial pollutants are common

hazards in the soil, water, and air of developing countries. In the future, the inability of developed countries to meet increasing strict phytosanitary and traceability requirements for food products will increasingly constrict exports to developed countries. Growers and processors in developing countries will thus have to learn to supply safe products with traceabilities labels if their participation in global trade shall continue and expand.

5 R&D activities in the regions and lessons learned

APAARI, the Asian Pacific Association of Agricultural Research Institutes, collects and publishes success stories of agricultural research on their webpage⁶. The studies cited are based on a variety of sources. In total 24 of such success stories have been published, and while not all of them refer to high value agricultural products, some of them do address fish production, livestock and horticulture. Another source describes a number of case studies commissioned by DFID for South Asia that look at the impact of postharvest technologies on the rural poor⁷. AVRDC has conducted an in-house impact assessment to study adoption of vegetable technologies and impact on the poor in Bangladesh, and IFPRI has assessed the impact of vegetable technologies on the poor within a livelihood framework.

Because the studies were conducted with different objectives and by different institutions, the information they provide is obviously not always comparable. Also, the number of successful R&D stories found was much larger than the number of studies dealing with unsuccessful cases – probably because there is a larger incentive to report on the former. However, a number of general conclusions can be drawn from the 12 studies reported below that span from India to the Philippines (Table 5). A drawback of several of the studies is that impact on poor and small-scale farmers is not addressed, although development of technologies for small-scale farmers is an explicit objective of most of the research and development studies summarized below.

First, all studies, whether explicitly or implicitly, show that successful research and development efforts rely on the collaboration between a number of organizations. While this will hold true both for research efforts in HVAP and in traditional agricultural products, it is probably more important for HVAP, since supply chains are longer and more complex, and a larger number of agents needs to be involved in the communication process.

This leads to the **second** point that where HVAP are concerned, it is important to include the private sector into the consultation process. Examples for positive interaction with the private sector include the alliance with a large commercial card

⁶ <http://www.apaari.org/>

⁷ <http://www.cphp.uk.com/>

box manufacturer in the case of the tomato postharvest technology project in the Himalayan Hills (Clark *et al.*, 2003), the informal exchange of information between national researchers and private corporations described in the Tilapia case study (Guerrero, 1994) and providing private seed companies in Thailand with open-pollinated baby corn seed for multiplication at low cost (Chutkaew and Paroda, 1994).

Thirdly, communication between the various agents in the supply chain, between researchers and donors benefits from facilitation, since it is a complex process (Hall *et al.*, 2003). Facilitation includes bringing together partners with a specific set of skills, and also with a joint vision and understanding. However, managing and nurturing relationships is a managerial task that requires proper competence in itself.

Fourth, production of HVAP will only increase when there is demand, whether domestic or international. A number of the studies mentioned below provide examples of products that were able to position themselves on markets, whether domestic (the case of dairy production in India (Aneja, 1994) and Tilapia in the Philippines (Guerrero, 1994)) or international as in the case of red seaweed in the Philippines, (Guerrero, 2001) and baby corn (Chutkaew and Paroda, 1994) and orchids in Thailand (Thammasiri, 1997). However, it is not clear from the publications whether any of the technological interventions were based on *a priori* demand studies. In fact, the baby corn study concludes that “*the steady growth of the foreign markets has also come as a pleasant surprise*” (Chutkaew and Paroda, 1994). Some of the studies however conclude that public awareness campaigns were important to increase demand in domestic markets (Chutkaew and Paroda, 1994, Pillai, 2001).

Fifth, HVAP can have impact on poor, marginal and small-scale farmers. However, none of the twelve studies summarized below was exclusively addressed towards the poor. Several authors report that the technology benefited both the poor and the non poor as for the tomato postharvest technology in the Himalayan Hills (Clark *et al.*, 2003), the horticulture development program in Kerala (Sulaiman and Pillai, 2003), the vegetable research project in Bangladesh (Weinberger and Genova, 2005) and the Tilapia case study in the Philippines (Guerrero, 1994). The one case study that describes a failed research program concludes that the poor did not benefit from the program because they were not given the opportunity to articulate their interest (Hall *et al.*, 2003). This links back to the third point that it requires a facilitator to ensure that all agents in the supply chain are given the opportunity to express their position.

Sixth, the impact on the poor that is documented (both case studies refer to vegetables in Bangladesh) includes employment and income effects through new employment opportunities, through substitution of family labor for hired labor and through increased wage income (Weinberger and Genova, 2005). Nutrition effects through the availability of higher quality food were also documented, in terms of a higher relative importance of vegetables in the diet, a higher consumption of total calories among adolescent girls, and positive health outcomes (school-aged and adolescents were found to be taller), as well as impacts on social solidarity and empowerment of women (Hallman *et al.*, 2003).

Seventh, positive effects for women are highlighted by Weinberger and Genova (2005) in increasing employment opportunities, and by Clark *et al.* (2003) who note that the improved technology reduced the drudgery for women. However, none of the research efforts mentioned below specifically address the impact of increasing participation in markets for HVAP on gender relations. As outlined above, export of HVAP is still relatively unimportant in Asia and the Pacific. However, it can be expected that as the market for these products grow, this will have an effect on the control of production, as has been documented for export vegetable crops in Eastern Africa (Dolan, 2002, Dolan, 2001). More research is required in the Asian Pacific region to assess changing gender relationships within changing markets for HVAP.

Eights, the prerequisites for technologies of HVAP to be viable for small and poor farmers are that they must be easy to adopt. This is influenced by a variety of factors, namely the expected impact of the technology on the vulnerability of the poor (to loss of income, bad health, natural disasters, and other factors); the availability of assets required for technology adoption; and whether institutions (such as agricultural extension services, government policies, nongovernmental organizations, the private sector, gender roles, markets for inputs and outputs, and so on) encourage or discourage adoption and represent the interests of poor people (Hallman *et al.*, 2003, Meinzen-Dick *et al.*, 2004). Several of the case studies thus describe supporting loan programs for farmers, such as the Tilapia case study, the bivalve mariculture program, the horticulture development program and the tomato postharvest technology project. Facilitating such activities is clearly out of the mandate of most research institutions, and links back to the points made under 1 to 3 – that research and development in HVAP may require more complex interaction within a range of actors than for traditional agricultural crops, and therefore requires participation of organizations with a clear mandate of facilitating this process.

Table 5. R&D activities on high value agricultural products in Asia, and lessons learned

No	Objective of intervention	Impact	Factors of Success or failure	Source
1.	Introduction of rainbow trout to expand aquaculture in the hills of Nepal	Rainbow trout production increased from nil in 1994/95 to 16.7 MT in 2001/02; (<i>Note: not all activities in the supply chain are yet fully commercialized</i>) No information on income/ poverty effect of this success story	Excellent research Good collaboration between national scientists and international donor Involved research institutions, development agencies, and private sector	(Rai <i>et al.</i> , 2005)
2.	Development of red seaweed industry to provide an alternative or supplemental means of livelihood for fishermen and their families in coastal areas with overexploited fisheries resources in the Philippines	Philippines is now world's largest producer of carrageenophytes and produces 31% of global supply, up from 1970 when it produced only 0.3% of global supply. Provides income to more than 100.000 families in coastal areas	Strong export demand R&D support of the government and academic institutions, and active role of the private sector.	(Guerrero, 2001)
3.	Development of bivalve mariculture (pearls, mussels and edible oysters) for income generation of coastal villagers in India	No data on production or value of production provided (<i>Note: no data recorded in FAO dataset</i>) Provides income to women	Mussel and edible oyster culture make use of simple technologies, few inputs required Loan support to farmers Market development through consumer awareness program	(Pillai, 2001)
4.	Development of orchids in Thailand	Value of cut flower exports increased from US\$ 0.4 million (1970) to US\$ 30 million (1995) No information on income/ poverty effect of this success story	Improved technologies from production to post-harvest to transport Efficient communication between stakeholders Maintenance of international standards	(Thammasiri, 1997)
5.	Dairy milk farming in India	Milk has become single largest agricultural commodity by value. Conversion of by-products of agriculture not suitable for human consumption (straw, maize, millet stalks) into a high value food.	Efficient milk production system, well integrated into the local farming system Use of indigenous genetic material Very professional cooperatives = very short supply chain, farmers get a large	(Aneja, 1994)

No	Objective of intervention	Impact	Factors of Success or failure	Source
		Average consumption of milk in India has increased rapidly and is now 200g per capita and day. Nearly 2/3 of the milk producers are small and marginal farmers	share of the consumers price (2/3 rd)	
6.	Technology development for Tilapia production for small-scale farmers and large commercial producers in the Philippines	Tilapia production increased from virtually none in the 1970s to 100.000 MT in the 1990s. It is the 3 rd largest producer worldwide Benefits for poor coastal communities Additional incomes for marginal rice farmers and landless peasants	Cooperation between government, international donors and private sector Informal communication between private sector and scientists	(Guerrero, 1994)
7.	Development of technologies for baby corn production and processing in Thailand	Increase in canned baby corn exports from 67 tons/ US\$ 0.038 million (1974) to 36,671 tons / US\$ 33 million (1992) No information on income/ poverty effect of this success story	Government supported the development of the processing industry Cooperation between government and industry Collaboration between development and research organizations Public awareness campaign to increase domestic market	(Chutkaew and Paroda, 1994)
8.	Development of tomato postharvest technology (packaging material) in the Himalayan Hills (India)	By the end of the third year of this intervention 30,000 cartons were produced on a commercial basis and sold to tomato producers. Impact is inclusive of the poor, i.e., both the poor and the non-poor benefit from the intervention; Gender concerns were addressed, since women rather than men suffered from existing package technology; Addressed the enabling environment of the poor by reducing their vulnerability to policy changes – in this case environmental policy related to raw materials for packaging.	Recognition that formal R&D was only one of a series of related tasks required to bring about change Linking up all agents in the supply chain – farmers, wholesalers, researchers, private sector required a facilitating institution that – identified partners with specific skills and involved them in the intervention; – identified partners with specific culture (i.e. work with and include farmers in the part of the intervention for which that partner assumed responsibility) – actively managed and nurtured relationships	(Clark <i>et al.</i> , 2003)

No	Objective of intervention	Impact	Factors of Success or failure	Source
			Experimental approach	
9.	Increase and stabilize the income of fruit and vegetable smallholder and marginal farmers in Kerala, India	<p>The project with its focus on smallscale horticulture producers benefits both poor and non-poor households.</p> <p>The project did not claim to be targeting the poor, instead it recognized that small-scale horticultural producers are vulnerable to exploitation in the market and that declining incomes can be supported by technical and market interventions. The evidence available suggests that the program has helped farmers in these aspects.</p>	<p>Success of partnerships in technology development is determined to a very large degree by the wider institutional environment in which these initiatives take place.</p> <p>Learning by doing or a trial and error approach to establishing arrangements is the key to success</p> <p>The technology development components of an initiative need to be woven into a broad-based set of activities that included organizational development at the village level, and the creation of new marketing and credit arrangements.</p>	(Sulaiman and Pillai, 2003)
10.	Development of quality management protocols for the export of mangoes to the European market in India	No pro-poor innovation	<p>Limited interaction with farmers and packhouse operators in the development of recommendations resulted in practical difficulties in implementing these recommendations.</p> <p>Development of technology was not integrated along the supply chain</p> <p>Lack of communication between different organizations</p> <p>Agenda was dominated by non-poor stakeholders</p>	(Hall <i>et al.</i> , 2003)
11.	Introduction of improved vegetable technologies in Bangladesh	<p>Total vegetable production has doubled from 1 million MT (1980) to 2 million MT (2004). Between 1996 and 2000, vegetable production grew at an average annual rate of 5.4%.</p> <p>Vegetable production is replacing traditional crops such as jute and pulses</p>	Government support - investment in irrigation facilities, rural infrastructure, agricultural research, and extension services	(Weinberger and Genova, 2005)

No	Objective of intervention	Impact	Factors of Success or failure	Source
		Vegetable production has had employment effects and under certain circumstances women can benefit from these opportunities High market integration of vegetable farmers Broad and widespread welfare effects		
12.	Introduction of improved vegetable technologies in Bangladesh	No significant impact on household income → small-scale technology But: poor households more likely to grow a large diversity of vegetables than better-off households which saves expenditures Impact on nutrition Impact on social solidarity and empowerment	<ul style="list-style-type: none"> ▪ Technology easy to adopt <ul style="list-style-type: none"> – Very little land required – Low levels of cash investment – Flexibly timed labor inputs – No need to move beyond homestead (<i>purdah</i>) ▪ Little risk involved, as opposed to other technologies (i.e. fishpond) <ul style="list-style-type: none"> – No displacement with other crops – Failure of vegetables does not imply loss of other income earning opportunities 	(Hallman <i>et al.</i> , 2003)

6 Conclusion

Research and development efforts in HVAP offer the potential to support the livelihoods of poor people in developing countries, including farmers, small-scale agroprocessing entrepreneurs, off-farm laborers, and consumers of food and agricultural products.

Efforts to strengthen production and processing of HVAP in Asia and the Pacific will need to pay much greater attention to the institutional environment in which change takes place. The institutional environment determines the level of transaction costs that are related to the production and marketing of high value agricultural products. Since high transaction costs are a main barrier to the participation of small and poor farmers in the supply chains for HVAP, reduction of transaction cost has to be the main objective of research aiming at enhancing diversification of smallholder farm operations by strengthening the production of HVAP.

Supply chains for HVAP typically are much more multifaceted than for traditional agricultural products. Research and development efforts have to take account of this complexity that involves managing communication between many different agents from farmers to the industry sector. A possible approach to deal with the requirements of such a chain is to facilitate interaction between all the stakeholders in the chain.

Knowledge on constraints in the input distribution chain for high value crops, i.e. for seeds, remains limited, making it difficult to enter into target-oriented promotion of the vegetable and fruit seed and seedling sector. It is therefore necessary to gain a solid understanding of the issues within the fruit and vegetable seed sector for high value crops, both private and public, identify constraints and problems the sector faces, and formulate a strategy for sustainable development to empower growers.

Appropriate quality systems means the set of programs, policies and procedures aimed at defining the quality characteristics and standards of agricultural commodities and agri-based products infrastructure will be crucial, as are the dissemination of standards, implementation and monitoring. A quality system infrastructure requires that standards and quality assurance systems be in place, with adequate incentives, and communicated to farmers. Correct information is vital in ensuring the efficiency of supply chains. With quality system infrastructure, farmers will be able to access correct information which will be a vital factor in maintaining

balance and efficiency along the chain. Capacity building to ensure that information is properly used is also required.

Postharvest and agroprocessing are two other areas that require attention. Limited processing facilities and high transportation cost are two limiting factors in the production of perishable agricultural produce and lower production cost of small scale farmers may be offset by higher transaction costs as compared to larger farmers. Emphasis in postharvest research needs to be on reducing losses in quantity and quality while ensuring food safety between harvest and consumption sites. Possible interventions include breeding for postharvest traits and development and adaptation of postharvest handling technologies to specific local conditions. The development of agroprocessing industries in rural areas will require the availability for low cost technologies as well as an enabling institutional environment.

Finally, policy makers need to turn their attention towards an enabling environment, to allow farmers to participate and compete with their products in markets increasingly determined by quality standards and food safety concerns. Only then will small and poor farmers be provided the opportunity to participate in markets for high value agricultural products.

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