Westernization of Asian Diets and the transformation of food systems: Implications for research and policy

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1. Introduction

Rapid economic and income growth, urbanization, and globalization are leading to a dramatic shift of Asian diets away from staples and increasingly towards livestock and dairy products, vegetables and fruit, and fats and oils. While the diversification of diets away from the traditional dominance of rice with rising incomes is expected and observed, current food consumption patterns are showing signs of convergence towards a Western diet. Globalization and the consequent global interconnectedness of the urban middle class, is the driving force behind the convergence of diets. The rapid spread of global supermarket chains and fast food restaurants are reinforcing the above trends.

The following six key stylised facts characterize the changes in food demand in Asia: i) reduced per capita consumption of rice; ii) increased consumption per capita of wheat and wheat based products; iii) increased diversity in the food groups consumed; iv) rise in high protein and energy dense diets; v) increased consumption of temperate zone products; and vi) the rising popularity of convenience food and beverages. As the demand profile changes with economic growth and globalisation, so the supply systems must adapt to accommodate this change.

Asian agriculture is on an irreversible path leading away from its traditional pre-occupation with cereal crop production, especially rice, towards a production system that is becoming increasingly commercialized and diversified. This paper addresses the opportunities and constraints in the transformation process. It discusses the prospects for the small farmer to share in the benefits from greater market integration. Finally, the paper identifies an agenda for science, technology and policy that will allow for a smoother transition to the emerging production and food supply system.

1. Diet and Nutrition change in Asia

1.1 The driving forces of diet change

The dietary changes across Asia result from the interaction of demand and supply factors. The main determinants of the changes in the demand for food are: income growth, which leads to major shifts in demand across different types of food; the process of urbanisation, which brings about new dietary needs; and more generally lifestyle changes. On the supply side, the main factors affecting the availability of food are: the closer integration of global economies, which severs the links between the local production and the availability of food (see Pingali and Khwaja, 2004); the liberalization of foreign direct investment, with the

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new role of multinational corporations; and the steep reduction in freight and transportation costs.

Urbanisation can be seen as the process whereby social and economic change is accompanied by industrial development. The United Nations Economic and Social Commission for Asia and the Pacific region predicts that by 2020, half the world's population will be urban and that Asia alone will contain half of that population. Urban population worldwide, estimated at about 2.9 billion in 2000, is projected to reach 4.9 billion by 2030. Most of the increase will be in the cities of developing countries. The urban population in developing countries is projected to increase from 1.9 billion people in 2000 to about 3.9 billion people by 2030, thus accounting for almost the entire increment in developing countries' population growth (see UNFPA, 2001).

These shifts in population distribution are considerable. At the beginning of the 1960s, only about 20 percent of the developing countries' population lived in urban areas. By 2000 the share had risen to nearly 40 percent and is expected to rise to 56 percent by 2030. The rural-urban population ratio declined from about 3:1 in the 1960s to almost 3:2 in 2000 and will be close to 3:4 in 2030 (FAO, 2003). The growth in urban populations is most evident when we look at the growth of the mega-cities in the developing world. In 1950 New York City was the only city with a population greater that 10 million people. By 2000 there were 19 cities with populations greater than 10 million people, and by 2015 the projections are that there will be 23 mega-cities around the world (UN, 2000).

Asian countries in economic and demographic transition are already showing dramatic changes in food consumption patterns **(**Shetty**,** 2002**).** The rapid quantitative changes in dietary intake indicating an increase in per capita availability of food have been accompanied by qualitative changes in the diet (Horton, 2002; Popkin, 1999). Particularly striking is the rising share of meat, milk and other animal products in the daily diet across Asia (FAO, 2003). At the same time there is a declining trend in rice consumption per capita that has been widely documented (Ito et al., 1989; Haung and David, 1993).

It is important to note that the growth in mega-cities, in addition to its implications for the demand for food associated with the lifestyle in urban areas, also have supply side effects. Large urban markets create the scope for the establishment of large supermarket chains, with their implications throughout the food supply chain. Over time, it is also expected that the expansion of agricultural trade and the progress in transportation and communications will contribute to a convergence of diets among groups of developing countries. Given the current trend towards globalization, there is a tendency for dietary structure to become increasingly similar across similarly developed countries. As income levels increase in developing countries, exposure to the global "urban" eating pattern increases, resulting in the consumption of many Western-style foods (Regmi and Dyck, 2001). There is evidence that diet transition is also witnessed in smaller and poorer households, especially with increased reliance on street foods (FAO, 2002f, Ruel et al., 1998). This is, in part, because the purchase of street foods frees up time for income-earning activities. Urban slums are often characterised by copycat street foods, that is, food stalls that seek to mimic the branded products of fast food outlets (Pingali and Khwaja, 2003).

Also, urban areas are centres of economic opportunity and have a greater percentage of women working outside the home. The evidence clearly shows that women's participation in the labour force is rising but also that it is rising in services sector. Given that the services sectors tend to be urban in nature, this explains why there is increased demand in urban areas for certain foods that reduce the preparation time of food in general and are also associated with lifestyle and income improvements. Studies have indicated that increased opportunity cost of women's time increases the demand for non-traditional "fast food" in many countries. The increased value of women's time appears to be an important factor in the rising demand

for bread in urban households in Sri Lanka (Senauer, Sahn, and Alderman, 1986). Huang and David found urbanization to have a negative effect on rice, but a positive effect on wheat consumption in Asia. In general, we could see an increase in the consumption of ready-made meals, or meals that cut the long preparation time of traditional dishes. In addition, reduced fertility rates for working couples could lead to smaller families, who could demand convenience processed food and who could eat outside the home on a more regular basis.

Generational differences between developed and developed countries also have an important bearing on the Westernization of food consumption patterns. A Japanese study has shown that, the younger generation consume more beef and beer whereas older people eat more rice, vegetables and fruits (Wilkinson, 2003). Similar patterns are observed in other Asian countries, implying divergence of food habits across generations. Consequently, the Westernization of food consumption patterns would have important long-run implications, as food habits are acquired at a relatively young age.

1.2. The emergence of super markets and fast food chains

With economic development, and driven by potential economies of scale, supermarkets tend to replace central food markets, neighbourhood stores and street sellers of food in urban areas. Retail food trade in developing country urban centres will be characterised by the co-existence of major distribution chains and small-scale, ill-organised commercial outlets (de Haen et al., 2003). Reardon, et al. (2003) argued that the supermarket revolution is taking off across Asia. By 2002, the share of supermarkets in processed/packaged food retail market was 33% in Southeast Asia, and 63% in East Asia. The share of supermarkets in fresh foods was roughly 15-20% in Southeast Asia and 30% in East Asia outside China. The 2001 supermarket share of Chinese urban food markets was 48%, up from 30% in 1999. Supermarkets are also becoming an emerging force in South Asia, particularly in urban India since the mid-1990s (Pingali and Khwaja, 2004).

Along with the growth in supermarkets, Asia has over the last decade observed a rapid rise in the number of Western fast food chains serving the big cities, and increasingly spreading out into smaller towns. Table 1 presents, as an example, the case of the spread of McDonald's in Asia between 1987 and 2002. Mc Donald's is a very visible indicator of the rapid change in diets in the Asia region and the evidence clearly shows that since 1987, the number of restaurants has grown quite markedly in Asia and the trend seems set to continue. The observed growth in fast food chains is not just from multi-national corporations, such as McDonald's, but also from domestic firms that begin to copy the products and operational procedures of the foreign companies. The spread of supermarkets and fast food chains, while most visible in the big cities, are also making in roads into smaller town, especially in East and Southeast Asia.

Table 1
The Spread of fast food chains in Asia/Pacific:
The Case of McDonald's 1987 - 2002

Asia/Pacific	1987	1997	2001	2002
Japan	604	2437	3718	3891
Australia	204	642	711	726
Taiwan	22	233	341	350
China	3	184	392	546
Philippines	13	157	231	236
South Korea	0	114	289	357
Hong Kong	36	140	185	216
Other	69	549	656	813
Total Asia/Pacific	951	4456	6523	7135
USA	7567	12380	12953	13491
Europe	755	3886	5622	6052
Latin America	99	1091	1546	887
Global Other	539	1319	2773	3543
Global Total	9911	23132	29417	31108

Source: McDonalds Corporation Annual Report

1.3 Current trends in diet diversification (urban/rural and by income levels)

The pattern of food consumption in Asia is changing rapidly with increases in income. The nature of the change is also significant. Both the range of foods consumed is moving away from traditional foods, that is those with a strong cultural identity towards more western patterns of food consumption. The result is the consumption of more energy dense foods and thus, typically, calorie intake has gone up substantially in this region particularly for higher income groups.

Data from China shows that while the intake of cereals and the consumption of coarse grains decreased during the past two decades in both urban and rural populations, this was accompanied by a dramatic increase in the consumption of animal foods over the same period illustrating a shift away from carbohydrates to fat and protein. A similar, but less dramatic change is also observed in India with figures that suggest a doubling in the intake of fat calories over a 20 year period. Although the consumption of rice and wheat has been increasing, the percentage of all cereals in the household expenditure has been declining. Meat consumption in India has been growing, although not as fast as in China (IFPRI, 1999). The major increases in food consumption in India are in milk, eggs, fruit and vegetables. Vegetable oil demand is also growing (USDA, 2001). The following section describes a set of indicators of the diet transition that is in progress across Asia.

1. Decline in per capita consumption of rice:

There is substantial empirical evidence to indicate that rice consumption in Asia declines, on a per capita basis with income growth. The negative trend in rice consumption is further exacerbated by urbanization as discussed earlier. It ought to be noted, though, that there will also be a significant shift into the consumption of high quality rice, such as,

Japonica, Jasmine, Basmati, etc. (See Pingali, et al., 1997). Chinese consumers now differentiate rice according to quality and attributes, including stickiness, fragrance, and gluten and protein content, with widely varying prices, reflecting high income elasticity for quality (Hsu, Chern and Gale, 2001).

2. Growth in per capita wheat consumption:

While in Western societies, wheat is considered an inferior good and a decline in per capita consumption with income growth is observed, in Asia wheat is fast becoming the preferred staple (Pingali and Rosegrant, 1998). Traditional rice eating societies are consuming increasing quantities of wheat in the form of bread, cakes, pastry, and other products. That is, wheat is not being used as a substitute in a traditional manner but wheat consumption reflects western preferences. In India, for example, western style bread consumption is rising (Pingali and Khwaja, 2004). Countries that traditionally imported rice for meeting food gaps may now be shifting towards increasing levels of wheat imports.

3. Growth in demand for other temperate zone products:

Products in this category include temperate zone vegetables, milk and dairy products, meat, and temperate fruit. Data on the structure of imports of temperate-zone commodities are revealing as to the changing dietary patterns in developing countries. Net imports of this category of products increased by a factor of 13, over the last 40 years, rising from a minor deficit of US$1.7 billion in 1961/63 to US$24 billion in 1997/99. What is important for the purposes of the discussion on the food economy is the expected pattern of food imports within the class of temperate zone products. While the cumulative increase in imports of those products is expected to be 154% between 1997/99 and 2030, meat imports are expected to increase by 389 percent during the same period, while a cumulative increase of 17% is expected for vegetable oils and oilseeds. It seems given these figures that these trends will create irreversible changes in dietary habits[2]. The overall result is that we are beginning to see a homogenisation of food tastes across the globe with regional variations. However, these variations are becoming less marked over time. For example, McDonald's sells a burger in Japan with teriyaki whereas in China the burger reflects Chinese tastes. The point remains that the basic product is essentially the same.

Another indicator of the Westernization of Asian diets is the rising consumption of potatoes. Bouis and Scott (1996) found potatoes to have positive income elasticities of demand in Bangladesh and Pakistan. Rising incomes have stimulated a demand for Western style fast food, including fried potato chips. Accordingly, Asia's share of global potato output jumped from 7.5% in 1961-63 to 28.2% in 1995-97 (Scott, Rosegrant and Ringler, 2000).

Over the past 15 years many of the faster growing categories in trade are non-bulk packaged products, where consumers differentiate products carrying unique brands and labels. Pastry, prepared foods, and chocolates have grown in World trade by nearly 105 per year over the past 15 years. These alone account for more than $15 billion in world trade, a value exceeding the value of world wheat trade. Wine, a highly differentiated product has grown at a rate of 6% a year and is now $7.4 billion and likely will surpass trade in corn in value of trade (Gehlhar and Coyle, 2001).

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[2] An issue that is not dealt with in this paper, but which is of growing importance, is the health consequences of the diet transition. Increased consumption of highly-calorific and more energy-dense food could lead to an increased incidence obesity and of diet-related diseases, like diabetes, coronary heart disease and certain types of cancer (see Shetty, 2002). Popkins *et al.* (2001) carried out an analysis of diet trends and nutritional status in India and China and calculated the economic costs of these changes. Whilst the incidence of undernutrition by their estimates is declining, the incidence of obesity, diabetes and hypertension is rising.

2. Transformation of food supply systems

Asia is observing a dramatic transformation in its food supply systems in response to rapid urbanization, diet diversification, and the liberalization of foreign direct investment in the food sector. The observed changes are in both the retail sector as well as in the production sector. This section describes the changes in food supply systems, with a particular emphasis on provisioning the cities. It then proceeds to examine the implications for domestic production and the specific impact on small farmers.

2.1. Feeding the cities

Feeding the burgeoning urban masses is one of the most important food policy challenges facing Asia today and for the foreseeable future. There are three specific dimensions to the issue of feeding the cities. The first stems from the quantitative aspect. As mentioned earlier, urban populations are rising extremely rapidly, this requires not only increases in total urban food supply, but also the establishment of large suppliers in order to manage the increased level of activity in the market. The second dimension draws from the location of urban centres. Asia's most populous cities and towns tend to be located on the coast. Importing food to satisfy the changing food demand could be relatively easier and less costly than acquiring the same food from the domestic hinterlands. There will be a growing choice, at the margin, between domestic supply and imports, although one would suspect that both would rise in absolute terms. The third dimension derives from the qualitative aspect of demand changes in cities. The rapid diversification (and Westernization) of the urban diet cannot be met by the traditional food supply chain. It requires in effect the modernisation of the food retail sector, and the vertical integration of the food supply chain, including the diversification of cereal based farming systems of Asia. The above quantitative, qualitative, and organizational changes in the urban food supply drive the process of commercialisation and diversification of domestic production systems.

Imports vs domestic production

FAO' study on Agriculture towards the year 2015/2030 indicates that the trends in international trade of foodstuffs, which have seen developing countries turn from net exporters to net importers of food commodities, are expected to continue in the future. In 1961/63 developing countries as a whole had an overall agricultural trade surplus of US$6.7 billion, but this gradually disappeared so that by the end of the 1990s trade was broadly in balance, with periodic minor surpluses and deficits. The outlook to 2030 suggests that the agricultural trade deficit of developing countries will widen markedly, reaching an overall net import level of US$31 billion. Although it is important to note that, where agro-climatically and economically feasible, one should also anticipate an increase in domestic production of the more temperate zone commodities, such as wheat, potatoes, temperate fruit and vegetables, etc.

The vertical integration of the food supply chain

The change in urban food demand is almost simultaneously accompanied by changes in retail preferences. Vertically integrated food supply chain that links input suppliers, producers, processors, distributors and retailers becomes essential for meeting the changing demand requirements as efficiently as possible. Trade liberalization greatly facilitates the widespread establishment of global supermarket chains and fast food outlets and thus speeds up the diffusion of homogenous foods and of a global diet in the Asian market. Supermarkets

are in the ideal position to deal with both the quantitative, qualitative and location elements of changes in the urban food market. Moreover, supermarkets also play an active role in accelerating and broadening the scope for diet diversification, while at the same time, setting new standards for quality and safety.

From the consolidation of the retail sector, integration of the food supply chain has begun to move downwards towards the farm producers. Integration arrangements may differ. At one end of the spectrum the decision-making authority of the farmer is displaced further down the production line to the processor or retailer (who may be one and the same) so that farmers essentially are employed by these large processing firms (see Reardon and Barrett 2002). Importantly though, there are ways in which small farmers can enter the chain at various points in the production line without compromising their autonomy. For example, farmers may sell their produce at a particular point and not be tied in any further. In this case, the farmer may be guaranteed a buyer but if there is a collapse in product price the farmer is no more protected than if he were operating at subsistence level. Thus, the nature of the contractual arrangement can vary and need not necessarily involve reducing the decision-making authority of individual producers. Vertically integrated food supply systems are serving both the domestic as well as the export market.

In Thailand, international retailers such as 7-eleven, Royal Ahold, Tesco, Makro, and Sainsbury have been establishing supermarkets to serve the growing domestic market for fruit and vegetables. Small farmers were integrated into the fresh food supply chains via networks of contract farmers and buyers who are preferred suppliers, and via informal farmers' associations (van Roekel, Willems and Boselie, 2002). Similar cases of agricultural diversification and the emergence of contracts between farmers and large food outlets can also be observed in India (see Sabharwal, 2003; Deshingkar, 2003). In India, companies such as McCain (major supplier to McDonalds') negotiate with small farmers directly for the provision of potatoes (see Sabharwal, 2003). In these types of agreements, the large food outlet undertakes the required investment necessary to produce the specific product.

Vertically integrated supply chains have also been focussing on the export market. Chen, et. Al (2003) provides an excellent example from China of the development of a vertically integrated vegetable export supply system in response to Japanese demand. Increasing proportion of Chinese vegetable exports to Japan has been produced under tightly coordinated supply chains. One of the possible reasons is that, while China has almost no quality standards on vegetables, Japan has one of the strictest standards in the world. Because of this difference in quality standards, Japanese vegetable importers conduct business very differently in China. For example, Japanese trading companies have typically provided the seeds, spores, and techniques of production and packing, and imported the harvest for Japanese retailers. The increasing demand for better quality and safety control has lead to larger-scale farming, using more automation in production, packaging and transportation, and ultimately lead to the creation of significant vegetable supply companies. This is likely to become a significant trend as more growers become actively involved in supplying the fast-growing supermarket and hypermarket chains that are spreading across China. There is a growing convergence between export standards and domestic retail product standards.

2.2 Commercialization of the small holder sector

Small holder production systems in Asia are facing increasing pressure to commercialize and diversify out of their traditional niche in cereal crop production. The FAO-World Bank Study (FAO 2001) characterised developing country agriculture in terms of eleven broad farming systems. The three most important systems described in the study are all rice-based farming systems (see Table 2), these are the tropical lowland rice system; the rice-

wheat system; and the rainfed uplands. They account for about 80 % of the agricultural population and some 50 % of the total agricultural area in Asia. The tropical lowland and the rice-wheat systems are the dominant sources of rice supply in Asia, these systems witnessed rapid productivity growth during the Green Revolution and their productivity continues to be high in the post-green revolution period. Yet, the pressure to diversify out of rice is also the greatest in these systems, primarily because of low returns to rice relative to high value alternatives such as vegetables (Pingali et al., 1997). Commercialization and diversification pressures are leading to a dramatic transformation of the rice monoculture systems of Asia. Some of the resulting changes include: larger operational holdings; reduced reliance on non-traded inputs; and increased specialisation of farming systems. While the speed of these transformations differs substantially across countries, they are all moving in the same direction.

As economies grow, and the opportunity cost of labor rises, the returns to intensive production systems that require high levels of family labour are generally lower than those from exclusive reliance on purchased inputs. With the expected rise in operational holding size, the ability of the household to supply adequate quantities of non-traded inputs declines. Power, soil fertility maintenance, and crop care are the primary activities for which non-traded inputs are used in subsistence societies. With the increased opportunity costs, family labour will be used less as a source of power and more as a source of knowledge (technical expertise), management and supervision. Farm decisions become increasingly responsive to market signals, domestic as well as international, and less driven by traditional practice. While at a regional or sub-regional level, trends towards diversification out of cereal monoculture systems are being observed, at the individual farm level the trend is towards product specialization. In China, for example, while livestock production was traditionally a sideline activity for farm households, more farms are now specializing in livestock production. Chinese households that specialize in livestock production accounted for 15% of national livestock production in 2000 (Fuller, Tuan, and Wailes, 2001).

In the process of commercialization, rapidly increasing scales of production are being observed particularly in the livestock sector, trying to supply rapidly growing markets for meat, milk and eggs. Both global analyses and country case studies (conducted by FAO in Brazil, India, Thailand and the Philippines) confirm that advanced technology embodied in breeds and feeds appears to be critical to the success stories for poultry around the world, and the same is likely to become true for hogs over time. Much of this technology appears to be transferable, but only at relatively large-scales of operation, at least for poultry. Thus there is strong reason to believe that technology itself is a prime driver of the displacement of smallholders from the livestock sector. Small-scale producers obtain lower financial profits per unit of output than large-scale producers, other things equal. This suggests that, in the absence of deliberate action, small-scale producers will eventually be put out of business by competition from large-scale producers, especially since the better-off producers will scale up (de Haen et al., 2003).

A common characteristic of the global food system is the adoption of ever more stringent quality criteria to which developing countries are increasing being forced to adhere. To the extent that developing country governments do not impose international-level standards, private standards are being implemented by the leading players in retail and food-processing (Reardon and Farina, 2002). HACCP, ISOs, traceability systems, and private quality labels, are becoming entry tickets to international markets and increasingly the reference for quality in the domestic market of developing countries. This has led to an acceleration of obligational contract relations with raw material suppliers, involving detailed specification of production and delivery conditions. There is much evidence to suggest that

this is leading to a considerable degree of exclusion of small farms and firms (Wilkinson, 2003).

The bottom line is that while small farmers can benefit from the process of commercialization, scale economies in access to technology and markets, and in meeting standards, etc, makes it more than likely that they will be displaced in the long term.

3. The Diversification of Rice-based Farming Systems

As discussed earlier, across Asia there is a gradual but definite movement out of subsistence food crop production, generally in a monoculture system, to a diversified market-oriented production system. Yet, in almost all Asian countries, agricultural policies and institutions have favored self-sufficiency in cereals and the inertia in this system would act as a strong disincentive for diversification unless drastic changes in policies and institutions are adopted. An example of this is the fact that the share of cereals in the value of agricultural output has generally remained unchanged in South Asia as a whole.

Table 2: Main Rice-Based Farming Systems in Asia

Farming system		Land area (% of region)	Agricultural population (% of region)	Principal livelihoods
Tropical lowland rice		**11**	**32**	
Agricultural population	604			Irrigated and rainfed rice, vegetables, legumes, off-farm activities
Cultivated area	93			
Irrigated area	42			
Rice-wheat		**9**	**22**	
Agricultural population	416			Irrigated rice; wheat, vegetables, livestock including dairy, off-farm activities
Cultivated area	93			
Irrigated area	158			
Rainfed uplands		**30**	**26**	
Agricultural population	636			Cereals, legumes, fodder, livestock, horticulture, seasonal migration & off-farm activities
Cultivated area	189			
Irrigated area	38			

Source: Tables 5.1 and 6.1 *Farming Systems and Poverty, FAO 2001*
Note: Population figures in millions, area figures in million hectares.

A framework for assessing the flexibility of rice lands and rice growers to respond to the commercialization trends through seasonal or permanent diversification out of rice

monoculture systems has been developed by Pingali et al. (1997)[3]. According to them, the potential for diversification out of cereal production depends on both physical and economic factors. The feasibility and cost of substituting other crops vary across the three farming systems: lowland rice, rice-wheat and rainfed uplands. Each of these systems presents different rainy and dry season profiles and requires different levels of physical and human capital investment to switch from rice to non-rice crops and vice versa. The flexibility of growing temperate zone crops is also severely restricted, and would be generally feasible only in the sub-tropical rice-wheat production zone, and in the mountain agricultural systems.

The flexibility of farmers to respond to the changing relative prices and relative profitability in their crop choice decision-making can be described in terms of the level of investments (both physical and human capital) required in switching from rice to non-rice crops and vice versa. Flexibility is low, during the rainy season, for the tropical lowlands and the rice-wheat zone, because the drainage costs for growing non-rice crops can be prohibitive (Pingali et al., 1997). Upland areas, however, can oscillate between rice and non-rice crops with minimum additional investments.

Access to markets and the relative prices of rice and non-rice crops, especially horticulture, are additional determinants of diversification. Whilst roads and market places are important, proximity to the urban areas expands the range of non-rice diversification options especially for fresh produce.

During the wet season, rice will continue to be the dominant source of income in all but upland environments. This is not to imply that rice is not an important source of income for the uplands, but rather to stress the fact that the uplands have always been diversified because they do not face the drainage constraints.

In the irrigated lowland rice and rice-wheat systems, dry season rice and/or wheat would continue to be the major source of income. Areas with good market access and those near urban centres would increasingly diversify to non-rice crops and vegetable production. The dominant dry season activity for the rainfed lowlands would essentially be non-crop activities, off-farm employment, livestock production and cottage industries. There is a scope for post-rice crops on residual moisture, or pre-rice crops during the early wet season. However, the share of total income from this activity would be relatively lower than from the other activities. Dry season cropping activities in the rainfed areas are limited because of technical problems related to timely and effective crop establishment, limited moisture (or excessive moisture in some cases), and generally modest or high yield instability. Off-farm activities are often more dependable sources of income, suggesting that dry season cropping intensities would remain low even if technical problems in crop production were solved.

3.1 Commercialization and Diversification Constraints

Diversification out of rice is constrained by market availability and size, land suitability and rights, irrigation infrastructure and labour supply. Where output demand is relatively elastic, the returns from investments in land, technology, and time spent in learning about new crops, are relatively higher.

Diversification and Risk

Liberalization of domestic markets, through removal of quantitative restrictions on trade, and opening up of economies to internal trade opportunities is often a key step in starting or accelerating the process of commercialization. However, the opening up of markets

[3] This section draws heavily from Pingali et al. (1997) Chapter 8.

also exposes producers to increased risk due to the greater volatility of world prices. Governments have historically intervened heavily in domestic markets to protect and stabilize the prices of agricultural commodities, with the result that domestic producer prices have varied substantially less than international prices. The relationship between diversification and risk is thus crucial in the context of trade and macroeconomic reform designed to align domestic prices more closely with international prices.

Risk aversion is a significant impediment to what would seem to be a rational diversification on the basis of average profitability of alternative crops. Behaviour in the face of risk aversion is affected by attitudes of farmer and the nature of technology. But the fundamental problem is the failure of local credit and risk institutions to provide any potential to farmers for transferring their risks to other parties. Risk avoiding thus becomes an internal household strategy, and many households concentrate on growing a familiar crop with known technology and yields and guaranteed prices rather than risking their livelihood on new crops with untested price patterns.

Many low-volume markets are associated with high-price volatility. Moreover, the diversification "start-up" phenomenon, of high prices for several seasons leading to over-supply and a consequent collapse of prices, is all too common. This can be countered by measures to expand the market by lowering transaction costs, improving external linkages or providing storage and processing technologies. Effective rural financial institutions will also assist in risk spreading and in the sharing of the benefits of commercialization more widely across the community and region.

Land Suitability and Land Rights

The ability to profitably convert ricelands to non-rice crops is constrained by the drainage requirements for the lowlands and erosion control investments in the uplands. It is important to understand that not all lands can be converted to non-rice production. Even for lands that can be converted, substantial investments in land improvements need to be made to sustain long-term productivity and profitability of non-rice crop production. Investments in land improvements are likely to be made only where secure rights to land exist.

In the irrigated lowland rice and rice-wheat systems, when the dry season returns to non-rice crop production dominate the returns to rice production the demand for and the price of land with the least constraints to diversification out of rice will be the highest. If market access is good, the profitability of diversified field crop production on soils not highly susceptible to erosion is high. For soils susceptible to erosion, profitability of field crop production is determined by the level of erosion control investments. Where such investments are high, tree crops may be a more viable option than field crops, particularly when land degradation has been allowed to occur through field crop production. In upland areas with poor market access, the returns from diversification out of subsistence rice production are limited in areas of either type of soil.

Secure rights to land create the incentives farmers need to invest in land improvements that conserve and increase the long-term productivity growth which can be induced by the start of commercialization (Pingali and Rosegrant, 1995). Secure land rights increase the probability that farmers would recoup the benefits from long-term investments (e.g. land development, orchard development, etc.), thereby increasing their willingness to make investments on them. Land titles act as collateral to loans and thereby enhance lender's willingness to offer credit, leading to easier financing of purchased inputs and land improvements.

Irrigation Infrastructure as a Constraint to Diversification

Large scale diversification of cropping systems necessarily involves diversified production in the irrigated lowlands, because of the importance of irrigation to overall agricultural production. Many observers have argued that the existing irrigation systems constrain diversification because of the rigid designs of infrastructure and inflexible water delivery systems (Shah and Agouti, 1988). It is argued that this inflexibility prevents appropriate allocation of water to non-rice crops, constraining farmers to rice monoculture. Based on these arguments, technology-based solutions to diversification within irrigation systems are advocated, mainly capital investment in improved conveyance, diversion, and drainage systems. An alternative argument would be that the failure to diversify within the irrigation systems is the result of incentive failures resulting from centralized allocation of un-priced irrigation water. Policies that establish markets in tradable water rights could establish incentives to economise on water and choose less water-intensive crops (in the dry season); by inducing water users to consider the full opportunity cost of water (Rosegrant *et al*., 1995). Establishment of transferable water rights can provide maximum flexibility in responding to changes in crop prices and water charges as demand patterns and comparative advantage change and diversification of cropping proceeds (Rosegrant and Binswanger, 1994).

Labour Constraint

Does diversified cropping increase labour requirements? Yes; relative to rice, the per hectare labour requirements for onions, vegetables and other high-value crops are substantially higher. Labour requirements, for providing temporary drainage structures, is an essential activity immediately following rice harvest. Planting, weeding, harvesting and post-harvest operations are also extremely labour-intensive for these crops. Given the higher labour requirements for crop and drainage, non-rice crops on irrigated lands are grown on extremely small plots, in general about a fourth of the rice area.

Does diversified cropping aggravate labour peaks between the harvest of the rice crop and the planting of the non-rice crop? As discussed above, additional labour is required for constructing temporary drainage structures; and additional labour or mechanical power is required for land preparation. The land preparation activity for non-rice crops following rice would require breaking the paddy hardpan (the compact soil surface caused by puddling paddy soils). If this hardpan is not broken, there would be problems with root penetration and hence the establishment of a non-rice crop. The power requirements for this soil modification are higher on heavy clay soils than on lighter soils. Mechanization to an extent can alleviate this labour peak. However, the machine power required for upland crops is substantially higher than that required for puddling rice paddies. The incompatibility in machines for tillage of rice versus upland crops can be overcome by contract hire operations, which however would be profitable only when large areas are grown to non-rice crops.

In addition to crop labour requirements, the supervision time required from the farmer is also significantly higher: this may be the dominant labour constraint to high-value non-rice crop production given the highly inelastic nature of management labour available in the farm household, compared to the hired labour augmented by seasonal migrants.

3.2 Agenda for Research and policy

The last section identified several constraints to the process of commercialization and diversification of Asian farming systems. Appropriate investments in research and technology generation as well as policy reform could help alleviate many of the constraints and help small farmers benefit from the transformation process.

The primary objective of the research system during the process of commercialization and diversification remains to generate new technologies that improve productivity and farmer income. In responding to diversification trends, the research should not abruptly shift from an exclusive focus on one set of commodities to another set of commodities. In addition to the productivity objective, the focus of research should be to provide farmers the flexibility to make crop choice decisions and to move relatively freely between crops.

Both substantial crop-specific research and system level research effort will be required to provide farmers the flexibility of crop choice. Crop-specific research includes increases in yield potential, shorter duration cultivars, improved quality characteristics and greater tolerance to pest stresses. System-level research would include land management and tillage systems that allow for shifts of cropping patterns in response to changing incentives and farm level water management systems that can accommodate a variety of crops within a season. Also important at the system level is research on the carry over effect of inputs and management practices across crops, for instance, high insecticide and herbicide applications, or the effects of intensification in terms of prolonged water saturation, the build up and carryover across crops of pest populations, rapid depletion in soil micronutrients and changes in soil organic matter could lead to reduced productivity of rice monoculture systems over the long term.

Given growing populations and income induced demand for increased cereal consumption there continues to be a strong need to seek higher productivity levels for the staple cereals. The need for increasing the productivity of cereals is higher the greater the diversion of high potential irrigated lands to non-cereal pursuits.

To what extent should the research system be concerned with technological developments in marginal or unfavourable environments? In large countries, such as India and China, with high domestic demand for cereals, the answer is relatively clear: investments in marginal environments are absolutely essentially for ensuring food security, even if the countries are integrated into the global economy. Cost-effective research investments would be in areas where the spill-over benefits from the favourable environments are high. Identification of strategies for diversifying the income and livelihood base of the farm households in these environments should also be an important area for research and policy.

Commercialization trends require a paradigm shift in agricultural policy formulation and research priority setting. The paradigm of staple food self-sufficiency that has been the cornerstone of agricultural policy in most developing countries is becoming more and more obsolete with economic growth. This can be demonstrated with the example of South Asia where the share of cereals in agricultural output has remained unchanged despite a marked decline in the share of cereals in consumption. The principal reason is inappropriate government price support policies and associated institutions for cereals in some countries.

Governments have a difficult task to perform: on one hand, continued food security needs to be assured for populations that are growing in absolute terms; on the other hand, research and infrastructural investments need to be made for diversification out of the primary staples. The tendency of governments to react to short-term `crisis situations' may be counter-productive in terms of meeting long-term goals of food security and income growth. "Ultimately the process of rural diversification must be consistent with the longer-run patterns of structural transformation" (Timmer, 1988).

The process of agricultural diversification should not be expected to be a frictionless process. The main contribution of this paper is to draw attention to some neglected aspects of diversification, especially the biophysical and economic constraints to the process in different farming systems. The flexibility of farmers in responding to diversification opportunities is constrained by the size of markets and price risks, soil suitability and land rights, availability and quality of irrigation infrastructure, and availability and cost of labour.

Significant equity and environmental consequences can arise in the short-to-medium term unless appropriate policies are followed. For example, the absorption of rural poor in the industrial and service sectors involve significant costs in terms of providing training in new skills and family dislocations. Also, where property rights are not clearly established, high-value crop production in the upland environments could lead to higher risks of soil erosion and land degradation.

Appropriate government policies can alleviate many of the possible adverse transitional consequences arising from the process of commercialization and diversification. Long-term strategies to facilitate a smooth transition to commercialization include investment in rural markets, transportation and communications infrastructure to facilitate integration of the rural economy; investment in crop improvement research to increase productivity, and crop management and extension to increase farmer's flexibility and reduce the possible environmental problems from high input use; and establishment of secure rights to land and water to reduce risks of farmers and provide incentives for investment in sustaining long-term productivity.

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