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# **FEEDING ASIA: CHALLENGES FOR THE NEW MILLENIUM**

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## **ABSTRACT**

Recent dramatic rises in the price of foodstuffs in a number of Asian countries have highlighted the issue of long-term food supply for the region. In the 1970s a number of commentators painted a rather bleak picture of future food supplies in Asia, and in China in particular, but these fears were largely forgotten in recent years as rapid expansion of output allowed many countries in the region to become significant exporters to the world market. However a number of factors have combined to raise new fears for the future. These include: rapid population growth; changes in the composition of food demand as incomes in the region rise; the growth of urban areas and the resultant conversion of farming land; rising pollution in many areas impacting on crop yields increased demand for biofuels; and climate change and its impact on food crop output. But these issues relate not only to the quantity of food available, but also to food safety, food security and reliability, and price. These complex sets of issues will have major impact on the quality of life in the region in coming decades and represent a major challenge. In this paper I will consider a number of possible responses from science and technology, from policy makers and planners, and from development specialists.

## **Introduction**

During 2007 global food prices increased by nearly 40 per cent, with a number of Asian countries experiencing steep rises. Public protests were reported from Pakistan, Indonesia and Malaysia against deteriorating living standards, hardly surprising since poorer people in Asia generally spend 50 to 70 per cent of their incomes on food. These price increases are just one symptom of what many commentators see as a crisis of food in many parts of the world, and the role of Asia in this emerging situation has received particular attention. While particular local factors have been responsible for some of the pressures on food supply, there are a number of structural factors that need to be examined carefully, and this is what I will do in the first part of this paper. I look not only at issues of food quantity and availability, but also at issues of food quality and safety. These are complex and interrelated issues that I can only briefly summarise, but I hope that this will be enough to stimulate some debate. With this as a background, I then turn to some policy issues that might be important in providing some kind of solution to this emerging crisis, as some see it. In particular, and relating my arguments to the major themes of this conference, I look at the role of science and technology in meeting this challenge. I should stress that I am not a scientist by training, but I hope that I can again raise some points for debate.

## **Factors in the Emerging Food Crisis**

### *Population Pressures*

The growth of the world's population is not a new phenomenon of course, but the pressures that derive from sheer numbers of people are being viewed with a new urgency. In particular, a number of recent studies have questioned whether it is possible for the world to support a population of 10 billion, something that is expected to be achieved around the middle of this century (see, for example, Evans, 1998; Brunel, 2001). Even before the achievement of this important symbolic milestone, a number of critics have sounded the alarm about the carrying capacity of the Earth, and our ability to feed an ever increasing number of people. It took until 1500 to achieve the first half billion, and until 1825 to reach the first billion. By contrast, the sixth billion was recorded in only a little over a decade, from 1986 to 1998. There are, of course, wide differences of opinion over the question of whether current and future levels of population are sustainable, especially in terms of supplies of food and water. On the one hand we have the pessimism of Thomas Malthus and his Chinese counterpart Hung Liang-chi, and more recently of Paul Ehrlich, while other have confidently predicted that any potential crisis will be solved through technological progress (Newbold, 2002). Some have even suggested that a population of 50 billion could be accommodated given potential scientific advances. It is generally recognised that there are six important ways in which the supply of food can be increased to meet future need (Evans, 1998):

1. Increases in the area of land under cultivation.
2. The use of higher yielding varieties to increase output per hectare.

3. Increase in the intensity of crop production through the achievement of more crop harvest each year.
4. Replacement of lower yielding crops with more productive ones.
5. Reduction of post-harvest losses.
6. Reduction in the amount of produce fed to animals.

Up to 1960, expansion of the area under cultivation was the major source of increased food output, but since then the area under cultivation has expanded only slowly. At present, some 1.34 billion hectares are under crops, and it is estimated that some 3 billion hectares more might be available, but much of this land is of poor quality, inaccessible, vulnerable to erosion or too valuable in its present use, for example the rich and biologically diverse forest areas of the Amazon and elsewhere in the Tropics. In addition, much good quality arable land is being consumed by urban growth or is being ruined by desertification, salinity or industrial pollution, a topic I will return to later. Thus, intensification of crops and the generation of higher yielding varieties seem to offer the best hope for continued increases in food output, but opinion is divided on the extent to which this may be possible. It may be that the limiting factor in the intensification of agriculture may be the supply of water for irrigation. Between 1900 and 1995, consumption of water grew by six times, or twice the rate of population increase. Now, more than 500 million people live in areas with chronic water shortages, and this is expected to increase to some three billion in the next 20 years (Newbold, 2002). There is also the unanswered question of what impact global warming may have on food production in the coming years. In any event, the generation of sufficient food for a world population of 10 billion will require enormous changes at all levels. Even to feed a population of 8 billion would require the average world yield of cereals to rise to a level equal to the yields achieved in Europe and North America at present, and an increase to 10 billions would mean an increase of 25 per cent above these average outputs per hectare. This is a daunting prospect, and highlights the need for continued emphasis on policies to limit national population growth in a wide range of countries. As Ruttan (1996) has pointed out, any attempts to tackle this complex set of problems – technical, institutional, environmental, cultural, political and more – will require much more than just science, and must rest on intense multidisciplinary efforts.

Within the Asian context, much attention has been focussed on China and India, questioning whether these two very large societies can feed their growing populations in the future. In the case of China, Lester Brown (1995) has consistently presented a rather negative view of the prospects, arguing that increased urban expansion and the compromising of agricultural yields through industrial pollution of land, air and water resources are bound to limit the expansion of food output. Yet others have given a much more optimistic assessment. In many Asian countries, and particularly those that have been able to achieve high rates of economic growth, overall population growth rates have declined dramatically, but a range of other demographic factors are impinging on demand for food. The significant ageing of the population in a number of countries such as Japan and South Korea will have an impact on the demand for particular kinds of foods. Between 2000 and 2020 the median age of the population in the region is expected to increase from 30 to 36 years, and life expectancy should increase from 72 to 77 years.

Generally, food intake decreases later in life as activity levels are reduced, and there is general tendency for the consumption of animal products to decrease, while intake of fruit and vegetable increases. In Japan, for example, it is expected that demand for meat will decline, while that for fruit, vegetables and fresh fish will increase. As populations age, the balance between the economically active and economically dependent parts of the population – the dependency ratio – will also change. This will have many implications for the structure of the economy, for rates of savings and for investment.

### *Industrialisation, the Growth of Cities and Changing Lifestyles*

The Asian economic miracle has been built primarily on the development of industrial products for the export market, and this industrialisation has been predominantly located in urban centres. In the Asia Pacific region as a whole it is expected that urban populations will increase by more than 580 million by 2020 as compared with levels in 2000. During the next few years the total size of the urban population in the region will overtake the total rural population for the first time in history. China's urban population is expected to increase by a further 308 million by 2020, and there will also be similarly rapid increases in Indonesia (+ 77 million), the Philippines (+ 33 million), Vietnam (+ 16 million), and Malaysia (+ 10 million). At the same time, rural populations will shrink rapidly in most of the region. The largest change in the balance between urban and rural populations will take place in China, where declines in total population growth rates plus large scale migration to the cities will reduce rural populations by some 145 million people by 2020. These changes will of course have massive implications for the overall food system and for the international food trade. Urban incomes are generally higher, and rather different kinds of foods are consumed there. Generally, rather higher proportions of animal products are consumed there, and there is a demand for a more varied range of foodstuffs. Also important in a number of countries is the loss of valuable farming land as cities expand.

With rapid growth in many Asian countries we have seen the emergence of what some have called the “new middle class” or the “new rich” in Asia, which represents a transformation of staggering proportions (Pinches, 1999; Robison & Goodman, 1996). This group now constitutes quite a large section of the population of nations such as South Korea or Japan, but it is clear that this “class” is very diverse, and much effort has been put into defining terms and identifying sub-groups. Much has also been written about why it should be that in Asia the process of growth has resulted in much higher levels of equity than in the West, although in the last decade inequalities in Asia have also increased sharply. But from the point of view of this discussion, one of the most interesting debates concerns the extent to which this large group has become “Westernised”, especially in its patterns of food consumption. While much has been made of the expansion of Western processed food franchises into Asia, a number of commentators have argued that the foodways have remained remarkably stable, and still very much Asian.

*All five of these East Asian countries [Japan, South Korea, Taiwan, Hong Kong and Singapore] have embraced Western capitalism. Most of their people are dressed in Western suits; many of them speak English; a good proportion of them travel, study, and do business abroad. In their outward appearance*

*these Asian nouveaux riches are Westernised. Yet behind this façade the people of these countries pursue a way of life that remains essentially Oriental. They prefer to eat oriental food, observe lunar-calendar-based festivities, place the family at the centre of their social and economic relationships, practice ancestor worship, emphasise frugality in life, maintain a strong devotion to education, and accept Confucianism as the essence of their common culture. (Tai, 1989, 1-2)*

A number of critics have however questioned this formulation. For example, the assertion of continued frugality flies in the face of much evidence about the growth of consumer cultures and the fashion industry in the region, especially among young women. Food, however, seems to be rather different from other consumer items, and the shifts there are rather less marked. For example, in the Asian society with which I am most familiar, South Korea, there is still a marked preference for Korean food even among the young people, and even a revival of restaurants serving identifiably “peasant” food and drinks. The growth of a new group of relatively rich consumers in the burgeoning urban centres of China has also attracted a great deal of interest in the literature, but without any real consensus emerging on the key questions of change versus continuity (Buckley, 1999; Goodman, 1996).

An important new contribution to this debate, and one that bears directly on the issue of changing or stable foodways is a recent study out of Hong Kong that investigates Chinese food consumption in a number of settings (Wu & Tan, 2001). In part, the chapters in this book consider the impacts of migrations of various groups on their food consumption patterns, something that will be touched on in the next section of this paper, but some also examine processes of change within communities undergoing rapid economic change. Space does not allow me to do justice to the very rich evidence that emerges from this study, but the dominant conclusion is that change and continuity in cuisine are very complex and subtle phenomena, and subject to a great deal of variety within individual settings. Foodways are changing, especially among the young, but there is also a great deal of affection for the traditional and tried components of diet, and adaptation of old patterns. We simply do not know enough about such changes in a wide variety of environments, and this is one of the challenges for the current conference.

Large-scale international population movements are also a factor here. This is not a new phenomenon at the global level, there some important new patterns in these migrations in the current era. There is a great deal of diversity in the current flows of population: many are refugees fleeing wars, famines and a range of environmental disasters; others are poor economic migrants seeking any kind of life in new lands that must offer better prospects than their impoverished homelands; and still others are highly skilled professional moving between or within corporations located in any one of the growing urban centres of the new global economic system. In some cases, these new arrivals conform enthusiastically to the patterns found in their new homes, but in most cases many of the old ways also survive. The evidence seems to suggest that foodways are perhaps the last remnants of the old to disappear. Food habits, it appears, survive even longer than language in many migrant groups. But, again, patterns of food consumption, in this case in an overseas situation, reflect a subtle combination of both continuity and change, processes about which we know far too little. As Tan Chee-beng has concluded in a study of food patterns among the Chinese community of Malaysia:

*Chinese immigrants to Malaysia (or for that matter anywhere in the world!) carried with them Chinese principles of cooking and consuming food (reflecting regional characteristics in China). These principles have persisted and the localised Chinese have used them to related to the local environment, modifying some principles and creating new ones in the process. Cultural principles are used creatively in local settings which are open to regional and global influences. Chinese Malaysian food and foodways today reflect both historical continuity and local transformations, as well as local identities. (Tan Chee-beng, 2001, p.154)*

### *The Growth of the Asia Pacific Food Trade and Some Emerging Trends*

An important factor for many commentators has been the growing internationalisation of the food supply system and the emergence of a massive global and regional food trade. It is well known that the food industry in the Asia Pacific region is now enormous, although precise and up-to-date statistics on many aspects of this area of the economy are surprisingly hard to come by. It is particularly difficult to assemble properly comparable statistics across nations, since there is such wide variability in many national definitions. But let me at least try to give some picture of this key sector. By 2000, the total value of the food and beverage industry in Japan was worth \$322 billion, compared with \$188 billion in China, \$67 billion in South Korea and \$46 billion in Taiwan. These are of course vast sums, and it is clear that the food industry is a key element in the economic development prospects of the regions. Much of this market demand is met from local sources. In many countries in the region, a significant element in agricultural production is the subsistence economy, although this is generally declining in importance. Beyond this, because of the relatively low value and high bulk of many foodstuffs, as well as questions of food spoilage and freshness, much demand for food is met within nations, often within local regions or communities. However, the food trade across national borders is of increasing importance. Japan now imports some 15 per cent of its total food consumption (by value), and the figure for South Korea is roughly similar. In the case of China, given the huge size of the agricultural sector, only 4 per cent of all imports are of food, but there is a clear upward trend. In the case of Indonesia, some 10 per cent of all imports and 9 per cent of exports are made up of food products.

At present, by far the most important components of the food trade – both within and between nations – consist of unprocessed items such as grains and bulk meat products. However, the growth of incomes and of urban populations in the region is resulting in a sharp increase in the demand for processed foods. Another factor here is the gradual liberalisation of the international food trade, as part of the overall reform of world trade rules, even though the trade in agricultural products is proving much more difficult to liberalise than that in industrial products. In the past, it was much more difficult to export processed foods, because of the prevailing tariffs and quarantine regulations, but this is slowly changing. Perhaps even more important has been the rise of the multinational food retailers. These companies have partly been responding to new kinds of demands for convenience foods in urban areas, especially from younger consumers, but it could also be argued that these emerging global food brands have created new demands through their advertising and related strategies. The majority of this demand, however, is not met through the flow of products through the food trade system. Rather, demand is met through direct foreign investment, the creation of new food outlets with their

accompanying systems of supply, many from local sources. The net result is a major change in the food supply structure, and a major change in the nature of the products consumed. In many cases, while the external emphasis may be on the supply of a homogenous global brand of product there may be some subtle changes that reflect local preferences and tastes. It is estimated that US food companies now sell some five times as much through FDI than through export sales (\$150 billion, as against \$30 billion). In some cases, this FDI strategy also involves alliances with local business groups.

Related to the growth of these new convenience food outlets has been the strong emergence of the supermarket as a new and dominant form of retail outlet in many countries. During the last decade or so there has been a rapid expansion of supermarkets in Asia and in Latin America. This has been driven by increasing incomes and new demands for processed food products. A major result of these new developments has been the increased centralisation of food distribution networks. One feature of the food available in supermarkets is the all-year-round nature of their products, and this in turn drives further expansion of the food trade. In part this has driven the increased flows of food between the northern and southern hemispheres, dictated by the succession of seasons and the need to maintain constant supplies. However, some commentators have also suggested that the presence of these global retailers also encourages more local processing companies to move into this new system, harnessing local production sources. It has also been argued that the use of global retail brands encourages an upgrading of quality standards.

#### *Declining Local Self-Sufficiency and Issues of Food Security*

Some commentators have argued that the growth of commercial agriculture throughout the world, the application of new scientific and technological advances to food production, processing, storage and distribution, and the growth of the global food trade have all served to reduce global hunger and the chances of renewed famine and starvation. However, the evidence on this is in fact very mixed. Certainly food production has increased markedly in much of Asia in recent years – for example, there was a 430 per cent increase in food production in China between 1990 and 2000, largely as the result of increased output of grain crops. However, these kinds of increases may not by themselves result in declines in the prevalence of malnutrition. Nor do programs designed to tackle problems of poverty always produce better results – the problems associated with food supplies are much more complex and multifaceted.

The concept of food security is perhaps the one that comes closest to expressing the reality of hunger, food availability and nutritional levels in a variety of environments. Food security is generally measured with reference to three quite distinct elements:

- *Food availability*: which measures the total food supply that can be accessed from local and other sources. Questions of the *reliability* of this supply are often included here as well.
- *Food access*: which evaluates the entitlement of people to an adequate food supply – which includes issues of power of various kinds – and their ability to

access in various ways of purchase the inputs necessary to produce their own food or to buy an adequate amount of food.

- *Food utilisation*: which measures the capacity of individuals to utilise and absorb the nutrients in the food that they eat, including micronutrients. This concept raises issues of food safety and quality and evaluates the adequacy of hygiene, sanitation and food preparation facilities in local communities.

Using these measures as much more mixed and complex picture emerges of recent trends in Asia. India, for example, has moved from being a large food importer to being now a major food exporter, but as recently as 2001 frequent cases of malnutrition were reported from all over the country. It is estimated that India still has some 200 million people living in hunger, or about 20 per cent of the population, although it has a current grain surplus of around 38 million tonnes. This picture is the result of poverty in large sections of the population, and many people are simply too poor to buy food. One of the key Millennium Development Goals is the halving of the number of hungry people between 1990 and 2015. However the FAO has reported that only 7 Asian countries are on target to meet this goal, while 8 Asian countries are in fact going backwards in terms of their targets. Some two-thirds of the world's undernourished people are still to be found in Asia, despite the real advances in food production in many areas, and India alone has more hungry people than are to be found in the whole of Africa.

A report by the Overseas Development Institute (Gill *et al.* 2005), based on seven detailed case studies of countries in Asia has put forward a number of reasons why food security is still such a serious problem in many parts of Asia:

- *Stagnating local production*. In many countries supplies of adequate land and water for increased food production are severely limited. The easy gains from the Green Revolution have now been used up.
- *Changes in prices for agricultural products*. Processes of trade liberalisation and changes in the structure of the global agricultural industry have tended to push up the prices of many of the inputs needed for food production locally. The rapid growth of industries and of urban areas is absorbing some of the best agricultural land. In some cases food prices more generally have increased, adversely affecting many consumers.
- *Lack of access to land*. Even where land is available in rural areas it is often taken by the richer and more powerful landowners, and smaller farmers are often denied land. Thus in many countries there are particular problems facing landless labourers, and this is compounded by seasonal factors. The hungry season is still a fact of life (or death) in many rural areas in Asia.
- *Rural-urban gap*. In many countries of Asia, the rapid growth of export-oriented industries has introduced a large income gap between urban and rural areas, and often between various parts of the country. For example, in China much attention is now being given to the large gaps between the coastal regions and those further to the west. Incomes are important factors here but so are differential access to power and influence over resource use.
- *Increased shocks and hazards*. Major economic shocks, notably the Asian

financial crisis of 1997/8, continue to cause major problems for large sections of society, and some commentators have suggested that with an increasingly integrated global economy such crises may in fact become more frequent and their shocks may now reverberate through larger numbers of countries. Similarly, many Asian nations are being seriously affected by natural disasters of various kinds. It seems certain that with global climate change these extreme events are going to be more frequent and catastrophic.

- *Conflicts and insurgencies.* In a number of countries in Asia there have been serious internal conflicts and insurgencies, resulting in severe hardship for many people. With increased competition for resources and increased gaps between the rich and the poor, such instability seems here to stay. There are also risks of terrorist attacks in several places.

Many critics of the emerging global food trade also point to its adverse impacts upon small farmers in much of the developing world. Once again, this is a complex and multi-faceted issue, but it is possible to isolate a number of key factors and processes that are having an impact in much of Asia, consequences that many commentators see as very detrimental to the quality of life of large numbers of people.

- *Overproduction, dumping and export subsidies.* Currently the world has a large surplus in many food products, partly as the result of the large subsidies that are paid to farmers in many rich countries. The result is that many of these commodities are dumped on world markets at prices that bear little relationship to production costs. For example, prevailing world prices for rice are some 25-35 per cent lower than the costs of production in the United States. This is only possible through large production and export subsidies to farmers, and this is having a devastating effect on producers in poorer countries, farmers that in many cases are much lower cost producers of such crops. Yet the rich countries that control international institutions such as the IMF and the WTO ensure that poorer countries are not allowed to give financial incentives to their farmers to stimulate higher production. Dumped food has a devastating impact on prices within many countries resulting in severe losses of income for most rural producers. It is hardly surprising then that at least 50 per cent of the people suffering from hunger are in the small farm sector of poor countries. Cheap food may be seen as advantageous to urban communities, but in fact devastation of rural communities results in increases in rural-urban migration, resulting in downward pressure on urban wage rates.
- *Land consolidation.* In a number of countries, the growing commercialisation of agriculture and the new opportunities offered to some large producers by an expanding global food trade is leading to the growth of a small number of very large production units, often through land consolidation. As was noted above, it is the landless rural labourer that is usually most vulnerable to poverty and malnutrition.
- *Growth of supermarkets.* The growth of supermarkets has resulted in the decline of traditional marketing channels of various kinds. These new retail units tend to concentrate their procurement practices, favouring the larger-scale farmers at the

expense of the smaller farmers that traditionally supplied local markets. Such procurement practices are designed to drive down the prices paid to farmers, and tend to decrease the amount of money that is spent in the local economy. The result of all these forces is to squeeze out the smaller, local producers in favour of the larger units often based in rich countries.

### *Environmental Degradation and Pollution*

The basic theory of competitive advantage, which underpins much of current economic orthodoxy, argues that each nation and region should concentrate on the production of those items in which it has some kind of advantage, and hence the benefit of a significant cost edge over other producers. The constant drive for a competitive edge in costs and efficiency has a number of detrimental effects in agriculture, as a number of commentators have pointed out.

The environmental and health impacts of the overuse of fertilizers and pesticides have been well documented, following a large number of food contamination and other safety issues in China and elsewhere. However, a number of other environmental issues are now being raised. The increasing commercialisation and scale of food production on a global scale is also increasing concerns about the impact on the environment of turning over large tracts of land to single crops, especially if this first involves the removal of forest cover or rain forest. The impact of soya bean and beef production in the Amazon region has received much attention in the international press, and there have also been concerns for the environmental impacts of large scale oil palm estates especially in a number of Southeast Asian countries. Malaysia, the world's largest producer of oil palm, some 54 per cent of total agricultural output is now accounted for by palm oil compared with 30 per cent in 1985. While declines in rubber cultivation partly account for this increase, concerns about the reduction in agricultural diversity are now being expressed. In Peninsula Malaysia some 62 per cent of all agricultural land is now devoted to oil palm production, and as land runs out for further expansion there, massive new estates are being developed in Sabah, resulting in considerable losses of rainforest. It is estimated that some 87 per cent of all deforestation in Malaysia is now the result of new oil palm developments. In Indonesia, oil palm production has increased 30-fold since the 1960s. Much of this new production is in Sumatra, again with large-scale losses of forest.

I have already noted the well-established links between high levels of pollution originating in many cities in Asia and the decline in crop yields over large area of the surrounding countryside.

### *Increasing Demand for Bio-fuels*

Recent increases in the world price for crude oil, coupled with growing concerns about greenhouse gas emissions has resulted in rising demand for alternative fuel sources, many of these derived from agricultural products such as maize and palm oil. This in turn has caused significant price rises for these items and the diversion of much output away from traditional food markets. Large areas of forest have also been cleared in areas such as the

Amazon to make way for crop production, but this is not resulting in increased food availability. The net result is that food prices for many items are becoming prohibitive for many poorer families.

### *Climate Change*

Finally I turn to an area of enormous current interest, and one which may well turn out to be of huge importance for future food supplies in the region. The 2007 report of the UN Intergovernmental Panel on Climate Change has highlighted some of the key challenges posed by climate change to future food security in Asia and the rest of the world. Climate change is a multi-faceted and complex issue, but some key elements that have potentially serious consequences for future food supplies are:

- *Increased storms and other natural disasters.* It is likely that the frequency and intensity of cyclones, typhoons, hurricanes and floods will increase. We have already seen recent natural disasters of this kind cause serious damage and significant loss of life in the Philippines, Vietnam, Malaysia, China, and North Korea among others. Such events are devastating for agricultural production.
- *Rising sea levels.* Coastal and low lying areas of a number of countries are likely to experience inundation and storm surges, making it necessary to relocate coastal populations to higher ground. The large delta areas of Asia, such as the Mekong and Red River deltas of Vietnam will be particularly vulnerable. These deltas are generally densely populated and are among the most fertile agricultural regions. The Mekong and Red River deltas, for example, currently produce around half of Vietnam's rice. Storm surges are also likely to disrupt fish breeding grounds and hence fish yields in many areas.
- *Shortages of water.* Higher average temperatures will result in decreased rainfall in a number of areas, leading to serious droughts and desertification of significant amounts of agricultural land. Australia has been in drought for a number of years now, a so called 'one in a thousand year drought', but large parts of China and Mongolia are also especially vulnerable. A number of crops currently produced in Asia will no longer be viable because of increased temperatures, and drought, desertification and soil erosion will render large areas unusable for agriculture. Less water will be available for irrigation through much of the region.

Putting these factors together it is predicted that in some parts of Asia crop yields could decrease by as much as 30 per cent, however it should be pointed out that in some areas, including parts of Southeast Asia, climate change may in fact result in increased rainfall and greater yields. Much attention has been given to the negative impacts of these changes on India and the rest of South Asia. The rapid melting of the Himalayan glaciers will severely damage the perennial flows of the major rivers, putting vast agricultural areas at risk. Groundwater resources are already under great pressure and with reduced rainfall and river flows this problem will intensify. Wheat yields in India and Pakistan will be seriously affected, as well as returns from key cash crops like cotton. The tea industry of Sri Lanka is also vulnerable to declining rainfall. Reduced food output will put severe

pressures on the household budgets of a large segment of the population in South Asia, and when this is put together with the predicted increase in a range of diseases as the direct result of climate change – malaria, cholera and diarrhoeal diseases for example – human security in the region will be severely damaged (Kelkar & Bhadwal, 2007).

Controversially, some authors are now arguing that the increasingly globalised food trade that I have already discussed is now a significant contributor to global climate change (Schwind, 2005). The environmental costs of transporting food products often over very long distances are argued to be quite significant. This would of course be an argument against all kinds of international trade, but it is argued that agriculture need to be looked at very carefully since buying food locally can almost always be seen as a viable alternative. Schwind argues that if the citizens of the state of Iowa bought just 10 per cent more of their food locally they would collectively save 7.9 million pounds of carbon dioxide emission per year. Similarly, if Japanese families consumed local food instead of imported products, the impact would be equivalent to a 20 per cent saving in household energy use. While some food trade is inevitable, since crops such as coffee cannot be produced in many climates, a good deal of food transport is ecologically disruptive and wasteful, Schwind suggests. For example, Californian tomatoes are sent to Canada for processing into Heinz ketchup, and a significant amount is then returned to California for consumption.

### **Some Ways Forward: Key Policy Debates and Areas for Technological Innovation**

These developments are now raising some fundamental questions about the whole question of food security in Asia, an issue which many believed was well on the way to being solved. Policy makers are being forced to look more critically and sceptically at some of the basic dynamics of food supply and demand in the region in their approaches to decision making. These are complex and multifaceted issues and no single solution is likely to be effective. Rather we need to think how a range of policies and innovations can re-enforce each other and together produce a more prosperous future. Work in this area is still in its infancy and much more research is needed, but let me outline what I see as some key areas for future analysis.

#### *Towards a More Sustainable and Effective Regional Food System*

This is an area that evokes strong emotions, and sometimes this has resulted in simplistic or unrealistic analysis and policy advice. Yet it is clear from the evidence that I have cited that all is far from well with the food system(s) of Asia, and there is much work that must be done to improve current policies and programs. At present, the rise of the global food trade can be seen as just one facet of some much broader forces that we generally call globalisation. It is clear however that many of the consequences of these processes are not contributing to the welfare of the region's citizens. While it is certainly not possible to turn back the clock and remove all of these strong global tendencies, it is necessary to temper all of the most pernicious of these impacts. In particular, governments need to re-emphasise the national and the local rather than simply accepting the often deleterious

impacts of internationalisation. This might be possible, since throughout the emergence of the Asian ‘miracle’ economies that role of government has been central, often to ensure the maximum benefits for local interests. Many governments in the region, for example in China, now realise that the unrestrained impact of international forces is resulting in many dangerous economic, social and political impacts on local regional and communities. It is also clear that part of this policy re-assessment will involve a rethink about the role of the small agricultural producer.

But in many cases, as I have already noted, detailed evidence on which to base new policies is lacking, and a great deal of carefully targeted research is needed. In all of the cases I have outlined, the food industry is complex and multifaceted, and to understand the true nature of these emerging food systems we need research that concentrates on the entirety of the food system at all scales from global to local, isolating factors and forces that operate at all these levels. We also need to recognise that national communities are becoming more differentiated, and we must therefore expect that some will gain and some will lose from the new features that are emerging again at various geographical scales.

All of this will require an approach that stresses the complex linkages that exist throughout all parts of these emerging food systems. Of necessity, this will involve collaborative research between a wide range of disciplines. We need to understand the nutritional outcomes as they impact on communities and individuals, but in order to do this we need to appreciate the political economy of food systems, of trade in agricultural commodities, of food production systems and wide array of other things. This will be difficult, but it is important that we make a start, because no other topic is of greater importance in determining the future quality of life of the region’s population.

#### *Issues of Food Quality: Food Safety, Nutrition and Health*

The question of feeding Asia in the future is not just about the quantity of food available, but also its quality. Food safety is a major concern in many countries but I note that other participants will be addressing this issue in some detail.

But also crucial are questions of what I referred to above as *food utilisation*, and these result in serious problems in many countries. Large parts of Asia are subject to iron deficiencies in their diet, and many suffer from Vitamin A and iodine deficiencies. Lack of iron results in anaemia and a consequent loss of energy and productivity. In India this deficiency is estimated to cost the economy some 1.3 per cent of GDP per year. Better availability of Vitamin A, it is estimated, could save some 1 million lives per year in Asia. It has been argued that such problems can more easily be solved through national food programs, and the presence of large quantities of imported food makes it more difficult to control nutritional and micronutrient components, but there is little real evidence on this. Contamination of water sources, often through the uncontrolled spread of manufacturing industries is certainly a serious problem that is directly related to structural changes taking place in many Asian economies.

## *The Contribution of Science and Technology*

Science has made valuable contributions to increasing food yields around the world for many years, but increasing concerns about climate change are stimulating a re-think about future priorities for research. Several key priorities are becoming evident:

- *Strengthening regional capacities to respond to natural disasters.* This must include the ability to supply emergency food and to respond quickly to the needs for re-establishing local agricultural systems.
- *Improving water management systems.* Water availability will be a key determinant for future agricultural output and there are difficult political issues involved in balancing the demands of urban residents, industry and farmers. The management of large river basins such as the Mekong also involve tricky international negotiations about water rights.
- *Rethinking farm management systems.* Some crops will simply not be available for production as global temperatures rise, and some agricultural areas may have to be abandoned. This involves the development of new ideas on what new crops or perhaps new varieties are likely to be more viable. This is not just a question of science or even agricultural economics, but often involves complex sociological issues.
- *Producing new crops and strains.* Much effort is already being put into the development of more drought resistant strains and varieties of crops, and also ones that can withstand higher salinity and frost levels, and this work is bound to become more important. In many cases this will involve new techniques of genetic modification, which of course raises a whole new set of concerns.

## **Conclusions**

I have tried to show that there are some important concerns about the future quantity and quality of food available to consumers in Asia over the coming decades. But I have also stressed that these issues are complex in nature and demand insights for a range of different viewpoints. The whole pattern of global and region development, including the emergence of a massive global trade in food products, is raising a wide range of concerns. Climate change is adding yet further complexity to this picture. Inevitably the answers to these problems are not simple and will involve political and sociological analysis as well as scientific progress. We are only beginning to understand all of these issues and their interactions and the challenges for those of us working in this area are enormous, yet the need for such research has never been greater.

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