Chapter 3

Agriculture: Rice

Every grain of rice is the product of sweat and labour.
Chinese saying

Objectives

- ✓ Show that rice self-sufficiency is an objective of most Southeast Asian countries.
- ✓ Highlight the problem of low rice productivity.
- ✓ Discuss credit issues pertaining to rice farming.
- ✓ Examine the policies implemented by the Government.
- ✓ Point out the prevalence of Green Revolution.
- ✓ Identify the technological and organisational requirements of Green Revolution.
- ✓ Show the importance of Government's role in the Green Revolution.
- ✓ Provide some suggestions for future agricultural development.

Introduction

Agriculture provides livelihood to a very large number of people in Southeast Asia. A new impetus was given for agricultural development with the Green Revolution, which started in Southeast Asia during the latter part of the 1960s. The expression "Green Revolution" normally refers

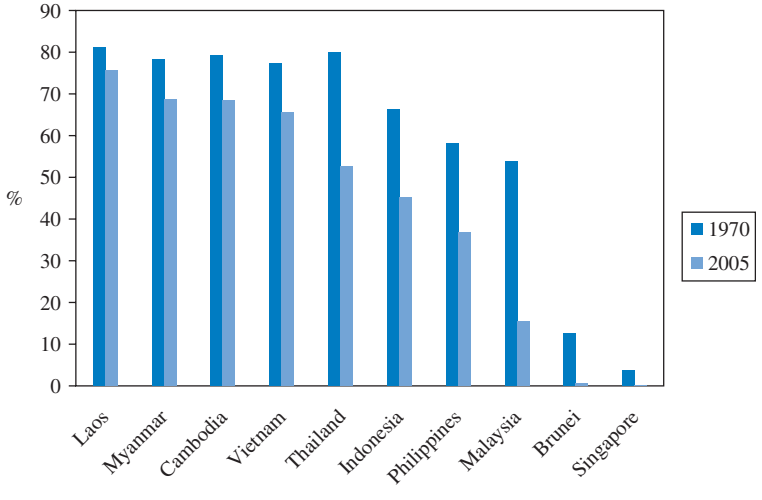
to the development of high-yielding varieties (HYVs) of rice and wheat. In Southeast Asia, however, we should also include rubber and oil palm.

In Southeast Asia, we must make a distinction between subsistence farming like rice farming and plantation crops like rubber and oil palm. Rice farming has a very long history in Southeast Asia, long long before plantation crops came in. It is a way of life that is being devastatingly challenged in the global development process. Unlike USA or Australia, rice farming in Southeast Asia is still a highly labour intensive industry. It is a way of life of the peasantry in Southeast Asia.

World Bank economists estimated that three of every four people in developing countries live in rural areas, of which 2.1 billion living on less than US$2 a day and 880 million on less than US$1 a day (World Bank, 2007). This is also true for Southeast Asia. The majority of the Southeast Asian countries are still largely dependent on the agricultural sector to provide employment for their population. This is illustrated in Diagram 3.1. Among the traditionally agricultural countries, the only exception is Malaysia, where the agricultural sector as a source of employment has steadily declined over the last 35 years to 15% of the total economically active population.

Diagram 3.1

Percentage of Economically Active Population in Agriculture, 1970 and 2005



Source: Food and Agriculture Organization of the United Nations, FAOSTAT, 20 Aug. 2008, http://faostat.fao.org/.

In most of Southeast Asia, the agricultural sector has 40% or more of the economically active population. In Indonesia, by far the largest country in Southeast Asia, the proportion is 45%. In Vietnam, Cambodia, Myanmar and Laos, the proportion of economically active population in the agricultural sector is between 65% and 76%.

Value-added per worker in the agricultural sector in Southeast Asia tends to be low, so are therefore incomes and living standards. Table 3.1 shows the value-added per agricultural worker in Southeast Asian countries compared to Japan. In general, Japan's agricultural productivity is more than 30 times that of Southeast Asia. Labour productivity is generally still low in Vietnam, Cambodia, Laos, Indonesia and Thailand, notwithstanding the fact that the countries of Southeast Asia achieved considerable productivity growth in recent decades. There are disparities in the levels of agricultural labour productivity within the Southeast Asian countries, with Malaysia's value-added per worker exceeding that of Indonesia by more than 9 times. This disparity is partly due to the difference in the crops planted in the various Southeast Asian countries, (i.e. the predominance of plantation crops in some countries, such as Malaysia) and partly due to diverse degrees of under-utilisation (underemployment) of labour.

Table 3.1
Value-Added Per Worker in Agriculture, 1970–2005

	Value-Added Per Worker (Constant 2000 US$)				
Country	1970	1980	1990	2000	2005
Malaysia	1,674	2,462	3,675	4,316	5,378
Philippines	762	926	909	963	1,098
Thailand	308	375	470	533	607
Indonesia	313	425	480	523	596
Lao PDR	n.a.	n.a.	363	450	456
Cambodia	n.a.	n.a.	n.a.	286	329
Vietnam	n.a.	n.a.	210	277	313
Japan	8,541	13,971	20,839	29,801	37,389

Source: World Bank, WDI Online, 3 Sep. 2008, http://publications.worldbank.org/WDI/.
Note: Exchange rate relativity changed over the years. This imposes a limitation over cross-country and over-time comparisons of productivity.

However, it is not well known that agriculture has made an important contribution to the industrialisation process in Southeast Asia by supplying raw materials for industrial output. For instance, food, beverages and tobacco industries contribute a significant share in total manufacturing value-added in the Southeast Asian economies in 2003: 23% in the Philippines, 23% in Indonesia, and 8% in Malaysia (World Bank, WDI Online, 6 Oct. 2008).

Another important contribution of agriculture is the foreign exchange earnings accruing from the expansion of agricultural exports. The major crops produced in Southeast Asia for exports include rice, rubber, palm oil, coffee, timber and pepper. Malaysia and Indonesia are the world's top two exporters of palm oil. The world's top four exporters of natural rubber are also found in Southeast Asia, they are, in descending order, Thailand, Indonesia, Malaysia and Vietnam. Rice, an important food crop in Asia, is exported by Thailand, Vietnam and Myanmar. Coffee is another cash crop that Southeast Asian countries have established a dominant position in, with Vietnam ranking the world's second largest exporter and Indonesia ranking the world's fourth largest exporter.

Rice in Southeast Asia

Among the major crops produced in Southeast Asia, rice is the most important within the subsistence sector, as it provides not only the bulk of the peasants' incomes but is also a major source of their daily calories intake. Rice forms one of the major crops in the agricultural sector of many Southeast Asian countries, with the exception of Malaysia, Brunei and, of course, the city-state of Singapore.

The cultivation of rice can be broadly classified into dry paddy and wet paddy. Dry paddy is grown on dry ground very much the same as other cereals, whilst wet paddy is grown on standing water. While dry paddy was at one time the only form of paddy cultivated in several parts of Southeast Asia, the cultivation of wet paddy has now exceedingly overtaken that of dry paddy. There are several advantages of wet paddy over dry paddy. Firstly, output per hectare of wet paddy has been usually very much higher than that of dry paddy, although labour and the manure input of dry paddy have been normally much greater. Secondly, dry paddy consumes much more nutrients from the soil than wet paddy, and often the land has to be fallowed

for one or two seasons after one or two seasons of cropping. Thirdly, the "Green Revolution" in Southeast Asia has significantly increased the yield of wet rice cultivation, rendering the productivity differences between wet and dry paddy even greater. Today, dry paddy cultivation is very much associated with the "slash-and-burn" agriculture carried out by the tribal people in the less developed regions.

As shown in Chapter 1, rural poverty continues to be a concern in Southeast Asia. The percentage of rural population living below national poverty line is more than 30% in the Philippines, Laos, Cambodia, Vietnam and Indonesia. Land fragmentation, credit indebtedness and population explosion are causes of poverty among the rural population. Unlike countries such as Australia and US, where rice cultivation generally takes place on a mega scale, rice farming in Southeast Asia is characterised by smallholdings, often subsistence smallholdings. Upon the death of the proprietor, his property is often divided among his heirs, resulting in fragmentation of farmland. A smaller plot of land is less efficient in terms of utilisation of machinery, and even the time and effort of the farmer. At times, the farmland is so small in size that profitable farming is not at all possible. Another important cause of poverty among paddy farmers is credit indebtedness. The root cause of indebtedness is capital shortage, which in turn could arise from a variety of causes, including extravagant wedding ceremonies, illness of farmers and poor harvests. Given that poor rural farmers have low average propensity to save, these farmers often have to resort to borrowing from the informal market in times of need, paying exorbitant interest rate in the process. As the consumption levels of the majority of paddy farmers are already around subsistence level, some misfortune in one or two years on one or two occasions would render the farmer indebted. Once seriously indebted they may forever remain so. Woes never come single. Last but not least, population explosion in the rural sector also plays a part in rural poverty. This is especially so when the population growth outstrips the technological progress in the farm or agriculture sector.

Apart from being an important crop, rice development in Southeast Asia also has a number of common characteristics.

1. Rice self-sufficiency is an objective of most Southeast Asian economies;
2. Yields are low compared to the Northeast Asian countries;

3. Serious problems persist in some aspects of institutional development, notably in the area of agricultural credit; and
4. Government policies, especially price policies, play an important role in the growth of the rice sector.

Production and Export

As shown in Table 3.2, Thailand, Vietnam, Myanmar and Indonesia are exporters of rice, although Indonesia was a net importer in 2005. Table 3.2 also

Table 3.2
Rice Production and Export ('000 Tons), 1970–2005

		1970	1980	1990	2000	2005
World	Production	316,346	396,871	518,556	598,894	631,868
	Export	8,255	12,566	12,367	23,821	29,747
Thailand	Production	13,850	17,368	17,193	25,844	30,292
	Export	1,064	2,800	4,017	6,141	7,537
Vietnam	Production	10,173	11,647	19,225	32,530	35,791
	Export	18	33	1,624	3,477	5,250
Myanmar	Production	8,162	13,317	13,972	21,324	25,364
	Export	641	653	214	251	58
Indonesia	Production	19,331	29,652	45,179	51,898	54,151
	Export	-	10	2	1	42
USA	Production	3,801	6,629	7,080	8,658	10,125
	Export	1,743	3,065	2,542	3,150	4,433
India	Production	63,338	80,312	111,517	127,400	137,690
	Export	27	483	505	1,534	4,025
Pakistan	Production	3,298	4,685	4,891	7,204	8,321
	Export	230	1,087	744	2,016	2,891
PRC	Production	113,102	142,877	191,615	189,814	182,059
	Export	1,695	1,377	405	3,072	672

Source: Food and Agriculture Organization of the United Nations, FAOSTAT, 20 Aug. 2008, http://faostat.fao.org/.

shows that the increase in rice exports from Vietnam between 1970 and 2005 is particularly impressive, while rice of exports from Myanmar is dwindling.

Of note from the table is that only two Southeast Asian countries, namely Thailand and Vietnam, are significant exporters of rice. The other important exporters include USA, India, Pakistan and People's Republic of China (PRC). The Southeast Asian rice exporters have to compete with them for markets, particularly outside Southeast Asia.

Rice Self-Sufficiency

Except Brunei, Malaysia and Singapore, Southeast Asian countries are self-sufficient or nearly so in rice. As Table 3.3 shows, Thailand, Vietnam, Laos and Myanmar experienced significant increase in production versus consumption over the period 1970 and 2003, thus enlarging their export capacity. Also noteworthy from Table 3.3 is that rice production in Brunei has fallen dramatically over the last three decades. In 1970, Brunei produced 35% of its rice consumption; in 2003, domestic production provided

Table 3.3
Domestic Production in Consumption of Rice (%), 1970 and 2003

	1970	2003
Thailand	170	275
Vietnam	101	168
Laos	118	166
Myanmar	128	158
Cambodia	223	149
Indonesia	108	112
Philippines	123	102
Malaysia	85	87
Brunei	35	2
Singapore	0	0

Source: Derived from Food and Agriculture Organization of the United Nations, FAOSTAT, 20 Aug. 2008, http://faostat.fao.org/.

Note: Food consumption quantity was converted back into primary equivalents, i.e. paddy, by FAO.

only 2% of Brunei's rice consumption. The high standard of living of this petroleum-producing country in part explains the decline of its rice-farming sector. Rice farming simply cannot yield that level of income and comfort in Brunei. Within the region, Brunei and Singapore thus provide important markets for rice in the Southeast Asian region. In this sense, the Brunei and Singapore economies are complementary to the rice exporting economies of Southeast Asia.

Insofar as the relationship between population growth and food supplies is of importance, it is useful to compare the growth rates of rice production and of population in the Southeast Asian economies. Table 3.4 shows that over the period 1961–2007, aggregate rice production rate has increased more rapidly than population growth in many Southeast Asian countries, including Laos, Myanmar, Indonesia, the Philippines, Vietnam, and Thailand. Brunei is the only country in Southeast Asia where population growth (3.3% per annum) far exceeds rice production (−3.0% per annum). Increases in land area devoted to rice as well as yield increases over the period explain the growth of rice production, with the latter yield factor becoming increasingly more important. We have to take note that the comparison done in Table 3.4 is highly important in a closed economy,

Table 3.4
Compound Annual Growth Rate of Rice Production and Population (%), 1961–2007

	Rice Production	Population
Laos	3.7	2.3
Myanmar	3.5	1.8
Indonesia	3.4	1.8
Philippines	3.1	2.5
Vietnam	3.0	1.9
Thailand	2.2	1.7
Cambodia	2.0	2.1
Malaysia	1.6	2.5
Brunei	–3.0	3.3

Source: Food and Agriculture Organization of the United Nations, FAOSTAT, 20 Aug. 2008, http://faostat.fao.org/.

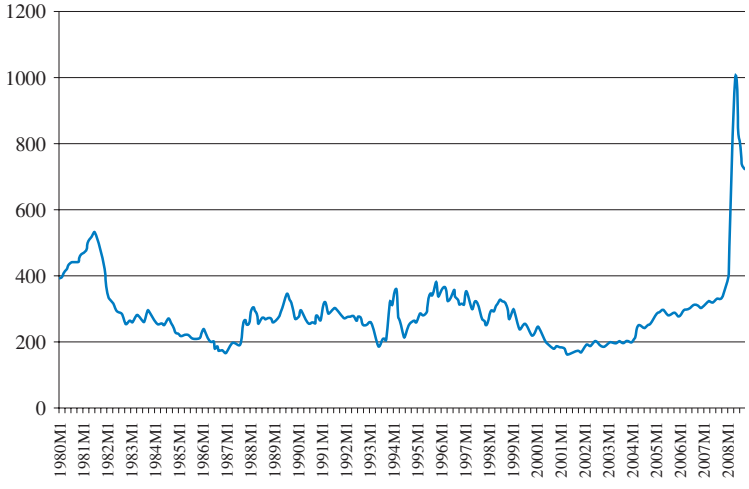
as it indicates the ability of a nation to feed its people. However, in an open economy, where trade can take place, a country can always import its food requirements and the comparison is irrelevant.

The issue of rice self-sufficiency took on considerable urgency in 2008 due to a sudden spike in rice prices. As we can see from Diagram 3.2, rice prices were on a general downward trend from 1981 to 2001. Rice prices embarked on a steady upward climb since 2001, but spiked suddenly in early 2008. Comparing to the previous month, rice price increased by 22% in February 2008, 40% in March 2008, and by another 51% in April 2008. By April 2008, rice price was 158% higher than in January 2008.

The price spike was partly due to a global rice shortage, which was in turn partly due to droughts in Australia and China. In their effort to secure sufficient stock for their domestic consumption, rice-exporting nations such as China, India, Egypt, Vietnam and Cambodia imposed export bans or export tariff. This further aggravated the price increase. The sharp increase in rice prices had set off violent protests in many countries including

Diagram 3.2

Rice Price (US$ Per Metric Tonne), 1980 Jan.–2008 Sep.



Source: IMF Primary Commodities Prices, 15 Oct 2008, http://www.imf.org/external/np/res/commod/index.asp.

Note: Prices used refer to the white milled, 5 percent broken, Thailand nominal price quotes, FOB Bangkok.

Cameroon, Egypt, Ethiopia, Haiti, Indonesia, Italy, Ivory Coast, Mauritania, the Philippines, Thailand, Uzbekistan and Yemen.

Although rice prices had eased since middle of 2008, the potential social unrest as a result of high food prices and the "beggar-thy-neighbour" actions by the rice-exporting nations to ban exports in time of crisis have serious ramification on food self-sufficiency policy of many nations. For example, the Malaysian government announced plan in April 2008 to achieve more self-sufficiency in rice by growing large amounts of rice in Sarawak. The Malaysian government has also urged private corporations to take up large-scale food-production ventures. In response, palm oil giant Sime Darby announced plans to diversify into rice production with an initial area of 7,000 ha in Sarawak, and integrated timber corporation Ta Ann Holdings also revealed plans of diversification into rice cultivation.

While it is an impressive technical and administrative achievement for a rice deficit country to produce all its rice requirements domestically, it is nevertheless, an issue as to whether it is economically worthwhile even though it may be justified from a strategic point of view (Fitzpatrick, 1991). Man does not live on rice alone. The higher the percentage of expenditure on rice consumption in a household, the poorer is the household. This is at times referred to as a variant of Engel's Law. In rice production, economic efficiency must be judged not by whether the country can export rice or is self-sufficient in rice, but by the productivity of rice per farmer and the relative productivity of other sectors. This issue of self-sufficiency will be further dealt with in Chapter 5.

Low Yields Compared to East Asian Countries

There exists a considerable productivity gap in rice production between Southeast Asia and other major rice exporters. This can be seen from Table 3.5. Although Vietnam and Indonesia had the highest rice yield among the Southeast Asian countries, it was only about half of that achieved in Egypt, which was producing 9.9 tonnes per hectare. Rice yields in Southeast Asia are also low when compared to USA and China. There is, *a priori*, still great scope for rice yields in Southeast Asia to improve. If productivity is

Table 3.5
Average Rice Yields (Tons/Ha), 1971–1975 and 2003–2007

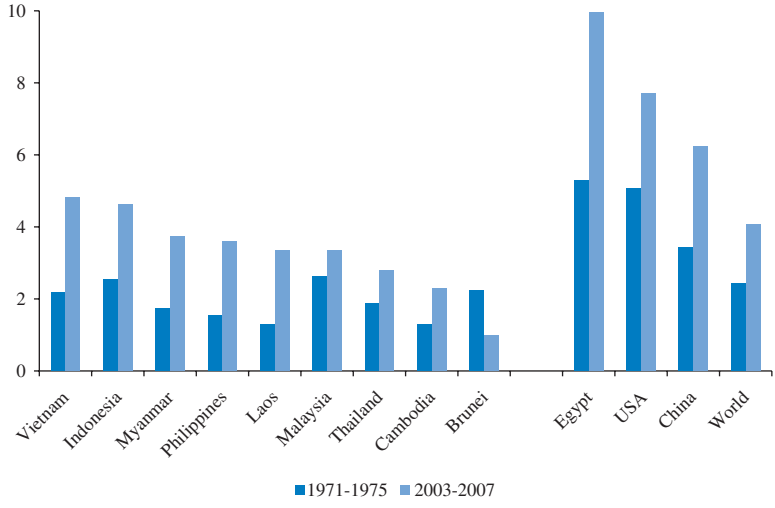
	1971–1975	2003–2007
Vietnam	2.2	4.8
Indonesia	2.5	4.6
Myanmar	1.7	3.7
Philippines	1.5	3.6
Laos	1.3	3.4
Malaysia	2.6	3.3
Thailand	1.9	2.8
Cambodia	1.3	2.3
Brunei	2.3	1.0
Egypt	5.3	9.9
USA	5.1	7.7
China	3.4	6.2
India	1.7	3.1
Pakistan	2.3	3.1
World	2.4	4.1

Source: Derived from Food and Agriculture Organization of the United Nations, FAOSTAT, 20 Aug. 2008, http://faostat.fao.org/.

relatively low, income will also be relatively low, and then the standards of living will be relatively low too.

Notwithstanding the productivity gap, rice yields improved across most of the Southeast Asian countries. The highest average yield achieved by a Southeast Asian country during the period 2003–2007 was Vietnam with 4.8 tonnes per hectare; this was more than double the yield of the period 1971–1975. The rice yield improvements were equally impressive for Laos, the Philippines, Vietnam and Myanmar. On the other hand, the yield improvement made by Malaysia and Thailand were just mediocre. The slow improvement in rice yield in Thailand can be attributed to the predominance of the rain-fed rice ecosystem and the farmers' preference to grow high-quality, low-yielding traditional

Diagram 3.3
Average Rice Yields (Tons/Ha) 1971–1975 and 2003–2007



Source: Table 3.5

aromatic Thai rice varieties that fetch a premium price in the domestic and the world market.

Productivity in rice growing, however, is not just a function of the skills and practices of the rice farmers per se, it is also a function of the essential capital input of fertilizer, irrigation facilities, better seeds, pest control, sale prices, planting and harvesting traditions, storage and transportation methods, and credit supply, many of which are outside their control.

System of Credit

Traditionally, credit institutions in Southeast Asian countries consider lending without tangible collateral (mainly land) to be an unsound practice. This requirement of collateral tends to discriminate against small and landless tenant farmers, who consequently may not have much access to institutional credit. Instead, they may have to turn to the informal market — the village moneylender, a local shopkeeper or a large landowner, for their funding needs. Rates of interest in the informal markets tend to be high due in part to monopoly elements, but more importantly because of the large overhead costs of small loans and the high risk of default due to a lack of

collateral. The lenders may consider them as sub-prime loans. The large farms may become the main beneficiaries of institutional credit. Thus, the capital market may be fragmented with the large farms paying less than the social opportunity cost of capital, while small peasants often paying substantially more.

However, by the 1970s, credit institutions in most of the Southeast Asian countries had changed their practice on collateral for lending (Asian Development Bank, 1978). Agriculture was designated by most Governments in Southeast Asia as one of the priority sectors and banks generally had to provide some minimum lending to agriculture. Collateral was not required for lending while status as a cultivator was sufficient to give eligibility for short-term institutional credit. Moreover, institutions could provide credit to the farmer, which would cover his total requirements. Loans were also extended for long-term farm projects. Often, Governments compensated the banks for the costs of lending to agriculture. Such a development of credit programmes reflects, firstly, the concern of most Southeast Asian countries to increase agricultural output, and secondly, the recognition of the growth potential of the HYVs. The credit programs typically had the following features: heavy fiscal and administrative costs, high degree of loan default, bias toward larger and well-to-do farmers, and negative real interest rates (Herath and Jayasuriya, 1996).

Two of the most widely publicised agricultural development programmes illustrating the change in attitude regarding the expansion of credit extended to farmers have been the BIMAS/INMAS (crop intensification) programmes in Indonesia and the Masagana 99 programme in the Philippines. A basic objective of both programmes was to increase rice production by providing credit and modern inputs to farmers. The BIMAS programme was launched in 1967 and reorganised in 1971 following substantial problems with loan defaults. The volume of credit was greatly increased by 1971 but provisions were inadequate for ensuring a high rate of repayment, and default rates tended to be high. A new BIMAS programme commenced in 1973–74, but loan default was again very high. However, helped by the availability of new HYVs better suited to Indonesian irrigated rice environment, adoption accelerated and rice self-sufficiency was achieved in 1984 (Herath and Jayasuriya, 1996). The Masagana 99 programme in the Philippines was a subsidized credit and fertilizer programme introduced in 1973. Although the

default rate was high, the programme played a positive role in stimulating early adoption of HYVs (Herath and Jayasuriya, 1996).

Another aspect of the credit system in the Southeast Asian countries is the adoption of a low interest-rate policy to encourage the purchase of agricultural inputs by small farmers. There was not enough evidence, however, to suggest that this policy had been successful (Asian Development Bank, 1978). Instead, given a shortage of credit, low interest rates have often encouraged large farmers to pre-empt the scarce institutional credit. What little credit that is available through organised institutions has probably tended to be rationed among those with secure titles to land and supplied at a relatively low rate of interest.

Government Pricing Policies

An important component of government policies aimed at rice production growth is the policies on rice price. Until the mid-1960s, the general orientation of policy-makers in the Southeast Asian countries was to keep food prices depressed. Government intervention to suppress economic incentives by pricing food products below competitive equilibrium levels is based on: (1) an under-emphasis on agriculture's contribution to economic development and (2) the assumption that the market mechanism permits middlemen to exploit the poor urban consumers. Policies that depress food prices relative to manufacturing prices have also been adopted in the belief that manufacturing provides the only means of rapid economic growth. The policy of depressed food prices, however, has generally been reversed after the mid-1960s.

As food-deficit countries in the region aspired to achieve self-sufficiency, and emphasised domestic production of food grains, raising food grain prices was considered to be an incentive for increased production. In Indonesia, the Government's recognition of the need for the farmer to receive an adequate price incentive if he were to expand his purchases of yield-increasing inputs that might bring rapid production growth, led to the establishment of BULOG, a food stock authority directly responsible to the President. BULOG generally succeeded over the 1970's in increasing nominal and real prices for the paddy farmers by periodically raising the floor price, with real price of rice rising by 47% during the period 1971–80 (Mears, 1981). Policies aimed at raising agricultural prices are, however,

not without costs. Higher food-grain prices are likely to result eventually in higher industrial wages, leading to an increase in industrial product prices after a time lag. With food and industrial product prices both higher, a rise in the general price level, that is, inflation, is virtually inevitable in LDCs where a high proportion of income is spent on food. Though other macro-economic factors are also important in explaining inflation, the contribution of food price increases cannot be understated.

Green Revolution in Rice

The large rice productivity differentials existing between the Southeast and Northeast Asian countries provided the impetus to narrow such gaps such as by the introduction of high yields varieties or HYVs.

The first semi-dwarf indica variety of rice was developed by plant breeders in Taiwan in 1956. The variety is known as Taichung Native I, and it is on this plant material that most of the subsequent research has been based. This is especially true of the important work done at the International Rice Research Institute (IRRI) at Los Banos, the Philippines.

IRRI was established by the Ford and Rockefeller Foundations.[1] Research on the Institute's 80-hectare farm started in 1962 and by 1965 many genetic lines had been developed. The best of these lines had doubled the yield potential of traditional rice varieties. The high-yielding varieties have short, upright leaves, which enable sunlight to penetrate. They are only mildly sensitive to length of day, and, therefore can be planted at any time of the year. Furthermore, they have a grain to straw ratio of 1.0 as compared to 0.6 or 0.7 of the indigenous varieties. Under ideal (experimental) conditions, the maximum yield of the HYVs is over 10 metric tons per hectare, and even in the cloudy, monsoon season yield can exceed 5 tons per hectare. In comparison, the average yield of rice in most LDCs, using local varieties, was less than 2 tons per hectare (Griffin, 1979).

In November 1966, the first of the IRRI varieties, IR-8, was introduced for general use. It was hailed as "Miracle Rice". Since then, the global rice

[1] *En passant*, the National University of Singapore conferred an honorary doctorate upon the Director General of IRRI for its outstanding achievement in kicking off the Green Revolution in Asia.

harvest has more than doubled, a pace that is slightly faster than population growth. IR-8 was followed by other new varieties of rice. Efforts were made to develop varieties that would suit local conditions. The rate of adoption of HYVs, however, differed among countries, with the Philippines being the most responsive and Thailand the least. Accordingly, one expects that, *a priori*, the spread and hence the impact of the Green Revolution differed among countries.

The magnitude and spread of the Green Revolution hinges heavily on institutional transformation, since productivity increases in agriculture depend not only upon the strength of technological innovations but also upon the favourable interaction of the technological change with the institutional environment. Wherever the necessary institutional support has not been forthcoming, this has prevented the diffusion of productivity gains from occurring more widely to provide a more viable base for the ultimate agricultural transformation.

Technological Possibilities

While the Green Revolution has not led to a dramatic increase in the trend rate of growth of rice production in some countries of the region, the introduction of HYVs has nevertheless brought about improvements in average yields. Rice yield per hectare has more than doubled over the period 1971–2007 in Laos, the Philippines, Vietnam and Myanmar (Table 3.5). The increase has been relatively rapid in Indonesia (increased by 81%) and Cambodia (increased by 76%), and relatively moderate in Thailand (increased by 50%) and Malaysia (increased by 21%) over the same period.

While the introduction of HYVs can lead to very substantial yield increases, their introduction has some technical demands. The successful adoption of HYVs requires not only large quantities of fertilisers and pesticides but also a well-developed system of irrigation capable of proper control over water supply to the individual fields. The problem of supplying these modern inputs on an adequate scale is very considerable — the most formidable problem being the provision of irrigation facilities. In many Southeast Asian countries, however, the share of irrigated land to total arable land and permanent cropland has not shown any significant increase.

Investment in irrigation and drainage systems is a priority in order for the technological innovation to have its full effect. This is due to the fact that within the region, a significant factor affecting rice production is the damage caused by natural disasters — drought or flood — in much of the planted rice area. For example, according to available data in Thailand for a 58-year period (1907–1965), there were natural disasters in 24 years, each affecting more than 10% of the cropped area. In some years, more than 30–40% of the rice area was damaged, with production dropping by more than 30% (Asian Development Bank, 1969).

A new technological possibility arising from the Green Revolution is the shorter harvesting time required. It, therefore, offers a real opportunity for a more intensive use of available land by growing at least two crops a year instead of the single crop that characterises the extensive agriculture of much of Southeast Asia. Large scale double cropping of rice in the traditionally single-cropping areas, however, involves comprehensive preparation and well-coordinated operation by the farmers, workers and all others concerned. Precise timing must be followed for practically every step of the operation because of the limited time available for each crop. It is the time element that generally creates difficulties with most double-cropping programmes in rice in their initial stages, and subsequently causes some reduction in the production targets.

The time element also necessitates finding future technological solutions to many problems that are not crucial in single cropping. A system of double cropping also requires a change, not only in cropping patterns, but also in harvesting methods. In addition, mechanical drying and increased storage facilities will be required for harvesting rice during the wet season.

Continuous research, not only by international research centres but also by individual countries, is necessary if the technological innovation is to have greater long-term impact in individual Southeast Asian economies. Apart from the longer-term research on plant protection and diversified breeding to reduce the risks of large-scale crop failures through disease and infestation, there are at least three fields of research that are of immediate economic importance (Myint, 1972). Firstly, research is needed to adapt the new high yielding varieties to the divergent local conditions of different Southeast Asian countries. Secondly, research is needed to make the new varieties of rice more appealing to consumers' tastes. Otherwise, the

domestic market for them will remain limited. Alternatively, attempts will have to be made to change the consumers' taste, which can be a Herculean task, certainly a long-term rather than a short-term measure. Thirdly, in order to obtain the full benefits from the Green Revolution, a more intensive use of land and the full exploitation of multiple cropping are necessary. This is also required to enable the farmers to earn adequate incomes, especially if they have to pay for irrigation, modern inputs and credit. Research to widen the range of the Green Revolution to other crops is also an important new research direction closely related to multiple cropping.

Organisational Issues

An important organisational requirement to ensure the spread of the potential benefits of the technological innovation is the framework for the distribution of credit, seeds, fertilisers and pesticides to farmers. The basic issue that arises here is whether the function is best performed by the market network of traders and middlemen or a Government sponsored centralised agency. Purely in terms of organisational efficiency, it is recognised that the task of distributing inputs to a large number of farmers all over the country is generally more efficiently performed by the former. For, it is costly for the central agency to open a sufficiently large number of local branches to deal directly with the farmers. The overhead costs of the local traders and money-lenders are relatively low. Co-ordination of the traders at various levels (wholesale or retail) is efficiently performed by the market, while bureaucracy may or may not be able to perform this function.

Another set of problems requiring the attention of policy-makers is in milling, grading, storing, transporting and marketing of output. With increased output, there is a need to market the agricultural surplus. Inadequate milling, storage and transport facilities can create bottlenecks in marketing these surpluses. In some of the Southeast Asian countries, the purely physical problems of marketing have also been exacerbated by social factors where specific ethnic or racial groups have traditionally controlled most of the commerce. Governments, in order to eliminate some middlemen for political reasons, tend to promote public marketing agencies, which may not be efficient. Often, such agencies create bottlenecks in the smooth flow of production and distribution. Another way out is to break the monopolies

through the introduction of competitors, to remove institutional rigidities and to free the markets so to speak. More competition by granting licences to more middlemen should be considered.

Price Support and Other Policies

To launch the Green Revolution, Governments have typically raised the price of rice to farmers by price supports or by import restrictions, which raise the domestic price above the world market price. In addition, input prices are subsidised. Moreover, it is generally argued that the factor markets in rural areas are distorted and that factor prices fail to reflect social opportunity costs. One effect of the distorted factor prices is that they tend to be biased in favour of large landowners who can adopt innovations more quickly than smallholder peasants.

The fact that factor market distortions need corrective policies can be illustrated with reference to rural credit markets where the interest rate charged on loans by the organised segment tends to be much lower than the rate charged by the unorganised segment. The majority of the rural people seeks credit in the unorganised capital market and pays the high interest rate. On grounds of equity and efficiency, this situation should be corrected. Suppliers of credit should not be restricted. Their number should be encouraged to increase in order to have more competitors in credit supply. The Government should also adopt policies to ensure that small peasants have access to the organised market on terms, which are not inferior to those enjoyed by large landlords.

In principle, similar policies should be advocated to ensure that small owner-operators have equal or preferential access to technological assistance, irrigation, and other inputs, which are vital to the success of the Green Revolution. Such policies are important because small farmers tend to be discriminated against in virtually all factor markets — either in terms of price, the way scarce resources are allocated by rationing, or because of restricted access to the bureaucracy.

The use of price supports by Governments has not been aimed towards turning the terms of trade in favour of agriculture as a whole, but towards raising the prices of particular items whose production needed to be encouraged. It may be argued that since the introduction of high yielding seeds

reduces total costs of grain production — and therefore raises farm profits and leads to increased output — it should not be necessary for Governments to support the Green Revolution by maintaining the domestic price of any particular commodity above that prevailing in the world at large. On the contrary, a sensible objective of government policy would be to ensure that lower costs are passed on to the community in the form of lower food prices. Already, large farms often benefit from what are in effect subsidised material inputs. If the same farms now receive a subsidy on output as well, the consequences for resource allocation will be serious. Undoubtedly, the price supports and input subsidisation would have induced farmers to expand their output rapidly through the private profit motive. The question, however, is whether the economic incentives given to the farmers are appropriate for the efficient allocation of the resources between rice production and other crops, and more generally, between agriculture and the rest of the economy. A country that has no real comparative advantage in rice should be encouraged to reallocate resources to other crops in which price and demand prospects are more attractive. This is an important economic efficiency issue often overlooked by the authorities.

There is also the serious problem of fragmentation of land, which has come about for a variety of reasons. Included in these is the inheritance law and practice, resulting in small lots not economically viable for cultivation. In Malaya in 1958, the Payne Land Administration Commission once stated (Lim C. Y., 1967: 170–171), "Without attempting to find fantastic cases, but merely looking through records at random, we came across nine persons having shares in a smallholding in the following proportions:

$$\frac{12522}{57024}, \frac{12522}{57024}, \frac{6276}{57024}, \frac{3080}{57024}, \frac{1540}{57024}, \frac{1464}{57024}, \frac{732}{57024}, \frac{1569}{57024}, \frac{10893}{57024}.$$

"In another holding of two acres, one rood, the shares held by eight people respectively were:

$$\frac{1}{2}, \frac{1}{14}, \frac{1}{14}, \frac{1}{14}, \frac{1}{14}, \frac{331737}{2286144}, \frac{27909}{2286144}, \frac{130242}{2286144}.$$

"Numerous similar illustrations could be given. In one instance we were informed that the share of rural land inherited by one beneficiary amounted to three square feet, and he insisted on having it!"

According to the World Bank (2007), panel data that followed household heads and their offspring in the Philippines and Thailand over roughly 20-year period show declines in average farm sizes and increases in landlessness. More discussion on land reform will be done in Chapter 5.

A similar issue of economic efficiency arises in the allocation of resources in the public sector, since the Green Revolution requires heavy government investments, particularly in irrigation, transport and storage facilities. Thus, policy-makers have to face the question of how much of the available resources should be allocated to promoting the Green Revolution and how much of it should be allocated to public investment in other sectors of the economy. In the rice-growing sector, obviously, without the help of important many-faceted extension services provided by the state, it would be difficult to raise productivity, and most farmers would have to resign to their fate of subsistence living and poverty. Public policy makers should also bear in mind that in developed economies, agricultural subsidy is the vogue, whereas in much of Southeast Asia, dependence on taxes on farmers, including export taxes, are still not out of fashion.

Lessons for the Future

The picture that emerges from the earlier analysis of the impact of the Green Revolution can be summarised as follows: a technology that has vast potential to increase yield has been introduced into environments in which institutional factors have sometimes been adverse. Evidence from the last few decades suggests that, if it is to be successful, an agricultural strategy must be based on the recognition and understanding of the inter-relationship between technology and institutions. The nature of this inter-relationship is seen, for instance, in the inaccessibility of credit by small farmers. In many areas, small farmers did not adopt improved food grain technologies or only adopted them after a considerable time lag. A major reason for this is the higher cash outlay usually involved and the limited access that small farmers have to formal credit institutions. There is also the problem of land

tenure and fragmentation of land to be solved. Where rice farming is carried out by tenant farmers, the problem becomes more serious. The problem is compounded with rapid population increase.

The above discussion, of course, assumes that profitable technologies are in fact available which are appropriate for a wide range of environments found in Southeast Asia. However, to date, the research efforts to generate better technology have favoured the cultivation of rice under conditions of good water management. Hence, the available technology is not easily transferable from one area to another. The technology development in agriculture in the future will have to address the more stringent environmental conditions imposed in most Southeast Asia by poor soils, lack of easy access to adequate water, and sometimes, social and cultural resistance to rapid change. An examination of the directional and content of agricultural research is an essential pre-requisite for evolving an appropriate strategy.

Finally, in view of the high incidence of poverty within the rural sector in most of the Southeast Asian countries, policies to raise the welfare level of the rural population require not only technological and institutional developments in agriculture, but more appropriately, more broad-based basic needs strategies affecting family size, education, health, sanitation and the allied social sectors. A multi-faceted big-push approach will have to be adopted. In some cases, where the comparatively disadvantages in rice growing are obvious, a deliberate movement away from rice farming to other more profitable cash crops might have to be encouraged and policy adjustment to ensure rice supply for consumption will have to be appropriately carried out. The aim must be a higher standard of living and a higher quality of life for the farmers.

Key Points

1. Agriculture plays an important role in most Southeast Asian countries. It can be separated into subsistence farming and plantation crops. Among subsistence farming, the growing of rice is the most common and has a long history in Southeast Asia.
2. Most Southeast Asian countries are self-sufficient or nearly so in rice. Thailand, Vietnam and Myanmar are net exporters of rice. Man, however, does not live on rice alone. Thus, for some countries, such as Brunei

and Malaysia, it may not be economically rational to be self-sufficient in rice. Comparative advantages in rice growing cannot and should not be ignored and the price of rice will have to be factored into the self-sufficiency equation.

3. Rice farming in Southeast Asia suffers from low productivity. Rice farmers are still using outdated technologies and inputs to grow their rice.
4. Credit systems in place were either biased or poorly managed.
5. The response to the introduction of HYVs is mixed. Indonesia and the Philippines are the most receptive to the new strain of rice. On the other hand, Thailand is the least receptive.
6. The Green Revolution has increased rice production in Southeast Asia but the benefits were not fully reaped. This could be attributed partially to the inability to have adequate modern inputs, such as irrigation facilities, fertilisers and pesticides as well as shortcomings with the system of credit and the land tenure and ownership systems.
7. To raise productivity in the rice sector, a concerted action by the Government covering different facets of the rice industry is necessary, not just through the adoption of higher-yielding rice seeds only.

Suggested Discussion Topics

3.1 Evaluate the "Green Revolution" in relation to rice farming in Southeast Asia. Discuss the obstacles that have to be overcome before the Green Revolution can be successfully implemented in the region.

3.2 Explain the low productivity in rice production in Southeast Asia. What could be done to help increase the productivity (and income) of the rice farmers?

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