Food Price Policy in Indonesia

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Foreword

Agriculture is the largest sector of the Indonesian economy in terms of its contribution to gross domestic product (GDP) and is a very significant employer of labour. Since the early 1970s, the Indonesian government has had an active approach to agricultural policy, with the particular objective of stimulating rice output in order to provide a stable base for the overall economy. The major instruments of this agricultural policy have been input and output price supports for producers.

Relatively little economic appraisal of these policies has been conducted, and in an attempt to fill this void research was begun at the University of New England in 1983. This monograph is a report on the research completed in the following six years. The research was undertaken as a collaborative project between the University of New England, Armidale, Australia and the Centre for Agro-Socioeconomic Research, Bogor, Indonesia, facilitated by a grant from ACIAR.

While the central theme is agricultural price policy, the overall approach is more comprehensive, and attempts to relate the impacts of the various policy instruments to the wider economy. Hence, while particular chapters concentrate on specific details such as the operation of fertiliser subsidies, the different pieces of analysis taken together present a picture of the overall effect of agricultural price policy on the Indonesian economy.

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Contents

1 Background to Price Policy

1.1 Introduction

The central theme of this monograph is Indonesia's economic policy for the agricultural sector. Such policy can be considered in terms of the three components: objectives, economic structure and instruments.

In Indonesia, the policy maker's objectives for agriculture are unavoidably interwoven with the objectives of overall national policy, because of the size of the agricultural sector and because the importance of rice as the national staple product ensures that agricultural policy adjustments significantly affect a large proportion of households. This means that, while the usual methods of analysing agricultural policy in microeconomic terms such as efficiency and equity considerations are relevant, a number of other more macroeconomic targets have appeared. These include balance of trade, employment and inflationary objectives.

Hence, in the trade area, a major stated objective of Indonesian food policy is to achieve overall food self-sufficiency. Self-sufficiency in rice is a major component of this policy. Until 1980, Indonesia was a major importer of rice. She took about 15% of world imports in 1980 and these imports were a considerable foreign exchange burden. The increase in domestic production since then has been sufficient to overtake the increase in domestic consumption. This expansion has occurred under the influence of input subsidies and output price support.

With more than 50% of the workforce employed in agriculture, changes in the sector have considerable impact on the Government's employment targets. Of particular importance here is the concern over rural-urban migration and the perceived need to maintain rural employment prospects in order to minimise the extent of urban poverty.

Turning to macroeconomic price level objectives, it is clear that the Indonesian Government must consider the impact on inflation when it guides agricultural (particularly rice) prices.

After considering objectives, the second component of economic policy is the structure of the economy, and the second component of policy analysis is modelling this structure. From the discussion above it is clear that the relevant elements of the economic structure, even in relation to rice price policy, are the rice production sector, its relationship with the *palawija* (secondary food crops), employment impacts, the rice consumers, suppliers of inputs, and flow-on effects to the general economy through inflation and trade effects.

It would be remiss not to outline the instruments of agricultural policy. Those which seem to have had the most prominent effect and which have been actively pursued are floor and ceiling price policies, of which those for rice are most complete in their coverage of wide areas of Indonesia; input subsidies, notably for fertilisers; trade policies amounting to import quotas and levies and export subsidies; and extension policy.

1.2 The Evolution of Policy Objectives

Over the last two decades Indonesia has been transformed from a low to a middle-rank less developed country. Annual growth rates of GDP over this period have generally exceeded 5%. Hence, if economic growth is considered the predominant objective, a modicum of success has been achieved. The Indonesian economy is officially encompassed in a broad public philosophy, dictated by the 1945 Constitution, known as Pancasila. This defines five principles: belief in god, humanitarianism, nationalism, democracy and social justice (Liddle 1982, p. 96). Interpretations of the economics of Pancasila have differed somewhat over the years, although the Constitution indicates that the State is expected to oversee the major economic areas, with private enterprise relegated to those fields not concerned with the basic needs of the people. The State has in fact concerned itself with much of the large-scale enterprise of the emerging industrial sector, either directly or through joint ventures, but has not become so directly involved in the agricultural sector. Direct State involvement is mostly concentrated in ownership of estate crops and, to a lesser extent, through joint ventures in forestry. While a cursory examination shows that the food-producing sector, which accounts for over 60% of the output of the agricultural sector, is almost exclusively in the hands of smallholders, even here there are extensive indirect controls over and above the various price policy interventions. Hence, overall, the economics of Pancasila seem to be based on 'a suspicion of market forces and a marked sympathy for "guidance" of the economy' (McCawley 1982, p. 106).

This guidance of the economy has had different manifestations at different times. Historically rice has been a major concern in Indonesian affairs. While Dutch colonial policy was one of minimal intervention (Mears and Moelyono 1981, p. 23), a floor price was set for rice at Javanese mills in 1939 (Pitt 1977, p. 5). By the time Indonesia achieved its independence from Dutch rule (recognised formally in 1949), a basic philosophy of government interference in the rice sector had been established (Timmer 1975, p. 208). Underpinning this philosophy was the view that '... rice was too important to be left alone, and direct intervention in the market place...was the proper government response'. (Timmer 1981, p. 35). In the decade following independence various initiatives were taken to expand rice production. Apart from the need to

feed a rapidly growing population, rice rations were part of the payments system for the army and civil servants (the so-called 'budget group').

Guidance of the economy was also manifest at the macroeconomic level. In the early 1960s, the Sukharno Government had ambitious public works projects and, with no other sources, financed the resulting budget deficit by expanding the monetary base. The resulting expansion of the money supply brought inflation to levels in excess of 1000% in 1965–66 (Booth and McCawley 1981, p. 107).

When the New Order Government took office in 1966 the economy was in disarray. The Government imposed upon itself a strict balanced budget discipline and more reasonable levels of monetary growth. Domestic prices of rice for both consumers and producers were kept below the trend of world prices and the domestic market was insulated from international instability. Both general price stability and consumer welfare objectives were enshrined in this rice-price policy (Falcon and Timmer 1975). There was also a desire to stimulate rice production through higher prices to producers, but the budgeting constraint and a perceived need to direct development expenditures to other sectors prevented the immediate attainment of this objective. In addition, the Government wanted to stimulate business investment through monetary policy. It achieved this by encouraging the largely State-controlled banking system to finance business rather than government expansion through the money creation process (Grenville 1981, p. 112).

Hence, between 1966 and 1972 with economic growth as the prime objective, the principal components of policy were a balanced budget, strict limits on monetary expansion to control inflation, control on rice prices as a significant influence on consumer prices and encouragement of private business investment. Given the extremely unstable domestic economic environment of the early 1960s, it was a commendable achievement to create an environment in which real GDP grew by 6% per annum between 1965 and 1971 (Booth and McCawley 1981). Agriculture grew at 3.8% per annum during this period, without the significant price incentives that were offered to the food production sector from the mid-1970s. However, since the start of the system of five-year national plans (called *Repelitas*) in 1969, the food–producing sector has received special attention. At first this was because growth in agriculture was essential if overall economic growth was to be achieved. Though still a significant sector of the economy, accounting for just over 25% of GDP in 1986 (BPS 1987) alternative employment and self-sufficiency goals became predominant after 1972.

The years 1972 and 1973 saw instability in international commodity markets associated with a fourfold increase in crude-oil prices. Although there were gains to Indonesia as an exporter of oil, some turbulence was transmitted to the domestic economy and especially the Indonesian policy-making process.

First, foreign exchange earnings increased and this led to domestic money supply creation. This would probably have created a larger inflationary problem, had the Government not restrained its own fiscal activity by maintaining a budget surplus. Another effect of the international oil price increases was to increase the Indonesian Government's revenue from taxation on oil companies, enabling it to increase its development expenditure (especially in agriculture) while maintaining the budget surplus.

Next, the world rice market suffered severe shortages in 1973 and 1974. Despite having the required foreign exchange from the sales of oil, Indonesia was unable to purchase sufficient imports of rice as its major supplier, Thailand, banned exports (Timmer 1986, p. 5). A significant effect of this was to stimulate a new drive on the part of policy decision-makers in Indonesia for domestic food security and especially for self-sufficiency in rice. The policy response was to establish both output price supports in the form of higher floor prices for rice producers and input subsidies across a number of purchased inputs. These have continued as the main thrusts of agricultural policy. One consequence of these policies has been the achievement of self-sufficiency in rice in 1985, and the continuation of production at close to self-sufficiency since.

Events of the early 1980s combined to alter the set of policy objectives further. As a result of falling international prices of oil, the country has faced severe balance of payments problems throughout the decade. In addition, Government expenditure has been constrained as oil revenues have fallen. As a result some development projects have been deferred, and overall economic growth has been less than it would otherwise have been. Sundrum (1988, p. 37) estimates the rate of economic growth at 2.9% per annum between 1981 and 1986, compared with an average of 7.7% from 1967 to 1981.

Throughout this unstable period, food security and the attainment of self-sufficiency in rice remained a dominant objective. Each year between 1977 and 1984 producer support prices for rice were increased in real terms and substantial subsidies for fertiliser were continued. These rice policies were a considerable drain on the budget at a time of restricted Government revenue. It is clear that the attempt to achieve rice self-sufficiency was being given priority.

In the years following 1985, when rice output first exceeded consumption, there has been continuing questioning about the level of support given to rice producers. Apart from the problem of finding the required level of finance to support the policy, there was concern that agricultural resources were being drawn away from the production of the *palawija*, or secondary food crops. The policy stance towards the *palawija* was one of neglect in comparison to the enormous efforts devoted to rice. However, following the attainment of self-sufficiency in rice, there have been reductions in real producer prices of rice and in the level of fertiliser subsidies. One effect has been to encourage palawija

production (EIU, 1989) while rice output has continued to grow. Another is that Government expenditure, particularly on fertiliser subsidies, is expected to fall considerably.

Currently, there are several sub-strands to the Government's growth policy. There are continuing attempts to reduce dependence on oil both as a foreign exchange earner and as a contributor to the budget. This has achieved partial success as exports of commodities like manufactured timber products have expanded. However, oil remains the dominant export product. Second, the Government has been encouraging foreign investment, and Schwarz (1989, p. 74) argues that the flow of funds from abroad, particularly into investments in the manufacturing sector, has 'helped rescue GDP growth from mid-decade stagnation'.

Such efforts have partly directed attention away from the food production sector. However, with consumption of rice growing as the population and income levels increase, the self-sufficiency must be regarded as fragile. The policy stance is one of attempting to keep output expanding while keeping Government expenditure on food policy programs to a minimum. This is a fairly difficult path to follow given the size of the food producing sector. In addition, despite significant recent employment growth in the manufacturing sector, the Government must ensure that farm incomes are kept high enough for agriculture to absorb labour.

1.3 The Structure of the Economy

Although its share of GDP has fallen, agriculture (including forestry and fishing) is still the largest sector (see Table 2.1). Also, since 1980, agriculture's share has declined more slowly as the output of food crops has expanded following price policy stimuli, technological change, and the relative decline in the value of oil exports. The main food crops (rice, maize, cassava, soybean, groundnut, and sweet potato) continue to provide more than 60% of agricultural output. Food production is characterised by small farm holdings (most are less than 0.3 ha), which occupy more than 80% of the agricultural land (Kasryno, Budianto and Birowo, 1982). With more than 75% of the population located in rural areas (Birowo and Sanusi, 1982), agriculture is also a major source of employment (see Table 2.6). On the consumption side, about 63% of consumer expenditure is devoted to food (BPS, 1987b).

Mining is the second-largest sector in the Indonesian economy (see Table 2.1). Here the predominant position of oil as an export earner means that events in the international oil market have been the main determinant of the fortunes of the sector as a whole. The years 1974 and 1979, in which oil prices reached their highest levels, were peak years for mining's share of GDP.

The manufacturing sector, dominated by State enterprises, has been developed largely to produce substitutes for imports. Its share of GDP grew from 8.4% in 1969 to just over 13.0% in 1980, and to about 14.4%

in 1986. Hence the period since 1980 has been one of slower growth for the sector as the economy as a whole has passed through a sluggish phase.

The linkages between these sectors must be considered in a full appraisal of food price policy — witness the current dilemma facing the Indonesian Government about whether or not to continue to maintain high levels of support for food production. Such levels of support for agriculture would imply lower development expenditure by government and hence lower growth in the other sectors of the economy. However, there would also be some beneficial effects of such a policy for these other sectors. For instance, there would be price effects from changes in fertiliser subsidies that would be expected to flow on to fertiliser manufacturers and importers (Hedley and Tabor 1989). Apart from such price effects, a stable producer price regime in agriculture tends to keep resources in the sector and, with productivity improving, would result in increasing output. This has the impact of increasing output in other sectors of the economy both to service agriculture and to absorb the extra demand generated by the sector. In addition, given the size of the agricultural sector, a gradually increasing output provides a stable base for the whole economy. In other words, there is a promotion of confidence overall which would be expected to result in, for example, increased investment in, and hence a larger output from, the manufacturing sector.

1.4 Policy Instruments

A series of intensification programs was the type of policy instrument initially adopted to promote food production. The BIMAS program was introduced in 1963. Others following it were the BIMAS GOTONG ROYANG, INMAS, INSUS and SUPRA-INSUS. The BIMAS programs were designed to increase production through the use of improved seeds, fertilisers, pesticides, water management, improved cultural practices and the development of farmer cooperatives. The parallel scheme, INMAS, aided farmers with capital (or access to it) and a keen desire to use modern inputs. In the case of the INSUS scheme, about 50 to 100 farmers with contiguous plots were encouraged to make joint decisions about seeds, planting times, and crop choices in addition to rice.

The Government also realised that adequate price incentives would help encourage farmers to adopt new technologies. The first stage in the development of price incentives was the announcement of the *rumus tani* (Farmer's Formula) in 1968, which linked the price of rice to the price of import urea fertiliser (Arndt 1968, pp. 11–12). While this marked the introduction of a price policy it was not effective until fertiliser distribution was also improved (Mears 1981, p. 390). Following the 1972 rice crisis, the introduction of the cooperatives (KUDs)

gave BULOG (the Government procurement agency) the opportunity to implement the pricing formula at the farm level. There were problems of interpretation and implementation (Afiff and Timmer 1971; Timmer 1975), but a rice price policy based on a Mears and Afiff model (Mears 1981, p. 391) was gradually put in place, became fully operational by 1974, and continues through to the present time.

The main price-policy instruments used for rice are floor prices, which are used to maintain a minimum market price for rice delivered to the KUDs; various input subsidies; ceiling prices, which limit the amount that consumers must pay to purchase rice; and storage-cost subsidies. The introduction of implicit export subsidies on rice in 1985 added a new policy instrument to the list. While there is a floor price policy for maize, BULOG intervention in the maize market is relatively slight compared with the rice market. This is, in part, because of the greater political importance of rice and the fact that marketing channels for maize are less clearly defined. Control over imports and exports is the principal means by which the Government influences the maize market. BULOG is the sole importer of wheat but does issue processing contracts to the private sector.

In summary, the Indonesian Government uses a mixture of price-policy instruments to influence grain production and marketing, and BULOG is the key implementer of these policy decisions. In addition, the Government devotes considerable resources to the development and dissemination of improved technologies. Some policy instruments can be viewed as supply shifters (e.g. fertiliser subsidies and technological innovations), while others encourage output expansion along supply functions (e.g. producer price supports).

1.5 Objectives

The general objective of this study is to provide an economic evaluation of the output and input price policies that have been implemented in Indonesia to expand rice production. Central to that evaluation is the identification of the effects of rice price policies. Examples of the issues to be addressed include: (a) the efficiency costs of current policy relative to a zero-intervention situation; (b) the effects on rice and secondary food crop production and consumption of marginal changes to existing policy; and (c) whether the current policy mix in terms of output price support and input subsidies is appropriate given the financial constraints facing the Government.

While policy evaluation is the main objective, there are a number of subsidiary objectives. These include reviewing the current status of rice and secondary food crop production and consumption, reviewing the considerable literature that exists on Indonesian price policy in relation to important food crops, and providing a description of the rather unique food policy-making process in Indonesia. The fulfilment of

these subsidiary objectives should be of considerable benefit to other researchers.

The final subsidiary objective is to outline a model which can be used for future food policy experimentation in Indonesia. The aim was to develop a model which was realistic in the sense of capturing important influences at work, yet simple enough to be used to address policy issues at short notice without the need for large-scale data collection.

1.6 Overview of Remaining Chapters

The next three chapters are basically survey chapters dealing, respectively, with (a) the economy, emphasising the status and role of the agricultural sector; (b) the cash crops, livestock, forestry and fisheries sub-sectors; and (c) the rice and secondary food crops sector. These chapters draw on a wide range of reference sources and assist in planning the subsequent policy analysis in general perspective. Chapter 5 is a review chapter dealing with recent modelling of Indonesian price policy. The methodology for the policy evaluation conducted in the present report is described in Chapter 6 and the policy evaluation is reported in Chapter 7. Finally, Chapter 8 serves an a summary and contains some recommendations for change.

The body of the report is supported by an appendix presenting an approach to price policy appraisal using equilibrium displacement modelling. This is a method of using Marshallian elasticity information across a number of commodities, independently of functional form, to reveal the qualitative impacts of price policy changes. Matrix manipulation is used to show the total effect of a policy change in terms of general equilibrium elasticities. Thus it is an approximate method of performing the policy analysis of Chapters 6 and 7. The method should be useful to those interested in price policy analysis in multi-commodity contexts similar to that found in Indonesia.

The researchers prepared substantial additional written material in support of the report, originally with the intention of including it as appendixes. This material, which is available from ACIAR in the form of three photocopied papers, should be useful for those undertaking food policy analysis in Indonesia for the first time. The first two papers, which are comprehensive reviews of the rice and the secondary food crop sectors respectively, contain substantially more detail than the report. The third is a review of the policy-making process for rice and secondary food crops.

2 Overview of the Indonesian Economy with Particular Reference to the Agricultural Sector

2.1 Introduction

Following World War II the economy of Indonesia was beset with problems of revolution, rebellion and armed confrontation. It was some 20 years before the Soeharto 'New Order' Government in 1966 began to provide stability as a basis for development. Subsequent rapid growth during the 1970s was largely concentrated in the natural resource industries, especially petroleum which experienced large price rises during 1972–74 and 1979, but also timber and mining. Substantial gains were made in rice production, but continuous progress was marred by crises with drought and insect pests. In addition, the exploitation of oil wealth was not without problems. Some of the early profits were needed to repay short-term debts of the State oil company, Pertamina, while inflation, fed by the oil-led export boom, averaged 19% per annum between 1973 and 1978. In the latter year a large devaluation was undertaken, ostensibly to improve the position of the non-oil traded goods sector, whose profitability had been eroded by the boom through an appreciation of the real exchange rate (the so-called 'Dutch disease').

At the beginning of the 1980s the Indonesian economy was still benefiting from the second oil shock, and was further buoyed by record rice harvests in 1980 and 1981. However, drought in 1982 reduced harvest levels, while a weakening oil market also exerted a depressive influence. Continuing oil price declines brought 1985 oil production to a ten-year low, and the accelerated oil price decline of 1986 seemed initially as if it would bring economic growth to a standstill. Although 1984 and 1985 rice production reached record levels and the desired aim of self-sufficiency was achieved, deteriorating balance of payments figures contributed to two more devaluations in 1983 and 1986. The seriousness of the oil price decline in 1986 led to significant policy changes which attempted to deregulate and restructure the economy. A partial downgrading of price incentives in 1986 resulted in a slowdown in the agricultural sector, exacerbated by a drought in 1987. Since then higher oil prices and growth in non-oil exports have contributed to an alleviation of the current account deficit, and to a significant revival of economic growth. Two good rice harvests in 1988 and 1989 have also contributed to the latter.

It is against this background that the present survey reviews the major changes in economic structure, performance and policy which have taken place over the period 1966–89. Particular attention is given to the role of agriculture in the later years of the period.

2.2 The Role of Government

In characterising certain countries of the region, Myint (1984) classified Indonesia in the mid-1960s as among the 'inward-looking countries'. These countries pursued protectionist import-substitution policies intended to insulate their domestic economies from international market forces. Although the advent of the Soeharto Government brought some weakening of inward-looking policies, especially in the form of encouragement of private foreign investment, it was not until 1983 that the Government reappraised its previous development strategy. The difficulties which prevented earlier policy change are numerous, but the major obstacles stemmed from the tradition of bureaucratic control and distrust of free market forces, both legacies of the Dutch colonial era.

The Indonesian economy is officially viewed in terms of a broad philosophy, dictated by the 1945 Constitution and known as *Pancasila*. This philosophy defines a number of goals — 'belief in God, humanitarianism, nationalism, democracy and social justice' (Liddle 1982, p. 96). The Constitution indicates that the State is expected to oversee the major economic areas, with private enterprise relegated to the remaining fields. The State has concerned itself with much of the large-scale enterprise of the industrial sector, directly or through joint ventures, but is less involved in agriculture. Foodcrops, which account for over 60% of the value of output of the agricultural sector, are almost exclusively in the hands of smallholders, as is the livestock sector. State involvement is mostly concentrated in estate crops and, to a lesser extent, in forestry. Excessive government regulation during the colonial era probably made it inevitable that successive Indonesian administrations would follow suit. The 1945 Constitution imposed a need to organise economic affairs as a 'joint effort based on family principle' (Rice 1983, p. 61) or, broadly speaking, a consensus. To achieve its aims the Soeharto Government uses both formal and informal methods of economic control. Formal control is set forth in a series of five-year plans, in addition to fiscal and monetary policies. The informal category is exemplified by the use of widespread bureaucratic controls and State-run enterprises, in addition to legal sanctions. It was to both areas of control that the Government turned in a post-1983 attempt to deregulate and restructure a slowing economy.

Formal control has been implemented since 1969 with a series of five-year plans (called *Repelita*). It is 'broad brush indicative planning' (Booth and McCawley 1981a, p. 14) applying to public and private sectors, although the latter freely chooses how to achieve targets. Subtle

pressure is brought to bear in certain sectors (e.g. rice farming) to achieve production targets in a specified manner (e.g. high-yielding varieties in intensification schemes). Repelita I (1969–74) aimed at stabilisation and a growth rate of around 4.7% per annum. The agricultural emphasis was on rice production, which failed to achieve the target, although other sectors reached targeted levels. Repelita II (1974–79) added equity to development aims and GDP growth was set at 7.5% per annum. In fact, it was slightly higher, following the unexpected oil price rise. Food self-sufficiency became the agricultural goal. Repelita III (1979–84) emphasised equitable income distribution and access to health and education. GDP growth was set at 6.5% annually, and 5.7% was achieved. Repelita IV (1984–89) was planned at a time of lower oil prices. The GDP growth rate of 5% per annum seemed unattainable in 1986. However, a good performance in the final years indicates the growth target has been met. Repelita V (1989–94) is the current plan and the target GDP growth rate is also 5% per annum, with 3.6% per annum set for agriculture. Employment creation and reduction in the debt service ratio are prime plan objectives.

2.3 National Output and Structural Change

Economic growth in the early 1960s was slow, and it was not until after 1966 that considerable real growth become evident and significant sectoral change took place. Tables 2.1 and 2.2 show the sectoral breakdown of GDP at current and constant prices, and Table 2.3 indicates average annual growth rates for the various sectors during 1984–89. In 1983 a new series of constant prices replaced the 1973 series which had become distorted because of heavy weighting attaching to the oil sector. Subsequently, the 1986 Economic Census showed a larger number of enterprises in the large and medium industry category, and the manufacturing sector's contribution to GDP was revised in 1989 and 'back-cast' to 1983 (Mackie and Sjahrir 1989).

The agricultural share of GDP was more than halved between 1960 and 1989 (Table 2.1). In 1960 agriculture accounted for over 50% of GDP and by 1970 still accounted for 48% . By 1989 the agricultural share had fallen to 23% of GDP. (The revised constant price data in Table 2.2 indicate agriculture's share falling from 22.8% in 1983 to 20.6% in 1989.) Warr (1986) points out that, by international standards, the decline in agriculture's contribution to GDP during the 1970s was quite high, occurred over a relatively short period, and despite heavy public investment and price support. While the share of agriculture in GDP has been declining, the share of mining (predominantly oil) rose from nearly 4% in 1960 to over 25% in 1980, before falling to 13% in 1989. (The revised data show the constant price share of mining in GDP has fallen from 20.7% in 1983 to 15.6% in 1989.) The output share of manufacturing has been edging upwards from an 8.4% share of GDP in

1960 to 18.4% in 1989. Its share rose from 12.7% in 1983 to 18.5% for 1989, in the revised constant price series. At this rate of growth Mackie and Sjahrir (1989) suggest that manufacturing in constant price terms will soon exceed agriculture as the major component of GDP.

Table 2.3 indicates the recent growth performance of the major GDP sectors at 1983 constant prices, using the 'revised' series. Agricultural sector growth during the five-year period 1984–89 averaged around 3.5% per annum. This compares with around 4.2% annually during 1978–83 (1973 constant prices). Sundrum (1986) calculates that agriculture grew at 3.5% annually during 1973–81 (1973 constant prices), while GDP grew at 7.5%, and that agriculture contributed 1.2 percentage points to the overall rapid growth of that period. In contrast, there was a sharp decline in growth in the first half of the 1980s. Sundrum (1988) estimates that GDP growth during 1982–86 (1973 constant prices) was 4.01% per annum, while agriculture for the same period grew at 3.16%. He argues that the agricultural sector contributed only 0.3 percentage points to the decline in the overall growth rate, while five other major sectors accounted for four-fifths of the decline.

Following deregulation and restructuring, the rate of economic growth has improved. Table 2.3 indicates the growth of the component parts of the agricultural sector between 1984–89 (revised constant price series). Estate crops grew at around 6% per annum, non-food crops and fisheries at 5% per annum, while livestock just exceeded the 4% average. The foodcrops figure of around 2.8% per annum resulted from a number of factors including the rice surplus of 1985, policy changes, reduced incentives and drought. The poor results of the forestry sub-sector followed a policy decision on the banning of log exports in 1980. The overall GDP growth rate during 1984–89 of 5.2% per annum exceeded initial expectations and, with a combination of favourable factors continuing, a real growth rate of over 7% for 1989 is also anticipated for 1990.

Changes in expenditure on GDP are indicated in Table 2.4 in constant prices. The 1965 data show the high percentage of household consumption expenditure as hyperinflation took its toll. Capital formation improved during the 1970s, slowed again during the mid-1980s, but rising rates are evident during the latter part of the decade, with growth in the private sector share. Pangestu and Habir (1990) indicate that non-oil exports have been the main source of expenditure growth.

The decline in the agricultural share of GDP evident particularly during the 1970s (Table 2.1) comprises elements of physical output and variation in price. To consider both aspects Table 2.5 sets out implicit price indexes for the agricultural and non-agricultural sectors. The results show prices in the former changing at a slower rate relative to prices in the latter. The ratio of the agricultural implicit price deflator to the non-agricultural implicit price deflator (Table 2.5, Col. 3) indicates the deteriorating position of the agricultural sector as the 'Dutch disease'

took effect. However, Warr (1986) argues that the constant price decline was concentrated, loosely speaking, in those agricultural industries in which prices were not Government controlled, and where the effects of the oil boom could be expected to occur more freely. The change to a 1983 constant price series shows that, by the mid-1980s, prices in the non-agricultural sector were changing at a slower rate relative to prices in the agricultural sector, except for 1988.

2.4 Population, Workforce and Income Distribution

2.4.1 Population

After China, India, the USSR and the USA, Indonesia has the largest population in the world. A growth rate of some 2.32% during the 1970s resulted in a 1980 Census figure of 148 million. An emphasis on family planning and declining crude birth rates reduced the growth rate to 2.1% per annum over the period 1980–85 despite increasing life expectancy, and it is hoped this will fall to 1.8% per annum by 1993–94. Repelita V estimates the 1988 population figure at 175.6 million, growing to 192.9 million by 1993 (Booth 1989).

The population is spread very unevenly throughout the country. Java, with 7% of land area has 60% of population, a density of 755 people to the square kilometre (BPS 1988). The relative under-population of the outer islands has led to official transmigration schemes, but numbers declined after the oil-related fall in Government revenue. Repelita V projects some 550 000 households will be moved, of which only about one-third will receive Government assistance (Booth 1989). A second facet of the population profile is the age structure. In 1985 some 39% of the population was under 15 years of age. Projections to 2005 indicate that the proportion of the population under 15 will have fallen to around 29%, and the 0–14 age group will grow at only a modest rate. The 1980 Census figures provided a breakdown of population by rural/urban definition and classified 22.4% in the latter category. To avoid increased urbanisation and its concomitant problems, Jones (1984) advocated that strategies be developed to move the rural economy's centre of gravity to higher-productivity activities without moving the workers to cities.

2.4.2 Workforce

The present age structure of the population and the resultant increase in the labour force anticipated during Repelita V (some 12 million) has been foreseen as one of the major problems of the plan period (Booth 1989). Part of the labour force growth rate is the result of an increased participation rate, including a higher female rate. At the beginning of the 1960s agriculture accounted for over 70% of the workforce and by 1971 the proportion was still some 65% (Table 2.6). However, by 1980,

agriculture's share had fallen to 56%, and declined to 54.7% in 1985. By the end of Repelita V it is hoped the proportion of the workforce accounted for by the agricultural sector will have fallen to just over half.

Table 2.6 indicates that during the 1970s the growth rate of agricultural employment of 1% per annum was lower than that for any of the other major sectors (Scherer 1982). Mining and quarrying had the largest annual increase at 16.5%, followed by finance at 10.1%. Trade, transport, construction and services all averaged between 5 and 9% and manufacturing 4.1%. However, since all except agriculture were operating from a low base, even a low growth rate for agriculture meant it absorbed one-fifth of the increased proportion of the workforce. As the economy slowed significantly during 1980–85, the rate of growth of agricultural employment increased, while other sectors declined except trade, transport and manufacturing. The data in Table 2.6 show a negative growth rate for utilities which seems unlikely, probably the result of some definitional discrepancy. All other sectoral data in Table 2.6 are consistent with the economic decline 1980–85 as reduced budget expenditure cut civil service recruitment, mining sector growth fell sharply, and construction reflected a flow-on effect from the oil-induced slowdown. The benefits from the 1983 devaluation, together with some improvement in commodity prices and a slight recovery in world trade, probably account for part of the stronger growth in employment of trade, transport and manufacturing, The strong growth of agriculture during 1980–85 and the large rice harvests of 1984 and 1985 indicate how it was possible for this sector to account for over half of the total increase in employment during that period.

During Repelita V agricultural employment is expected to grow at 2% per annum, and absorb about 4 million of the 11.5 million extra workforce (Booth 1989). The agricultural share of the increased workforce is expected to decline from 50 to some 35% for 1988–93. Non-agricultural employment is anticipated to grow at 4.1% annually, with industry accounting for the bulk of the increase (6.7% per annum), while trade, construction and transport average between 4 and 4.5% per annum. Industry and trade are expected to absorb most of the non-agricultural workforce increase, taking 2.3 and 2.6 million, respectively. Booth (1989) indicates that agricultural employment growth is expected to be concentrated in cash crops, livestock and fisheries. The lack of employment growth expected in foodcrops appears to be part of a long-run trend. For 1961–80 Jones (1984) reports a 162% increase in non-agricultural employment in rural areas, with only a 10% increase in direct agricultural employment. There was a diversification from traditional dependence on direct agricultural work to rural industries related to commodity processing, including a switch from large to medium-scale rice milling, cottage industry, food processing, leather goods, weaving and batik. An expectation that high-yielding rice varieties might increase employment has not been realised. It appears that triple harvesting (now

discouraged because of disease problems) resulted in peaks of labour demand becoming sharper and closer together. Mazumdar and Sawit (1986) concluded that labour demand in agriculture may have been confined to the prosperous fertile lowland areas, while in poorer upland villages there remains an increasing demand for non-agricultural employment.

2.4.3 Distribution of income

Data on income distribution are not directly available and researchers are restricted to 'making do' with approximate indicators. A series of household consumption surveys (SUSENAS) are not directly comparable over time, although they show consumption patterns for regions by different expenditure groups. Using SUSENAS data Booth and Sundrum (1981) document an increase in per capita expenditure inequalities in urban Java between 1964–65 and 1976, and a decline in equalities elsewhere. However, between 1970 and 1976, while inequalities continued to increase in urban Java, they fell in rural Java and remained almost constant elsewhere. These changes in per capita expenditure reflect changes in the economy during the 1970s. Garnaut (1980) argues that the effects of the resources boom were concentrated in the modern (urban) sector, but had only small net effects on the traditional (mainly rural) sector. The income (and numbers) employed in the modern sector increased, while there was little improvement in traditional sector living standards. Booth and Sundrum (1981, p. 202) conclude that the benefits of the boom 'disproportionately accrued to a small segment of the urban population, who were most advantageously placed to begin with because of their access to Government jobs and their higher levels of education'. One of the ways in which agriculture benefited was through the fertiliser and oil subsidies and the price support scheme for rice, all budget financed. Kasryno (1981) argues that most of the benefits of the BIMAS rice program accrued to the land-owning class, while until 1979 the level of real agricultural wages was almost static (Kasryno 1985). However, Warr (1986) indicates BPS data show real rural wages increasing in three of the four regions of Java during 1976–82.

During 1979–81 Kasryno (1985) noted an upward trend in agricultural wages as a result of higher labour productivity in the non-agricultural sector. Village level studies by Collier et al. (1982) also support the proposition that real agricultural wages increased after 1978. However, the oil-induced downturn in growth resulted in a reversal of the earlier trend. Jayasuriya and Manning (1988) suggest that real wages have fallen recently in the rice sector of Central and East Java as well as in urban construction, although estate sector real wages may have risen slightly. The downward pressure on real wage rates resulting from the 1983 and 1986 devaluations and Government fiscal policy have contributed to maintaining Indonesia's competitive edge. This, in turn, has

contributed to non-oil export growth and the recent higher levels of economic activity. Nevertheless, there is a cost in terms of stagnating real wages, under-employment and unemployment, now involving educated job seekers. According to a recent Presidential speech, between 1980 and 1987 there was a slight fall in the share of total income accruing to the top 20% of the population and a slight increase in that accruing to the poorest 40%. This appears to indicate no major deterioration in income distribution over the period (Mackie and Sjahrir 1989).

2.5 The Manufacturing Sector

The Indonesian manufacturing sector of the 1960s was hardly different from that of the 1930s, but during the 1970s there was a rapid rate of growth of real output as well as an increase in product type and establishment (Dapice 1980). The manufacturing share of GDP in constant prices rose from 11% in 1975 to 15% in 1983 (Table 2.2). Despite the slower economic growth of the mid-1980s manufacturing performed better than expected. After the 1986 Economic Census the constant price manufacturing share of GDP increased from 12.7% in 1983 to 18.5% in 1989. The 1983 constant price figures show manufacturing growing at around 10.4% per annum for 1984–89 (Table 2.3). Together with significant changes in trade policy, modification of industrial policy has brought about a revision of the previous highly-protectionist attitude to industrial development, re-oriented a former inward-looking domestic market stance towards a more export-led strategy, and tempered a long-standing attitude of extensive Government intervention in, and regulation of, the sector.

Industrial census data for 1974–75 show some striking facts noted by McCawley (1981). These were: (a) the concentration of production on Java; (b) the narrow base of industry and its dependence on the agricultural sector; and (c) the engagement of 80% of the manufacturing workforce in cottage industry, predominantly in rural areas. Across the provinces the same two or three agricultural-based industries dominated. Oil revenues in the 1970s allowed rapid industrialisation, and there was more diversification as intermediate and capital goods industries were introduced. The Government moved into large-scale industry and invested in fertiliser, cement, paper, iron, steel and oil refineries. From the mid-1970s to around 1980 McCawley (1984) suggests that the medium and large-scale sector grew at around 15% annually, while Hill (1984) notes that the consumer goods share of manufacturing output almost halved between 1971 and 1982. However, Warr (1986) thinks it likely that the petroleum boom held back the rapid growth of manufacturing.

The decade of the 1970s widened the industrial sector and, with the easy phase of import substitution undertaken, the Government opted for a further push into large-scale, key or upstream basic industries to fill gaps in its industrial structure. Soehoed (1988) proposed 52 basic

industries, centred on natural resources, in which the Government was expected to take the initiative. In the event, some of the plans had to be modified or postponed as a result of the oil price decrease of 1982 and the 1983 devaluation. With Repelita IV to commence there was disagreement about the direction industrial policy should take. Consideration of the choice between 'basic' development/import substitution and labour-intensive/export-oriented enterprise suggested that the latter contributed most to a labour-intensive industrial strategy (Roepstorff 1985, Kuyvenhoven and Poot 1986). Hill (1984) indicated that basic 'upstream' industries raised critical policy questions, since most of the industries would not be internationally competitive and many downstream users would be penalised. Hill was also sceptical of the venture into 'hi-tech' industry.

The oil price decline and devaluations of the 1980s to a large extent determined the direction of the industrialisation pattern, at least for the short to medium term. A series of deregulatory 'packages' between 1984 and 1989, involving trade, finance and investment has resulted in the quarterly index of industrial production (base 1983=100) rising from 126.95 in 1986 to 146.37 in 1987, and 169.0 in 1988, indicating growth rates of 15.2% and 15.4% respectively. However, there appears to have been a fall during 1989, to a growth rate of 9.5% (Conroy and Drake 1990). Pangestu and Habir (1990) indicate the slowdown has been in the main manufactured exports (plywood, textiles, garments), with some decline also in paper and rubber products, while certain consumer, intermediate and capital goods growth remains strong (soft drink, cigarettes, cement, crumb rubber and machinery). Footwear is one industry which is still growing strongly, the result of export-oriented investment, predominantly foreign investment. Figures on approved investment from the Investment Coordinating Board (BKPM) indicate that Japan is the largest foreign investor (particularly in Javanese manufacturing) although, as Thee (1984) points out, the USA is the largest investor if the energy sector is included. Of realised total foreign investment between 1967 and 1980, the agricultural sector attracted around 9% and manufacturing 60%. Approved foreign investment in 1987 totalled US$1.2 million, of which agriculture accounted for 9% and manufacturing 57%. By 1988 there was a more than threefold increase of foreign investment approvals to US$4.4 million, with agriculture's share falling to 4%, and that of manufacturing increasing to 78% (BPS 1989).

Until the mid-1980s at least, Indonesian data do not support the argument that Japanese direct investment proposals were export-oriented (Thee 1984). Data from BKPM for approved foreign investment proposals for 1988 indicate that 42% was from Asia, although Japanese discontent with the regulatory regime (Hill 1987) continues to be reflected in falling investment from that country. Schwarz (1990b, p. 42) reports that Indonesia has recently become the preferred

destination for manufacturers from Hongkong, Singapore, Taiwan and South Korea who all face rising wages and appreciating currencies. Labour-intensive, low-to-medium-technology industries are most favoured. In 1987 BKPM released a new investment priority list and indicated several initiatives towards a more liberal business climate (Hill 1987). Some efforts have been made also to consider the efficiency and accountability of State enterprise (Mackie and Sjahrir 1989). So far seven possible choices have been outlined, but no specific action has been initiated.

Between 1980 and 1987 Indonesia's trade in labour-intensive and resource-intensive manufactures grew rapidly (Hill 1987), but this export-oriented approach may not continue, given vested interests, reforms needed at the industry level (Thee 1989) and future structural changes. With these constraints in mind, the implications for agriculture are not entirely clear. The backward and forward and high employment linkages of commercial crops (Kasryno, Budianto and Birowo 1982) remain important and explain the Repelita V emphasis on this sector, together with a more general awareness of agribusiness opportunities (Schwarz 1990c, p. 58). The potential for further agricultural and industrial linkages may depend on the strength and convictions of policy makers, the perception of export markets and the technology mix chosen.

2.6 The Oil Industry

Between World War II and 1963 little oil exploration took place in Indonesia and, although some new production-sharing agreements were signed after 1965, it was the 1967 Arab-Israeli war which to a large degree established the industry on a firm footing, as Japan and other countries diversified their trade. Major issues during the 1970s revolved around production increases accompanying the price rises during the two oil booms; the continuing growth in domestic consumption, and its subsidisation at the expense of exports; and the need for continuing exploration to guarantee future exploitation. New concerns involve the consequences of the 1980s oil price falls and declining oil reserves. Although the industry's importance has lessened during the 1980s, the extent of its economic influence can be gauged by the fact that in 1980–81 oil company tax provided 71% of domestic revenue. In addition, despite significant growth in non-oil exports, oil and gas in 1988 still accounted for 40% of total exports.

By 1972 oil production was increasing steadily and off-shore fields were brought into production to benefit from the 430% increase in oil prices 1972–74. However, the Pertamina debt crisis in 1975 took a large share of early oil profits. By 1976 production increased threefold and the oil sector accounted for one-fifth of GDP, three-quarters of exports and over half of Government revenue (Johnson 1977). At this point the

significance of natural gas began to be appreciated, although industrial use and exports were some time away. Meanwhile, domestic oil consumption was growing steadily, and became of concern. By 1977 the oil boom appeared to have faded, and to counter the loss of profitability in the non-oil traded goods sector a devaluation was undertaken in November 1978. The results were not entirely as planned but, in any case, the whole economy was once again overtaken by the February 1979 Iranian revolution and the subsequent oil price rises of 1979–80.

The second oil boom was short-lived and it became evident during early 1982 that a depressed world oil market, requiring OPEC production cutbacks, spelled problems. OPEC attempted to stabilise the world price at $35.70 a barrel, but the price fell during 1983 and 1984, and by January 1985 was down to $29.50 a barrel. During early 1986 the price fall accelerated sharply from $24 mid-January, until Minas light crude was quoted in March at $11 a barrel. Muir (1986), commenting upon the speed and extent of the price decline, felt that the macroeconomic problems it presented were of a magnitude not experienced by Indonesia since the late 1960s. Glassburner (1986) estimated the extent of the calamity by calculating that every $1 loss in the average export price of oil resulted in a loss of some $400 million in export earnings, as well as Rp300 billion in oil revenues. Efforts by the Government to deal with the problem and its economic consequences have covered several policy initiatives, including two devaluations, new approaches to trade policy, a review of tax policy and financial deregulation.

2.6.1 Oil production

Although Indonesia is one of the older oil-producing areas, it has small shallow 'pools', unlike the extensive deep fields of the Middle East. Consequently, there is need for continuous exploration to maintain steady production. Although there were production increases during the 1970s, the oil booms were primarily the result of price rather than production increases. Production during 1973–75 averaged around 1.3 million barrels per day (bpd), and by 1978 stabilised at around 1.6 million bpd. Production fluctuated over subsequent years and, when world demand weakened, OPEC responded in 1982 with a production cutback. From late 1983 to October 1984 the Indonesian quota was set at 1.3 million bpd, then reduced to 1.189 million bpd. The situation was complicated by OPEC policies, which stipulated an agreed Government scale of prices (GSP), although the latter did not necessarily coincide with the so-called market 'spot' price and the divergence could become quite large (e.g. $6 to $8). Indeed, this divergence, combined with low prices, forced Indonesia to abandon the GSP in negotiations with its foreign production-sharing partners, whose taxes were based on the GSP. After negotiation the GSP was replaced by a market-price based formula (Handley 1986, p. 89).

In December 1985 Indonesia reaffirmed its adherence to the OPEC policy of defending market shares . Production for 1985 averaged only 1.2 million bpd, and a new OPEC agreement was negotiated in December 1986 in an effort to re-assert market control. The policy resulted in a return to the fixed price structure, with Minas crude set at US $17.56 a barrel, and Indonesia was allocated a quota of 1.133 million bpd until June 1987, a quota retained for 1988. The end of the Iran–Iraq war contributed during 1988 to a further oil price fall — to US $13 a barrel during October. In February 1988 the Government returned to its use of the GSP, and it was upon this price (US$17.56) that oil companies once again paid taxes (Evans 1988). To overcome the price divergence and prevent problems, the oil companies were given a $1 a barrel rebate. Although lower prices made it difficult for OPEC to enforce production quotas, the option to ignore quotas was unavailable to Indonesia, given that former Minister Soebroto had become OPEC Secretary-General. However, during 1989, oil prices firmed following unexpectedly strong world demand, rising towards US$20 a barrel. At the same time Japan succeeded in renegotiating its price for oil and LNG.

2.6.2 Domestic consumption

During the 1970s domestic consumption of oil grew at around 13–14% annually, helped by a subsidy which arose when domestic prices were pegged in 1973. Dick (1979) explained the difficulty of increasing domestic petroleum prices in terms of two 'political' considerations, viz. the widespread consumption of kerosene for cooking and lighting (then 5% of total rural consumption expenditure) and its inclusion in the price index of nine basic commodities; as well as the widespread use of petrol by urban consumers, and its inclusion in the cost of transport. By 1981–82 the oil subsidy had risen to Rp 1316.4 billion, and over succeeding budgets prices were gradually increased until, by 1983, aviation gas, turbine fuel and super grade gasoline had reached world levels (Lukman and McGlinchy 1986). Prices were increased for kerosene and fuel oil in 1984, but a subsidy remained until the price of oil fell in 1986. In 1988–89 the subsidy was Rp 133.1 billion, an estimated Rp 400.7 billion in 1989–90, and was projected to be Rp 626.5 billion in 1990–91 . However, the price of fuel was increased in March 1990 and the subsidy phased out (Schwarz 1990b, p. 42).

2.6.3 Exports

The volume of exports of crude oil in 1981 was 362.2 million barrels but had fallen to 274.4 million barrels in 1988–89 (Mackie and Sjahrir 1989), while the value of exports fell from US$18.1 billion in 1981 to US$5 billion in 1988–89. Gas exports (predominantly LNG) have helped a little to offset falling oil prices, as gas is not subject to OPEC

quotas. The price of LNG is, however, tied to oil, so that although the volume of exports has increased from 772.0 billion cf in 1984–85 to 964.9 billion cf in 1988–89, the value of gas exported has fallen from US$3.4 billion to US$2.6 billion over the same period. Nevertheless, proven reserves mean its future export potential outweighs that of oil.

2.6.4 Exploration

Continuous oil exploration is necessary to ensure an uninterrupted flow of output. Exploration fell during the later 1970s, although contracts signed between foreign firms and Pertamina averaged around 10 per year during that decade. The rate of signing fell from 12 in 1983 to 10 over the period 1984–86. There was some recovery during 1987 and 10 contracts were signed in 1988, rising to 19 in 1989 (Conroy and Drake 1990). Exploration increased in 1988 and 1989, with major gas finds off Natuna Island and Madura (Mackie and Sjahrir 1989). The joint Australia–Indonesia zone of exploitation around Timor is also expected to bring results. Apart from oil and gas, Indonesia's mineral resources include tin, bauxite, copper, nickel, with smaller reserves of silver, gold, phosphate, manganese and mineral sands. Coal mining has been increased to diversify domestic energy consumption and conserve oil for export. All minerals, except possibly gold, have tended recently to find the world market beset with low or fluctuating commodity prices.

2.6.5 Oil and agriculture

The oil price increases of the 1970s dramatically changed the economic outlook for the country through relaxing previous constraints on the balance of payments and allowing large increases in budget expenditure. Agriculture benefited both directly and indirectly from increased oil revenues. The fertiliser subsidy contributed directly, but there is also the fertiliser itself, imported and domestically produced. Oil money provided for extension and upgrading of irrigation facilities, an indispensable ingredient in the expansion of fertiliser-responsive high-yielding rice varieties. Food subsidies, the operation of the floor price scheme, storage costs and BULOG's buying and selling activities have been direct charges on the budget. The upgrading of roads and a fuel subsidy assisted with more efficient transport and marketing of agricultural produce, while Government revenues built vast storage complexes to maintain the rice price scheme. Oil provided also the background climate of economic growth and, consequently, the downturn in oil prices and shortfall in revenue have had important implications for the availability of resources to agriculture.

2.7 Fiscal Policy

The Sukarno years left an unenviable legacy of economic disruption. To protect themselves from inflation Indonesians reversed monetisation and

went back to barter (Nasution 1983). The prime platform of the 'New Order' Government was a promise of fiscal responsibility and a commitment to a balanced budget as a guarantee against future deficit spending and inflation. The balanced budget concept plays a 'political cum psychological role' (Booth and McCawley 1981b, p. 144) and is one of the two major strands of macroeconomic management, the other being a free foreign exchange rate. In theory, the budget is balanced in the sense that total expenditure equals total revenue, although total revenue includes Government borrowing from abroad. The main difficulty is that this ostensible balance needs various background measures to accommodate deficits or surpluses. Surpluses involve building up resources with the central bank, repaying past borrowings, or concealment in the balance of payments (Nasution 1983). Deficits are camouflaged by category changing, as circumstances demand, to produce the desired result, and can be measured in various ways (Booth and McCawley 1981b). Other fiscal goals include widening the tax base, increasing Government saving to eventually eliminate foreign aid, and emphasising productive development expenditure. Policy emphasis has been changed or modified as circumstances and revenue dictated. The formal Government budget, covering only central Government activities, excludes the activities of public sector enterprises, except for their contribution to non-tax revenue.

2.7.1 Sources of Government revenue

Government revenue falls into three basic categories: oil tax revenue, non-oil tax revenue (direct and indirect taxes), and foreign borrowings (Table 2.7). Oil tax revenue was 26% of 1970–71 domestic revenue, increased rapidly after the first oil price rises and peaked at 71% in 1980–81. Thereafter it fell, until by 1990–91 it is projected at 34%. During the 1970s the Government increased its spending without considering other sources of revenue, and non-oil revenues increased marginally or stagnated. With reduced oil revenues it was necessary to boost the non-oil tax base, and a review of the tax system was undertaken in 1983 (Gillis 1985). Existing personal and company tax scales were revised and amalgamated, a new value-added tax (VAT) was introduced, and some taxes were abolished or replaced. Control of imports by a Swiss firm (SGS) has doubled revenue and quickened clearances, but it has been decided to phase out SGS services in 1991 (Schwarz 1989d, p. 57).

Direct and indirect taxes include income tax, VAT/sales tax, import duties, export, property and other similar taxes. Previously the personal income tax system was criticised for evasion, underassessment and negotiation between tax payer and tax officer. Indeed, in 1974 there were only 195 000 registered tax payers (Lerche 1980). In 1981 personal income tax was projected to yield 1.7% of domestic revenue. When the new tax package became effective in January 1984 income tax replaced

four previous tax categories. It is levied on companies as well as individuals, and in the 1990–91 budget was projected at 20% of domestic revenues. The Ipeda land tax (Booth 1974), as revised in 1965, was meant to cover rural and urban land owners, and be seen as a contribution to regional development. However, although realised collections were small it seemed inequitable, since all rural landowners paid, even the smallest peasant. When compared with the earlier-mentioned scale of income tax evasion, it can be argued that the agricultural sector was disadvantaged. Booth and McCawley (1981b) noted that while central Government tax on the agricultural sector appeared light (Ipeda and export tax), there were other levies in cash, kind and labour, collected by local and regional governments. Together these taxes indicated that farm incomes might have been taxed at a higher rate than other sectors. The new land and building tax which replaces Ipeda may be more equitable and remains the responsibility of regional authorities. The main thrust of the 1984 tax revision was to replace most sales taxes with a value-added tax (VAT). This tax applies to domestic and imported manufactures, not agricultural products, and manufactured exports are taxed at zero. It has proved a highly successful means of revenue raising, accounting for 21.6% of domestic revenue in the 1990–91 budget. In contrast, export taxes, which mainly fall on agriculture, have remained a minor form of revenue.

Foreign aid, the final component of Government 'revenue', comprises project and program aid. The Inter-Governmental Group on Indonesia (IGGI), formed in 1967, assisted in rescheduling debt and provided program aid (including food). Project aid followed later when specific projects could be fitted into development objectives and donor capacity. Generally, the foreign donor meets the foreign exchange component of projects/programs, while the development budget allocates the local rupiah (counterpart) funds. The oil price declines of 1986 resulted in a need for yet more foreign aid to fund the development budget. For several years IGGI provided 'special assistance' aid, now being phased out as the economy improves.

2.7.2 Public expenditure

Government expenditure is divided between 'routine' and 'development' categories, but the distinction is somewhat blurred in practice, and Booth and McCawley (1981b) suggest there is a case for abolishing the arbitrary division. Routine expenditure covers salaries and pensions, procurement of materials, regional subsidies, food and fuel subsidies (when applicable) and the presently large item of debt servicing. Civil service salaries were frozen after 1986, but have been increased in the 1989–90 and 1990–91 budgets. Subsidies for fuel and food have appeared in the routine budget since the 1970s. Food subsidies were commenced when rice, sugar, wheat and soybeans were imported and

sold at a loss. With a large rice harvest in 1984 direct food subsidies were discontinued in the 1984–85 budget.

Development expenditure has been subject to change over the years. Since 1969 the Government has been able to fund part of development expenditure from domestic revenue, although initially the vast proportion was accounted for by aid. With the oil boom, total expenditure increased sharply, so that in 1975–76 development expenditure accounted for over half total expenditure, and by 1985–86 the share was still 46%. The share of development expenditure fell to 34% in 1987–88, and is predicted to be 38% in the 1990–91 budget. The fertiliser subsidy accounted for 3% of the development budget in 1983–84, but rose to 8% in 1987–88. Thereafter the pesticide subsidy was phased out and the fertiliser subsidy reduced to Rp 200 billion in 1988–89 and Rp 155 billion in 1989–90 (1.6 and 1.2%, respectively, of the development budget). The 1990–91 budget projects a fertiliser subsidy of Rp 155 billion. These 'nominal' figures have resulted from the Government shifting part of the subsidy off-budget and funding it through bank credit (Booth 1988a).

Development spending by sectoral share shows agriculture and irrigation have always been in the top three to four places, being 15.2 and 14.7% for the 1989–90 and 1990–91 budgets, respectively. In these budgets only transportation and tourism received a higher allocation (19%). Although the relative sectoral shares have not varied widely during the 1980s, the actual level of development spending began to decline after 1983. The budgets of 1983–84 and 1984–85 were contractionary and development expenditure was restricted further after the 1986 oil price decline and devaluation, partly to restrain foreign borrowing. The 1986–87 budget was below that of the previous year, and the development budget fell again in 1987–88. Although the 1988–89 budget projected an increase of development expenditure of nearly 15%, its influence on domestic demand was counterbalanced by the large debt repayment figure, which accounted for 33% of that year's realised Government expenditure (Table 2.7). The 1989–90 budget remained contractionary although oil revenues were larger than projected, and development expenditure is expected to be lower than projected. The consequent 'saving' and a similar 'saving' projected for 1990–91 will probably be used to reduce reliance on foreign aid, according to Pangestu and Habir (1990).

2.8 The Financial Sector

The hyperinflation of the Sukarno years resulted from deficit finance, and the 'balanced budget' was meant to prevent future borrowings from the domestic financial system. The oil price rise of 1973 increased pressure on the financial sector as vast amounts of oil revenue were injected. The central bank in 1974 initiated strong controls over credit expansion,

together with selective credit policies and subsidised interest rates to certain sectors (Arndt 1979). However, once the Government began to spend oil money through the budget, without removing domestic purchasing power, the result was continuing inflation throughout the 1970s. The inflation rate varied, falling to around 14% in 1976, but averaging 19% between 1973 and 1978. It reached 27% in 1979, was 17% in 1980, only to increase again in 1981 after the second oil price boom. The static oil prices of 1982 and 1983 and deteriorating balance of payments brought a further devaluation in April 1983, giving more impetus to inflation. In conjunction with the tax review a second major policy initiative occurred in June 1983 when the Government made significant reforms to the banking system. Most of the 1974 direct central bank control of credit and interest rates was eliminated. Further banking reform was undertaken in October and December 1988 and March 1989, in a number of packages designed to promote competition in the financial sector, including the stock market.

2.8.1 Monetary policy during the 1970s and early 1980s

The Soeharto Government reorganised the five State banks which, together with the central bank (Bank Indonesia) and small private commercial banks (later some foreign banks), formed the financial sector. By 1972 some non-bank financial institutions were allowed to function, and in 1977 the stock exchange was reinstated. Monetary policy was operated through informal means ('special relationships'), and the formal control of the volume of bank credit through issue of reserve money, reserve ratios and indirect control of credit volume (Grenville 1981), although Nasution (1983) considers reserve requirements were no more than a subsidiary policy element, if indeed used at all, in controlling the credit volume. State banks each concentrated on a particular sector (e.g. Bank Raykat Indonesia (BRI) was responsible for rural development and smallholder agriculture, Bank Bumi Daya for estate agriculture and forestry). The private banks were excluded from central bank 'cheap funds', while the State banks were the instruments of credit directed to certain areas at concessional rates (e.g. the BRI dispensed BIMAS credit). Credit ceilings were used to direct loans to certain ethnic (*pribumi*) businessmen, and interest rates were differentiated according to loan purpose, rather than credit worthiness and loan maturity (Nasution 1983). The problem of trying to reconcile market-oriented banking with development-oriented lending guidelines resulted in inefficient State banks and bad debts. Grenville (1981) points out that monetary policy in the 1970s had to be operated through a financial sector which was still evolving, and which touched upon only the modern sector. However, the rice program, in particular, brought modifications to the rural sector, increasing monetisation and linkages with financial institutions.

2.8.2 Major banking reform of 1983

Substantial capital flight in early 1983 before the April devaluation was followed by major banking sector reform in June. Direct central bank control of credit and interest rates was eliminated. State banks were to control their own rates for lending and fixed deposits, with the exception of certain concessional rates to particular priority clients (e.g. BIMAS farmers, other smallholders and small-scale enterprise) and credit ceilings were abolished (Arndt 1983). The aim was to stimulate, and use more productively, private savings, in addition to enhancing the credit role of the banking system. Changes in June 1984 named the central bank as lender of last resort, with two discount windows for banks suffering liquidity problems (the second window dealt with special Indonesian conditions). A market in Government bearer certificates (SBIs) was also introduced (Rosendale 1984). The SBIs were intended to form the basis for the conduct of open-market operations.

By mid-1984 the impact of the 1983 deregulation was becoming evident. State banks attracted time deposits with high short-term interest rates, but were unsuccessful lenders. Private banks increased lending at such a rapid rate that they began borrowing on the call money market to finance further lending. Bank Indonesia stepped in with supplementary measures and Booth (1984) argued that the problems would solve themselves as banks became used to a deregulated system. In February 1985 Bank Indonesia widened further its possible monetary tools with the introduction of a promissory note facility (SBPU). Glassburner (1985) remarked upon the financial deepening which took place in 1985 (as time deposits grew at a higher rate than cash and demand deposits), and the fact that the SBI and SPBU markets had developed to a point where open-market operations were considered to be possible.

Interest rates remained high, even after the 1986 devaluation. Nevertheless, the foreign exchange market witnessed episodes of capital flight in late 1986 and the first half of 1987. Bank Indonesia twice raised interest rates on its short-term monetary instruments, and finally on 22 June 1987 ordered four large State enterprises to withdraw funds from State and commercial banks and purchase SBIs. This resulted in a sharp rise in inter-bank rates and, coupled with mild appreciation, induced large capital inflows (Hill 1987). The major cost was in terms of continuing high interest rates, 25% or above (with a real rate of 15–20%) which discouraged private investment. Time and savings deposits grew rapidly in 1987 and 1988, having a contractionary influence on money supply, narrowly defined (M_1).

2.8.3 Further banking reforms 1988 to 1990

Further reform of the financial sector began on 27 October 1988 (PAKTO 1988). The main focus was on removal of entry restrictions, allowing new private banks, including joint ventures with foreign banks.

Other measures included the reduction of reserve requirements to 2%, but imposition of a 15% withholding tax on time deposit interest. During March 1989 certain implementation regulations related to PAKTO 1988 were announced. For example, the tax on bank interest income applied only to savings deposits over Rp 5 million (Schwarz 1989c, p. 83). The major impact was evident throughout 1989 in terms of the large growth in bank numbers and branch expansion, competition for deposits (including lotteries), and shortage of experienced staff (Mackie and Sjahrir 1989, Pangestu and Habir 1990). Between 1988 and 1989 savings deposits more than doubled. Competition during 1989 resulted in the lowering of interest rates to around 19–20%. A further measure was announced in January 1990 when domestic banks were required by the end of the year to have at least 20% of loans directed to small business. This measure was the result of Bank Indonesia cutting its volume of subsidised (liquidity) credit to selected sectors, although agriculture and BULOG were largely unaffected. There was also a revival of the share market. The PAKTO 1988 tax on bank interest income had been designed to improve the appeal of the capital market since dividends were already taxed. Throughout 1989 the Jakarta stock market surged with intense share demand and, although still small by Asian standards, seems set to provide an alternative capital source for some companies.

2.8.4 Finance and the agricultural sector

Finance for agriculture comes from both formal and informal sources. Informal finance includes village money lenders, family/relatives, and odd borrowings at certain times of year/life. Measures were suggested to outlaw the informal system, but it persists, and McLeod (1980) believes it is best left alone. Glassburner (1985) estimated that informal finance accounted for some four-fifths of the total capital needs of the agricultural sector. Early formal finance to the agricultural sector centred around the BIMAS scheme for rice, *palawija* and livestock. Other smaller schemes were directed to rural areas and still others related to particular cash crops. At the time of the 1983 banking reforms BIMAS credit was terminated after it became evident that repayment rates had dropped significantly, arrears being around 50% (Booth 1984). In early 1984 a new rural general credit scheme (KUPEDES) was launched. The existing BRI village banking system set up to administer BIMAS was retained and expanded. Loans were no longer tied to specific agricultural programs, but were available to various small rural enterprises for investment as well as working capital, and interest rates were structured to encourage rapid repayment (Dick 1985). Figures to November 1985 showed that agriculture directly accounted for only 23% of loans while trade accounted for 72%. Glassburner (1986) argues that agri-business and rural enterprise generally are so interlinked that this categorisation

may not reflect the true economic impact; while, in view of the large demand for funds in the rural sector, Dick (1985) considers that it does not matter to which part of the matrix credit is injected. By 1988 credit under KUPEDES had quadrupled to Rp 462 million (Bank Indonesia 1989).

As previously noted, Bank Indonesia, in January 1990, began to phase out some of its subsidised credits to selected sectors. Export credits, fertiliser company and mining enterprise credits ceased, although farmers, including cash crop farmers, cooperatives, and BULOG will continue to get access to credit at Government 'market rates' of 16% (Schwarz 1990a p. 56). The curbing of subsidised credit to fertiliser companies is noteworthy, given that the Government has shifted a large portion of the fertiliser subsidy off-budget. A further consideration involves the tradition of village institutions and self financing. Given their predominance, the spread of banking facilities may take some time to have an impact upon rural areas. Moreover, the continuation of subsidised credit to most sectoral activities removes some incentive for the private financial sector to penetrate poorer and remoter areas. However, the BRI with its large branch network has begun to promote new consumer savings and credit schemes (Schwarz 1989a, p. 47), while wearing its 'commercial hat'. If this approach provides greater availability of credit as against selective subsidised credit, the sector will be better served.

2.9 Trade and the Balance of Payments

In 1966 the Government had exhausted its foreign exchange reserves, faced spiralling foreign debts, and was promoting a confrontation policy with Malaysia which exacerbated an already inward-looking development policy. To restore stability a debt moratorium was introduced, the currency was devalued, and a resumption of normal regional trade and diplomatic ties negotiated (Nasution 1983). The next major policy decision was the encouragement of foreign investment, a reversal which has helped develop the export base.

2.9.1 Trends in the balance of payments

After inflation was controlled and the exchange rate devalued exports improved, and by 1972 foreign exchange reserves began to accumulate. The period of the 1970s and 1980s was one of current account deficits, except for the oil surpluses of 1974 and 1980. (Commodity price rises also made some contribution to the 1980 surplus.) The deficits have been financed by capital inflow in the form of foreign aid, official loans and direct private investment. The overall balance of payments was in surplus throughout the 1970s, except for the 1975 Pertamina crisis. Thereafter, continuous additions were made to reserves until 1981 when

the trade balance deteriorated. As oil prices stagnated the current account deteriorated, with a deficit exceeding US$ 5 billion in 1982; and in 1983 the trade balance was weakened further by the oil price decline. Following the devaluation in March 1983 the current account deficit declined as exports increased in the aftermath of devaluation and a mild world economic recovery. The oil price decline of 1986 resulted in a devaluation in September of that year, and the current account deficit for 1986–87 was $4.1 billion (Table 2.8). Improved exports, especially non-oil exports, and slower import growth have reduced the current account deficit to $1.6 billion for 1989–90 and a provisional $2.6 billion for 1990–91, despite large net services of over $8 billion for both years. Reserves stood at $US 5.5 billion in September 1989 (BPS 1990). Net official capital inflow for 1990–91 is expected to be just under the $6 billion total, while private capital inflow shows a slight increase as the deregulatory climate helps the flow into realised investment.

2.9.2 Exports

While traditional exports stagnated, oil began to dominate during the 1970s. In 1980 oil and gas accounted for 75% of merchandise trade, but by 1989 this proportion had fallen to 40%. Some of the traditional exports (coffee, rubber), which formed the base of exports in the late 1960s, contributed to the late 1980s surge of non-oil exports. Agricultural exports (see Table 3.2) contributed 16.5% of total non-oil exports in 1988, but in 1989 this percentage fell to 15% after a decline in primary commodity prices. However, many commodities now classified as industrial sector products (e.g. processed rattan, palm oil and crumb rubber) are but one step away from their original form, so that agriculture's contribution to non-oil exports is greater than initial statistics indicate. Following the 1986 devaluation and a series of trade packages, non-oil exports grew 31% between 1986 and 1987, and increased to 34.5% between 1987 and 1988. Provisional figures for 1989 indicate, however, that there has been a slowdown in export growth to 16.8% between 1988 and 1989 (Pangestu and Habir 1990). Part of the explanation for the decline rests with commodity price fluctuations, part is the result of direct policy intervention (e.g. sawnwood) and part appears to be a matter of supply constraints.

2.9.3 Imports

Import composition has changed since 1975, with the 1980s showing more emphasis on raw materials, less emphasis on consumption items and a fairly static pattern of capital good imports. As the rice program increased production the large cost of rice imports fell (to zero in 1985) after accounting for 6.4% of total imports in 1980. The import replacement program has succeeded in reducing demand for many consumer

durables and some intermediate products. Industrial policy emphasis has kept the proportion of raw materials which are imported quite high (70–80%) during the 1980s, while capital goods have remained around 17–19%. Arndt (1983) argued that the effort at import substitution undertaken in the intermediate goods industries (e.g. fertiliser, cement) could be regarded as probably representing an efficient use of economic resources, although he was doubtful about capital-intensive import substitution. Imports fell in value terms between 1984 and 1986 as the depressed state of the manufacturing sector demanded less raw materials, while the 1986 devaluation contributed to keeping down the import level. However, higher economic growth from 1987 to 1989 has resulted in stronger import demand.

2.9.4 Early 1980s trade restrictions

In response to a deteriorating balance of payments in the early 1980s there was an increase in the use of non-tariff barriers. This was achieved through direct import bans, quotas, import licensing and special 'deletion' programs (Pangestu 1987). Particular measures used to control imports included: (a) an approved importer system for goods in nine categories; (b) a few importers or a sole importer authorised to import certain raw materials and agricultural products; and (c) a sole agent importer authorised for certain brand products. Agricultural commodities under category (b) included cotton, wheat flour, milk and milk products, soybeans, soy flour, cloves and sugar, for many of which BULOG was (and remains still) the sole importer. Out of 5229 items some 28% were under licence, including 296 under quotas. The agricultural sector accounted for 122 items under licence and 64 under quotas.

2.9.5 Trade reforms

In the aftermath of the 1980s oil problems there was concern about the narrowness of the export base and the need for diversification. The first response was the New Trade Policy of 1982, which had as its main theme a counter-purchase scheme for Government contracts. INPRES (Instruction of President) 4/1985 handed customs responsibility to a Swiss firm, abolished protection to inter-island shipping and eliminated a system of check prices used to subsidise exports and discourage imports. Nasution (1985) argued that tariffs should replace non-tariff barriers, since Indonesia in March 1985 signed the GATT Agreement on Subsidies and Countervailing Duties. Further trade measures were announced in May 1986 (PAKEM), and included a range of initiatives to encourage foreign investment as part of a program to increase non-oil exports within GATT guidelines. PAKEM measures hardly began to operate before the 1986 devaluation, and were closely followed by the Post-Devaluation Package of October 1986. On 15 January 1987 new

regulations eliminated quotas on 146 components in the steel and textiles industry, reduced tariffs on a further 55 categories of parts and components, and simplified regulations for expansion into new products. The overall impact of the last two packages was the removal or relaxation of 40% of import restrictions on the manufacturing sector (Pangestu 1987).

A new Investment Priority List (DSP) was released in June 1987, licences issued from BKPM are now valid indefinitely, processing has been simplified and product categories broadened (Hill 1987). Further measures followed on 24 December (PAKDES 1987) which covered export promotion and incentives, import monopolies, the domestic share market, tourist promotion and attraction of more foreign capital (Booth 1988a). Three categories of commodities remain subject to export control and items are either banned, controlled by the Department of Trade or restricted to licensed exporters. The majority of these items originate in the agricultural sector and include rice, soybean flour and vegetable oils. Booth (1988a) argues that Government policy seems to be shifting key commodities from quantitative import restrictions to tariffs, with the ultimate aim of reducing the tariff level. The November 1988 (PAKNO) package focused on shipping deregulation, and allowed foreign companies some latitude in domestic trading. Simandjuntak (1989) concludes that, although the deregulation packages have introduced transparency into import policy, Indonesia's export policy entails a type of protected export substitution for primary commodities with world trade market power, particularly restricting exports with low degrees of processing. The PAKMEI 1990 trade measures have brought reform to the tariff schedule, removed certain non-tariff barriers (although other tariffs were increased), and introduced some deregulation to pharmaceuticals and agriculture (Conroy and Drake 1990).

2.9.6 Devaluation

After two devaluations in 1966 and 1970 the exchange rate of Rp 415 = US$1 was tied to the US$ and kept constant from 1971 to 1978. As a result of the oil boom the currency appreciated during the 1970s, disadvantaging the traded goods sector. Rosendale (1981) argues that devaluation in Indonesia was generally envisaged as having its principal effect on income distribution by increasing prices of traded good prices relative to non-traded goods. It was with the aim of exchange rate protection (Warr 1984) that the 1978 devaluation was undertaken. The tie between the US$ and the rupiah was broken and a managed float against an unspecified basket of currencies was undertaken at a rate of Rp 625 = US$1. Although monetary and fiscal policies were broadly consistent with the aim of devaluation, at industry level Government actions were counterproductive (see Dick 1979). There was an apparent reluctance to see a rise in the price of tradeable items move

resources out of the non-tradeable sector. Price control on tradeables was enforced and Dick (1979, p. 29) cites informal administrative bans on coffee and pepper. Price increases for rubber and tin were not allowed to exceed 10%, while palm oil was subject to a higher rate of export tax, and quotas were set for the supply of palm oil to the domestic market at prices below export prices. Corn, rice, soybean, flour and sugar were among 20 items subject to export quotas, although most would not have been exported anyway. Dick cites copra as a smallholder crop stifled by taxes, mainly borne by the farmer at the farmgate. There was no export surplus, the industry was run by quotas, and from 1976 BULOG imported coconut oil and sold it at a loss to hold down domestic prices. Most of the export quotas and bans were later replaced by additional export taxes, as fiscal policy was used to remove part of export sector profits to prevent inflationary pressure.

By 1982 most of the benefits of the 1978 devaluation had been dissipated by on-going inflation (see Warr 1986). Declining oil prices, capital outflow and a large current account deficit triggered the March 1983 devaluation. This time the Government avoided most of the 1978 problems, although it still tried to minimise domestic inflationary effects by not allowing BULOG to increase prices of rice, sugar and flour. The Government instituted strict monetary and fiscal policies as a follow-up to devaluation and shortly afterwards began its process of tax reform and financial deregulation. There was little or no capital outflow before the 1986 devaluation but, as Booth (1986) pointed out, the current and projected balance of payments deficit justified the devaluation. Tight fiscal and monetary policy has helped to contain domestic inflation, so that real effective exchange rates have been maintained, allowing the increased competitiveness of non-oil exports to be sustained from 1987 to 1989. However, to reap the full benefits of the devaluation, the re-allocation of resources to tradeable sectors must be quickly and efficiently made and the deregulatory packages have aimed at this transition.

2.10 Agriculture and the Macroeconomy

It is evident, even with the profound changes of the 1970s, that agriculture remains of major importance, not only as a provider of food and employment, but also as a substantial contributor to export income. Glassburner (1985) argues that it is not merely the size of the agricultural sector that needs to be considered but also the intersectoral linkages, and the impact of macroeconomic policy variables on incentive patterns and agricultural sector performance. Macroeconomic policies primarily impinge upon Indonesian agriculture through trade, the balance of payments and the exchange rate, fiscal and monetary policies. Glassburner (1985), in considering the impact of past policies, concluded that while previous specific policies were somewhat mixed in quality (supportive in some areas, neglectful or worse in others),

macroeconomic policies were of sufficient quality to provide a stable background which allowed the agricultural sector to produce a healthy average growth rate of 3.7% per annum over the three Repelitas. Despite the ups and downs provided by the oil economy, Gelb (1986) concludes that Indonesia was most successful in using oil revenues to strengthen its agriculture, while the World Bank (1986, p. 72) considered that, 'Indonesia, all but unique among the oil-exporting developing countries with large populations, succeeded in avoiding serious disruption to its agriculture'. There is thus a large measure of endorsement of the argument that macroeconomic policies to 1985 were largely supportive of agriculture, despite some areas of concern.

Subsequently there have been major deregulatory changes. This survey is concluded with a brief review of the measures to see if available information indicates their impact upon, and support for, agriculture.

2.10.1 Macroeconomic policies post-1985

The 1984 reform of the tax system widened the tax base. Increased revenue has resulted from more progressive income taxes and efficiency of collection, with VAT providing a major source of non-oil revenue. There has also been some growth in revenue from State enterprises. While land taxes have risen, these fall on urban as well as rural areas, and there is no indication of increase in the rural burden. The export tax on sawn logs has been used from January 1990 as a protective rather than a revenue device. Government expenditure on agriculture has remained at about the same proportion of total development expenditure, but the contractionary budgets post-1986 have generally meant static or falling absolute levels. New irrigation projects were abandoned, and it was difficult to fund operation and maintenance of existing services. Budget stringency also influenced provision for other infrastructure which supports agriculture (e.g. transportation, communications, health and education). However, the 1990–91 budget appears to be slightly less austere and the rural sector should benefit from expenditure on roads, irrigation, electrification, harbours, and INPRES grants (special local government programs funded by direct presidential decree).

The 'financial deepening' (a rise in the ratio of monetary assets to GDP) which occurred during the 1970s and early 1980s has continued and the ratio has increased more rapidly from 0.208 in 1983 (Glassburner 1985) to 0.296 for 1987. Currency, although declining as a proportion of broad money (M_2) since 1983, exhibited a steady upward trend until 1987. Boediono (1985) believes this component of monetary assets is more closely related to the 'traditional' sector than 'quasi' money, which is primarily a 'modern' sector phenomenon. Certainly, the recent explosion in banking activity and facilities appears to be concentrated in the larger cities although, since BRI launched its savings plan, rural savings have jumped from Rp 42 billion in 1984 to Rp 649 billion in July 1989

(Vatikiotis and Schwarz 1989, p. 73). Rural areas will benefit from the fall in inflation during the second half of the decade, and the higher growth rates for agriculture during 1988 and 1989 probably reflect, at least partly, confidence in economic management as well as better seasons and stable incentives. Although Bank Indonesia has curbed subsidised lending, agriculture has been largely exempted, and BRI continues to advance about 60% of loans under its program loan category (Schwarz 1989b, p. 74). However, the increase in subsidised lending rates exhibited in the move from BIMAS to KUPEDES should emphasise the scarcity value of capital and help to curb abuses. Informal finance will continue in the short run to provide the bulk of the sector's capital needs, but as the economy develops and financial deregulation settles into a stable pattern, it is inevitable that private sector banking will push further into rural areas.

Since 1986 fiscal and monetary policies have contained inflation so that the improvement in the real effective exchange rate has been maintained, which in turn has contributed to continuing non-oil export competitiveness. Trade policy changes have aimed at boosting non-oil export performance, and figures for 1987 and 1988 indicate the success of this initiative, although provisional figures for 1989 show that the current account improvement in that year was mainly the result of higher oil prices. Continuing progress in export growth will need further investment and, although investment approvals are promising, realisation takes time.

The trade policy changes outlined previously were aimed primarily at the manufacturing sector, and trade policy has been one of selective rather than general export encouragement. Bans remain on the import and export of certain agricultural commodities. There are other agricultural exports subject to controls by the Department of Trade or restricted to certain exporters. The ban on semi-processed rattan and rattan skins and the export tax on sawn timber (effectively a ban) have been justified in terms of increasing value-added and export earnings. However, timber industry bans are criticised on two counts: (a) they are all seemingly engineered by one entrepreneur, and this protected infant industry may take a long time to contribute to export growth; and (b) the policies contradict the general deregulatory push and acceptance of market forces.

Cash crops generally have been assisted by the 1986 devaluation, controlled inflation and a stable real effective exchange rate, although commodity prices have fallen recently. Foodgrains (except cassava) have always been subject to strong Government influence and protected from international competition, as attempts were made to reduce foreign exchange costs, stabilise prices (primarily for urban consumers), and increase production and farmer incomes. The 1986 devaluation reduced effective protection rates for rice and maize to world parity but domestic (imported) wheat prices are above world prices, while sugar and soybean

remain highly protected at rates of 62 and 39% respectively (Rosegrant et al. 1987). Cassava is the only economically-efficient food crop export.

2.10.2 Concluding comments

The generally prudent macroeconomic management of the 1970s resulted in steady and substantial growth, although there were areas where Dapice (1980) noted that performance was modified as the result of compromise among conflicting goals. The Government's response to the problems of the 1980s oil revenue downturn has been decisive in terms of tax, trade, financial and investment reform, and reduction in domestic subsidies. This response has already altered the pace and direction of growth, while the longer-term outlook will be further influenced by the acknowledgment in Repelita V of the larger role now accorded to the private sector.

Policies directed to the agricultural sector during the 1980s have followed the same broad lines as those of the previous decade, and elicited the same mixed quality of results noted in subsequent chapters of this report. Yet there has been a growing appreciation of the need to balance rice against secondary crops and initiatives in other sub-sectors, credit policy has been restructured, and input policy partially reappraised. While most aspects of macropolicy during the 1980s have been basically sound, much of the sectoral and macroeconomic policy inconsistency (Tabor et al. 1988, Booth 1988b) remains, although slightly modified by recent policy changes. Foodgrains and cash crops (smallholder and estate) suffered discrimination and/or benefited from a varying mix of export taxes, exchange rate protection, subsidised inputs, credit and infrastructural support. However, continuing pressure for economy-wide reform is evident, including advocacy of a shift to market-oriented agriculture (Hedley, Hadiwigeno and Sarkanputra 1987), and this may ultimately provide for a more coordinated policy approach in the 1990s.

Despite the problems associated with rice in 1986 and 1987, this industry improved its performance in 1988 and 1989, yielding a 3.5% annual growth rate for Repelita IV. This in turn contributed to an annual growth rate of 3.3% for the agricultural sector as a whole for the plan period, a more than adequate result, given the circumstances. Within an overall growth target of 5% per annum, Repelita V projects a 3.6% per annum growth rate for the agricultural sector, with cash crops, livestock and fisheries expected to reach between 5.5 and 6.7% per annum, while foodcrops are expected to contribute a more modest 2.8% per annum (rice alone, 2.9%). Given adequate intersectoral terms of trade and allocatively-sound sectoral policies, the macroeconomic policies which have been in place during the latter half of the decade, and which have continued to be supportive of agriculture, should allow this sector to continue to make a significant contribution to overall growth.

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Table 2.1. Indonesia: GDP, sectoral output shares, selected years, current prices (%).

Sector	1960	1970	1980	1985	1989[p]
Agriculture	53.9	48.6	24.8	23.2	23.5
—foodcrops	(34.3)	(28.8)	(14.0)	(14.3)	(14.5)
Mining	3.7	5.3	25.7	14.0	13.1
Manufacturing	8.4	9.0	11.6	16.0	18.4
Utilities	0.3	0.5	0.5	0.4	0.6
Construction	2.0	3.1	5.6	5.5	5.3
Trade	14.3	16.6	14.1	15.9	17.0
Transport	3.7	3.0	4.3	6.3	5.5
Government	4.5	5.6	6.9	8.2	6.7
Other services	9.2	8.2	6.5	10.5	9.9
	100.0	100.0	100.0	100.0	100.0

p Preliminary figures

Sources: 1960, 1970 Booth and Glassburner (1975).
1980, World Bank (1983).
1985, 1987 BPS National Income of Indonesia 1984–1989.

Table 2.2. Indonesia: sectoral output shares of GDP, selected years, constant prices (%).

Sector	1960 Constant prices		1973 Constant prices			1983 Constant prices[a]	
	1960	1970	1975	1980	1983	1983	1989[p]
Agriculture	53.9	47.5	36.8	30.7	29.9	22.8	20.6
—foodcrops	(34.3)	(30.8)	(22.2)	(18.6)	(18.8)	(14.2)	(12.5)
Mining	3.7	5.6	10.9	9.3	7.4	20.7	15.6
Manufacturing	8.4	8.9	11.1	15.3	15.1	12.7	18.5
Utilities	0.3	0.5	0.5	0.7	0.9	0.4	0.6
Construction	2.0	2.6	4.8	5.7	6.3	5.9	5.5
Trade	14.3	17.5	17.0	16.6	17.4	14.9	16.1
Transport	3.7	3.2	4.0	5.4	5.9	5.3	5.3
Government	4.5	5.3	7.4	8.7	9.2	7.4	7.8
Other services	9.2	8.9	7.6	7.6	7.9	9.9	10.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

a Revised series
p Preliminary figures

Sources: 1960, 1970 Booth and Glassburner (1975).
1975 Glassburner (1978).
1980, 1983 (1973 constant prices) Booth (1984).
1983, 1989 Conroy and Drake (1990), BPS National Income of Indonesia 1984–1989.

Table 2.3. Indonesia: GDP 1984–1989 at constant 1983 prices (Rp billion).

Sector	1984	1985	1986	1987	1988	1989[p]	Growth rate[a] 1984–89[p]
Agriculture	18 513	19 300	19 799	20 224	21 168	22 086	3.5
– foodcrops	11 680	11 986	12 287	12 415	12 974	13 446	2.8
– non-food crops	2 349	2 576	2 581	2 693	2 835	2 999	5.1
– estate crops	446	511	562	565	578	607	6.3
– livestock	1 890	2 037	2 064	2 111	2 212	2 324	4.2
– forestry	894	851	889	968	1 013	1 083	3.9
– fisheries	1 253	1 341	1 418	1 472	1 557	1 626	5.4
Mining	17 120	15 480	16 309	16 366	15 893	16 727	–0.5
Manufacturing	12 079	13 431	14 678	16 235	18 182	17 836	10.4
Utilities	324	361	430	495	549	616	13.7
Construction	4 394	4 508	4 609	4 803	5 259	5 878	6.0
Trade	11 811	12 399	13 399	14 356	15 657	17 230	7.9
Transport	4 443	4 487	4 668	4 939	5 212	5 667	5.1
Government	5 997	6 455	6862	7 366	7 932	8 397	7.0
Other	8 357	8 661	9 327	9 735	9 904	10 884	5.4
GDP	83 037	85 082	90 081	94 518	99 936	107 321	5.2

a Logarithmic slope of the line between end points.
p Preliminary figures.

Sources: BPS National Income of Indonesia 1984–1989.

Table 2.4. Indonesia: expenditure on GDP (constant prices) (%).

Item	1960 Constant prices	1973 Constant prices				1983 Constant prices				
	1965	1970	1975	1980	1983	1985	1986	1987	1988	1989[p]
Household consumption expenditure	82.8	75.3	74.7	79.4	89.6	58.1	56.1	55.2	54.3	52.6
Government consumption expenditure	6.7	9.3	10.9	13.3	13.7	10.6	10.3	9.8	9.9	10.2
Gross domestic capital formation	8.4	13.8	21.6	25.9	30.5	30.9	30.8	29.2	26.3	27.8
Exports of goods and services	13.0	16.1	18.5	15.1	11.9	22.9	24.9	27.2	26.0	26.0
Less imports of goods and services	10.9	14.6	25.7	34.0	45.7	22.5	22.1	21.5	16.5	16.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

p Preliminary figures.

Sources: 1965 Grenville (1973), Table 14.
1970–1983 UN National Account Statistics 1983, 1985.
1985–1989 BPS National Income of Indonesia 1984–1989.

Table 2.5. Indonesia: implicit price indexes for agricultural and non-agricultural contribution to GDP, and ratio of implicit price indexes of the two sectors (1973 = 100 and 1983 = 100).

Year	Agricultural sector implicit price index[a] (1)	Non-agricultural sector implicit price index[a] (2)	Ratio of agricultural to non-agricultural implicit price deflator[b] (3)
		(1973 = 100)	
1970	66.8	58.8	113.6
1973	100.0	100.0	100.0
1974	124.4	161.7	76.9
1975	142.4	179.2	79.5
1976	163.5	204.4	80.0
1977	198.1	222.5	89.0
1978	213.9	249.4	85.8
1979	276.3	333.3	82.9
1980	329.6	441.0	74.7
1981	379.6	477.3	79.5
1982	426.9	507.9	84.0
1983	488.1	582.9	83.7
		(1983 = 100)[c]	
1983	100.0	100.0	100.0
1984	110.3	107.7	102.4
1985	116.6	113.4	102.8
1986	125.6	110.7	113.5
1987	144.0	128.8	111.8
1988	161.5	176.0	91.8
1989[p]	176.6	149.4	118.2

a Index is calculated by dividing the current price by the constant price contribution of the sector to GDP.
b Ratio is obtained by dividing column 1 by column 2.
c The revised 1983 constant price series.
p Preliminary figures.

Sources: 1970–1983, UN National Account Statistics, 1983.
1984–1989, BPS National Income of Indonesia 1984–1989.

Table 2.6. Indonesia: distribution, size and growth of workforce, 1970, 1980, 1985.

Sector	1971		1980				1985			
	('000)	(%)	('000)	(%)	Growth rate 1971–80[a]	Share of total increase 1971–80[a]	('000)	(%)	Growth rate 1980–85[a]	Share of total increase 1980–85[a]
Agriculture	24 964	65.9	28 040	55.5	1.0	20.6	31 142	54.7	3.7	51.0
Mining	91	0.2	369	0.7	16.5	2.4	416	0.7	2.1	0.4
Manufacturing	2 950	7.8	4 361	8.6	4.1	11.5	5 796	9.3	5.6	12.2
Utilities	38	0.1	85	0.2	8.9	0.4	70	0.1	-4.1	-0.1
Construction	741	2.0	1 573	3.1	8.4	7.0	2 096	3.4	5.6	4.5
Transport	919	2.4	1 468	2.9	5.0	4.5	1 958	3.1	5.7	4.2
Trade	4 144	10.9	6 611	13.1	5.0	20.4	9 345	15.0	7.0	23.5
Finance	96	0.3	233	0.5	10.1	1.2	250	0.4	1.2	0.1
Public Service	3 940	10.4	7 739	15.4	7.5	32.1	8 317	13.3	1.2	4.2
Other[a]	1 604	[a]	713	[a]	–	–	67	[a]	–	–
Total workforce	39 475	100.0	51 192	100.0	2.9	100.0	62 457	100.0	4.1	100.0

a Distributed proportionately among other industries.

Sources: 1971, 1980 Scherer (1982, Table 9).
1985 BPS (1988) Statistik Indonesia 1988, derived from Table 3.2.8.

Table 2.7. Indonesia: Government budget (1988–89 – 1900–91 (Rp billion).

Item	1988–89 (Realised)	1989–90 (Projected)	1990–91 (Projected)
Domestic revenue	23 004.3	25 249.8	31 583.6
1. Oil revenues	9 527.0	7 899.7	10 783.2
2. Non-oil revenues	13 477.3	17 350.1	20 800.4
Income tax	3 949.4	4 947.6	6 515.8
Value-added tax	4 505.3	5 830.9	6 824.9
Customs duties	1 192.0	1 421.2	1 971.8
Excise taxes	1 389.9	1 487.0	1 911.2
Export taxes	155.6	159.8	107.8
Land taxes	424.2	638.5	620.4
Other taxes	292.1	424.6	288.5
Non-tax revenue	1 568.8	2 047.6	2 560.0
Proceeds fuel sales	–	392.9	–
Development revenue	9 990.7	11 325.1	11 289.5
1. Program aid	2 040.7	1 798.9	2 885.3
2. Project aid	7 950.0	9 526.2	8 404.2
Total revenue	32 995.0	36 574.9	42 873.1
Routine expenditure	20 739.0	23 445.0	26 648.1
Wages	4 998.2	5 966.5	6 909.3
Purchase of goods	1 491.6	1 476.6	1 720.9
Subsidies to regions	3 037.7	3 594.1	4 226.7
Debt service	10 940.2	12 236.8	12 984.4
Other	271.3	171.0	806.8
—Fuel subsidy[a]	133.1	–	626.5[a]
Development expenditure	12 250.7	13 129.9	16 225.0
Rupiah funding	4 300.7	3 603.7	7 820.8
Govt departments	1 855.3	1 474.0	4 316.0
Regional development	1 491.7	1 759.1	2 834.5
Other	953.7	370.6	670.3
—Fertiliser subsidy	200.0	155.0	155.0
Project aid	7 950.0	9 526.2	8 404.2
Total expenditure	32 989.7	36 574.9	42 873.1

a Subsidy phased out March 1990 (Schwarz 1990b, p. 42).

Sources: BPS (1989) Indicator Ekonomi Tables 2.2 and 2.3.
Pangestu and Habir (1990) Tables 4 and 5.

Table 2.8. Indonesia: balance of payments 1986–87 – 1990–91 (US$ billion).

Item	1986–87 (Realised)	1987–88 (Realised)	1988–89 (Realised)	1989–90 (Realised)	1990–91 (Provisional)
1. Exports	13.7	18.3	19.8	23.8	27.4
2. Imports	–11.5	–12.9	–14.3	–17.4	–21.5
3. Net services	–6.3	–7.1	–7.4	–8.1	–8.5
4. Current account	–4.1	–1.7	–1.9	–1.6	–2.6
5. Official capital	5.5	4.5	6.6	5.5	5.2
6. Other capital	1.2	1.7	–0.2	0.6	2.9
7. Debt repayment	–2.1	–3.0	–3.8	–3.7	–4.3
8. **Total** (1–7)	0.5	1.5	0.8	0.8	1.2
Monetary movements	–1.3	1.6	0.7	–0.2	–1.8
Errors and omissions	0.7	0.06	–1.4	–0.6	0.7

Sources: Booth (1988a) Table 8.
Simandjuntak (1989) Table 4.
BPS (1989) Indikator Ekonomi Table 6.1.1.
Pangestu and Habir (1990) Table 6.
Parker (1991) Table 7.

3 Cash Crops, Livestock, Fisheries and Forestry

3.1 Introduction

This chapter reviews the agricultural sector other than the foodcrop subsector. In 1987 the cash crop sector (both estate and smallholder), livestock, forestry and fishing together constituted some 39% share of the total agricultural sector, and contributed just over 8% of GDP in constant prices.

Except for palm oil and tea most of the cash crops are produced by smallholders (Table 3.1). The cash crop sector is predominantly established in the outer islands. These commercial crops traditionally have played a large role in foreign trade although this role was reduced somewhat in the 1970s, partly as a result of declining world commodity prices, but mostly as a result of large increases in export receipts from oil and gas. While Java wields commanding influence in Indonesian agriculture with respect to foodgrain production (its early 1900s contribution to agricultural exports having dwindled), Sumatra is the foremost earner of foreign exchange in terms of commercial crops, oil and gas (Baharsyah and Hadiwigeno 1982). Cash crops serve as export earners as well as meeting the needs of domestic consumption, and it is in this dual function that conflict can arise. Large estate production tends to be oriented almost completely to the export market, while smallholder production (sometimes of inferior quality) is directed at both internal and external markets. Sugar was an important export earner before World War II, but the industry since then has been overwhelmed by growing domestic demand. Imports became necessary, and only now is a stage of near self-sufficiency being reached, albeit at a domestic price up to four times higher than the world market price. (Further discussion of sugar is held over until the next chapter where it will be discussed in relation to *sawah* rice and *palawija*, even though statistically it is treated as a cash crop.) There has been conflict also between domestic and export market needs in relation to both coconut and palm-oil during the late 1970s and into the 1980s.

Another factor of importance relates to population growth rates, which are slightly higher for the outer islands in comparison with Java. This fact, together with the push for transmigration programs, means that there is an increased reliance on the cash crop sector to provide for increases in per capita income.

A further distinction to be noted is the breakdown of the cash crop sub-sector between smallholders and estates. The latter may be private estates (small or large), or large-scale, State-sector enterprises. The State sector appeared after Independence when many of the large private estates were nationalised. Small private estates continue to operate for some crops, while Government policy has encouraged foreign private investment in joint-venture estate crops and 'nucleus estate' projects (explained later in chapter). Moreover, there is the 'sharp technological dualism' (Booth 1984, p. 27) which is manifest in the split between smallholder and estate production. This is evidenced by the lack of change in smallholder technique, while estates have made large strides in technical progress. Government neglect of the smallholder sector until the late 1970s has contributed to the technological divergence between the two sectors.

The livestock and fisheries sub-sectors provide small, though important, sources of animal protein in the Indonesian diet, but have suffered from lack of investment and technology. BIMAS (intensification) programs existed for the livestock sector, but like BIMAS for secondary food crops, suffered from lack of implementation for various reasons. Exports of live cattle ceased in the mid-1970s although products of this sector (e.g. animal hides) are still export earners. Export of prawns from the fishery sub-sector reached second place by the mid-1980s (in value terms) behind coffee in the agricultural exports category. In 1988 their value was US$498.7 million while coffee exports were US$549.5 million (Table 3.2).

The forestry sub-sector became a significant export earner for Indonesia in the early 1970s in the form of timber products and was surpassed only by oil and gas as an earner of foreign exchange. A 1979 policy decision to begin to phase out the export of logs (in an effort to expand local timber industries) caused problems, and there was a downturn in export earnings. It has taken nearly a decade for timber industry net export earnings to recover to the pre-1980 level of export income from logs (Mackie and Sjahrir 1989, p. 12). A ban on raw rattan exports in 1986, a ban on exports of semi-processed rattan and cane webbing in 1988 and an export tax on sawn logs in 1990 have raised further problems and questions of policy in the forestry sector (see 3.12). With the downturn in international oil prices the Government had to look to the expansion of non-oil products to increase export earnings. In fact, by 1988 a major structural change had emerged in the export pattern as the non-oil/gas sector increased its share to 60% of total exports, of which agriculture accounted for 16%. Indeed, the agricultural sector makes a larger contribution to exports than is implied by this latter percentage, since commodities like processed wood and rubber are classified as industrial products.

3.2 The Cash Crop Sector

The cash crops include rubber, palm oil, coffee, tea, copra, spices and tobacco. Apart from the basic cultivation constraints (e.g. soil type and weather), these crops all face certain common problems with processing, marketing, research, extension and credit. A comprehensive review of all these aspects is not attempted for each crop, but references to further reading are provided. Here an attempt will be made to highlight the special constraints on one crop (rubber), together with mention of present progress and future plans for the other crops.

3.3 Rubber

Indonesia is second to Malaysia in the world production of rubber (having held number one spot until 1957). Around 70% is produced by smallholders (mainly in Sumatra and Kalimantan) while estates account for the remaining 30%, of which State-owned enterprises produce 18% and private estates 12% (Barlow and Muharminto 1982). The USA and Singapore are the major export markets, with the former taking around 46–47% of the total during most of the 1980s.

3.3.1 Smallholder rubber

Smallholder production forms part of the shifting cultivation system, normally found in remote areas, where land is cleared and rice or other intercrops are planted with unselected (i.e. not high-yielding) rubber seedlings for about three years. After this time the growing rubber tree canopy obscures the sunlight and the natural soil nutrients are exhausted (fertiliser and chemicals are rarely used). Following abandonment of the area it is about ten years before these rubber trees are tapped, while the system allows for mature trees to be rested if output declines or price falls (Barlow and Muharminto 1982, pp. 90–1). The product of smallholder rubber is the low quality 'slab', rarely the better quality 'sheet'. Barlow and Muharminto (1982, p. 93) draw a picture of a 'vast unimproved area of rubber smallholders, with virtually no use being made of new technologies'. These authors outline the easily available technology as: higher-yielding selected seedlings, maintenance methods for immature plants, more careful tapping methods and better processing techniques. This technology is widely used in Malaysia, Thailand and Sri Lanka, but has made no impact at all in Indonesia. The existing system can be argued to have some economic rationale in terms of crude extensive exploitation of widening areas, but Barlow and Muharminto believe new knowledge available to smallholders would result in better exploitation of traditional resources. They suggest a 'dispersal approach' to the improvement of smallholder rubber which would incorporate four basic changes — planting with selected seedlings, increased density of tapping, raising the standard of resource exploitation and improving farmer edu-

cation. With the addition of extension services and limited input subsidies this proposal was put forward as a policy alternative or supplement to official programs.

A significant aspect of the official programs was the restructuring of agricultural research in 1975. This confirmed the position of rubber by making it one of a four-pronged research approach. IDA credit during the 1970s was granted for high-yielding variety programs on Government estates, complemented later by some assistance to private estates. Loans and grants from the World Bank were extended to smallholders and to the 'nucleus estate' scheme or NES (see 3.10.2) which covered rubber and other cash crops. A further project involving smallholder rubber was commenced in 1981 with the establishment of a scheme for the rehabilitation and extension of export crops (PRPTE) which covered rubber and other crops like coffee.

In reviewing these Government initiatives Barlow and Muharminto (1982) believe that the special schemes to assist the smallholder monopolise the comparatively small number of extension workers, leaving them no time to assist farmers outside the schemes. They consider that their 'dispersal' approach would be able to dispense the benefits of new technology much more widely and in part supplement the existing schemes.

3.3.2 Estate rubber

Some 30% of rubber is produced by estates and the 1973 Census of Plantation Rubber showed nearly half were on Java, 44% on Sumatra and the remaining 8% on other islands (mainly Kalimantan). Montgomery (1978) in analysising the data noted the 44% increase in yields between 1963 and 1973 for estate rubber. He proposed various possible explanations for the productivity increase including:

(a) accelerated change in certain provinces;

(b) clonal variety, cultural methods, tapping methods and frequency of tapping;

(c) replanting, new planting and changes in the age structure; and

(d) more widespread use of stimulants (Etherel) and chemical fertilisers.

Montgomery's investigations confirmed three of these factors as possible sources of growth — replanting, increased use of fertiliser and pesticide and use of stimulants. Apart from replanting and consequent alteration in the age structure of trees, the increase in fertiliser use was judged to be the most striking change. Between 1963 and 1973 usage of fertiliser increased from 10 860 tonnes to 50 000 tonnes (with the rise in Sumatra being over 600%), while pesticide use was also extremely high, involving a multiplicity of types. Use of stimulants (to inhibit the

coagulation of latex veins once opened for tapping) is recommended only on adult trees over 15 years old, but appears to be used inappropriately on young trees, inviting damage during their later production years.

The yields on estates continued to grow during the 1970s with Government estates averaging 725 kg (per planted ha) in 1977, foreign estates 753 kg and private Indonesian estates 291 kg (Baharsyah and Hadiwigeno 1982, p. 87). This compares with a smallholder (outside of special projects) average of 290 kg. The technology differences between the estates and smallholders are multifaceted. Estate use of high-yielding varieties of plants responsive to fertiliser is further enhanced by careful monitoring of the age structure of trees. Smallholders use virtually no fertiliser or pesticide, few weed their trees, and the price structure they face is quite different from the estate sector, with the latter's access to capital, research and technology, marketing and transport advantages (Montgomery 1978, p. 81). Whether the policy changes already initiated by the new schemes will assist smallholders to upgrade, as is the avowed intention, remains to be seen.

During the 1970s export earnings from rubber increased as a result of increased prices rather than output, but the low prices of the 1980s produced a substantial fall in production in 1982 (Table 3.1), attributed to the smallholder sector. The recovery of prices in 1983 and 1984 brought 1984 exports to a peak of US$45 million (Table 3.2) before a further price slump reduced export earnings by nearly US$5 million. Prices recovered during 1986, and remained at about the same level in 1987 until unexpected bad weather in South-east Asian countries resulted in a large price increase in the first half of 1988. Stocks, built up during the life of the first International Natural Rubber Agreement (INRA I) which expired in October 1987, were rapidly depleted. It appears, however, that Indonesia may not have benefited to the fullest extent during the 1988 price increase, as the bulk of its exports do not pass through established markets, being sold directly to consumers in private deals. This apparently prevents exporters obtaining full market value (EIU 1988a, p. 23). To reduce this perceived disadvantage Indonesia decided to undertake a new regional policy initiative. This involved calling a meeting in March 1988 with Malaysia, Singapore and Thailand to put forward a set of proposals for establishing a coordinated marketing strategy(EIU 1988a, pp. 23–4). While this initiative has yet to yield results, there is some indication of progress toward standardising rubber futures trading contracts between Indonesia and Singapore (EIU 1988b, p. 22).

In another policy move the Government announced plans to ban the export of one particular grade of rubber, Standard Indonesia Rubber (SIR) 50, from 1 January 1989. This was aimed at ensuring adequate supplies for the domestic rubber-products industry which is presently expanding very rapidly (EIU 1988b, p. 22). Meanwhile, in a reaction to the price increases in the early part of 1988, prices fell again in October .

The price of the main export grade of rubber, SIR 20, fell by 50% during the year July 1988 to July 1989. Despite the renegotiation of a new rubber agreement, INRA II (which began on 29 December 1988), the virtual depletion of the buffer stock, and consequent hopes for stability in the world market, the Indonesian industry has suffered a further setback. The falling rubber price, which has continued into early 1990, has been exacerbated by rising producer costs. These costs are attributable largely to increased electricity charges, VAT charges on related services, and higher interest rates on export credit, the result of a reduction in the previous rate of subsidy (EIU 1989b, pp. 24–5). Fears are expressed that this squeeze on profitability may result in a large number of the crumb rubber factories closing (there are an estimated 90 at present), with consequent implications for exports and employment. Perhaps more importantly, the downturn in profitability and pessimistic outlook might induce smallholders to decrease tapping and turn to other activities. This, in turn, would reduce prospects for achieving the targeted production level of 1.5 million tonnes by the end of Repelita V. Production has grown annually at around 3% during 1981 to 1988, and Repelita V has set a target growth rate of production from 1988 to 1993 of 5.4% per annum, although area growth is scheduled at only 0.5% per annum (ROI 1988, Tables IV.D.4 and IV.D.5).

3.4 Coffee

The coffee industry dates back well over 200 years in Indonesian history and, as is the usual case with export cash crops, its story is one of fluctuating fortunes. A shift of coffee tree variety was made in the early part of this century when Robusta supplanted the disease-prone Arabica, which is still cultivated in a few higher altitude areas, although it constitutes only about 5% of exports. Some 95% of total production is now from smallholders, mainly on the outer islands where production still continues to expand, with Sumatra accounting for around two-thirds of production. Java has only about 10 to 12% of smallholder coffee, but accounts for most of the (small) estate sector whose importance declined, as a result of price falls during the Depression years. The estate sector has been slow to recover in importance despite the Government's change of emphasis on foreign investment.

During the 1970s production grew steadily at around 8% per annum (McStocker 1987) and during the 1981–88 period has continued to grow at around 3% annually. Repelita V has projected a growth rate of 2.8% per annum to 1993 (ROI 1988, Table IV.D.4). Coffee makes few demands on the smallholder (except during the harvesting season it is often grown in an intercrop system, does reasonably well with minimum care, and is thus considered by many farmers as an ideal 'speculative' crop when it is not the primary source of income. However, this method of production, in addition to the haphazard methods of harvesting (unripe

berries, inefficient bean separation from shell and unclean drying) results in coffee beans of poor quality (Baharsyah and Hadiwigeno 1982, p. 159). McStocker (1987, p. 49) presents conflicting evidence regarding yields, so that there is no firm indication that estate production is superior to smallholder cultivation where coffee is concerned. However, estates do use a more capital-intensive method of post-harvest bean technology, resulting in the production of a superior-quality dry bean.

An increase in coffee prices in 1975 was short-lived, but showed the potential of the crop as it pushed coffee into third place in export ranking, after oil/gas and timber. Prices fell again in 1981 and 1982 After a peak of US$655 million in 1979–80, the value of exports decreased during 1983–85. A new peak was reached for both volume and value in 1986 (Table 3.2), following the Brazilian crop failure of that year and a consequent increase in world prices. Despite a continued increase in production (Table 3.1) and stability in the volume of exports, the value of exports has fallen during 1987 and 1988. Prices fell again in 1989 after the suspension of quotas, and exports for that year are expected to decline in value by about one-fifth (Schwarz 1989b, p. 44).

Part of the difficulties experienced by the Indonesian coffee industry during the recent past have revolved around its participation in the International Coffee Organization (ICO), responsible for the implementation of the International Coffee Agreement (ICA). The ICO, whose membership included all major producers and consumers, has allocated world export quotas among member countries in an attempt to keep a moving-average indicator price for coffee within the bounds of a set range (e.g. from 1980 to early 1989 this range was US$1.20–1.40/lb). Member country quotas were set, by negotiation, for export sales within the ICO membership. Those countries who were not members of ICO, largely the Soviet Union and its satellites (McStocker 1987, pp. 44–5), purchased coffee on the so-called non-quota market. In Indonesia's case the quota market allocation was 5.19% in 1987–88 (slightly up from 4.75% previously), but a quota which accounted for only about 54% of domestic production, and which Indonesia believed did not reflect her status as the world's third largest coffee producer (EIU 1989b, p. 24). Indonesia attempted to recoup her losses on the quota market by sales on the non-quota market (to which she was a leading exporter), although from time to time the ICO also imposed restrictions on non-quota sales. Moreover, the non-quota sales were more often than not undertaken at a discount.

Although two separate rounds of talks failed by mid-1989 to renegotiate a new coffee agreement and in July 1989 the ICO export quotas were suspended for two years, it is unlikely that a deregulated international market will, in the space of two years, prove to be the answer to domestic coffee industry problems. The major problems for the industry involve the quality of production, previously mentioned, and the predominance of the Robusta variety in local production. There

has been a shift in world demand from the Robusta variety to the milder Arabica, reflected in 1988 in unprecedently wide price differentials between the two varieties (EIU 1988c, p. 21), which the ICO attempted to reduce with selective quota increases for the Arabica variety. In a recent response to these problems the Government has announced plans for upgrading of bean quality, together with encouragement of higher-altitude growers to replant with Arabica (EIU 1989b, p. 24). There is hope in Indonesia that the deregulated international market will force rationalisation on the world industry, and that Indonesia's lowcost production profile will help her to withstand any long-run associated problems. Nevertheless, there are predictions of short-term costs to this strategy, especially as export constraints in the form of a new agreement in September 1991 are probably inevitable, and a larger quota share is by no means assured.

The USA imported the largest share of the Indonesian crop until 1986 when Japan took the number one position in the trade for 1987 and 1988. In the light of the 1986 record export figure, McStocker (1987) argued that Indonesia should embark upon a production push for coffee since he believes that, despite 25 years of fluctuations in real coffee prices, the world price will remain high enough to offer favourable returns into the foreseeable future. He believes also that yields and quality could be improved, and that the low opportunity cost of coffee grown on surplus land (particularly by migrants to transmigration areas) makes coffee a cheap source of foreign exchange.

3.5 Tea

Tea plants were introduced to Indonesia in the 1820s and both estate and smallholder production were well established by the beginning of the 1900s. The depression of the 1930s brought the usual price decline problems, while the war years devastated whole areas and many trees were uprooted to plant food crops. Unlike most other commercial crops, including tree crops, the tea bush matures at around ten years, but its reproductive life with pruning 'can be well in excess of one hundred years' (Etherington 1974, p. 84).

In 1957 the Dutch plantations were nationalised and became Government estates known as PNP or PTP (the distinction depending on corporate structure and accountability). The breakdown of tea production between estates (public and private) and smallholders has changed significantly over the period of the New Order Government. In 1964 State-owned plantations accounted for 30% of area and 47% of production, while between 1964 and 1979 smallholder and private estate areas planted fell, as did their contribution to total production (Baharsyah and Hadiwigeno 1982, p. 173). By 1984 smallholders contributed only 21% of production and their yields were only about half that obtained on State plantations (although private plantation yields were even lower).

World tea prices have been dropping steadily over the years as world output has exceeded demand, with a consequent stock build-up. India and Sri Lanka dominate the market with more than a 50% share. Indonesia's best export year, 1984, resulted when world prices increased following a reduction in Indian tea exports. The USA and Pakistan are the major export markets for Indonesian tea. Tea produced for export is of the black variety, which is quite different from the green and scented varieties preferred by the domestic market, so that excess export production cannot be sold on domestic markets when world prices fall. State-owned plantations grow black tea for export, while smallholders and private estates produce green and scented tea for a domestic market where demand is not strong. This particular constraint must receive close consideration if further expansion of the tea industry is contemplated. Etherington (1974) argued that, given the world tea situation as well as the dictates of domestic demand, any tea industry expansion might indeed be questioned. However, he pointed to the labour-intensive nature of the crop (harvesting) and the implications of that fact, together with the potential for productivity increases on estates, as two factors which also needed consideration.

Meanwhile, despite the above constraints and despite world price fluctuations, production has continued to increase except in 1982 (Table 3.1) when drought and volcanic activity brought a temporary reduction. Following 1984 when export value almost doubled over the previous year's total, export value declined again in 1985, reaching a low in 1986, with a gradual improvement in value during 1987 and 1988 (Table 3.2), after a recovery in world prices. Export volume also recovered in 1987 and 1988 following a low in 1986. Repelita V projects a growth in area cultivated of tea of 2% per annum to 1993, while production is expected to grow at 4% per annum for the same period (ROI 1988, Tables IV.D.5 and IV.D.4), a production growth rate less than the 1981 to 1988 period of over 6% annually.

3.6 Palm oil

Palm oil is produced almost completely from estates with smallholder production being extremely small (1080 million tonnes in 1984 compared with 3.5 million tonnes), although there is now some encouragement under the Nucleus Estate System (see 3.10.2) to extend smallholder production. Indonesia is the world's second largest producer of palm oil after Malaysia, and most production is concentrated on Sumatra. As domestic demand for coconut oil grew during the 1970s and even exports redirected to domestic demand failed to fulfil needs, palm oil supply was increased to help fill the gap. In fact, domestic preference is for coconut oil and palm oil in the past has had to be blended with a certain amount of coconut oil or flavoured with a coconut oil taste to make it acceptable (Gwyer and Avontroodt 1974, p. 99). In addition,

palm oil needs to undergo a relatively expensive refining process to convert it to a liquid. A Government policy decision of 1979 ordered that 60% of palm oil production be allocated for domestic needs at a price below world market prices (Teken and Soewardi 1982, p. 93), and by 1981 Government regulation forced almost all the crop on to the domestic market (Arndt 1981). Exports remained restricted in 1983 in an effort to prevent domestic price rises (cooking oil is one of the nine basic commodities), and export opportunities were neglected.

Exports during the late 1970s reached over 400 000 tonnes before Government intervention, fell during the early years of the 1980s as a result of that intervention, and recovered significantly in volume between 1985 and 1988. However, prices have been volatile during this latter period, rising to US$740/t in March 1986 before rapidly falling within the month to US$235/t, thereafter reaching a low of US$190/t in August 1986. Indonesia (and Malaysia) contributed to the price volatility during 1985 and 1986. After increased coconut oil production allowed domestic vegetable oil demands to be met, export restrictions on palm oil were relaxed and large amounts were placed on a world market already suffering a glut of subsidised vegetable oils from USA and the EC. Prices increased again during 1987 and early 1988, partly the result of adverse weather (US drought conditions), but peaked mid-year, averaging US $437/t for 1988 (FAO 1989, Table 67).

The short- and medium-term prospects for palm oil have been uncertain, partially as a result of actions by other countries. Soybean growers in the US have advocated the rejection of 'tropical' oils on the basis of health hazards, and the EC, in 1987, attempted to levy a consumption tax on vegetable oils and fats, both domestically produced and imported. As the EC (and the Netherlands in particular) is the main export market for Indonesian palm oil, taking over two-thirds in 1985, and one-half in 1987, the defeat of this latter proposal was of particular importance.

Another factor which has influenced palm oil prospects has been the change in Government policy. World prices of palm oil and coconut oil began to diverge in 1985 and have continued to widen, so that by 1988 they averaged US$437/t and US$568/t, respectively (FAO 1989, Table 67). This led, in 1987, to a reversal of the policy of retaining coconut oil for the domestic market and exporting palm oil. In fact, both oils were being exported and domestic demand for cooking oil was met by an allocation of palm oil from domestic production, supplemented with lower-priced Malaysian palm oil imports during 1987 (EIU 1988b, p. 23). At the same time export restrictions for palm oil still applied, and the oil producers association (GAPKI) has lobbied for the abolition of these restrictions. They also sought the withdrawal of a 10% export tax on palm oil imposed on 1 January 1989, on the argument that it reduced export competitiveness in traditional markets (EIU 1989c, p. 25).

Despite these problems Government policy remains one of continued promotion of the industry, with particular emphasis being given to the setting-up of domestic refining capacity so that processed oil will eventually dominate over crude palm oil.

The growth rates of production of palm oil and palm kernel between 1981 and1988 were over 15% and 17% per annum, respectively, reflecting to a large extent the key role given to oil palm in the tree crop development strategy of the 1980s. Area planted of palm oil (estate and smallholder) rose from 270 000 ha in 1981 to 729 000 ha in 1987 (BPS 1985, 1988), or a rate of around 18% annually. Despite the difficulties resulting from international price instability and problems related to competition from vegetable oils, the Government has projected area planted to oil palm to continue to grow during Repelita V at 11.8% annually, and production to grow at 19.3% annually (ROI 1988, Tables IV.D.5 and IV.D.4).

3.7 Copra

In contrast to palm oil, copra is produced almost exclusively by smallholders, scattered over all islands. The traditional supply of edible oil to the Indonesian domestic market had been from locally-grown copra. In the early 1970s exports declined as domestic demand overtook supply, coinciding with a general world shortage of edible oils. By the late 1970s Indonesia was importing copra (or coconut oil) which had previously been an export crop (Teken and Soewardi, 1982, p. 92). Some replanting took place in 1975 in response to world demand and, in 1979, high-yielding hybrid seedlings became available. However, just as the trees were beginning to produce, the 1982 drought brought some damage to the stock. Production fell in 1982 and 1983 (Table 3.1) but recovered in 1985 when exports again became feasible. Despite the drought in 1987 Indonesia increased the volume of coconut oil exports and by 1988 exports were reported at 207 000 tonnes, second only to the Philippines in world trade (EIU 1989c, p. 25).

As noted in the previous section, there has been a reversal of Government policy which retained coconut oil for the domestic market and exported palm oil. Indeed, vegetable oil pricing policy was subject to a review which commenced on 1 July 1989, but further policy changes are so far unannounced. Higher world prices for coconut oil, partly resulting from reduced Philippines exports, have encouraged Indonesian exports. These exports are backed by expanded area under production (almost doubled between 1970 and 1987 to 3.2 million ha) and a renewed emphasis on research, replanting and use of hybrid stock. Repelita V projects an area growth of only 0.3% per annum although production is expected to grow at 5% per annum (ROI 1988, Tables IV.D.5 and IV.D.4).

3.8 Spices

Spice production is a major source of income for some smallholders, with cloves, black and white pepper, nutmeg and mace being among the more important crops. Indonesia dominates the world nutmeg market and is second to India in pepper exports. Cloves are grown purely for domestic consumption (used in locally-consumed *kretek* cigarettes) and for several years imports were necessary. Home production increased in 1982 to 32.4 million tonnes and continued this trend to 55.9 million tonnes in 1987 (BPS 1988). Clove production can, however, be considered somewhat hazardous as it is hindered by the existence of a disease known as 'Sumatra disease' (Gwyer and Avontroodt 1974 p. 61). Between 1968 and 1976 some 70% of clove trees in West Sumatra were destroyed by the disease and, although research has located the source, no control measures are as yet available (AARD Newsletter, 1986). Cloves are also the subject of a floor price scheme although it is seldom, if ever, called into play (Daroesman 1981, p. 24).

Pepper is producing improved cash returns for smallholders, as during the mid-1980s world prices increased after several depressed years. Between 1984 and 1988 the volume of exports of white and black pepper rose from 34 million kg to 35 million kg, while export receipts rose from US$64 million to US$150 million (BPS 1988). In 1988 pepper accounted for 67% of the total value of spice exports. However, during 1989 an infestation of the fungus phytophthora (foot rot) was reported from Bangka (EIU 1989c, p. 25). This island produces white pepper and accounts for over half of total pepper production. Phytophthora is the pepper plant's most serious disease, and it was thought (Vinning 1989, p. 61) that the Indonesian cultivars were resistant to the disease. So far the other major producing area, Lampung, appears to be free of the disease.

Repelita V projects a growth rate of 4.2% per annum for area under pepper production, with output scheduled to grow at 2.3% annually. Only 0.1% per annum area growth is envisaged for cloves, while production is expected to grow at 5.6% per annum. Projected nutmeg area growth during Repelita V is 0.3% per annum, with production growth at 0.5% per annum (ROI 1988, Tables IV.D.5 and IV.D.4). According to Vinning (1989), the prospects for nutmeg and mace are not encouraging. The cartel formed by Indonesia and Grenada to coordinate marketing and help stabilise prices was not functioning smoothly, possibly partly as a result of static world demand.

3.9 Tobacco

As with several of the other cash crops the story of tobacco goes back to the Indonesia of last century. The 1920s were the high peak of the tobacco industry which collapsed with the 1930s Depression and remained stagnant through the war years. In 1957 the Dutch plantations

were taken over and became public sector enterprises (referred to as PTP), but they constitute less than 10% of production with smallholders now dominating the industry. The early days of tobacco were concentrated upon the production of cigar tobacco, the famous 'Deli' of Sumatra and 'Na-oogst' of East Java, which were large export earners. Virginia tobacco is also grown, but in insufficient quantities as yet to meet the demand of domestic manufacturers, and imports continue. Some cigar-tobacco farmers have shifted to Virginia tobacco production to provide a more assured, but possibly lower, income. Only 15% of local tobacco production was exported in 1988 and the volume of exports fell between 1981 and 1988. Low international prices and increased domestic demand appears to have been responsible for the fall in export volume in the early 1980s, while the low points of 1984 and 1987 are most likely the result of rice and drought, respectively. Area planted also fell during 1984 and 1987. In 1988 both export volume and value fell to their lowest point of the decade.

Mackie (1985, p. 115) points to tobacco as one of the casualties of expanded rice production. It is possible that increased emphasis on soybean may also have played a part. Originally cigar tobacco was a short season crop (two months from planting to harvest) which complemented rice on *sawah*, but the advent of the also short growing season of high-yielding rice has resulted in some decline in the old comparative advantage of tobacco, especially with the assured price of rice under the floor price scheme. Even so, it would seem that the future prospects of cigar tobacco are clouded by the fairly static world market prospects. Virginia tobacco, once home consumption demands are met and imports wiped out, will face exactly the same world tobacco prospects, constrained by the growing health awareness and smoking restraints. Despite the evident export prospects (but possibly with an eye on import demand for Virginia tobacco), the Government continues with intensification programs to raise productivity, particularly of smallholders. The Federal Republic of Germany takes over half of Indonesia's tobacco exports, while the USA accounted for 13% in 1988. Repelita V projects growth in area and production at 3.6 and 7.8% per annum, respectively (ROI 1988, Tables IV.D.5 and IV.D.4).

3.10 Government Initiatives in the Cash Crop Sector

Government initiatives cover a range of programs for the cash crop sector. Where large State run plantations are concerned, direct intervention and assistance is fairly easy to implement. To develop the smallholder cash crop sector the Government has organised a series of programs, the foremost being the Nucleus Estate System (NES), which is supplemented by Smallholder Programs (since the NES is not large enough to cover all farmers). Where necessary further specific types of commodity programs may also be set up (e.g. cloves and coconut).

Research and extension is under the direction of the Ministry of Agriculture. There has been also an attempt to improve marketing, so that the smallholder receives at least 70% of the f.o.b. price of his product (Booth 1984). The abolition or reduction of many export taxes has helped this goal. However, as mentioned in Section 3.6, export taxes continue to be imposed (e.g. a 10% tax on palm oil from 1 January 1989).

3.10.1 Research and extension

The Directorate General of Estate Crops within the Ministry of Agriculture is responsible for the direction of policy within the cash crop sector, both smallholder and Government or private estates. The direct responsibility is greatest for the Government estates. Within the Ministry there exists an Agency for Agricultural Research and Development (AARD) which is responsible for all research, and it in turn directs the Central Research Institutes on coconuts, tobacco, fibres, spice and pepper (Baharsyah and Hadiwigeno 1982, p. 148). Extension work is undertaken by the Agency for Agricultural Education, Training and Extension (AAETE). Within the Ministry structure there is also the BIMAS Secretariat and two further directorates which oversee animal husbandry and fisheries. The latter two sub-sectors are dealt with in later sections of this chapter.

3.10.2 The Nucleus Estate System (NES)

The Government has declared NES 'to be the principal approach to develop smallholder commercial crop farming' (Baharsyah and Hadiwigeno, 1982, p. 173). This scheme commenced in 1977 to provide for the transfer of technology from the large estates (where yields had increased substantially) to smallholder farmers. The idea was for the large estates (the nucleus) to gather round them the surrounding farmers and provide an example of how higher yields could be achieved, provide processing facilities for smallholders, show how to improve product quality and assist farmers with marketing expertise, or even extend their own marketing facilities for use by smallholders. Booth (1984) classifies NES as a land development program, mainly for transmigrants, and Daroesman (1981) describes NES as essentially a program of regional development, although officially designated to assist the smallholder and improve export crops. Both descriptions are correct. Squatter farmers and shifting cultivators, especially those occupying land and having no formal ownership proof, are given first priority of participation. Where new land is opened up farmers are initially paid wages for three years until formal land title is given. Twenty-year credit is provided, since the full cost of clearing and planting/replanting (except overheads) is borne by the farmer. Transmigrants are settled under the same terms, and the NES is expected to operate in close liaison with transmigration schemes.

Daroesman says the main problem of NES is staffing of the existing large plantations (the nucleus) and their ability to cope with the extra demands made upon them by the NES scheme.

For some crops the nucleus estate is also expected to act as a contractor in extending areas under cultivation (e.g. rubber and sugar). The TRI sugar program (*Tebu Rakyat Intensifikasi*) is a special case of the NES program. Baharsyah and Hadiwigeno (1982) suggest the NES is most suitable for rubber and oil palm. Coffee has not been added to the list because inefficient pest control on the part of smallholders might imperil estate crops. They suspect there may also be problems arising between estate and smallholder coffee growers, because the two groups have different outlooks and expectations.

3.10.3 Smallholder and community programs

Where there are not enough nucleus estates established to provide examples for surrounding farmers, the special smallholder programs are meant to fill this niche and do a similar job. These are sometimes described as the smallholder cooperative programs or UPP. In some respects the programs are likened to the BIMAS approach for foodcrops, in that assistance is in the form of subsidised (longer-term) credit. Booth (1984) points to the inflexible nature of the credit package (a mistake of the original BIMAS). She also acknowledges the need for smallholder credit and considers that any subsidy element may be justified by the burden of export taxes imposed on this sector for many years. Although Bank Indonesia (the central bank) moved to cut subsidised credit in early 1990 (Schwarz 1990a, p. 56) certain categories including farmers were exempted. Lending for farmers was to continue at a rate of 16% as against a prime rate of 20%. Another type of scheme is the commodity program. In 1981 a scheme for the rehabilitation and extension of export crops (PRPTE) was set up to cover crops like rubber, coffee and coconuts. The program aims to provide high-yielding stocks of plants to farmers on their own land, with long-term investment credit and crop supervision until the plants reach bearing age.

3.10.4 Recent policy changes and the NES

The NES is the central peg of the Government strategy for smallholder development and the World Bank has financed seven NES projects in conjunction with the relevant State plantations. However, declining commodity prices (especially the 1986 palm oil price fall), has meant some State plantations have run into financial problems, especially those whose management has not been as efficient as it might have been. A further plank of Government policy is to interest foreign investors in the NES scheme, and to this end an initial 20% ownership share in estate crops and NES was set. However, this land ownership rate is considered

unprofitable from a strictly commercial viewpoint (Handley 1986) and little interest has been shown by private investors. Another factor mentioned by Hill (1984) for the apparent reluctance to invest is that the leasehold is only 35 years compared with 99 years in Malaysia, and investment in agro-business differs in several respects from investment in industry. There is still a 'colonial stigma' attached to large private land holdings (Hill 1984, p. 28). Despite this the May 6 Package of 1986 announced new measures to encourage foreign investment. There was an increase from 20 to 40% of the private share in the ownership of agricultural estate crops and NES projects (including aquaculture), in an endeavour to provide more realistic returns for investors in the agricultural sector (IDN 1987, pp. 66–7). However, Muir (1986, p. 22 footnote) argues that the May 6 Package, with respect to foreign investment is not, strictly speaking, a policy change at all, but rather a rescheduling and expansion of existing obligations and opportunities offered to foreign investors.

3.11 Livestock

Livestock products provide a small but increasing source of animal protein in the Indonesian diet. In addition, livestock provide a valuable source of manure for fertiliser, while certain types (e.g. buffalo) provide the main source of traction in agriculture. Lastly, but perhaps most importantly, livestock act as a cash reserve. Livestock production is almost completely in the hands of the smallholder sector and forms part of the background of many traditional farms. However, while cattle raising is a traditional part of the rural scene, it is important to note that cattle breeding is not (Leake 1980, p. 68). This fact places long-run constraints on the quality of cattle. Numbers of cattle and buffalo are reported to have decreased substantially between 1970 and 1976 (Leake 1980). Birowo and Sanusi (1982, p. 15) also maintain that the cattle population fell during the 1970s. However, opinions differ on this matter and data vary greatly. Kristanto (1982, Table 4) shows the cattle (*sapi*) population constant around the 6 million range all through the period 1967 to 1978. BPS data (*Statistik Indonesia* 1985, Table 5.4.1) shows 1983 figures at nearly 9 million; a possible but unlikely growth in five years after such static trends for 11 years. The BPS data in the 1988 edition of the same publication shows a cattle population of 9.7 million for 1986.

Bali cattle are indigenous to Java and Sumatra and have been interbred with Indian Zebu types as well as with many European breeds. However, even with regular infusions of new types (e.g. Brahman) the initial vigour of the cross-breeds has dwindled, and a continual breeding program will always be necessary if quality stock are to be produced. Dairy cattle, originally brought in during the Dutch era, also need continuous upgrading. Buffalo are prized for their ability to work in the swampy areas

of paddy fields, and have the additional advantage of being able to survive and reproduce on much poorer quality feed than normal cattle breeds.

Sheep and goats have always been part of the smallholder farm, and are, in fact, much more widespread across the sector than cattle and buffalo. They have the advantage of being adaptable to most environments, reproduction rates are higher than the larger ruminants, forage requirements are smaller and marketing is easier.

The poultry industry, unlike other subsectors of livestock, is regarded as performing well, averaging an 11% increase during Repelita II (1974–79), compared with 7% for Repelita I (Birowo and Sanusi 1982, p. 15). Progress during Repelita III and Repelita IV has also met expectations. Much of this progress has been by the growing commercial poultry farming sector whose demands for maize have at times outstripped domestic supply and necessitated imports. Although the maize income elasticity of demand for human consumption is generally regarded as negative, it is positive at 1.5 when used as an animal feed (Rosegrant et al. 1987, Table 5.12). The income (expenditure) elasticity of demand for poultry and eggs is high (1.50 as estimated by the ASEAN Study Team of 1980, Teken and Soewardi 1982). Other expenditure elasticities of the livestock sector are also high (e.g. 1.03 for pork, 1.50 for beef and 1.27 for all meat). Although 1976 data used for estimation of the figures are now dated and these estimates need revision, it nevertheless remains true that livestock protein will remain a luxury item for the vast majority of the population for some time to come.

3.11.1 Cows and buffalo

Cows and buffalo form part of the traditional smallholder farm in Indonesia. According to Leake (1980) over 25% of smallholdings report cattle or buffalo ownership, although these animals are usually limited to numbers of 1 to 3 and penned in small areas, at least on Java (where grazing is virtually impossible). Some ranch-type farming of cattle was commenced on the outer islands in the late 1960s (Kristanto 1982) by both State and private companies, but lack of managerial experience resulted in poor annual growth performance. Now there is a move to types of mini-ranches holding about 50 cattle on about 50 hectares.

Feeding of cattle and buffalo on smallholdings presents the most difficult problem. A range of products is used (e.g. natural grasses, leguminous straw, cassava chips, copra cake and other byproducts). Even so, the main feed needs are seldom met, and cattle are often in poor condition. Buffalo are used only at certain times for draught purposes and feeding is often kept at a level to just avoid death through starvation. Farmers do not perceive any benefit in caring for an occasionally-used asset. Animals are often fed and tended by children. With an increasing number of young children now entering school (after emphasis on

budget spending for education purposes), this fact may constrain the expansion of cattle numbers (Kristanto 1982). The additional problems posed by ignorance of breeding practices means that stock quality, as well as quantity, is jeopardised.

Leake (1980) maintains that smallholder cattle contribute little to the diet of the farm family since they are usually sold in times of need or drought, or at the end of useful life. Indeed, during Repelita III, production of meat from cattle fell by 0.9% per annum, although preliminary figures indicate that the trend was reversed to a 3.6% per annum increase for Repelita IV (ROI 1988, Table II.8). Cattle act, however, as the small farmer's store of wealth and are considered second to cash as the most liquid asset for South Sulawesi farmers (Kristanto 1982). There is a strong domestic preference for fresh lean beef, and cattle are normally marketed locally in rural areas. There is also some inter-island transport of cattle to provide for a large urban demand for meat which has resulted from growth in per capita income. On the export front the Singapore Government's policy of phasing out livestock farming has resulted in investment in Indonesia's livestock sector to fill this potential gap (EIU 1989d, p. 31).

3.11.2 Dairy cattle

Dairy cattle might be considered something of a special case in the Indonesian context since dairying in a hot humid climate presents many problems, and there is the tendency to restrict it to higher-altitude areas. Friesian cattle were introduced by the Dutch to provide milk for expatriate families. Most dairy cattle are found on Java, numbering some 207 200 in 1986 out of a total of 222 300 for Indonesia (BPS 1988, Table 5.4.1), but dairying generally is a small industry in comparison with the rest of the livestock sector.

Early Government initiatives in this sub-sector involved the encouragement of foreign investment in plants for the production of milk products from imported milk products and butter fat (Leake 1980). With imported milk products cheaper than domestic production, there was little incentive for local expansion. However, the Government decided on a policy of support for smallholder dairying (presumably the main reason being one of employment generation). Since 1979 there have been further policy changes which introduced an import quota tied to the level of local milk supplies, set at 8:1 in 1980, to decline to 1:1 by 1988 (Remenyi 1986, p. 61), together with minimum farm-gate prices and a levy on imported milk set at 25% *ad valorem*.

Repelita IV targets were set well above those achieved under previous plans and realised growth in milk production appears to have been 6.9% annually, with the Repelita V target set at 12.9% annually (ROI 1988, Tables II.1; III.2). Remenyi (1986) argued that achievement of Repelita IV targets was unattainable without major research, investment and

improvement in productivity. Remenyi believes that certain goals (cooperative development, nutrition, income generation and foreign exchange saving) are important factors, beyond strict economic considerations, which have been used to encourage the development of dairying in Indonesia. The main constraint on the improvement of dairy production levels is the same as applies to beef cattle, namely, the availability and quality of fodder. To this Remenyi adds the further constraints of marketing and poor reproduction rates. Marketing of fresh milk presents problems in Indonesia with widespread lack of refrigeration, lack of a consumer tradition of milk consumption, together with high costs of processing milk products putting milk beyond the means of low wage earners (without massive subsidies). The poor reproductive performance of both domestic and imported cows indicates the unsuitability of the animals to the local environment, and Remenyi believes that all-purpose animals (suitable for draught, milk and meat), utilising suitable fodder, might present smallholders with a more viable alternative. However, the vexed question of the economic rationale for dairying in a tropical country still remains.

3.11.3 Sheep, goats and poultry

Apart from pigs which numbered some 6.2 million in 1986 (BPS 1988, Table 5.4.1), the other most numerous types of livestock are poultry, goats and sheep in that order, with goats at 10.7 million being twice the population of sheep in 1986. Both pigs and chickens are farmed commercially but smallholders raising sheep and goats outnumber those keeping cattle (Knipscher, Boer, Sabrani and Soedjana 1983) and averaged about 19% of farming households in Indonesia in 1979, with 27% concentrated on Java. Of the total population of sheep and goats, 88% and 62%, respectively, were situated on Java in 1986 where landholdings tend to be small in size (averaging around 0.5 hectares or less). Given the size of these holdings the keeping of small ruminants makes sense in terms of ability to raise, feed and market the animals. Reproduction rates are also likely to be higher, at least for goats, given their known adaptability to a large environmental range.

Little research has been done on smallholder sheep and goats and the Knipscher et al. (1983) study on three areas of Java indicates the direction for future work. The reproduction rate of this sample was shown to be much less than their genetic potential (1.1 lambs/kids annually as against a potential 3), mortality rates were high for sheep grazing in lowland areas (parasite infections suspected) and breeding problems were evident (lack of stud management).

In the poultry sector, village chickens far outnumber both layers and broilers of commercial enterprises, being 105.7 million, 24.8 million and 10.9 million, respectively, in 1983 (BPS 1988, Table 5.4.2). However, Mink (1987, p. 170) notes that the size of the flock fluctuates

widely because of disease losses and celebratory slaughterings. Moreover, despite the contribution to meat and eggs made by the numbers involved, there are constraints on improvement (basic genetic stock, disease, quality of scavenged feed and high chick losses). Mink believes that while some grain may be used in feed, village chickens are more frequently fed household byproducts.

Commercial poultry enterprises tend to be small, the more so since a September 1981 edict restricted the size of poultry farms to 5000 hens (Arndt 1981, p. 5 fn. 3) or 750 boilers a week (Mink 1987, p. 167 fn.2). This restriction arose after complaints from small poultry farmers, hard pressed by large commercial producers. During the 1970s there had been substantial foreign investment in the domestic feedgrain industry and, when moves were made to restrict this industry to domestic investment, some of the foreign investors diversified into large-scale commercial poultry. However, the 1990 PAKMEI deregulation changes doubled the size of smallholder poultry farms and allowed foreign investment in this sector if more than 65% of production was exported (IDN 1990, p. 6).

Mink (1987, pp. 167–8) indicates that small scale, family-run enterprises dominate the industry, and there is a wide range of managerial skills, mostly clustered at the lower end of the scale. Improvement is limited by credit constraints, and productivity is lowered by problems with sanitation, water, disease and heat stress. Feed preparation tends to distinguish small and large producers, as the latter usually mix their own preparations, while the former lack knowhow, capital or scale of operation, and depend upon purchased feed.

Production of poultry meat and eggs during Repelita IV is preliminarily estimated to have achieved growth rates of 11.4% and 12% per annum, respectively. Projections for Repelita V are for a growth rate of production of poultry meat of 8.9% per annum and eggs 5.2% per annum (ROI 1988, Tables II.8 and IV.B.3). In March 1981 a floor price scheme for broilers and eggs was instituted (Daroesman 1981, p. 24), although it is seldom, if ever, called into play. The KUDs (cooperatives), as well as operating the floor price scheme, were also changed with the operation of BIMAS Ayam, the Government's credit scheme for poultry (Mink 1987, p. 168).

The only Government intervention in the goat/sheep sub-sector has been an animal distribution ('dropping') scheme, where animals are provided on credit to increase the size of the farmers' stock. However, as repayment conditions were vague and not then operational, and administration was haphazard, the results of the scheme were uncertain (Knipscher et al. 1983).

3.11.4 Problems and policies of the livestock sector

The one overriding factor which appears to face all of the livestock sector

is the general lack of suitable forage, poor quality of what little forage is available, and the consequent inadequate nourishment of much of the livestock. The possible exception is the stock able to graze on parts of rubber plantations where better forage is sometimes available. Added to this are the general problems of livestock disease control and the serious lack of qualified veterinarians and supporting staff. The upgrading of breeding and tackling of specific problems related to each sub-sector are no less important than the forage issue, but the latter needs first priority, and fortunately this has been recognised and research begun (some projects funded by ACIAR).

Policy initiatives in the livestock sector are based around broad measures to induce smallholders to increase their involvement with livestock population expansion. Two schemes operate for cattle, one called paron (like share cropping) and another called Sumba (based on the area of Sumba in East Nusa Tenggarra) whereby farmers either fatten cattle or engage in a breeding program, and share the proceeds of sale with the Government or private merchants (Leake 1980). With both schemes credit is provided by the Bank Rakyat Indonesia (BRI) under its small industry KIK credit program. Dairy policy includes import quotas and minimum farm-gate prices, but also distribution of imported cows to smallholders, artificial insemination programs and public investment in providing infrastructure to milk services. The only scheme so far for sheep and goats is restricted to 'dropping' of animals to farmers to help increase numbers, but the haphazard arrangement of the repayment phase of the operation, together with the ever-present forage constraints, may reduce the probability of success in the long run.

3.12 Forestry

Much of the outer islands are covered in stands of hardwood, mainly tropical rain forest, and timber was the major resource (other than oil) which attracted early foreign investment interest to Indonesia in the 1950s. In fact, some joint ventures for exploitation were arranged just prior to the New Order Government takeover. The initial new foreign investment post-1967 was by way of direct private investment or joint venture with private or State enterprise (Thalib 1967). Since 1984 no new foreign investment has been approved as a matter of policy, although existing concessions continue to be honoured.

By 1971 there was a huge expansion of both volume and value of timber production and timber was second only to rubber as an export earner. Manning (1971) pointed to the need to distinguish between the potential conflict of immediate gains, the long-run objective of developing the wood industries, and exploiting the resource in such a way as to generate future supplies. Policy at that time embraced three elements:
(a) reafforestation of areas of Java, Madura and East Indonesia;
(b) converting suitable-soil forest areas to agricultural land; and

(c) classifying the remainder into potential and productive forest (Manning 1971, p. 34).

In the early 1970s log exports to Japan were beginning to accelerate, but exploitation without provision for forest regeneration was evident as a particular constraint. By 1972 the choice of a policy of industrialisation of the timber industry was being discussed (Koehler 1972). Domestic processing for export (milling, veneer and plywood, pulp and paper manufacturing) was considered as an option, to be financed mostly by foreign investment. However, Koehler pointed to the need for the Government to consider its strategies so that investors were motivated towards processing plants. There was a tendency for investors to oppose policies for enhancing timber processing (and potential employment creation), while appropriating too much of the resource rent for themselves. In fact, Ruzicka (1979) argued that on the whole the Government probably failed to achieve full rent appropriation between 1972 and 1977.

In 1979 a Government decision was taken to progressively phase out the export of logs in favour of encouraging local timber production in Indonesia (concessionaires were required to build plywood/veneer factories). Export controls were to be tightened until total prohibition of log exports by 1985. There had been an increase in the production of logs as timber prices rose in 1978 while the gradual increase in sawn timber is evident in the 1980s (BPS 1988, Table 5.3.4). Both volume and value of plywood increased between 1981 and 1988 (BPS 1988, Tables 6.5.1; 6.5.2). Total exports of timber, however, reached a peak of US$1806 million in 1980 and it was 1987 before exports exceeded that level. Arndt (1981) argued that apart from the drastic effect on Japan and Korea (whose plywood industries were dependent on Indonesian logs), and the competition Indonesian exports were to meet within the region, there were serious doubts whether infrastructure, management and skilled labour constraints would permit the forced pace of development which was desired by the Government. The implementation of the new policy coincided with a decrease in world timber demand (Scherer 1982), and the Government's insistence on the construction of mills led to their operating, at the time, at only half capacity. In addition, the mills had difficulty meeting export standards, and the Government was committed to helping their financial viability by keeping domestic prices of logs below world prices.

It was 1988 before plywood exports exceeded the total earned from log exports in 1979. There is doubt that the short-term losses sustained will be outweighed by the medium-term gains, despite the fact that Indonesia has captured 70% of the worldwide market for plywood (Schwarz 1989a, p. 86). In 1986 the export of timber products from certain tree species was prohibited, while in 1988, exports of sawn timber valued at less than a specific amount were also stopped. On 1 January 1990 a new tax came into effect on sawn log exports, the aim

of which was to act as a ban (Schwarz 1990b, p. 56). The tax is expected to divert timber from exports to the domestic furniture-making and construction industries. Furniture production, accorded protection as an infant industry, is expected to contribute to the non-oil export effort.

In a move reminiscent of the export ban on logs, the Government on 1 January 1987 banned the export of raw rattan. This was followed on 1 July 1988 by a ban on exports of semi-processed rattan. From October 1988 there was also a ban on cane webbing (used by the furniture industry), which is made from rattan skins (Vatikiotis 1989, p. 50). Apart from the financial costs involved and the possible violation of GATT membership status with the use of non-tariff trade barriers, there is also concern that the policy is contrary to the spirit of deregulation espoused for other sectors of the economy. Moreover, the Chairman (Hasan) of the rattan producers' association (ASMINDO), is also Chairman of four other forestry-related associations, Plywood or Wood Panels (APKINDO), Loggers, Sawmillers and Furniture Industry, in addition to chairing the 'umbrella' organisation for all forestry-related associations. APKINDO 'acts as a virtual cartel determining export volumes and influencing prices', but in response to these initiatives the major US plywood market is moving to substitute lower-cost products (Schwarz 1989a, p. 86–8). The policy-making function appears to have been wrested from the Forestry Ministry, according to Schwarz, and Hasan wishes to impose a centralised APKINDO-style system on other forestry-based associations.

Hunter (1984) points out that although the Government is determined to promote the development of the forest industry, this policy may not lead to resource conservation. He advocates the establishment of exotic plantations as a measure to supplement the management of the existing natural forest. Growing world-wide hostility to indiscriminate tropical forest logging resulted, by the late 1980s, in the banning of total tree felling, and the initiation of some further reafforestation and regreening programs in Indonesia (EIU 1989d, p. 33). Additionally, research is continuing into other forest preservation measures including artificial propagation of tropical hardwoods, and another which involves tapping tropical hardwoods for resin (Goldstein 1989, p. 51). The resin, called *damar*, is used as a superior alternative to synthetic varnishes in the fine arts area. Exports of damar have risen from US$2.5 million in 1981 to US$14.4 million in 1988.

3.13 Fisheries

Fish constitute a small but important contribution to Indonesian dietary protein through the exploitation of inland as well as salt-water fish. The sector accounted for just under 2% of GDP in 1987. Although domestic volume of production of marine fish in 1984 to 1986 was treble that of inland fisheries, in value terms the difference was much smaller. On the

export side prawns (shrimps) have made a valuable contribution to agricultural exports (US$498.7 million in 1988), second only to coffee since 1985 in value terms. The volume of exports has also been rising steadily during the period 1981 to 1988. Japan is the key market taking 77% of exports in value terms during 1988. Fish exports (tuna and skipjack) reached US$98 million in 1988, with Japan again the major market.

The development of the fisheries sub-sector has been relatively slow. During the 1970s there was some capital investment in the salted fish industry, and research into types of fish processing and marketing was undertaken (Baharsyah and Hadiwigeno 1982). Fishermen in East Nusa Tenggara were reported behind their fellow fishermen of Java, Kalimantan and Sumatra in terms of development with their use of hundred-year-old boats without motors. However, at that time there were simply no businesses selling engines for them to buy (Makaliwe and Partadireja 1974). Although close to good fishing waters the consumption of fish on East Nusa Tenggara was estimated in 1974 at less than half the Indonesian per capita consumption of about 10 kg per year. Part of the explanation might lie in the lack of salted fish which, while being used in other parts of Indonesia, was considered too expensive in this province. Moreover, there are regional preferences for varieties of fish. Food Balance Sheet data for 1986 indicate that per capita availability of both inland and marine fish for that year was 11.47 kg.

In addition to the problems of perishability and marketing constraints, 'fish is not a staple food' (Krisnandhi 1969, p. 51) and the expenditure (income) elasticity of demand for fish is quite high. An estimate by the ASEAN Study Team in 1980 was 1.06 (Teken and Soewardi 1982). It is thought that there exists a much greater potential for improving consumption of protein through fish than through the relatively more expensive animal protein.

Rehabilitation of harbours and improvement of processing facilities were used as a basis for inviting domestic and foreign investment in modern fishing production. The small-scale local fishermen have continued their traditional operations, but the use of motors has enabled more extensive and distant fishing grounds to be exploited, with the aid of some foreign fishing under licence. Inland fishing is pursued in open water, but also in fresh water and brackish ponds, in paddy fields and cages.

Despite the export growth of prawns, other fish exports were relatively static during most of the 1980s. (1988 was a good year, when exports almost doubled.) It appears that the marine fishing industry as a whole has been subject to fairly slow growth considering the industry's possible potential. However, this potential is less easy to realise than, for example, forestry and minerals. The reason appears to be the Government's prohibition on trawlers in an effort to protect traditional small fishermen, as well as a desire to conserve resources.

Collier considers that Indonesian policy-makers are faced with a dilemma in trying to expand fishing to improve nutrition, increase shrimp exports and modernise the fishing fleet. 'Their dilemma is, that to accomplish these three goals, the impact on the traditional fishing industry may cause social problems' (Collier 1981, p. 283). The final conflict is once again between goals of growth and equity.

3.14 Concluding Remarks

Booth and Sundrum (1981, p. 193) provide data to suggest that the income terms of trade for cash crop farmers (rubber, tea, sugar) declined in comparison with rice and *palawija* farmers between 1971 and 1977. In fact, the terms of trade of *palawija* producers (except of soybean) rose more rapidly than of rice farmers. Most of the improvement in the income terms of trade is attributed to prices rising more rapidly than living costs. Further data show production rising more slowly than price for all crops, although smallholder tea, rubber and sugar grew less rapidly than similar estate crops from 1966 to 1976. Only coffee and tobacco production (smallholder and estate) grew at a similar (if slow) rate. Booth and Sundrum feel that cash crop smallholders were 'relatively more disadvantaged during the seventies compared to other sectors of the agricultural economy' (1981, p. 194).

McCawley (1985) pointed out that despite improvements in technology there was little in the way of cash crop output growth showing up in the early 1980s and only modest growth continues for the smallholder cash crops with the exception of spices. The estate sector of palm oil, palm kernel and, to a lesser extent, tea show higher growth rates for the 1980s, but remain vulnerable to movements in international commodity markets.

Commodity analysis earlier in this chapter has shown that each cash crop faces particular restraining factors on either production, export or both. Although there is some use of high-yielding stock and increased awareness of fertiliser (mainly by estates), there is nowhere near the emphasis on, and usage of, new technology that is now common in rice cultivation. Smallholder yields tend to be lower than estates, extension services are stretched to the limit or non-existent, credit facilities may be poor or unavailable outside special schemes, quality control is ignored outside the estates, and marketing and access to markets is difficult. The Government made an effort during the 1980s to give more attention to the cash crops through various schemes, especially nucleus estates and specialised smallholder schemes. However, Booth (1988, p. 237) argues that 'it has been virtually impossible to implement effective policies to assist small-scale export producers, and this remains a major challenge for agricultural planners'. The first moves towards some deregulation in the agricultural sector have been made in the 1990 PAKMEI initiatives. These have attempted to simplify some of the licensing procedures in the

poultry, cattle and fishing sub-sectors, and remove export controls on coffee, sandalwood, nutmeg and mace (IDN 1990, p. 6).

The livestock sector is unlikely to make significant progress until the forage situation is investigated and improved. Programs of upgrading for both beef and dairy cattle are underway and advice is being sought on all aspects of cattle, sheep, goats and poultry (including overseas advice). However, real progress may await further intensified programs which coordinate all the aspects of livestock management (e.g. breeding stock, forage, disease control and marketing).

Timber products have been a large export earner over the years and, although the plywood and veneer industry have just managed to replace the lost revenue from log exports, debate remains about the policy methods chosen to promote the development of the timber industry. Exploitation and appropriate reafforestation policies will be needed if this sector is to continue its contribution well into the future.

Fisheries are providing a small, but growing, contribution to dietary protein and, in addition, one part of the industry (prawns) is contributing strongly to agricultural exports. Provision for future exploitation of this resource, together with appropriate conservation, should ensure that this sector continues to provide for both domestic and export needs. Careful policy coordination will need to be devised to overcome the problems of potential conflict between traditional and modern fishing methods.

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Table 3.1. Indonesia: production of selected cash crops, smallholder and estate, 1981–88 ('000 t).

Crops	1981	1982	1983	1984	1985	1986	1987	1988[a]
Large Estate[b]								
Palm oil	752	834	891	1 080	1 159	1 260	1 477	2 018
Palm kernel	133	149	157	230	238	265	287	416
Tea	85	74	89	102	105	136	135	144
Smallholder[c]								
Rubber	943	586	674	715	734	1 040	1 141	1 187
Coconut	1 765	1 587	1 590	1 738	1 895	2 091	2 001	2 047
Coffee	314	262	287	303	292	339	358	394
Tobacco	110	97	100	83	153	164	115	123
Spice[d]	69	72	86	86	83	94	105	102

[a] Preliminary figures for 1988.
[b] Predominantly estate crops, but figures given are for estate and smallholder combined.
[c] Predominantly smallholder crops, but figures given are for smallholder and estate combined.
[d] Cloves and pepper.

Sources: 1981–85, BPS Statistik Indonesia 1985, 1987, 1988.
1986–88, EUI (1989a) Country Report Indonesia p. 24.

Table 3.2. Indonesia: agricultural exports, 1983–88, volume ('000 t).

	1983	1984	1985	1986	1987	1988
Coffee	241.2	294.5	282.7	298.1	286.2	298.7
Tea	68.6	85.6	90.1	79.0	90.5	92.8
Prawns	26.1	28.0	30.8	36.0	43.9	56.2
Logs	2 747.4	1 573.0	141.3	116.3	99.0	19.5
Spices	79.4	71.2	63.5	75.4	78.6	97.2
Rubber latex	39.1	39.4	38.0	45.9	46.5	51.9
Tobacco	23.4	19.3	20.2	23.1	18.7	18.2
Cassava	257.0	385.3	543.3	424.6	783.1	583.8
Rattan[a]	81.2	89.8	82.8	104.5	(130.3)[a]	(56.5)[a]
Fruit and vegetables	56.6	75.7	80.3	69.5	79.9	127.6
Other	107.5	215.8	492.8	285.9	286.3	274.3
Total	3 727.5	2 877.6	1 865.3	1 558.3	1 812.7	1 620.2

Value (US$ m)

	1983	1984	1985	1986	1987	1988
Coffee	427.3	565.2	556.2	818.4	535.4	549.5
Tea	120.4	226.2	149.1	99.1	118.9	125.2
Prawns	193.9	195.5	202.3	284.7	351.9	498.7
Logs	290.7	172.4	8.9	2.1	1.7	0.5
Spices	93.8	111.8	125.9	209.0	239.5	221.8
Rubber latex	44.4	45.0	35.1	42.9	53.6	77.6
Tobacco	40.5	32.9	43.1	62.5	57.4	42.7
Cassava	27.9	32.3	45.6	49.8	89.6	67.7
Rattan[a]	78.3	86.0	81.1	89.1	(151.8)[a]	(74.4)[a]
Fruit and vegetables	10.2	18.1	22.2	19.1	22.0	34.0
Other	45.4	47.5	118.2	77.4	195.9	291.4
Total	1 372.8	1 532.9	1 387.7	1 754.1	1 665.9	1 909.1

[a] Since January 1987 included in industrial products.

Source: BPS Indicator Ekonomi, September 1989.

4 The Status of Rice and the Secondary Food Crops

PART A: Rice

4.1 Introduction

Rice is the food staple of Indonesia. There is a distinct preference for rice in the food consumption pattern and this has been strengthened by cultural influences. Furthermore, rice plays a key role as a 'wage' good and, when this is reinforced by political overtones, it is not surprising that there is a long history of Government intervention in the rice economy.

Traditionally, rice was grown with, or followed by, one of the secondary crops (*palawija*) such as maize, cassava, tubers or legumes, although the cropping pattern varied considerably according to soil, region and climate. Some 95% of the rice crop is now *sawah* grown (i.e. 'wet' rice). This contrasts with 'dry' or upland rice (*padi ladang*) which is seeded directly into the ground and rain-fed. In the mid-1960s the proportion of *padi ladang* was around 14% . Yields of *ladang* have barely doubled since the 1960s while *sawah* yields have nearly trebled. In the early 1960s lowland cropping was one of *sawah* rice during the wet season followed by maize or legumes during the dry, unless rainfall/irrigation allowed a second rice crop. The upland cycle contended with less fertile soil and rice planted during the wet season usually had a cassava or legume intercrop. In particularly dry seasons or regions only *palawija* would form the intercropping pattern.

The introduction of the high-yielding varieties (HYV) in the late 1960s was confined to the volcanic lowland plains, as they required an assured water supply to facilitate expanded fertiliser uptake. New and renovated irrigation projects extended the potential rice area and, together with pesticides, credit and extension, resulted in expanded production through higher yields and double or triple cropping.

4.2 Early Government Intervention in the Rice Sector

Trade measures affecting rice date back some three centuries, but it was events following the Great Depression (farmers unable to pay taxes) which increased colonial Government intervention. Floor and ceiling price arrangements were attempted with varying degrees of success. Agencies set up to procure rice and operate market injection schemes on the Government's behalf were forerunners of the present agency, BULOG.

The immediate post-independence agency, BAMA, had the role of providing rice rations to the army, civil service and other Government employees (now the 'budget group'). This function remains a continuing responsibility of BULOG. The Kasimo Plan (1952) had the goal of rice self-sufficiency by 1956. Its methods of expanding production were based on the Dutch system of agricultural extension ('oil spot' or gradual spreading outwards of a demonstration effect). This approach was modified and perfected by the subsequent BIMAS intensification programs of the 1960s and later. The first BIMAS program was carried out as a pilot project by students from Bogor Agricultural University in the 1963–64 wet season. Initial results were excellent, but when the program was expanded the following year, the benefits of the original scheme were lost.

4.3 Progress During the Late 1960s

The New Order Government of 1966 set out to restore stability, turning its attention to rice in an effort to restrain inflation and maintain supply to the 'budget group'. The BIMAS program was modified when the credit repayment requirement was converted to cash instead of repayment in kind and, in 1967 a new scheme, INMAS, provided inputs for farmers keen to use them, but not in need of credit. A change in rice policy occurred in 1968 when previously consumer-oriented interests were tempered by concerns for producers. The Farmer's Formula (*rumus tani*) set the price of rice to the price of imported urea in a ratio of 1:1 in an effort to provide a production incentive. This was the first time price targets formed part of Government policy. In fact, quantity acquisition remained paramount at the time. In an effort to recapture the success of the first BIMAS programs a new program, GIMAS GOTONG ROYONG (mutual self-help), was commenced in 1968. The Central Bank paid for inputs and farmers were given no choice about participation. It was unsuccessful, and abandoned in May 1970 as a production and financial disaster. The decision-making function had been withdrawn from farmers and this caused resentment. In addition, the input repayment requirement (a one-sixth levy on production) resulted in extensive avoidance of repayment as farmers understated production.

4.4 Problems of the Early 1970s

A new program, PERFECTED BIMAS, immediately followed the abandonment of BIMAS G.R. It was based on an initiative by the State rural bank BRI (Bank Rakyat Indonesia). The bank had set up 'village units' to overcome problems of lending to small farmers. To operate the scheme and complement the credit element, the BRI established a village retailer of fertiliser (reducing late delivery) and a village warehouse (for rice storage while awaiting sale). The stored rice also served as a warranty

for further credit. This scheme envisaged the availability of increased numbers of extension workers (replacing the original BIMAS students). The major change of PERFECTED BIMAS involved allowing the private sector to sell fertiliser in the BIMAS market, originally the preserve of the State-owned company. With proclaimed floor and ceiling prices in operation and BULOG purchasing in accordance with a price target, the years 1970 and 1971 were successful in production terms.

4.5 The 1972 Rice Crisis

Changes in BULOG procurement, determined by delayed funds and stricter quality standards, resulted in low acquisitions in the first half of 1972. This was succeeded by a poor dry season crop following drought which swept across Asia. The Asian drought reduced the potential import supply from traditional regional exporters. Medium quality rice prices rose steadily during the second half of 1972, peaking in January 1973 at nearly twice the price of July 1972.

4.6 The 1973 (Cooperative) Failure

Government reaction to the 1972 crisis was a reform of domestic marketing and procurement arrangements by building up a nation-wide system of rural cooperatives (BUUDs). Unfortunately, the initiative was a 'top-down' solution. The BUUDs were expected to purchase paddy from farmers, process it in their own small mills (credit extended for establishment), and sell the milled rice to BULOG. The floor price was set below the existing market price and, despite various pressures (including military enforcement), farmers were reluctant to sell to the BUUDs. A floor price increase and bans on inter-provincial rice trade did little to change the situation, and procurement through the BUUDs was abandoned on 3 July 1973. Indeed, the domestic procurement target for 1973 was abolished completely. Fortuitously, the second half of 1973 coincided with the first oil price increase so that ample foreign exchange allowed import of over 1.8 million tonnes in 1973 and 1.1 million tonnes in 1974.

4.7 Repelita II and Major Policy Changes 1974

The Second Five Year Plan (Repelita II) was inaugurated on 1 April 1974 and, in November, major policy changes were announced. These involved: (a) a 50% increase in the fertiliser price; (b) an increase in the floor price of paddy together with an increase in the credit package for BIMAS crops (including *palawija*); and (c) BULOG's intention to purchase only dry *gabah* (threshed paddy), whilst not announcing a purchase price for milled rice. The result, if not the objective of the new policy, was to increase the influence of BULOG and the BUUDs at the

expense of the private rice market. During Repelita II most of the structure of modern rice policy was put in place but the implementation process was not one of smooth progress. Four issues were important: fertiliser; floor and ceiling prices; the emergence of *wereng* (the brown planthopper which destroys paddy in the stalk) and problems with BIMAS/INMAS. These issues each appear to have had considerable influence over changes during the 1970s.

4.7.1 Fertiliser

While fertiliser use had increased in the early part of the decade it was to level off by 1976, the result of price rises combined with a Government decision in 1973 to give the BUUDs sole distribution rights. Policy changes in 1976 included a price reduction and the entry of the private trade into a market free of Government control. Over the next three years consumption increased at a rate of 20% per annum.

4.7.2 Floor price

The floor price was in place by 1974 when it was changed from a cost-of-production concept to an incremental benefit/cost ratio based on the BIMAS package. While changes to the fertiliser price were announced at the beginning of the planting season (1 November), changes to the floor price operated from 1 February of the next year. Problems of implementation centred on failure of the BUUDs/KUDs to purchase paddy on BULOG's behalf (mainly the result of inadequate credit). There was also some confusion regarding the floor price concept and most farmers continued selling to middlemen. BULOG was importing large amounts of rice during the 1970s. Indonesia was the world's largest rice importer at this time, domestic procurement was comparatively small and most was obtained at regional level or above.

4.7.3 Ceiling price

Traditionally, the ceiling price was not announced until the second half of each calendar year as the lean months before the next main rice harvest approached. From 1973 there were two ceiling prices established, one being higher for deficit areas. By the early 1980s the Government ceased to announce the ceiling price. During the 1970s the floor price continued to be increased yearly, the exception being 1979, when a second rise was announced following quality imposition and consequent low procurement. At the same time, the Government attempted to hold ceiling prices down for urban consumers and contain inflationary pressure. The result was a narrowing band between the two prices, making it unprofitable for private stockholders and pushing the burden of stockholding to BULOG (necessitating a warehouse construction program).

4.7.4 Wereng problems

The *wereng* first became evident as a problem during 1975 on Bali and Java. Initially, the areas affected were difficult to estimate and this remains true to the present. Farmers were reluctant to report outbreaks, the control measures contributing to this reluctance. The new resistant varieties of that time were in short supply, and many farmers shifted back to traditional varieties which needed little fertiliser (large application of fertiliser appeared to be correlated with *wereng* damage).

4.7.5 Problems of BIMAS/INMAS

The BIMAS program was rapidly expanded in 1974 with a 50% increase in the number of farmers included (to some 3.5 million). By 1975, however, problems began to emerge as less credit-worthy farmers were included and *wereng* damage brought repayment problems. Some farmers were excluded, whilst the drought of 1976 and a drier 'dry' in 1977 contributed further problems. Between 1974 and 1975, there was also a distinct fall in farmer numbers under the INMAS scheme. It is thought that the inability of the BUUDs to support the floor price in 1974 influenced many farmers against joining BIMAS. Part of the problem appeared to result from village-level corruption (the pocketing of repayment money), and a further factor may have been the low interest rate, which tempted farmers to withhold repayment. Further changes in 1977 allowed INMAS farmers credit in kind for fertiliser and pesticide purchase, and a partial amnesty on bad debts was declared for the 1979–80 season. The BIMAS outlook remained uncertain and, in 1979, a further program, INSUS, was introduced. It was based on groups of farmers on contiguous plots acting together to make decisions on seeds, planting times and crop choices. The BIMAS credit package was phased out in 1984 when the KUPEDES market-oriented program was introduced.

4.8 The 1970s Experience

The basic price policy structure put in place during the first part of the 1970s suffered implementation problems as weather, fertiliser, *wereng*, BIMAS/INMAS participation rates and floor/ceiling price policy issues each contributed discordant elements. Between 1974 and 1977 production hovered around the 15 million tonnes mark, but in 1978 several factors combined to contribute to the 17 million tonnes figure. These were: favourable weather; increased fertiliser usage; and availability of IR36 and IR38 to solve *wereng* problems and allow second and third crops (a shortened growing period). In addition, BIMAS/INMAS problems were tackled and the floor/ceiling price scheme operated fairly satisfactorily (albeit at a narrow band level and with quality impositions in early 1979). The first oil price increase in 1974 had allowed an expanded budget to increase expenditure on infrastructure, health edu-

cation, industry and, not least, agriculture. For agriculture this implied easy finance in several categories (e.g. irrigation, fertiliser, pesticide, food and fuel subsidies; large and easy rice imports to sustain population and income growth; stock build-up; BULOG warehouse construction; rural road construction). The resources boom of the 1970s had resulted, however, in a loss of international competitiveness, as the terms of trade of tradeable goods declined relative to non-tradeable goods. It has been argued that the good 1978 harvest and a reduced inflation rate contributed to the Government's decision to devalue in late 1978. A second oil price rise in 1979 once again temporarily changed the economic outlook. While the 1979 harvest was a little disappointing (adverse weather and *wereng* resurgence), the scene was set for the improved production performance of the 1980s, culminating in the peak 1985 harvest.

4.9 Structure of the Rice Economy in the 1980s

The 1980s commenced with a favourable outlook. This resulted from major export increases (higher oil prices), a record balance of payments surplus, healthy foreign exchange reserves, a comparatively moderate inflation rate and a good rice harvest (over 20 million tonnes). This encouraging picture was not to continue for the overall economy following a series of oil price collapses. The rice sector, however, continued to perform particularly well through to 1985. Rice accounted for 6.4% of imports in 1980. As production increased imports dwindled to nil (except for glutinous rice not locally grown), and in 1985 and 1986 a small amount was exported, although at a subsidy.

4.10 Production in the 1980s

Overall there has been a steady increase in area harvested, yield and production of rice from the 1960s to the 1980s despite some trend variations. Area harvested on-Java fell somewhat in the 1960s with concomitant stagnation in yields, although BIMAS checked the decline by the end of the decade. Off-Java area harvested, yield and production all showed slow but overall improvement over the 1960s, so that the result for Indonesia as a whole was one of temporary stagnation rather than actual decline. There was a decline in area harvested on-Java between 1975 and 1977 as BIMAS ran into difficulties, although yields continued to rise. Credit for the production increase between 1980 and 1985 was shared almost equally between Java and the other islands. Yields continued to grow both on-Java and off-Java between 1980 and 1985, although the latter were slightly greater than the former.

Production increased steadily during 1980–85 from 20.2 to 26.5 million tonnes, although for the drought year of 1982 the increase was only half a million tonnes, to bring a total of 22.84 million tonnes. The fertiliser price was increased in November 1982 from Rp70 to Rp90/kg

(the first increase since 1976), but at the same time the floor price of *gabah* was increased from Rp135 to Rp145/kg. The fertiliser: rice price ratio remained more favourable to farmers than it had been in 1977, although slightly below the peak year of 1982. Production in 1983 was 24 million tonnes. The high rate of procurement and low rate of market injection brought a build-up of BULOG stocks to reach 2.7 million tonnes by mid-January 1985. In the 1985 season the floor price of *gabah* rose from Rp165 to Rp175/kg while the fertiliser price rose from Rp90 to Rp100/kg. The fertiliser price ratio was still favourable, although the floor price increase was only 6% while the fertiliser price increased by 11%.

Consequently, there was no shift out of rice for the 1985 season and with large stocks and low market injections, BULOG in early 1985 imposed qualitative restrictions. Farm-gate prices fell during the wet season harvest of 1985, but BULOG stocks continued to build to more than 3 million tonnes by September 1985. Poor quality rice, together with the lower level of world rice prices (following Indonesia's exit as the world's leading rice importer) did not allow BULOG the option of exporting without subsidies. A further warehouse construction program was instituted, plus hiring-in of private storage, and stock holding costs began to escalate. To deal with the problem a team of outside experts (the Falcon Team) was invited to asses the situation and offer advice. The Government accepted their advice to retain the existing floor price for 1986, and increased the price of pesticides. After the accelerated oil price decline of early 1986, the Government increased the price of fertiliser by 25% to Rp125/kg, slightly more than suggested. This attempt to dampen production incentives for 1986 brought the desired results as the increase was less than half a million tonnes. The production target for 1987 was 28.0 million tonnes, with a final figure of 27.3 million tonnes (the result of drought and renewed *wereng* attack), while production reached 28.3 million tonnes in 1988. A reported 7% increase brought 1989 production to 30.4 million tonnes.

4.11 Consumption in the 1980s

The Indonesian population in 1987 was estimated at 169.9 million, with a growth rate of 2.1% per annum. Population is projected to grow at this rate for the foreseeable future. At the same time there was slower growth in per capita income during the mid-1980s. However, stronger economic conditions in the late 1980s have improved income growth and this, together with population growth, indicate a demand for rice around the 2.5% per annum level at least into the 1990s.

Levels of Indonesian rice consumption are not known with any degree of precision as the two basic methods of calculation (food balance sheets and household expenditure surveys) yield substantially different results. The per capita availability of rice from the Food Balance Sheets show a

general upward trend, especially from 1977 to 1983. A slight downward movement in 1984 and 1985 possibly reflects higher stock levels as well as consumer satiation with poor quality rice. Household consumption surveys (SUSENAS) show an increase in annual per capita rice consumption between 1976 and 1980 (107 kg to 111 kg), but there was a decrease in 1984 to 107 kg. It has been argued that the reason for this decrease appears to be a decline in per capita rice consumption in the high expenditure classes (especially urban areas). This is consistent with more rice consumption outside the home (not recorded in SUSENAS data). SUSENAS data also show aggregate rural per capita rice consumption in 1980 and 1984 as exceeding that of urban areas, reversing the 1976 trend. However, per capita consumption off-Java exceeded that on-Java, unchanged from 1976.

Estimates of demand parameters for rice have been calculated for Indonesia from cross-sectional and time series data. The estimates of income (expenditure) elasticity of demand follow the expected declining trend over time as incomes increase. Timmer (1971) made an early (Jakarta-only) estimate of expenditure elasticity at between 0.25 and 0.35 and an all-Java 'best estimate' of 0.65. Estimates from 1976 SUSENAS data vary between 0.47 and 0.69 for all-Indonesia . An estimate by Mears (1981) using time series data was 0.319 for all Indonesia (years 1969–79). The latest estimates of expenditure elasticities are incorporated in three econometric models of the foodcrop sector (see Rosegrant et al. 1987, World Bank 1987, Tabor et al. 1988). These vary from 0.17 for rural areas to 0.26 for Java (0.29 off-Java) to 0.29 for all Indonesia. Timmer (1985) has postulated a figure of 0.20 for 1990, although other writers suggest figures around 0.10.

Most estimates of (own) price elasticity of demand for rice have been calculated from cross-section data. Estimates for the early 1960s by Jones were –0.28 (urban) and –0.49 (rural). Use of 1976 SUSENAS data provided estimates of around –0.63 and –0.84 for all-Indonesia. Mears (1981) considered the 1976 figures high and expected a figure closer to –0.40. Latest estimates from econometric models range through –0.25 (rural), –0.17 to –0.20 (Java) and –0.19 (off-Java).

Estimates of cross-price elasticities from statistical studies are generally considered to be poor. The traditional relationship between the three major staples (rice, maize and cassava) indicates that any increase in the price of rice would be likely to result in an increase in the consumption of maize and cassava (i.e. positive cross-price elasticities). The effect of an increase in the price of rice on the demand for the remaining *palawija* is more uncertain. There is a reasonable degree of unaminity of view on the small change in the demand for rice which price changes in *palawija* would bring.

4.12 Rice Prices

Because rice has always been an important (though slowly declining) component of the cost of living, every effort has been made to contain

rice prices as a means of limiting inflation. The average rate of increase of rice prices between 1968 and 1978 was 6% in Jakarta and 7.3% for Indonesia. At the same time the Cost of Living Index for Jakarta (excluding rice) rose at an annual rate of 15% . The Jakarta Real Rice Price Index declined by 35% from 100 in June 1970 to 65 in December 1978 (Mears 1981). Part of the decline was the result of productivity growth and part was lower costs of production. However, by including expensive rice varieties in the composition of a Rural Real Price Index, it is possible to show an income gain for farmers. Rice varieties differ in terms of taste, texture and price commanded, and knowledge of the varieties included in an index is necessary for judging real rice price changes.

The large rice import bill at the end of the 1970s seemed to indicate a need to provide greater farmer incentive. While farmgate prices rose relative to consumer prices during the 1970s, the rice:fertiliser price ratio continued to rise into the 1980s, from 1.01 in 1977 to a peak of 1.93 in 1982. This production incentive succeeded in helping to deliver the large harvests of the 1980s. At the same time BULOG's buying price for milled rice from the KUDs was becoming virtually the same as its release price to distributors. Thus, without an increase in the retail price BULOG was having to absorb the wholesale marketing margin in subsidy. As the large harvests of the 1980s came in BULOG stocks began to grow. Releases were small, and the growing stocks combined with lack of physical storage space and problems of managing large stocks to substantially increase the cost of the storage subsidy.

BULOG's reaction to growing stocks was to restrict acquisition to higher-quality grain, resulting in reports of falling farmgate prices for the 1985 wet-season harvest. Data on prices received by Javanese farmers tend to confirm the 1985 fall in farmgate prices. Yet Jakarta wholesale prices for rice have risen steadily during the 1980s and the Real Rice Price Index has risen in Jakarta by nearly 30% during 1980–88. (This contrasts with a decline in the same index of 35% between 1970–78 mentioned above.) However, the terms of trade for rice farmers declined after 1979, reached a lowpoint in 1985 and have shown only marginal improvement since then.

4.13 Marketing and Storage

The seasonal and geographic concentration of the rice harvest (monsoon and Java dominated respectively) emphasises the relative importance of marketing and storage. Traditionally, the west to east sweep of the north-west monsoon dictated the main harvest. The later south-east monsoon is important to certain areas and, combined with extended irrigation and increased HYV cropping, allows a year-round harvest. Yet, despite this partial smoothing out of seasonal variation, some 70% of the total rice harvest occurs during the three to four months of the main wet

season. Moreover, Java's predominance as the foodgrain producer necessitates adequate and timely transport to deficit areas. A further important fact is that the shorter growing span of HYV rice has meant harvesting taking place before the end of the wet season, increasing moisture uptake during harvesting and complicating drying. Added to this constraint is the large number of small marketings especially from Java.

No precise estimate is available of the marketed crop but Mears (1987) estimates annual marketings of 50% , double his 1950 estimate. Other studies have suggested 60 to 70% as the marketed surplus, and this may be correct for certain larger commercial farms in particular provinces during the main season. Part of the reason for increased marketings is the larger harvests, increasing cash needs of rural areas and perceived riskiness of storage. A further factor is probably farmer confidence in BULOG's ceiling price, as they sell more post-harvest and expect to buy later at comparatively reasonable prices. Of the marketed crop, BULOG procures quite a small proportion (3–5% during the 1970s, rising to 8–9% during the early 1980s). By the mid-1980s procurement fell as stocks increased. The private market is responsible for moving the bulk of the marketed crop. The role of the private market is quite diverse, varying between provinces and consisting of thousands of big and small traders operating at various levels. Private traders tend to purchase higher-quality rice above the floor price, or poor quality rice, with BULOG concentrating on the medium qualities. BULOG's narrowing band between the floor and ceiling price has crowded out the longer-term profitability of private storage.

The potential for the benefits of increased production to be outweighted by accompanying problems was clearly emphasised in 1985. The imposition of quality standards needed more guidance, and farmer awareness of proper post-harvest handling procedures was poor. Appropriate measures are now being instituted to cope with these problems. Farmers previously appeared unaware of quality deterioration resulting from piles of newly-harvested paddy left in fields for several days (involving heat build-up and yellowing of grain). The storage crisis of 1985 resulted in BULOG requesting villages to resurrect the traditional village rice barn, as well as increasing its own construction program. It became imperative to look to trained staff to implement techniques for maximum preservation of stocks combined with minimum deterioration of eating quality.

4.14 Research

Rice breeding began at Bogor in 1905 and six regional stations were established between 1926 and 1945. One of the breeding results was Peta, parent stock of the IRRI variety IR8, which helped to lead the rice revolution of the 1960s and 1970s. The International Rice Research Institute (IRRI) was set up in the Philippines in 1962, releasing the first

of its varieties in 1966, coinciding with the establishment of the New Order Government. There have been close links between IRRI and Indonesian rice institutes and, by the mid-1970s, around 50% of the rice area was planted to IRRI varieties. The variety IR36 helped overcome *wereng* problems during the late 1970s and its shorter growing period allowed multiple cropping, contributing to the production success of the 1980s. By 1985 it was estimated that over 60% of Indonesia's rice area was planted with IR36 or close relatives. Concern is now expressed that new biotypes of pests could devastate large areas if IR36 succumbed, so that continuous research must provide alternative varieties.

The research branch of the Ministry of Agriculture (AARD) oversees the work of six research institutes, coordinated by the Central Research Institute for Food Crops (CRIFC). Future research priorities include hybrid rice, quality improvement, pest and disease control, fertiliser efficiency and use of crop residues. Hybrid use demands good organisational capacity of the industry to multiply and distribute seed each season. Moveover, the growth span of some hybrids can be longer than the HYV types, although further research has been reducing this constraint. The large harvests of 1984 and 1985 emphasised the need to improve quality (given storage costs) together with drying and general post-harvest handling problems. The large budgetary costs of the fertiliser subsidy have been used as a reason to investigate fertiliser efficiency. It is thought that the subsidised price may have contributed to excessive use or inappropriate application of fertiliser.

Given the importance of research to the future of the agricultural sector, expenditure has been modest. The CRIFC budget for 1985–86 is only 4.7% of the overall budget allocation to agriculture and irrigation, or 0.3% of agricultural GDP (excluding forestry) for 1985. In addition, the bulk of the research remains devoted to rice, with few resources assigned to *palawija*.

4.15 Present Policies

The 1985 problems of the rice economy prompted BULOG to seek assistance from outside experts in assessing options. Answers to three basic questions were sought: (a) problems of large procurement and relatively small market sales (resulting in build-up and aging of stock for BULOG); (b) low prices for farmers in February–April 1985; and (c) stable retail prices (leading to problems for the private sector in storage, long-run farmer income and financial viability for BULOG).

The Falcon Team of experts made three main recommendations: (a) peak 'operational' stocks should be 1.5 million tonnes in addition to an 'iron' or buffer stock of 1.0 million tonnes, with the remaining surplus disposed of by immediate measures and reduced production growth (achieved by keeping the existing floor price and increasing the fertiliser price); (b) floor and fertiliser price policy should by used for two to three

years to reduce production incentives relative to alternative crops; and (c) a three-pronged funding mechanism for BULOG should be adopted, each prong corresponding to a stock level (with operating stocks financed in the normal manner from BRI credit and the buffer stock funded from the Budget). These recommendations were modified slightly by the government, in that while the stock figures were adopted, the buffer stock was purchased outright, maintenance and interest charges for 1986–87 were covered, and an intention was expressed to cover maintenance costs for the 'buffer stock' for the future. While the floor price was retained as suggested, pesticide prices were increased and, after some delay, the fertiliser price was increased to slightly more than originally recommended.

4.16 The Rice Economy in the Late 1980s

The Falcon Team suggestions resulted in a production growth of only 1.8% for 1986, allowing BULOG to dispose of excess stocks. There were fears, however, that farmers were showing too much sensitivity to price policy, and an increase in the floor price was announced for the 1987 season, with the existing fertiliser price retained. Anticipated drought was allowed for in the new program SUPRA-INSUS launched in February, 1987. Even so, *wereng* attack and drought resulted in actual production of 27.25 million tonnes, only 240 000 tonnes above 1986 figures. BULOG stocks were able to cope with demand and imports were unnecessary (glutinous rice excepted).

Following fairly modest subsidy figures for fertiliser during 1985–86 and 1986–87 of Rp477 billion and Rp467 billion, respectively, the realised figure for 1987–88 increased to Rp756 billion (exceeding the previous high of Rp732 billion in 1984–85). This resulted in the Government indicating a budget figure of only Rp250 billion for 1988–89, and shifting the remainder of the subsidy off-budget to be funded by bank credit, a system continued with the 1989–90 budget (subsidy reduced to Rp155 billion). The large increase in the fertiliser subsidy in 1987 may be accounted for by several factors, including possibly the lack of increase in the fertiliser price in that year, expanded fertiliser usage under the SUPRA-INSUS program and a partial return to triple cropping (banned earlier to assist *wereng* control).

More favourable weather allowed a production increase of 4% in the 1988 season to 28.34 million tonnes of rice. A 10.5% increase in the floor price appears to have sustained farmer incentive (despite an 8% increase in the fertiliser price). BULOG stocks of one million tonnes were reported after the wet season harvest, although these fell to only 300 000 tonnes by the end of 1988. A very favourable harvest of 30.4 million tonnes was reported for 1989 and mid-year stocks were estimated at 2.4 million tonnes, giving rise to a BULOG announcement of possible exports. However, low rainfall delayed the main season

planting in late 1989, so that the 1990 harvest was expected to be slightly below that of 1989.

4.17 Prospects for Foodcrop Diversification

The rice problems of 1985, the dramatic decline in the international price of oil in 1986 and a further devaluation provided policy makers with crucial decisions. The Government settled upon a restructuring of the economy, away from dependence on oil revenue to a more diversified export base. A series of 'packages' incorporating reform and deregulation of the trade and financial sectors has been undertaken, and future changes foreshadowed. However, as yet, the deregulation push has not impinged significantly upon the agriculture sector. Growth in GDP has recovered from a low point of 2.5% in 1985 to an estimated 7% in 1989, the result primarily of growth in non-oil exports.

While the rice sector has shown improved performance in 1988 and 1989 it must remain of some concern, given the problem of 'fine-tuning' production relative to domestic consumption and an allowance for reasonable stock levels. It appears that rice farmers are significantly influenced by price policy, possibly highly responsive to fertiliser prices directly, or to the rice/fertiliser price ratio. Thus, phasing out of subsidies as a first step towards greater economic efficiency in the agricultural sector may need to be more gradual than initially hoped.

At the same time, the attainment of self-sufficiency has brought some appreciation of the need to consider a more diversified food base. The *palawija* crops have been comparatively neglected. Yields are low by neighbour-country standards, and a large number of farmers are reliant solely upon *palawija* for income. Given that the income elasticity of demand for rice in Indonesia has declined over the past 20–30 years and will continue to do so, per capita rice consumption will peak and then decline as consumption diversifies into food with higher income elasticities (e.g. poultry). These foods, in turn, form part of the derived demand for the *palawija*, in addition to the *palawija's* contribution to basic food needs, nutritional diversity and additional protein. Even so, there are quite challenging problems to be overcome in pressing ahead with foodcrop diversification, while formulating policies which will lead to sustained growth in the rice sector, albeit at a lower level than in the previous decade, and also working within the confines of a substantially reduced budgetary framework.

PART B: Secondary Food Crops

4.18 Introduction

While rice is the preferred staple of the vast majority, *palawija* play an important role in the food sector. This role covers: (a) substituting for rice when price and seasonal variations make it expensive or scarce; (b) providing nutritional balance and variety; (c) providing feedgrain for livestock; and (d) providing cash income (and foreign exchange). The major crops listed as *palawija* are maize (corn), cassava, soybean, groundnuts (peanuts) and sweet potato. Mungbeans and sorghum are relatively minor, although a floor price scheme commenced for the former in 1979, and the latter tends to replace maize in dry areas, principally for feedgrain.

During the early 1900s *palawija* became important, contributing around half of the foodgrain production by the 1930s. The non-rice crops were grown on *sawah* (flooded rice land) during the dry season, or throughout the year on upland fields, usually, but not necessarily, in rotation with upland (or dry) rice. Some upland and dry areas were (and remain) monocropped according to soil and climate. The rice intensification schemes of the 1960s and later influenced both the pattern and harvested area of *palawija*. While foodgrain production in the rain-fed uplands was largely unaffected, the high-yielding varieties (HYV) program induced changes in rice production on the volcanic lowland plains.

The increased rice production was often achieved at the expense of the *palawija* crops, at least in the early years. There was some progress with improving maize yields towards the end of the 1970s, and BIMAS (production intensification) *palawija* programs existed from the early 1970s. Thus, non-rice crops were not ignored in Government planning (Repelita II stressed food rather than rice self-sufficiency), but BIMAS *palawija* were never afforded the same degree of resources and research effort as rice.

4.19 Palawija Research

Indonesia has had close links with the International Rice Research Institute (IRRI), and information on new strains has been quickly transferred and absorbed, but early links with dryland crop institutes were tenuous. At the beginning of the 1980s little work had been done on dryland soils, their response to fertilisers, genetic research or processing problems. There are indicators that this has changed. The CRIFC has strengthened ties with major international institutes. Furthermore, the United Nations in 1981 set up a centre for course grains, pulses, roots and tubers (CGPRT Centre) at Bogor, concentrating on problems of these crops in the Asia-Pacific area.

4.20 Consumer Preferences

Part of the neglect of *palawija* results from basic consumer attitudes, with maize and cassava considered inferior goods. There is a distinct preference for rice, and a shift to rice consumption is regarded as an indicator of increasing welfare and higher social status. A rice consumption pattern, where rice alone contributes about 90% of total carbohydrate calories, covers some 45% of the population. Two other main consumption patterns cover the remaining provinces in roughly equal proportions, a rice–maize–cassava pattern and a rice–cassava/sweet potato–maize pattern. There are minor pattern variations in some provinces and two (East Timor and Irian Jaya) are excluded in this broad classification. The estimated consumption in the predominant rice pattern area was 140.5 kg and 152.0 kg per capita in 1976 and 1980, respectively, compared with 116.19 kg and 130.7 kg per capita availability as calculated in the Food Balance Sheet for the same years.

4.21 Nutritional Considerations

While a rice diet is preferred, it is not necessarily superior, as rice is deficient in Vitamin A which is important for eyesight and skin. Yellow maize has a significant Vitamin A content and is higher in protein than rice. Fresh or dried cassava, low in protein, may be nutritionally superior to a rice diet if consumed with legumes and leafy green vegetables. Legumes also rank highly in terms of iron, essential in preventing anaemia deficiency. Polished rice provides only very small quantities of iron.

Nutritionally, increased consumption of *palawija* would be desirable, especially the protein-rich legumes, in addition to fruit and vegetables and other protein sources (e.g. fish and chicken). Some *palawija* (e.g. soybean and maize) serve a dual purpose in providing for direct human consumption and animal feed. While dietary needs are complex it seems clear that balanced agricultural production as well as nutritional education are important for adequate nutrition.

4.22 Monocrop Disadvantages

The rice intensification programs tended to push *sawah* farmers towards rice specialisation. A major disadvantage of rice monocrop culture became evident between 1975 and 1979 with the emergence of *wereng*. By 1978 the introduction of IR 36 controlled the problem and its concomitant early maturity allowed commencement of double and triple cropping. However, this latter attribute discouraged a two months break between crops to minimise the carryover effects of (possible) infestation. In 1982 a new biotype of *wereng* emerged in certain areas, but further resistant varieties were available. An IRRI-supported integrated system of biological control of *wereng* was introduced in 1986, to overcome a new outbreak. Virus diseases (e.g. tungro) cause production losses also if

variety rotation is not followed . The sucess of the rice program tended to limit interest in, and search for, alternative food crop strategies. Further, existing nutrition imbalances may have been exacerbated by crop specialisation. Drought and pests still have the potential intermittently to wreak havoc, while there is the distinct possibility that the HYV have reached (or soon will) the peak of their yield potential. The introduction of hybrid rice offers further potential gains in yields, but the costs are difficult to assess as yet.

4.23 Sugar Cane

Sugar cane is grown throughout Indonesia but Java is the climatically favoured area (East Java in particular). Before World War II Java was the second-largest world exporter, and sugar provided three-quarters of exports. Production dropped dramatically in the 1950s, but improved in the 1970s. Imports have continued into the 1980s despite an emphasis on self-sufficiency.

In 1975 a policy change shifted emphasis from 'estate' to 'smallholder' production (called TRI). Javanese farmers were no longer required to place land at the disposal of mills, and were given credit to produce cane on their land, with mills managing input supply, advising on techniques, cutting, transporting and milling the cane. The extensification aspect of TRI brought unirrigated land under cane, and from 1981–82 eight hectares of *sawah* under rice had to be included in the INSUS program for each hectare removed from rice to sugar. During 1970–84 area under sugar trebled while production doubled (a steady decline in yield and extraction ratio). BULOG controls imports and over the same period domestic prices doubled when world prices were falling. Although categorised as an estate crop, sugar needs to be taken into account when considering rice or *palawija*. Moreover, it has the potential to reduce employment opportunities.

There is substantial capital investment in mills and the industry dominates short-term finance to the agricultural sector (averaging 32% between 1985 and 1988). Resources devoted to sugar may be more productively diverted elsewhere, but the self-sufficiency question remains on the policy agenda.

4.24 Cropping Systems

The cropping pattern from lowlands to upland basically results from soil type and water availability. Rich volcanic lowland soils produce *sawah* rice with possibly some *palawija* if rainfall/irrigation is insufficient for further rice crops during the dry season. Upland areas have a complex cropping pattern, partly influenced by soil type but, more importantly, the timing, onset, and length of the wet season. Dependence on rainfall largely determines which crops are grown, where and when. Size of

holdings also influences cropping decisions and intensity, particularly on Java where average size is less than 0.5 hectares. There is less size constraint on the outer islands where cultivation can be extensive and pure stands of maize and cassava are more likely to be found.

Upland rice is normally given first priority at the beginning of the rainy season if the length of the season allows. In West Java, where rainfall is relatively assured, rice may be intercropped with maize, cassava, peanuts and soybeans. The pattern usually starts with rice and maize, followed by cassava. Later soybean and/or peanut replace the harvested rice. Where rainfall is less certain (e.g. Central and East Java), only maize, cassava and legumes may form the cropping pattern.

The ability to cover the land with crops year round improves soil fertility and provides a continuous supply of staple foods, partly avoiding production peaks, drying and storage problems. Current research stresses the place of high-yielding, early-maturing varieties, but these seem better adapted to monocropping, which needs less moisture than intercropping. Yet, while pure stands appear to give higher yields, they may be more susceptible to pests and diseases. Measurement of production and yield is more complicated in intercropping and figures may be biased in either direction. An advantage of intercropping is the potential nutrition benefits, as crop combinations compensate for individual crop deficiencies.

4.25 Regional Focus of Agricultural Production

Java contains some 40% of all cultivated agricultural land and produces the bulk of *palawija* crops. Of total production in 1988, Java produced between 60 and 68% of maize, cassava and peanuts, 58% of soybean and 45% of sweet potato. However, lack of suitable land for expansion on Java mostly results in switching between crops if area targets are set. The outer islands are relatively underpopulated, soils are less fertile and many areas are cropped under shifting cultivation. While irrigated rice land has been extended, comparatively little extra dry land cultivation has been initiated. Given the finite supply of fertile Javanese land, soil conservation needs in upland regions, and diminishing yield potential for HYV rice in *sawah* areas, outer-island lands must receive closer attention if food production is to keep pace with population and income growth. Transmigration targets are having some impact on this problem.

4.26 Price Trends

Between 1969 and 1980 it is estimated that the prices of both rice and *palawija* declined in real terms, the only exception being peanuts. However, if price trends of rice and *palawija* are compared, the latter increased faster than the former between 1971 and 1977, but the reverse is true from 1978 onwards (once again excepting peanuts). During 1986 average wholesale prices of mungbeans and soybean increased between

24 and 26%, maize and cassava were relatively stable, while peanuts declined by 3.5% . All six *palawija* crops showed increases in wholesale prices between 1986 and 1987, varying between 6 and 30%, but between 1987 and 1988 average wholesale prices increased significantly. Mungbean, cassava, peanut and sweet potato prices increased on average between 28 and 45% , although maize and soybean were in the 14 to 16% range. Regional *palawija* prices were largely unaffected by the rice crisis of 1985. Between June 1984 and June 1985 the index of the average price of rice for the three provinces of Java fell by between 8 and 11% , but *palawija* remained about the same (except for a 4% fall in East Java). Regional *palawija* prices continued to increase during 1986 to 1988, with the exception of Central Java where prices fell by 3.3% between June 1987 and June 1988.

4.27 External Trade

Indonesia has been a substantial exporter of dried cassava (*gaplek*) for livestock since 1975, and has been both an importer and exporter of maize during the 1970s and 1980s. Peanuts were exported intermittently during the 1970s, but imports began in 1975 and averaged 39 000 tonnes during 1982 to 1988. Soybeans have been imported since 1975, and between 1981 and 1989 averaged 364 000 tonnes annually (excluding soybean meal and processed products). Small mungbeans exports in the early 1970s turned to imports in the late 1970s and 1980s. These are around 2000 tonnes in most years, but intermittently higher.

With the exception of *gaplek* (subject to little Government restriction), *palawija* have been mainly imported, in varying quantities, and controlled through licensing procedures, and to an extent, import taxes. Exports have been relatively minor except for *gaplek*, and control has been exerted through licensing and export taxes. BULOG is the sole importer of soybean and soybean meal (through assigned agents) and has become, de facto, sole importer of maize since the early 1980s. The major influence on *palawija* trade has been the exchange rate policy pursued by the government. The exchange rate became overvalued following the 1974 oil price increases, discriminating against agricultural exports by rendering them uncompetitive. Licensing procedures offered some protection for domestically produced *palawija* against cheaper imports. The 1978 and 1983 devaluations temporarily brought domestic *palawija* prices closer to, or equal to, world prices. How long the benefits of the 1986 devaluation last are yet to be seen. Trade liberalisation since 1984 has been aimed mainly at the industrial sector and the *palawija* were not affected. However, the PAKMEI 1990 package indicated the beginning of some reform to export regulation of agriculture.

4.28 Maize

Maize (corn) is grown mainly, but not exclusively, as an upland crop under rain-fed conditions, as part of a monocrop or intercrop system. White and yellow maize are grown, the former for domestic human consumption and a small amount for the noodle industry. Yellow maize covers some 65% of producing areas, and is preferred by the poultry industry for its higher carotene level.

During the 1980s Java and Madura have accounted for between 66 and 74% of total production, with Sulawesi and East Nusa Tenggara accounting for a further 17 to 23%. Maize survives on relatively marginal soils and in uncertain climatic conditions, making it the principal crop of upland East Java. During the 1980s East Java accounted for some 42% of total production. Yield growth for Java has been marginally higher than for all-Indonesia. There are two distinct harvests, the main one being between December and March, two to three months before the main rice harvest. The main crop accounts for about 60% of production in East and Central Java, but between 75 and 93% in other areas.

4.28.1 Maize production

During the 1970s the area under maize remained fairly constant while production increased at a rate of nearly 3% annually as a result of rising yields. Although production grew between 1970 and 1986 at over 4% annually, there were some disappointing years (e.g. downy mildew in 1975 and 1976; 1979 was a wet year and there was a drought in 1982). Figures for 1985 show a reduction in area and production but not yield. Reasons are not clear but several factors may have contributed: (a) price support for rice makes it financially more attractive; (b) a longer wet season increases rice plantings; and (c) the harvesting date complicates production figures, as two crops can be recorded in one year.

The maize production system is extremely diverse. In addition to distinctions between *sawah* and upland, crop frequency and productivity vary. *Sawah* areas are reasonably uniform, but irrigated *sawah* (covering about 11% of planted area) is more productive than the rain-fed *sawah* (covering about 10%). The former may have one or two high-yield crops, the latter usually has two crops. The upland system divides between multiple and single cropland, covering about 55 and 24% of planted area, respectively. Single cropland includes parts of East Java and Lumpung (high productivity areas) but is mostly intercropped, often with longer duration, higher-yielding varieties. Local varieties are shorter-duration but lower-yielding. The major cropping system (multiple crop/upland) may produce three crops per year, but the last depends upon the length of the wet season. The first crop is the major one, using HYV, but possibly not yet enough fertiliser for highest potential yields. Second and third crops may be of traditional local varieties. The two major white

maize areas are included in the latter system, but white varieties are not fertiliser-responsive and little research has been initiated. Indonesian maize yields have been improving, but they are still below those of neighbours and developed countries.

4.28.2 Maize consumption

Maize demand involves three main components: (a) staple food, constituting about three-quarters of production; (b) animal feed; and (c) industrial use (oil, starch, glue, sweeteners). Livestock use is estimated at over 20% of production and industrial use is very small (maybe 1%). The main harvest provides a cheap source of calories for the poor at a time when rice prices tend to rise. Consumption is highest in this quarter and then tapers off. White maize is predominantly for human consumption, yellow maize serves both humans and livestock, but human consumption predominates. Maize has a poor image for consumers, is classed as 'inferior' and is consumed basically in rural areas, with consumption some 25% higher on-Java. A negative expenditure elasticity (varying between –0.31 and –0.55) is revealed from household survey data, but time series data (Food Balance Sheets) indicate positive elasticities between 0.72 and 1.77. Feed mills dominate commercial use of (yellow) maize. Both livestock and industrial usage demand year-round supply which necessitates storage (difficult and expensive in tropical areas) or imports.

4.28.3 Maize cropping patterns

The single most important factor affecting maize cropping patterns (apart from land size) is the length and the timeliness of arrival of the wet season. Maize takes second place in the rice-dominated cropping calendar, although less so in East Java where it is monocropped or intercropped with cassava and legumes. Previous patterns demanded early maturing, local (low-yielding) varieties. While this constraint remains operative for some farmers, the shorter time span of HYV rice has allowed an extra degree of flexibility to others by allowing use of longer-duration HYV or hybrid maize. Increased fertiliser and new varieties tend to shift farmers to monocropping, which makes less demands on moisture levels but appears more labour-intensive.

4.28.4 Maize marketing

The main harvest is often during the rainy season. To keep for more than a short period maize must be dried to 14% moisture content to avoid aflatoxins. In wet conditions farmers must dry it by the heat of kitchen fires. In disposing of surplus the farmers sell direct to consumers, a middleman/trader or the cooperative. The proportion marketed differs among the major systems, varying between 40 and 80% in sawah areas

and 30 to 80% in upland systems. Broadly speaking, 50% appears to be marketed. The amounts marketed range from small offerings provided by many farmers, to large volumes trucked directly to feedmills. The main harvest produces about 60% of total production, but higher on-farm consumption at that time reduces storage needs. The rest of the harvest is spread fairly evenly over the remainder of the year.

4.28.5 Maize research

As a result of the downy mildew problem (more evident in monoculture than intercropping), it became obvious that new varieties were necessary. Harapan and Arjuna were released in the late 1970s. Arjuna out-yielded other varieties, proved disease-resistant under humid conditions and solved the problem of short maturity (90 days) to fit the cropping calendar. Several other varieties were released, higher yielding but of longer maturity, until the emphasis switched in 1983 to hybrids. Virtually no research has been done on white varieties (only Bromo was released), and this is a serious constraint in the two major growing areas. Problems of research are exacerbated by lack of regular distribution facilities for improved seeds (both open-pollenated and hybrid), and is partly the reason some farmers have opted against hybrid use.

4.28.6 Maize floor price scheme

A floor price scheme for maize commenced in East Java in 1978 and was extended country-wide in 1979. BULOG was to buy dried yellow maize from the KUDs, but few had ever marketed maize or were equipped to dry it. The floor price was set at an incremental benefit-cost ratio (but with the constraint that the price should not exceed half the rice price). Initially the floor price was set higher than the peak harvest price, so that BULOG had to subsidise the consumer price. Later the domestic price rose (higher than world market prices) and the floor price stayed below domestic prices through to 1988.

Between 1970 and 1974 Indonesia was a small maize exporter until the overvalued exchange rate reduced competitiveness. During the rest of the decade small amounts of maize were exported and imported , but in all years a net import situation resulted. The Government intervened from time to time (e.g. in 1979 export licences were suspended to stabilise domestic prices). Trade continued to be restricted by a system of import and export licences with BULOG the present de facto sole licenced importer. By 1984 (after the 1983 devaluation) domestic prices were once again competitive, and exports resulted in that year from a fortuitous combination of circumstances (bad weather and a temporary reduction in US exports).

The livestock industry, whose products have high income elasticities of demand, has contributed to the emergence of a year-round demand for maize. However, problems of drying and storage increase costs,

making imports cheaper in pre-harvest months. BULOG's subsidised sales to feed mills to keep costs stable removes the incentive to invest in drying and storage facilities. It is not clear at which point in the market chain drying and storage can be performed most economically.

4.29 Cassava

Cassava is grown throughout Indonesia, often in small plots or house gardens, but the main production areas are the hilly regions of Java and Madura. It is bulky, perishable and must be consumed within a few days, or transformed into either starch or dried, thinly-sliced roots (*gaplek*). Starch is used for snack foods or industry, while *gaplek* is exported (mainly to the EC as feedstock) or consumed by the relatively poor, especially in the rice pre-harvest quarter. A major difference between cassava and rice or maize is the length of the growing season. Rice and maize need, respectively, 3 months and 4.5 months to grow, while cassava requires at least 8 months.

4.29.1 Cassava production

Areas planted to cassava have not grown significantly over the past 30 years. The main retarding factors include: (a) extended rice programs and irrigation; (b) soil erosion in upland Java; (c) relatively high prices of competing staples; and (d) some shift to perennial cash crops. Cassava tends to be cultivated on hillsides subject to various degrees of erosion (classified from 'moderate' to 'severe'). In badly depleted soils cassava is often the last crop grown. Production has fluctuated, but the long-term growth rate between 1970 and 1988 is about 2% per annum. Java accounted for 62% of production in 1988 although this has fallen from over 70% at the beginning of the 1980s. Lampung and East Nusa Tenggara are other important producing areas. Area harvested declined by over 200 000 ha during the 1980s, the bulk of this on Java.

4.29.2 Cassava consumption

While rice provides at least half of total calories, maize and cassava each provide about 10% , with the former slightly more important. However, there are marked regional variations, with urban dwellers having a basic rice diet, including only small amounts of fresh cassava and virtually no maize. Rural dwellers are classified by region with Madura consuming nearly all fresh cassava and West Java including some fresh cassava in its rice-dominated diet. Central and East Java have a high consumption of both maize and cassava, while Yogyakarta and the Central Southern Coast have the highest consumption of *gaplek*. In addition to regional variations seasonal factors are of importance, especially for the poor. Following the rice harvest quarter, fresh cassava, and then *gaplek*, substitute for the seasonally-expensive rice. In the final rice pre-harvest

quarter, maize and *gaplek* are relatively cheap substitutes. Expenditure elasticities for *gaplek* are negative or zero while fresh cassava varies. For urban consumers they are moderately large and positive. Fresh cassava has a negative price elasticity for rural consumers but positive for urban consumers (possibly a 'quality' effect).

4.29.3 Cassava cropping patterns

Some cassava is grown in pure stands mainly on the outer islands, but mostly it is intercropped with grains, legumes and sometimes vegetables. The intercrops vary with district and rainfall, making production and yield estimates difficult. Upland rice takes precedence if soil and moisture are satisfactory, but if rainfall is uncertain, cassava is better adapted to soil and climate variation. Although needing moisture in early life it can then tolerate long drought periods. Cassava does not grow well in excessively moist soil, cannot be grown under flooded *sawah* conditions, and moisture intolerance puts an upper limit on harvesting. It can be 'stored' in the soil to a certain extent, but is usually harvested between 8 and 12 months after planting.

4.29.4 Gaplek

Gaplek is made by sun-drying peeled and thinly-sliced roots. It can then be stored for several months. Flour from the pounded dry roots is used as an admixture in baking. *Gaplek's* calorific value is roughly similar to those of rice and maize but the protein content is lower. If consumed with legumes and vegetables, and especially if the leaves (containing protein) are also eaten, it can provide the basis of an adequate diet. While *gaplek* is used in the EC for livestock it is rarely used for this purpose in Indonesia. Protein deficiency requires supplementation by soybean or fish meal (both expensive) and farmers prefer maize.

4.29.5 Starch

Starch is produced by peeling and grating fresh roots and filtering a liquid from the residue. After water is removed the starch is dried and used in cooking, either for home or commercial purposes. A small proportion is used in the textile, paper and pharmaceutical industries. Starch-making requires a plentiful supply of clear water, and West Java leads in starch production with over half of harvested roots used for starch. Overall, starch accounts for about 23% of production and imports have been occasionally necessary. Starch is used for making the snack food, *krupuk*.

4.29.6 Cassava marketing

Although there are regional variations, about two-thirds of the crop is

marketed. Of this, starch accounts for some 23%, exports (mainly *gaplek*) about 15% , and the balance could be fresh roots or *gaplek*. The marketed share of cassava appears to be higher than for other crops, and is an important source of cash income. The bulkiness and perishability of fresh roots means quick marketing, and while *gaplek* can be stored for 3–4 months, storage losses are higher than for grains (mould and insect pests). Marketing is handled by village traders who deal in fresh roots and *gaplek*, or wholesalers who deal only in *gaplek*. Transport costs are the major item of marketing but infrastructure development (plus a fuel subsidy) has reduced costs. Competition is increased by the quick transferral of price information. While credit is mostly informal, Government institutions are now entering the field.

4.29.7 Cassava research

Improved cassava yields during the 1970s and 1980s are presumed to have resulted from fertiliser use on other intercrops. Little research has been done on improved varieties but two local strains, Adira I and II, show promise with moderate levels of fertiliser. Yields may be improved by changing the method of fertiliser application and better choice and treatment of cuttings.

4.29.8 Government policy

The cassava industry operates without specific Government policies, excepting irregular export bans. *Gaplek* is exported to the EC which sets an export-determined floor for domestic prices. The import price of starch from Thailand (plus transport and tariff) sets a ceiling price. Some past trade policies have had a depressing effect on production (e.g. a 1973 export ban and starch imports in 1976).

4.30 Soybean, other grain legumes and tubers

The grain legumes (soybeans, peanuts and mungbeans) and sweet potatoes tend to be the product of upland intercrops, although in some areas they are grown on rain-fed *sawah* during the dry season. Floor price schemes were introduced for the three legumes in 1979, but prices set have generally been below domestic free market prices, which in turn tend to exceed world market prices. Legumes have been providing an increasing percentage of total calorie and protein consumption since the late 1960s. Some (mainly imported) soybean is processed into *tahu* and *tempe* in traditional bean curd mills and, in addition to soybean grain, there is now increasing importation of meal for animal food. Production of sweet potatoes has remained virtually static since 1968.

4.30.1 Soybean production

Soybeans were once a specialisation of East Java and all-Java accounted

for 80% of total production in the early 1980s, but by 1988 the proportion has fallen to around 60%. Area under production has almost doubled since 1971, the largest proportion being on the outer islands. Production also increased on the outer islands (particularly Sumatra) with an eight-fold increase between 1970 and 1988. Yields have been increasing over the same period (over 2% annually) but remain low by world standards.

4.30.2 Soybean consumption

Consumption of soybean has been rising steadily throughout the 1970s and 1980s. Imports of grain started in 1977 and have averaged 360 000 tonnes annually during 1981 to 1986. In addition, import of soybean meal for animal feed has increased rapidly over the past ten years, reaching 313 000 tonnes in 1986. Soybean meal complements maize in feed rations. Generally, soybean and other legumes tend to be consumed in the producing area, but Java leads consumption, and urban exceeds rural consumption. Consumption is expected to increase with growing incomes (an expenditure elasticity of 0.98 has been estimated).

4.30.3 Soybean cropping patterns

Cropping patterns tend to vary between districts. East Java tends to monocrop soybean after rice, Sumatra appears to intercrop, while Central Java varies between the two. Yields seem not to vary between monocropping/intercropping, but appear to be lower in upland than in lowland areas. Seed type may be influential, as some upland farmers use local, short maturity seeds to fit their needs. Improved seeds are often of longer maturity. While other crops benefit from fertiliser use, this is not necessarily so with soybean (which absorbs nitrogen from the air and returns it to the soil). Some areas respond to phosphatic fertiliser and in certain acid soils lime is beneficial.

4.30.4 Soybean marketing

Marketing is spread over large areas, with farmers presenting small scattered offerings. Farmers sell to village traders, middleman/traders or wholesalers for large crops. The KUD should be an option, but BULOG's purchases are small. In 1985 BULOG imported 302 000 tonnes of grain, 175 000 tonnes of meal and procured domestically 29 000 tonnes of grain. Imported grain and meal is the monopoly of BULOG, which appoints distribution agents. Soybean is the most heavily protected of the food commodities. Quality control is a problem as grain is graded by traders and BULOG sets its own standards. Distinct preferences have emerged as local soy manufacturers demand domestic seeds for taste, while *tempe* and feed industries prefer larger imported beans. Real district

and rural market prices have been virtually static since the mid 1970s.

4.30.5 Soybean research

Soybean research is disadvantaged by lack of an international centre concentrating on production in the tropics. In 1974 CRIFC released Obra, the main variety planted, which has a maturity span of 90 days. This may be too long for certain cropping patterns. Two earlier-maturing varieties were released next, but with disadvantages of lower yields and poor rust resistance. In 1984 Dempo was released. It shares Obra's yield and maturity pattern, but is more rust-resistant. Production and distribution of seed, poor quality and timely delivery, are major constraints on the industry.

4.30.6 Soybean price support scheme

The price support scheme instituted in 1979 is implemented through the KUDs, but the floor price has been mostly lower than current market prices, and BULOG procurement is about 3% of domestic production. Isolated and small scattered marketings contribute to high marketing costs and low producer returns. The situation appears exacerbated by the low floor price, poor seed quality and distribution, low world market price leading to imports and possible producer disincentive.

4.30.7 Peanuts (groundnuts)

Peanuts, consumed both as a vegetable and snack food, are a valuable protein source. Java produces about three-quarters of total production. Yields of 0.9 t/ha compare unfavourably with Malaysia's 3.5 t/ha, but varieties suitable to tropical conditions are not easily developed. Production growth was just over 4% per annum from 1970 to 1988, but imports have been necessary since 1979. Domestic prices are more than double world market levels and BULOG controls imports, restricted to a sole importer. While peanuts are not as difficult to store as other crops, humidity and aflatoxin development must be considered.

4.30.8 Mungbeans (green grams)

Mungbeans are also covered by the 1979 floor price scheme although production is small (284 500 tonnes in 1988). Imports, averaging 6000 tonnes during the 1980s, have been relatively minor. Mungbeans are normally consumed as sprouts or porridge and constitute an additional protein source. Harvested area was 315 500 ha in 1988 and yields averaged around 0.65t/ha during the 1980s. Mungbeans are a potential replacement for soybeans in drier areas although some liming would be necessary in acid soils.

4.30.9 Sweet potatoes

Sweet potatoes are the staple of Irian Jaya although 45% of production is on Java. Mainly upland-grown during the dry season, they are bulky, transport costs are high and marketing is poorly developed. Harvested area fell by 31% between 1970 and 1988, but also fluctuates, particularly on Java. Over the same period production stagnated despite a slight yield improvement from 6 t/ha to 8.7 t/ha. Yields of 25 t/ha on research plots indicate the large gap. Although three new varieties were released between 1978 and 1984, their penetration to farm level is not evident and fertiliser use is considered low or non-existent.

4.31 Wheat Flour

Sporadic attempts at wheat growing have been unsuccessful and imports have grown steadily over the past 30 years. A high point was reached at 1.74 million tonnes in 1983, but imports have declined since then in the wake of large rice harvests, budgetary constraints and a price increase. Imports during the 1950s, some concessionary, were used to contain inflationary pressure, but commercial purchases now dominate, with the USA supplying over 60% of imports in 1984. There is disagreement on the role of wheat in Indonesian food policy. Some argue it is a widely-traded commodity internationally, its per calorie price is lower than rice and it is thus a sensible alternative to rice imports. Others point to its high income elasticity and predominant consumption in urban areas. The use of tariffs is suggested in controlling supply and demand, rather than BULOG's sole import control and the monopoly profits on domestic milling. Large investment in the milling/baking industries must be considered in any food policy reformulation.

4.32 Future Prospects for Secondary Food Crops

Rice policy has been the cornerstone of food policy strategy for the past 15 years with concomitant relatively slow progress in *palawija* , excepting maize. Success with rice cannot be replicated with *palawija* . Rice is now 95% *sawah*-grown, while *palawija* represents a great diversity of production techniques and is mainly upland-produced. Rice is the preferred staple with maize and cassava facing consumer discrimination, and sweet potato production virtually stagnant. The legumes form a special category because of dietary protein and, while production has been growing steadily from a small base, all have been supplemented by controlled imports, especially soybean which includes livestock feed demands. Java dominates *palawija* and total foodgrains production but two provinces, East and Central Java, accounted for over 45% of total maize, cassava, mungbean and soybean production and 39% of peanut production in 1988. The two systems of *sawah* and *palawija* are interlinked in the sense that *sawah* land is interchangeable between wet

rice and most *palawija* crops, although the reverse is not true. Many farmers own plots of each type (often some distance apart), and decisions on cultivation invariably involve consideration of both systems. Hence it is not feasible to consider changes in *palawija* area without noting the possible consequences for *sawah*.

4.33 Prospects for Maize

After the release of Harapan 6 the growth rate of maize output accelerated to 7% annually between 1979 and 1986. Future production increases may be absorbed in several ways: (a) domestic human consumption; (b) livestock industry; (c) processed forms of maize; and (d) export. Since virtually no dried maize is consumed in urban areas, domestic human consumption increases need consideration. They may depend upon relative price changes between rice and maize in rural areas. Processed forms of maize may increase consumption in urban areas. Demand from livestock sources is expected to increase, especially when income growth recovers from the mid-1980s downturn. However, maize price fluctuations induce changes in the maize proportions used in feed rations, as do price and proportion changes in complementary feed products. Problems of drying and storage need resolution to contain seasonal price rises and consequent resort to subsidised imports. Indonesia is disadvantaged in exporting by a lack of bulk handling facilities, and the narrow margin of comparative advantages induced by the 1986 devaluation could be easily eroded. Hybrids have provided a further option for some farmers, but the seed multiplication and annual distribution continue to exert constraint (financial and otherwise).

4.34 Prospects for Cassava

The rice intensification programs have financially benefited the lowland farmers but upland farmers, relying upon cassava for cash income, have not been favoured in research, intensification or soil rehabilitation programs. Negative consumer attitudes may be changed by processing measures used in other countries, increasing the storage life of fresh and dry roots. The yield gap between existing varieties, new varieties and experimental plots is extremely large. Better root choice, handling procedures and fertiliser (including application measures) offer potential for future productivity growth, even with declining areas under production.

4.35 Prospects for Legumes and Tubers

It is likely that income growth in the 1990s will continue to influence the strong demand for legumes, increasingly met by imports unless domestic production improves. A 1986 soybean intensification plan increased

production (possibly from area switching), but total grain equivalent imports, including livestock demand, were equal to 64.5% of domestic production. After the 1986 devaluation domestic soybean prices remained more than double the world price (real and nominal). Demand for different seed types by industry, poor seed quality, lack of production facilities and timely delivery are important constraints. Peanuts and mungbeans suffer similar seed problems and continuing basic research is needed. There is some prospect that pigeon pea, easier to grow than soybean and suitable for drier areas, will increase legume output.

4.36 Future Policy Issues

Indonesia has reached the incongruous position where rice yields are among the highest, if not the highest, in Asia while *palawija* yields are among the lowest. There are three major constraints involving the *palawija:* (a) socioeconomic (consumer resistance and rice preference); (b) infrastructural (roads, shipping, port handling, communications, markets); and (c) technical (seeds, fertilisers, cropping patterns, extension, storage, drying, credit). Of these three major constraints, the last presents policy makers with the major challenge.

5 Indonesian Food Crop Models

5.1 Introduction

In this chapter a review is completed of the four contemporary modelling projects allied to ACIAR Project 8362. These are reported by Tabor et al. (1988) (the Ministry model), Rosegrant et al. (1987) (the IFPRI model), the World Bank (1987a,b) (the World Bank model), and Johnson et al. (1986) (the FAPRI model). These four documents form the basis of the review. In addition to this work, Timmer (1986) also provided guidance for the ACIAR Project at some crucial points.

All of the research mentioned above was being performed at the same time as the ACIAR project. As a consequence there was useful interaction between the modellers from the different groups. The culmination of this collaboration was the International Workshop held in Jakarta in January 1988. A significant conclusion of the workshop was that while the general impacts of agricultural price policy in Indonesia were understood, more detailed analysis was required if the price policy instruments were to be used with precision.

5.2 Relationships between the Models

The overall relationships between the five models can be seen in Figure 5.1. IFPRI, the World Bank and Ministry models were developed more-or-less independently of each other. The FAPRI team made few of its own parameter estimates, drawing most of its information on elasticities from the IFPRI model. In a similar vein, the ACIAR model used previous estimates from all of the other models and from other sources. While this suggests that the latter two models are more modest than the rest, their contribution has been to concentrate on modelling the effect of price policy instruments more completely.

The horizontal dimension of Figure 5.1 is an index of comprehensiveness of the various models. In constructing this index the characteristics that were taken into account were number of food commodities included, regional disaggregation, income class definition on the demand side, and extent of the macroeconomic component of the model. Each of these characteristics is considered in Section 5.4. Suffice it to say at this point that the Ministry model was considered the most comprehensive. It is particularly impressive in terms of the number of commodities included (seven) and its macroeconomic content. The remaining models

are close to each other on an overall comprehensiveness index, and could easily change their ranking depending on the weighting given to the components of the comprehensiveness index.

5.3 Structure of the Models

As the Ministry model is the most comprehensive, discussion commences with a consideration of it. Then similarities and differences between this model and the others are examined.

5.3.1 Structure of the Ministry Model

A flow diagram of the structure of the Ministry model is shown in Figure 5.2. The two main components are a food crop sub-model and a macroeconomic sub-model. The core of the food crop model, as in all the models considered, is a set of demand and supply functions. For each crop there are three estimating equations. Demand for each crop is dependent on consumer income, own price, price of competing crops and population. An almost ideal demand system estimation is adopted. On the supply side, an area equation and yield equation are estimated for each crop. Thus, supply of each crop is the product of area harvested and yield, with area harvested dependent on own price, price of competing crops, area targets set by the Government, and lagged harvested area. Yield is a function of output and input prices.

When the model is used in simulation mode, demand and supply are closed off using food gap (stock changes and/or net imports) as the equilibrating mechanism. A fixed proportion of the generated supply is used for seed, waste and non-food use (see Figure 5.2). The remainder is available for human consumption and confronts the simulated demand, with any surplus or deficit being taken up in stock changes or net imports. A similar equilibrating mechanism applies to all four models. Finally, in the Ministry model, food crop output links to the macroeconomic sub-model as a component of GDP.

As shown in Figure 5.2, GDP is the sum of food crop output, mining/defence production and industrial/services production. GDP then determines private consumption expenditures and hence links back to the food crop sub-model through consumer incomes. Equations estimated by the Ministry team to establish the macroeconomic sub-model are (a) mining/defence production as a function of the petroleum price index, (b) industrial/services production dependent on food crop prices, non-food prices and inflation, and (c) private consumption as a function of production in the food, mining/defence and industrial/services sectors.

Crop prices, input prices and area targets are manipulated within the model to assess the impact of price subsidies, input subsidies and area targets. In Figure 5.2 the points labelled (P) show where the main policy instruments are modelled. A significant interaction, unique to this

model, is the influence of food price policy on industrial/services production. Another is the explicit way in which area targets are recognised and analysed as a policy instrument.

5.3.2 Structure of the IFPRI Model

The structure of the IFPRI model is shown in the flow diagram of Figure 5.3. The obvious first difference between it and the Ministry model is the lack of a macroeconomic component. This means that in the IFPRI simulations there is no feedback from the quantity of food crops produced to GDP and through personal consumption expenditure back to the food-producing sector, and there is no explicit modelling of the influence of Government food price policy onto the macroeconomy and hence onto personal consumption.

Like the Ministry food-crop model, the core of the IFPRI model is a set of crop demand and supply functions. However, there are significant differences in the model structures at this point. While there are sets of estimating equations for area, yield and food demand, just like the Ministry model, the explanatory variables are somewhat different. For each crop, area is dependent not on price, as in the Ministry model, but on own expected revenue, expected revenue of competing crops and lagged area. In addition to crop prices and fertiliser prices, crop yields are dependent on the variables representing lagged yield and shifts in technology. The technology shift variables (proportion of modern varieties, proportion of area irrigated, proportion of area under intensification and trend) are particularly important because they permit analysis of non-price policies like investment in irrigation.

Demand for food in the IFPRI model is estimated as per capita demand dependent on per capita consumption expenditures, own prices and prices of other food commodities. For all commodities except rice, the IFPRI team used previous estimates of demand elasticities (Rosegrant et al. 1987, p. 5.13).

Another minor difference between the Ministry and IFPRI models is in the method of closure of the gap between demand and supply of food crops. While the Ministry projections treat this as a food gap to be met from either stock changes or net imports, the IFPRI analysis has stocks fixed at a particular absolute level for each commodity and assumes the gap is filled only by net imports.

Returning to Figure 5.3, the points at which policy enters the model and hence the types of policy considered are indicated by (P). As mentioned above, in addition to consumer and producer price support, and fertiliser subsidies, Government investment in irrigation facilities is included in this model.

5.3.3 Structure of the World Bank Model

The structure of the World Bank model (shown in Figure 5.4) resembles

the IFPRI model, being a food crop model with supply estimated as the product of area and yield, and demand estimated on a per capita basis. The structure of the area equations is the same in both models and the structure of the yield equations is similar, with the World Bank (a) excluding the proportions of the area irrigated and intensified and (b) using the ratio of crop-to-fertiliser prices as an explanatory variable rather than crop and fertiliser prices separately.

The most significant differences between the two models are in the method of estimating the demand relationships and in the method of closure of the model when used in simulation mode. In estimating the demand relationships as well as own price and price of competing crops, real GDP per capita was used by the World Bank modellers as an explanatory variable rather than per capita consumption expenditures.

In the World Bank projection exercises, the model is closed in a more complex manner than in the other models. The equilibrating mechanism for each crop is through per capita net imports, which are the sum of demand plus ending period stocks less supply and beginning period stocks, with all variables measured on a per capita basis. Moreover, stocks are not simply measured as a proportion of output, but a stock function is estimated with current supply, the previous level of consumption and own price as explanatory variables.

The influence of policy in the simulation runs of the World Bank model is shown by (P) in Figure 5.4. It is clear that the emphasis in this model is on output price policies and input subsidies.

5.3.4 Structure of the FAPRI Model

The FAPRI team made no independent estimates of the various relationships, but used previous estimates of parameters such as elasticities. Hence, discussion of the structure relates to the use of the model in projection exercises. The structure is the simplest of the four models considered and is shown in Figure 5.5. Again, supply is the product of area and yield. The area function is similar to that of the Ministry model with own price and price of competing crops together with lagged area as explanatory variables. It is easy to envisage this lagged area variable being adjusted in projection exercises to represent area targets, as in the Ministry model.

The yield function in the FAPRI model resembles that of the IFPRI model except that it excludes the technology shift variables. Thus, yield is a function only of lagged yield, crop prices and fertiliser price.

On the demand side, consumption per capita of each crop is a function of lagged consumption, own price, prices of competing crops and income per capita. This again is similar to the IFPRI model except for the additional variable lagged consumption.

In the closure of the model the FAPRI team employs net imports as the mechanism for drawing demand and supply together. Net imports are equal to quantity demanded for human consumption plus seed, feed

and waste plus ending stocks, less production and initial stocks. The difference introduced at this point by the FAPRI team is to have the levels of stocks as a fixed proportion of demand rather than supply.

The policy emphasis in the FAPRI model is on output price policies and input subsidies, although, as mentioned above, area targets could also easily be incorporated.

5.4 Some Details of the Models

5.4.1 Commodity coverage

The crops included in each of the four models are shown in Table 5.1. The inclusion of wheat (on the demand side) in the World Bank and FAPRI models is a reflection of their price policy orientation in a partial equilibrium framework, and its exclusion in the Ministry and IFPRI models reflects their production orientation.

Sugar is included in the Ministry and IFPRI models, but excluded from the other two. This may reflect the difficulty of estimating econometric relationships, acknowledged by Rosegrant (1987, p. 5.13), for a commodity which has been subject to various forms of Government regulation.

In terms of harvested area, the first six commodities in Table 5.1 are the most significant food crops. Of the other three crops, wheat is not grown commercially, and sweet potatoes and mungbeans are each grown on almost 300 000 ha (Johnson et al. 1986, p. 48; Tabor et al. 1988, p. 44), which is about half the area devoted to groundnuts. It therefore seems appropriate that sweet potatoes and mungbeans are overall considered minor commodities and represented only in one model each.

5.4.2 Disaggregation of the models

The three types of disaggregation included in the models are regional, rural and urban, and by income class. The IFPRI model is the most disaggregated of the four, with supply regionally disaggregated and demand disaggregated into three income classes and by rural and urban areas. Supply first is disaggregated into Java and off-Java, then using dummy variables into East, Central and West Java, North Sumatra, other Sumatra, South Sulawesi, other Sulawesi and other Indonesian.

The Ministry and World Bank models have a regional definition similar to each other. On the supply side the regions are Java and off-Java, and on the demand side all-Indonesia demand functions are estimated (except for maize in the World Bank model which has the two demand functions for feed and all other uses).

In the FAPRI model, the crop supply function relates to all-Indonesia, and demand is disaggregated into rural and urban functions. In fact the demand functions are based on IFPRI estimates for medium income categories of rural and urban dwellers.

In summary, the Ministry, the World Bank and the FAPRI models are highly aggregated. In contrasts, the IFPRI model succeeds in achieving a modicum of disaggregation both regionally and by income class.

5.4.3 Estimation and projection periods

The three modelling groups that made their own estimates of demand and supply functions (the Ministry, IFPRI and the World Bank) used the same underlying data covering the period from 1969 to 1985. They then completed some simulation experiments to analyse the impact of price changes. The projection periods for these simulations were for the Ministry 1987 to 1992, for IFPRI 1985 to 2000, and for World Bank 1987 to 1995.

There are a number of differences between the models discussed in earlier sections which would lead to the expectation that the results from these various projection exercises would not be the same. Apart from the structure, commodity coverage and level of disaggregation, there are differences in the values of key parameters like the production response to fertiliser that are embedded within each model. Another difference is the base period selected for the projection. For the Ministry and the World Bank this was 1986, for FAPRI it was 1985 and for the IFPRI model it was the mean of 1984 to 1986, with allowance being made for commodities like cassava which had an atypical year in 1986.

5.5 Some Results

In each of the models there are two types of results, viz. the estimated functions which are the basis of the projections and the projections themselves. Representative of the first type are the elasticities shown in Table 5.2. While the discussion will restrict itself to the all-Indonesia elasticity values, it is clear that there are regional differences.

The Ministry's estimates of both the rice area and rice yield elasticity with respect to own price are higher than IFPRI's, with the other two groups between the extremes. At the extremes the short-run own price elasticities of supply work out to be 0.20 and 0.49. That is, taking all the results together, a 10% increase in price of rice would be expected to increase production by between 2.0 and 4.9%.

If the impact of fertiliser price on rice supply is now considered we find elasticities ranging from –0.03 to –0.16, with IFPRI's values being the highest on this occasion and the Ministry's the lowest. This means that in the IFPRI model a similar effect on rice output will result from a given proportional increase in fertiliser price or reduction in rice price. To be more precise, no change in output could be expected from a 10% increase in fertiliser price combined with an 8% increase in rice price. The no-change-in-output combination from the Ministry model is a 10% increase in fertiliser price combined with a 0.6% increase in rice price. It is clear that such elasticity values are different and would be expected to

provide different policy prescriptions.

Turning to consider the demand elasticities portrayed in Table 5.2, the contrast is again between the Ministry and IFPRI models. However, this time the differences are not so pronounced, with own price elasticity of demand for rice ranging from –0.13 (Ministry) to –0.25 (IFPRI, rural middle income) and income elasticity of demand from 0.10 (IFPRI, urban middle income) to 0.30 (FAPRI, rural).

Given these differing elasticities, there is a surprising concordance between the projections made using the various models. An example, concerned with a policy of reducing fertiliser subsidies, is shown in Table 5.3. Although there is some difficulty in comparing results from different models because of differences in (a) the bases used for the projections, (b) reporting of results for different years, and (c) the precise definition of the policy under analysis, some general agreement can be observed.

The target which is the centre of attention is the level of self-sufficiency in rice. The first observation is the close correspondence between both the policy analysed and the target results of the IFPRI and World Bank studies. The correspondence between the results is so close that it would be easy to envisage the two sets of results being placed in a single sequence and being presented as if they came from a single model.

Although the results from the remaining two models do not accord so closely with the IFPRI and World Bank models there is still a fairly close correspondence if allowance is made for the exact nature of the policy being analysed. With the FAPRI analysis, for example, a lesser reduction in fertiliser subsidy is envisaged, and there is a correspondingly higher level of self-sufficiency in the projections.

In terms of the impact on rice self-sufficiency presented in Table 5.3, the Ministry model also seems to agree closely with the others. However, such agreement may be slightly spurious when the policy that is under analysis is examined more closely, This is a 20% increase each year in nominal fertiliser prices, with rice prices increasing at 8% per year in nominal terms. Such a policy entails a more rapid increase in fertiliser-to--rice price ratio than the other models, and therefore a more rapid reduction in self-sufficiency might be expected in the results. The fact that effects on rice self-sufficiency of a similar order of magnitude to the other models are observed in the Ministry analysis is largely due to its lower elasticity of output of rice with respect to the price of fertiliser discussed earlier.

5.6 Lessons

The review of the four models highlighted several key features common to them. Importantly, the structure of their food crop sector is similar even though each emphasises particular explanatory variables. The common structure reflects the state of the art in this type of modelling.

There was also some similarity in the type of policy analysis completed using the models. All the teams performed projection exercises in which the target variables were quantities of production and consumption of (and hence self-sufficiency in) both rice and *palawija*. They showed the likely impact on production and consumption of policy changes, and indicated that different combinations of policies could be used to achieve self-sufficiency targets. Such analysis did reflect the overriding policy concerns in Indonesia, and some general prescriptions were developed on the basis of model results. For example, taking the model results together, the International Workshop in Jakarta (January 1988) concluded that rice output could be maintained close to the self-sufficiency level following a reduction in fertiliser subsidies.

While these quantitative results are useful, they do not provide a complete picture. Significantly, little information was provided on the relative cost of using alternative policies to achieve self-sufficiency targets. The provision of this type of information became the central target of the ACIAR project. It was the opinion of the leaders of this project that the pioneering work in estimating the underlying demand and supply parameters had progressed far enough, and that a more comprehensive policy analysis was now more appropriate. By integrating the previous estimates into a consistent policy model that measured the impacts of policy changes on (a) social and governmental costs and benefits and (b) the distribution of such costs and benefits, an attempt could be made to obtain a reasonable picture of the trade-offs involved in policy selection. Thus the contribution of the ACIAR project would be to augment the results already achieved by extending them into additional dimensions of the policy space.

In pursuit of this objective, the previous models provided the empirical ammunition and Timmer (1986) was influential at the conceptual level, particularly with respect to Indonesia's international rice trading stance.

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Table 5.1. Crops included in the various models.

	Ministry	IFPRI	World Bank	FAPRI
Rice	X	X	X	X
Maize	X	X	X	X
Cassava	X	X	X	X
Sugar	X	X		
Groundnut	X		X	X
Soybean	X	X	X	X
Sweet potato				X
Wheat			X	X
Mungbeans	X			

Table 5.2. A sample of elasticity value from the various models.

	Rice area with respect to own price	Rice yield with respect to own price	Rice supply with respect to fertiliser price	Own price elasticity of demand	Income elasticity of demand
Ministry[a]	0.22[c]	0.24[e]	−0.03[e]	−0.13	0.29
	0.05[f]	0.41[f]	−0.03[f]		
	0.17	0.31	−0.03		
IFPRI[b]	0.10[c]	0.13[e]	−0.22[e]	−0.25[g]	0.15[g]
	0.08[f]	0.04[f]	−0.07[f]	−0.20[h]	0.10[h]
	0.09	0.11	−0.16		
World Bank[c]	0.28[i]	0.30[e]	—	−0.19	0.29
	0.13[j]	0.10[f]			
FAPRI[d]	0.10	0.19	−0.10[k]	−0.25[l]	0.30[l]
				−0.20[m]	0.20[m]

Sources: [a] Tabor (1988, pp. 94, 141), [b] Rosegrant (1987, pp. 5.27, 5.32), [c] World Bank (1987b, Appendix 1, pp. 3, 11), [d] Johnson (1986, pp. 8, 9).

Notes: [e] Java, [f] off-Java, [g] rural medium income, [h] urban medium income, [i] Java revenue elasticity, [j] off-Java revenue elasticity, [k] yield elasticity, [l] rural, [m] urban.

Table 5.3. Simulated impact on rice self-sufficiency from a reduction in fertiliser subsidies.

Model	Year (%)	Self-sufficiency	Policy change
Ministry[a]	Base (1986)	103.07	20% increase each year in nominal fertiliser prices, with rice prices increasing at 8% in nominal terms
	1992	97.86	
IFPRI[b]	Base (1984–1986)	100.00	Phased elimination of fertiliser subsidy by 1991, with rice prices fixed
	1990	95.37	
	1995	93.15	
World Bank[c]	Base (1986)	101.03	Removal of fertiliser subsidy by 1991
	1991	94.44	
	1995	93.04	
FAPRI[d]	Base (1985)	101.27	50% reduction in fertiliser subsidy by 1993, with rice prices fixed
	1990	96.69	
	1992	95.10	

Sources: [a]Tabor et al. (1988, p. 219).
[b]Rosegrant et al. (1987, p. 6.57).
[c]World Bank (1987a, p. 68).
[d]Johnson (1986, pp. 24, 25, 65).

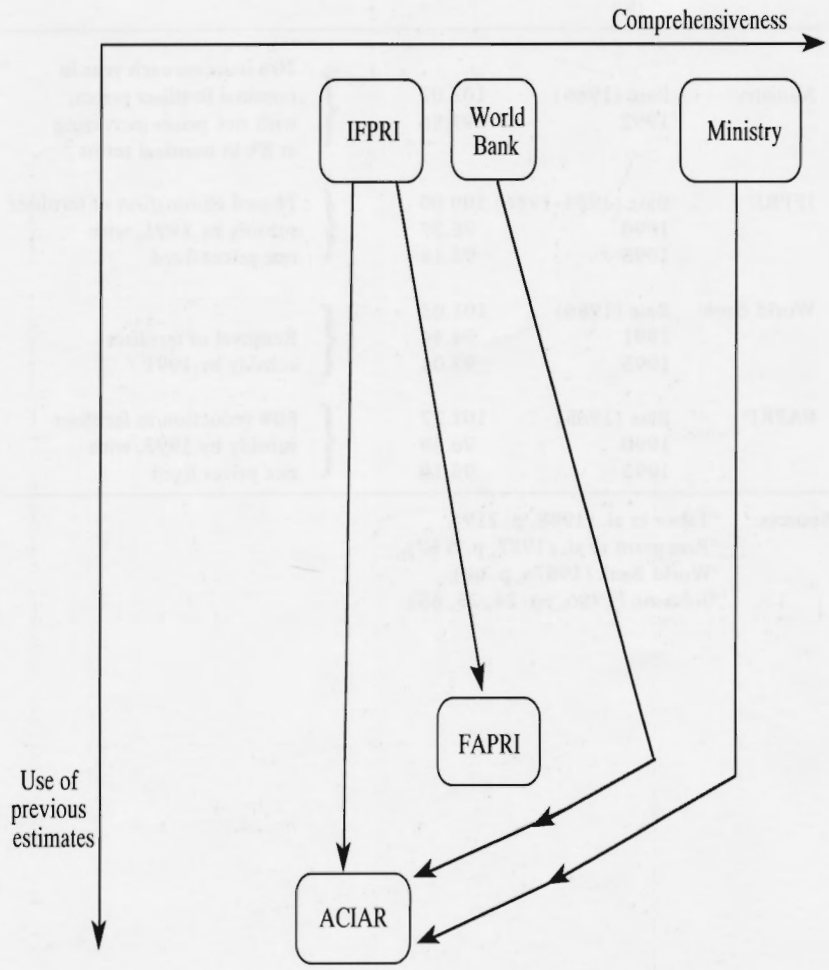

Figure 5.1. Relationships between the five models.

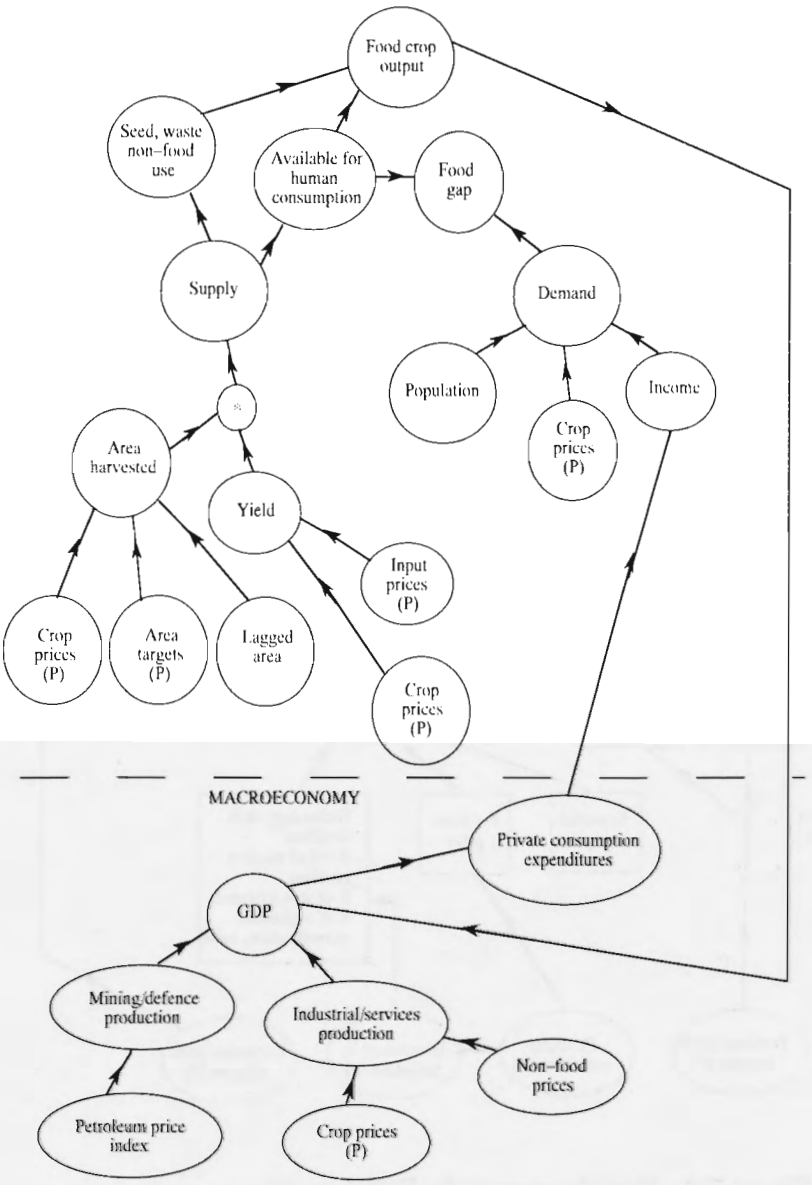

Figure 5.2. Flow diagram of the ministry model.

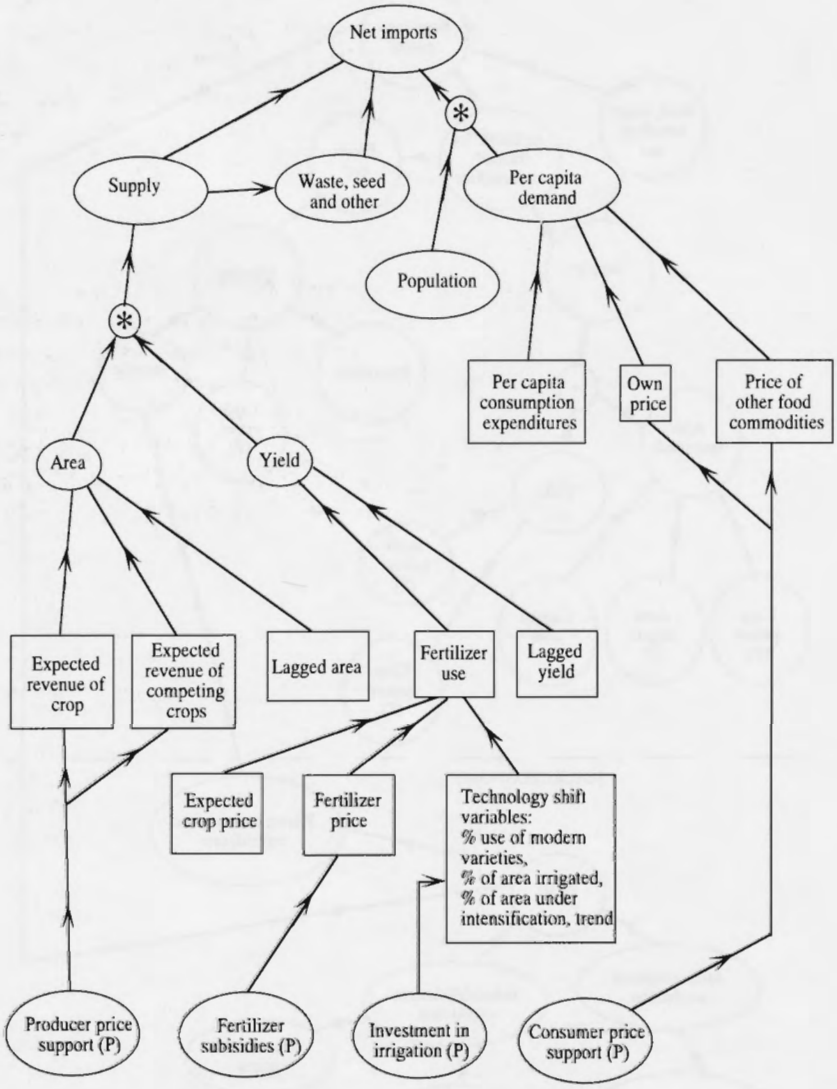

Figure 5.3. Flow diagram of the IFPRI model.

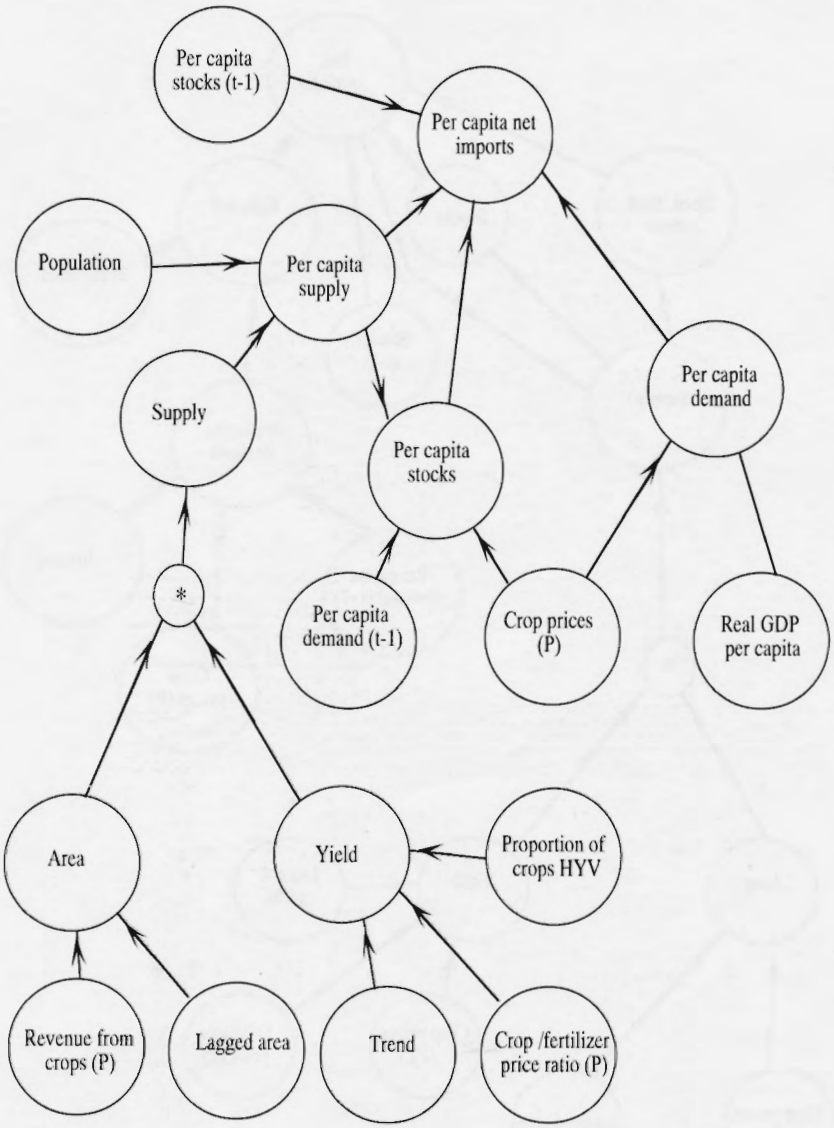

Figure 5.4. Flow diagram of the World Bank model.

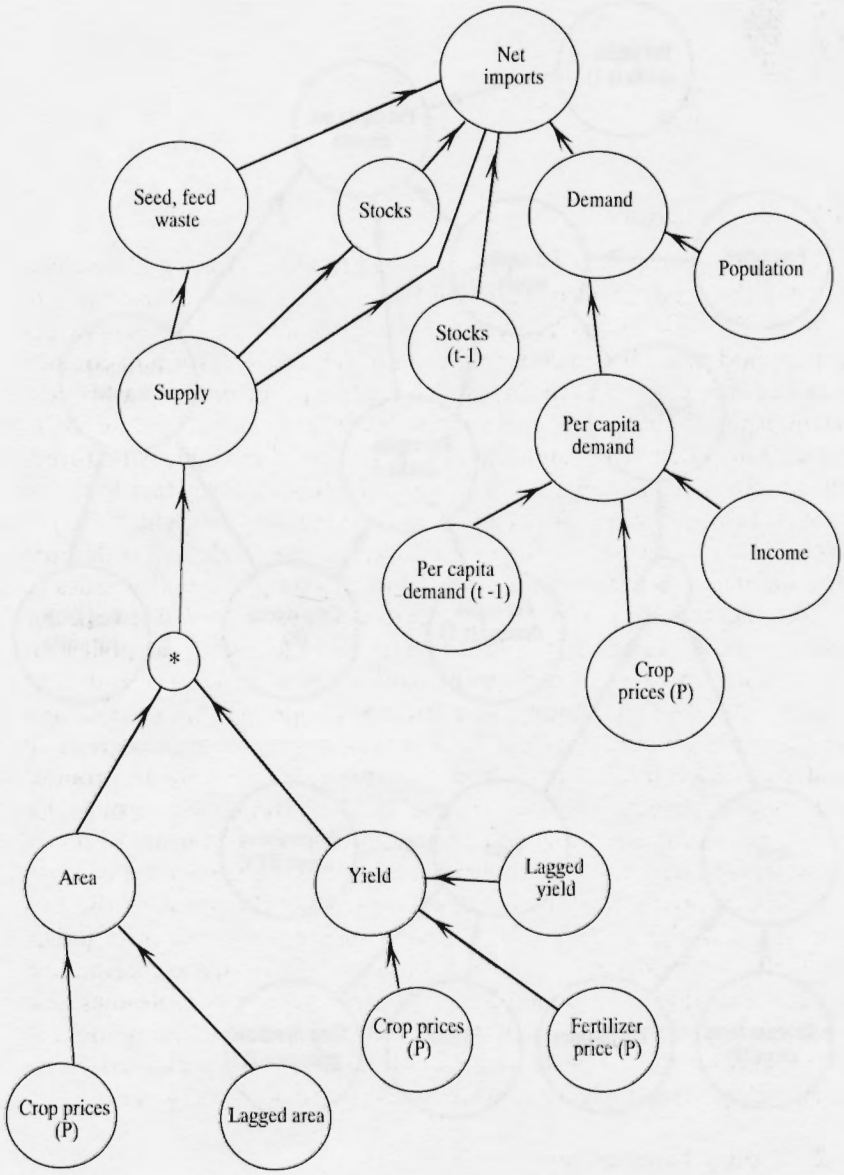

Figure 5.5. Flow diagram of the FAPRI model.

6 Study Method

6.1 Introduction

The detailed description of the Indonesian food production sector provided in the previous chapters is vital for understanding such an intricate system. To complement this and provide a tractable analysis of contemporary food policy it is necessary to draw together the significant components of the earlier description and focus attention on only a few key relationships. This process of concentration brings together low structured, low value data, and transforms it into the highly structured, informative construct we call a model. In this chapter, this focusing process is outlined by describing the methodology of policy analysis adopted in our research. Then, in Chapter 7, the modelling technique that was developed is applied to several Indonesian food policy issues.

The methodology adopted is a partial equilibrium framework for measuring the effects of the instruments of Indonesia food policy on producers, consumers, government, and overseas producers and consumers. A linked commodity-by-commodity approach was used so that results can be presented at various levels from a completely disaggregated analysis of eight food commodities (rice, maize, cassava, sugar, groundnut, soybean, sweet potato, and wheat) by these five societal groups, to, at the other extreme, a single aggregate estimating the impact of policy on all groups across all commodities (i.e. an Indonesia-wide outcome).

The framework developed is necessarily a simplification of the real world which highlights the key features of the complexities of policy regulation and agricultural markets. The instruments that are considered are domestic floor-and-ceiling price schemes and fertiliser subsidies; and trade restrictions and subsidies. Other policy instruments are ignored as being beyond the scope of the current analysis and presumed to be unchanging in their effect or included only as an accounting item.

6.2 Policy Instruments

The main price-policy instruments used for food crops are subsidies on various inputs, and output price support through a floor-and-ceiling price scheme. In the case of rice, the key instruments are floor prices, which are used to maintain a minimum market price for rice delivered to the agricultural cooperatives; various input subsidies (which apply to these inputs irrespective of the crop to which they are applied); ceiling

prices, which limit the amount that consumers must pay to purchase rice; and storage-cost subsidies. The introduction of implicit export subsidies on rice in 1985 added a new policy instrument to the list. While there is a floor price policy for maize, BULOG intervention in the maize market is relatively slight compared with the rice market. This is, in part, because of the greater political importance of rice and the fact that marketing channels for maize are less clearly defined. Control over imports and exports is the principal means by which the government influences the maize market. BULOG is the sole importer of wheat but does issue processing contracts to the private sector. Output price policies have not been effective for the other food crops, though farmers growing these crops do benefit from the input subsides that have been used.

In addition to these price policies the government devotes considerable resources to the development and dissemination of improved technologies. The BIMAS programs were designed to increase production through the use of improved seeds, fertilisers, pesticides, water management, improved cultural practices and the development of farmer cooperatives. A parallel scheme, INMAS, which lacked a credit element, aided farmers who desired to use modern inputs. Yet another of this type of scheme is INSUS. Under this scheme about 50 to 100 farmers with contiguous plots were encouraged to make joint decisions about seeds, planting times, and crop choices other than rice. Hence, some policy instruments can be viewed as supply shifters (e.g. fertiliser subsidies and technological innovations), while others encourage output expansion along supply functions (e.g. producer price supports).

The food-crop model is designed to analyse the impact of the various price policies that are currently used by the Indonesian government. It is composed of a set of partial equilibrium demand and supply equations for each of eight commodities. The commodities covered are rice, maize, cassava, sugar, groundnut, soybean, sweet potato and wheat. They account for more than 90% of the country's caloric intake. Given a set of policy parameters such as output price supports or input subsidies, this model can be solved for the quantities of production, and amounts of Government revenue and expenditure, export receipts, payments for imports, and economic surpluses.

The model is capable of analysing the price policies for the various commodities mentioned above, viz. the floor-and-ceiling price scheme, input subsidies and export subsides. These policies involve the Government in the regulation of four types of prices, viz. consumer and producer prices of food, farm input prices, and export prices of food. Changes in the various policies are simulated in the model by alteration in the level of these prices. The impacts on the various quantity and expenditure levels are taken to represent the effects of policy changes. Therefore attention is focused on the implications of altering the agricul tural price policies of Indonesia for the Government's budget, for pro-

ducers and consumers of the affected commodities, and for the other sectors of the economy.

6.3 Model Fundamentals using the Indonesian Rice Market as an Example

6.3.1 The no-policy situation

Agricultural economists make extensive use of demand and supply functions to represent the behaviour of consumers and producers. These functions show relationships between quantities demanded (and supplied) and important explanatory variables, including the price of the commodity concerned. The impacts of policy changes can then be observed by using these demand and supply functions because the types of policy under consideration influence the price or restrict the quantity of the various commodities.

Figure 6.1 shows a conventional downward sloping demand function (D) and upward sloping supply function (S) for a commodity of interest. Given that the purpose is to develop a diagrammatic representation of the Indonesian rice market, we can think of the commodity as being rice. Then, step-by-step, the complexities of the rice market can be included.

Also shown is an excess supply from other countries (ES). This indicates the quantities of rice that are imported into Indonesia at various levels of price. The situation that would occur in the Indonesian rice market in the absence of any Government policy intervention is shown at the price level OA. This is the free market equilibrium price without any policy intervention. At this price the quantity of rice imported OQ_3 is exactly equal to the shortfall between domestic supply OQ_1 and domestic demand OQ_2.

6.3.2 The fertiliser subsidy policy

The first component of policy to consider is the fertiliser subsidy policy. This part of the analysis is commenced using a figure representing the fertiliser market. In Figure 6.2, demand (D_f) and supply (S_f) functions for fertiliser are shown. Without the fertiliser subsidy the equilibrium price in the fertiliser market is OP_1, with the quantity OQ_{f1} demanded and supplied.

In Indonesia the farm price of fertiliser is subsidised. In Figure 6.2 the subsidised price that farmers pay is OM. At this price farmers demand the higher quantity OQ_{f2}. In order to maintain this demand price of OM, a subsidy of MN per unit of output must be offered. This means that the price that suppliers of fertiliser receive is ON. At this price, the quantity which suppliers wish to place on the market is OQ_{f2}, exactly the amount that is demanded.

A final item to be shown in this diagram is the Government cost of the subsidy. This is equal to the subsidy per unit (MN) multiplied by the marketed quantity (OQ_{12}). Hence, the subsidy cost is represented by the area KLMN.

In order to show the impact of the fertiliser subsidy on producers and consumers of rice it is necessary to move back to the diagram representing the rice market. In Figure 6.3 the direct impact of the fertiliser subsidy is to shift the rice supply curve from S_0 to S_1. This shift occurs because the costs of production are lower as a result of the subsidy, and each rice producer finds it profitable to supply a higher output at every rice price level. A more technical way of describing the same events is to observe that the supply function can be regarded as the horizontal summation of individual firms' marginal cost curves. Then the subsidy has the effect of lowering the marginal cost of producing every level of output.

As the supply curve shifts from S_0 to S_1, the domestic production of rice expands and displaces some imports. Thus the fertiliser subsidy is seen to encourage domestic production which, at the margin, becomes more competitive vis-a-vis imports. In Figure 6.3 the equilibrium price (at which imports equal the domestic supply shortfall) is OH once the fertiliser subsidy is in place. At this price the quantity OQ_4 is supplied by domestic rice farmers, OQ_5 is consumed, and the difference OQ_5 minus OQ_4 (= OQ_6) is imported.

It is now possible to describe the costs and benefits of the fertiliser subsidy policy on producers and consumers. Treating the areas below the two supply functions as total costs, so that the areas above these curves but below the price line are producer surpluses, the policy-induced increase in producer surplus of rice producers is measured by DEFG minus ACDH. Thus producers gain as a result of the surplus generated by the increased output, but lose from the dilution of price.

The gain to consumers occurs as a result of the fall in the market price of rice that results from the output-expanding effect of the fertiliser subsidy policy. This gain is shown by the change in the consumer surplus, and is measured by area ABJH.

In this net social benefit framework, the net domestic effect of the fertiliser subsidy policy is the sum of changes in the three aggregates: net government cost, producer surplus and consumer surplus. This is measured by area EFGCBJ in Figure 6.3 minus area KLMN in Figure 6.2. In a closed economy situation this total would in fact be negative, indicating a net domestic loss. However, the fact that Indonesia is a large trader on international rice markets means that its domestic fertiliser policy can, by altering the level of domestic rice production and thereby influencing the international price of rice, effectively transfer efficiency losses abroad. Such losses to foreign rice-producing countries are measured by the surplus area AYZH in Figure 6.3. While the sum of the domestic and international effects of the policy must be a loss, the fact that the

international effect is a loss means that it is possible that there is a net social benefit in Indonesia.

6.3.3 *The floor-and-ceiling price policy in conjunction with the fertiliser subsidy policy*

The second major component of Indonesia's rice price policy is the floor-and-ceiling price scheme. This scheme is operated by BULOG, the Government rice storage and trading agency. By means of its buffer stock and trading activities it defends pre-specified floor-and-ceiling prices of rice. The objective is to stabilise price, so that the average domestic consumer and producer prices during any season could end up above or below those which would occur without the policy in operation. In Figure 6.4 average consumer prices are raised from OH to OT under the influence of the floor-and-ceiling price arrangement, while producer prices are increased to OR. This configuration describes the situation in the rice market in 1985.

As a result of the fertiliser subsidy and the floor-and-ceiling price policy, output is OQ_8 and consumption of rice is OQ_7. The surplus is OQ_8 minus OQ_7 ($=OQ_9$) and is exported under subsidy by BULOG. Again there are four aggregates to consider to assess the impacts of the combined policies: net government cost, producer surplus, consumer surplus and overseas surplus effects. Again also, both the rice market and the fertiliser market must be analysed to show these effects.

In the fertiliser market shown in Figure 6.5 there is a shift to the right in the demand for fertiliser function. This represents the response of rice farmers as the price of rice is increased from OH to OR in Figure 6.4. They value fertiliser more because its use in producing rice is more profitable once the rice price increases. Under free-market circumstances this increased demand for fertiliser would bid up its price to a level higher than the original farm-gate price OM. However the Indonesian Government wishes to maintain the price to farmers at the level OM. In order to achieve this the per unit subsidy must be increased to N'M. This enables fertiliser suppliers to receive the price ON' and stimulates them to produce more to meet the extra demand.

The first component of the government cost of the combined fertiliser subsidy and floor-and-ceiling price policy is shown in Figure 6.5 as area K'L'MN'. This is the fertiliser subsidy component, and is measured as the per-unit-subsidy N'M multiplied by the quantity of fertiliser used OQ_{f3}.

The second component of the government cost (the floor-and-ceiling component) is shown in Figure 6.4. In order to achieve the rice prices OR for producers and OT for consumers, the Government must procure the quantity $Q_{10}Q_8$, at the price OR. After procurement, the quantity $Q_{10}Q_7$ is then resold domestically, at price OT, and the rest ($Q_7Q_8 = OQ_9$) is exported under a per unit export subsidy of UU'. The

government cost of the floor-and-ceiling price policy is then seen to be the sum of a consumer subsidy and an export subsidy, and is measured by the area WSS'U'UW'.

The effects of the combined floor-and-ceiling price policy and fertiliser subsidy policy on producers, consumers and overseas rice market participants are also shown in Figure 6.4. The gain to producers is the producer surplus occurring with both policies in operation minus the producer surplus with none. It is measured as the area VSFG minus area ACVR. This gain is more than with only the fertiliser subsidy policy because the floor-and-ceiling price policy is effectively a rice price support policy for producers, so that the final policy configuration is a combined fertiliser subsidy and output price support policy.

The gain to consumers from the combined policy is shown by the consumer surplus area ABUT. This is a smaller gain than with just the fertiliser subsidy policy, but still a gain compared with the no-policy situation; a result which reflects the fact that the final price (OR) is between the price with the fertiliser subsidy only and the no-policy price.

Once again the net domestic effect of the policies is the sum of changes in net government cost, producer surplus and consumer surplus. However, the sum provides no simple observable areas in the various figures, as was the case with the fertiliser subsidy policy alone. Nevertheless, the separate effects are summarised in Table 6.1. Also shown there is the overall surplus impact on overseas markets of the two domestic policies. The net loss overseas is AYA' minus E'F'G' in Figure 6.4. In this instance it is possible that this overseas effect is a net gain. This would be the case if the subsidised exports from Indonesia were sufficient to drive down international prices to the position where overseas consumer gains exceeded overseas producer losses. If, however, this net overseas effect is a large loss, it is again possible that there would be a net domestic gain from the operation of the fertiliser subsidy and floor-and-ceiling price policies.

6.4 Elaboration of the Model to Include Other Food Commodities

The analytical description of the previous section has been presented as if the policies under consideration had an impact only on rice. More realistically, policy effects on the other seven food commodities which are included in the model must be assessed. In this context, each crop is influenced by both direct and indirect effects. The direct effects occur as a result of the fertiliser subsidy, which makes the application of fertiliser cheaper not only for rice, but for all crops. The indirect effects occur as the policy-induced price of one crop makes it more competitive in production or consumption than others. For example, maize production may suffer as a result of the producer price support afforded rice through the floor-and-ceiling price scheme. Likewise, maize consumption may

decline as a result of a lower consumer price of rice.

Diagrammatic representation of these commodity-by-commodity interactions becomes cumbersome and the more elegant mathematical representation is preferred. A system of seven supply and eight demand equations is used to achieve this representation (there is one fewer supply equation because wheat, although consumed, is not produced in Indonesia). In contrast to the description provided in Section 6.2, each of the supply equations has quantity dependent on the price of all the commodities in the model and the price of fertiliser. The demand equations also have quantity as the dependent variable. Quantity demanded responds to price of all the other commodities, and the level of income measured by real gross domestic product.

The food-crop model is described in the following set of equations.

$$(6.1)\quad q_{si} = b_o + b_i p_i + b_j p_j + b_k p_k \quad j = 1, \ldots, n;\ k = 1,\ldots m$$

$$(6.2)\quad q_{di} = c_o + c_i p_i + c_j p_j + c_y y \quad j = 1, \ldots, n$$

The variables q_{si} and p_i are quantity supplied and price, respectively, of commodity i (i=1,...,8); the p_j are prices of other crops; and the p_k are input prices. On the demand side, q_{di} is the quantity demanded of commodity i and y is income.

Together, equations 6.1 and 6.2 amount to a system of 15 equations with 15 independent endogenous and eight exogenous variables. The exogenous variables are either policy instruments (like rice price) or heavily influenced by international prices under a small-country assumption (like soybean price). The list of exogenous variables is: GDP per capita, producer price of rice, consumer price of rice, and prices of maize, cassava, soybean, wheat and fertiliser.

These equations define the data needs of the analysis. To make the model operational requires a set of demand, supply and income elasticities together with base period prices and quantities for each commodity. Tables 6.2 to 6.7 outline the current base values for each year from 1985 to 1988 together with a description of sources. Given uncertainty about the value of the elasticities, sensitivity analysis is a key component of any policy appraisal.

Having established this multicommodity model for each of the above four years, there are several alternative methods by which policy appraisal can proceed. In general two have been applied and these are now described.

First, observing that the base model solution incorporates the actual policies being pursued, it is possible to compare this solution with another which removes all policies. This would be an analysis conceptually similar to that presented in Section 6.2, but for the multicrop case. Such an analysis would show gains and losses across the various groups in

society (by commodity or in aggregate) which result from the Indonesian food price policies.

Second, using the base model solution as a starting point, it is possible to adjust the policy instruments marginally and produce a second solution showing, by comparison, the effects of such marginal shifts. Given that a primary target of the Indonesian food policy during the period under consideration was the maintenance of self-sufficiency in rice, the policy appraisal that is presented in the next chapter examines alternative marginal shifts in policy which all would achieve this target.

Table 6.1. Surplus effects of combined policies (areas refer to Figure 6.4 unless otherwise stated).

Component of net social benefit	Measurement area
Net Government cost	K'L'MN'(Figure 6.5) + WSS'U'UW'
Producer gain	VSFG – ACVR
Consumer gain	ABUT
Overseas loss	AYA' – E'F'G'

Table 6.2. The major food crops : 1985.

Commodity	Wholesale price (Rp/kg) (1)	Floor price (Rp/kg) (2)	Area ('000 ha) (3)	Yield (t/ha) (4)	Production ('000 t) (5)	Consumption ('000 t) (6)
Rice (milled)	360.85	175.00	9 902	3.9(b)	24 316	23 987
Maize	208.34	110.00	2 440	1.77	4 330	4 375
Cassava	59.93	–	1 272	10.9	14 057	12 496
Sugar (refined)	604.17	–	273	91.2(c)	1 677	1 854
Groundnut	1 181.90	(a)	510	1.04	528	545
Soybean	508.35	300.00	896	0.97	870	1 143
Sweet potato	70.53	–	256	8.4	2 161	2 161
Wheat	217.75	–	–	–	–	1 317

(a) Floor price for groundnut last set at Rp425/kg on 1 November 1981.
(b) Yield in gabah (threshed paddy).
(c) Yield in sugar cane.

Fertiliser price: Rp100/kg (Hobohm 1987, p. 25).
GDP 1985: Estimate Rp80 119.6 billion, constant prices (BPS National Income of Indonesia 1984–1987, Table 2).

Sources: Col. 1 : Wheat, cif price, Tabor et. al. (1988, p.261). All others BPS Harga Perdagangan Besar di Jakarta, Triwulan 2, 1989 (Jakarta Wholesale Prices). For rice, see Table 2, Col. 7.
Col. 2 : BULOG: Statistik Bulog, 1969–1984; Statistik Bulog, 1969–1987.
Col. 3–5 : BPS Buletin Ringkas, December 1987 and Food Balance Sheet 1985; FAO Production Yearbook 1986, Vol. 40, p.161 for sugar.
Col. 5–6 : BPS Food Balance Sheet 1985.

Table 6.3. The major food crops: 1986.

Commodity	Wholesale price (Rp/kg) (1)	Floor price (Rp/kg) (2)	Area ('000 ha) (3)	Yield (t/ha) (4)	Production ('000 t) (5)	Consumption ('000 t) (6)
Rice (milled)	431.15	175.00	9 988	4.0(b)	24 744	25 162
Maize	206.54	110.00	3 143	1.88	5 920	5 984
Cassava	64.28	–	1 170	11.4	13 312	12 094
Sugar (refined)	622.22	–	303	86.5(c)	2 024	1 942
Groundnut	1 141.00	(a)	601	1.10	642	676
Soybean	641.66	300.00	1 254	0.98	1 227	1 602
Sweet potato	70.96	–	253	8.3	2 091	2 091
Wheat	217.23	–	–	–	–	1 610

(a) Floor price for groundnut last set at Rp425/kg on 1 November 1981.
(b) Yield in gabah (threshed paddy).
(c) Yield in sugar cane.

Fertiliser price: Rp125/kg from 3 April 1986 (Hobohm 1987, p. 25).
GDP 1986: Estimate Rp83 318.2 billion, constant prices (BPS National Income of Indonesia 1984–1987, Table 2).

Sources: Col. 1 : Wheat, cif price, BPS Buletin Ringkas, March 1987, p. 72, converted at Triwulan 2, 1989 (Jakarta Wholesale Prices). For rice, see Table 2, Col. 7.
Col. 2 : BULOG: Statistik Bulog, 1969–1984; Statistik Bulog, 1969–1987.
Col. 3–5 : BPS Buletin Ringkas, December 1987 and Food Balance Sheet 1986 ; FAO Production Yearbook 1988, Vol. 42, p. 207 for sugar.
Col. 5–6 : BPS Food Balance Sheet 1986.

Table 6.4. The major food crops : 1987.

Commodity	Wholesale price (Rp/kg) (1)	Floor price (Rp/kg) (2)	Area ('000 ha) (3)	Yield (t/ha) (4)	Production ('000 t) (5)	Consumption ('000 t) (6)
Rice (milled)	489.58	190.00	9 922	4.0(b)	24 970	24 990
Maize	267.56	110.00	2 626	1.96	5 155	5 373
Cassava	76.53	–	1 222	11.7	14 356	13 206(d)
Sugar (refined)	646.16	–	335	86.0(c)	2 128	2 087
Groundnut	1 250.94	(a)	551	0.97	533	579
Soybean	756.68	300.00	1 101	1.06	1 161	1 420
Sweet potato	82.48	–	229	8.8	2 013	2 013
Wheat	237.62	–	–	–	–	1 664

(a) Floor price for groundnut last set at Rp425/kg on 1 November 1981.
(b) Yield in gabah (threshed paddy)
(c) Yield in sugar cane
(d) Net gaplek (dried cassava) imports converted back to cassava at rate 0.36.

Fertiliser price: Rp125/kg (Economist Intelligence Unit, Country Report Indonesia, No.1,1988, p.31)
GDP 1987: Estimate Rp86 307.1 billion, preliminary figure, constant prices (BPS National Income of Indonesia 1984–1987, Table 2).

Sources: Col. 1 : Wheat, cif price, BPS Buletin Ringkas, March 1988, p.55, converted at exchange rate Rp1644 = US$. All others BPS Harga Perdagangan Besar di Jakarta, Triwulan 2, 1989 (Jakarta Wholesale Prices). For rice, see Table 2, Col. 7.
Col. 2 : BULOG: Statistik Bulog, 1969–1984; Statistik Bulog, 1969–1987.
Col. 3–5 : BPS Buletin Ringkas, March 1989 and Food Balance Sheet 1987 (forthcoming); FAO Production Yearbook 1988, Vol. 42, p. 207 for sugar.
Col. 5–6 : BPS Food Balance Sheet 1987 (forthcoming).

Table 6.5. The major food crops : 1988.

Commodity	Wholesale price (Rp/kg) (1)	Floor price (Rp/kg) (2)	Area ('000 ha) (3)	Yield (t/ha) (4)	Production ('000 t) (5)	Consumption ('000 t) (6)
Rice (milled)	504.68	210.00	10 138	4.1(b)	25 975	26 770
Maize	303.59	125.00	3 406	1.95	6 652	6 678
Cassava	99.97	–	1 303	11.9	15 471	14 552(d)
Sugar (refined)	726.00	–	324	99.0(c)	2 175	2 133
Groundnut	1 676.38	(a)	608	0.97	589	617
Soybean	877.22	325.00	1 177	1.08	1 270	1 785
Sweet potato	119.32	–	248	8.7	2 159	2 159
Wheat	239.56	–	–	-		1 649

(a) Floor price for groundnut last set at Rp425/kg on 1 November 1981.
(b) Yield in gabah (threshed paddy)
(c) Yield in sugar cane
(d) Net gaplek (dried cassava) imports converted back to cassava at rate 0.36.

Fertiliser price: Rp135/kg (Economist Intelligence Unit, Country Report Indonesia, No.1 1988, p. 31).
GDP 1988: Estimate Rp90 450 billion, constant prices, based on Economist Intelligence Unit, Country Report Indonesia, No. 3, 1989, p. 2 estimate of 4.8% real growth rate of GDP for 1988.

Sources: Col. 1 : Wheat, cif price, BPS Buletin Ringkas, March 1989, p. 58, converted at exchange rate Rp1686 = US$. All others BPS Harga Perdagangan Besar di Jakarta, Triwulan 2, 1989 (Jakarta Wholesale Prices). For rice, see Table 2, Col. 7.
Col. 2 : BULOG: Statistik Bulog, 1969- 1984; Statistik Bulog, 1969- 1987.
Col. 3–5 : BPS Buletin Ringkas, October 1989 and Food Balance Sheet 1988 (preliminary figures); FAO Production Yearbook 1988, Vol. 42, p. 207.
Col. 5- 6 : BPS Food Balance Sheet 1988 (preliminary figures).

Table 6.6. Demand elasticities used for cross-commodity analyses.

	Rice	Corn	Cassava	Sugar	Gr. nut	Soybean	Sw. pot.	Wheat	Income
Rice	–0.60	0.04	0.03	0.02	0.03	0.03	0.02	0.04	0.36
Corn	0.34	–0.80	0.28	0.02	0.02	0.03	0.03	0.04	0.01
Cassava	0.10	0.15	–0.55	0.02	0.05	0.04	0.14	0.02	0.01
Sugar	0.04	0.02	0.02	–0.70	0.02	0.04	0.02	0.02	0.59
Gr. nut	0.05	0.05	0.05	0.02	–1.00	0.10	0.03	0.02	0.65
Soybean	0.08	0.04	0.04	0.03	0.12	–0.90	0.02	0.03	0.50
Sw. pot.	0.01	0.05	0.10	0.01	0.02	0.01	–0.25	0.01	0.01
Wheat	0.12	0.04	0.01	0.02	0.01	0.02	0.01	–0.80	0.55

Table 6.7. Supply elasticities used for cross-commodity analysis.

	Rice	Corn	Cassava	Sugar	Gr. nut	Soybean	Sw. pot.	Fertiliser
Rice	0.30	–0.05	–0.01	–0.02	–0.01	–0.02	–0.01	-0.15
Corn	–0.12	0.50	–0.02	–0.02	–0.02	–0.02	–0.02	-0.20
Cassava	–0.08	–0.01	0.20	0.00	0.00	0.00	–0.02	-0.05
Sugar	–0.02	–0.02	0.00	0.30	0.00	0.00	0.00	-0.15
Gr. nut	–0.01	–0.02	0.00	0.00	0.40	–0.02	0.00	-0.10
Soybean	–0.02	–0.02	0.00	0.00	–0.02	0.40	0.00	-0.15
Sw. pot.	–0.01	–0.02	–0.02	0.00	0.00	0.00	0.25	-0.05

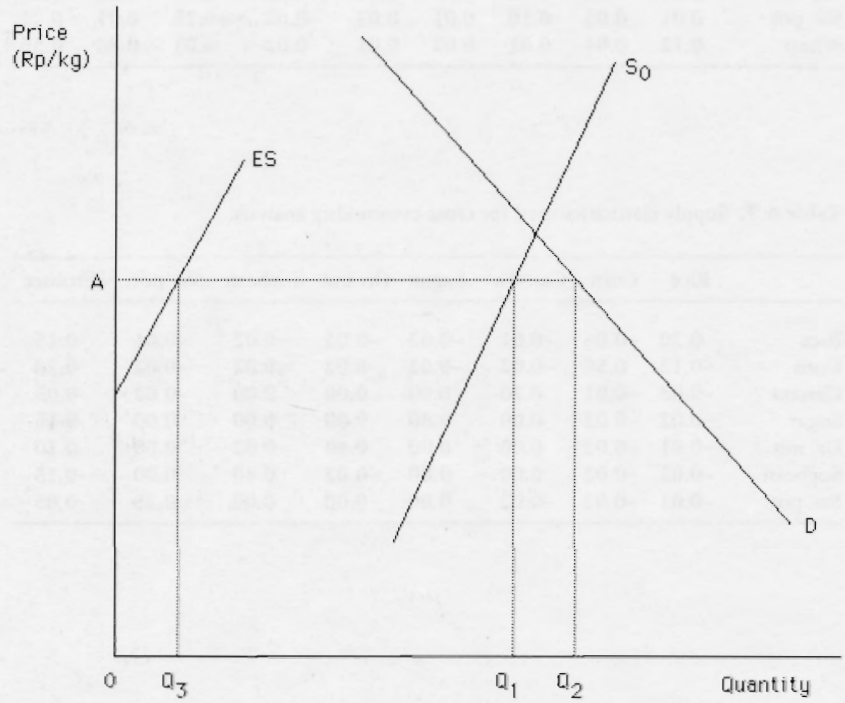

Figure 6.1. The Indonesian rice market with no policy intervention.

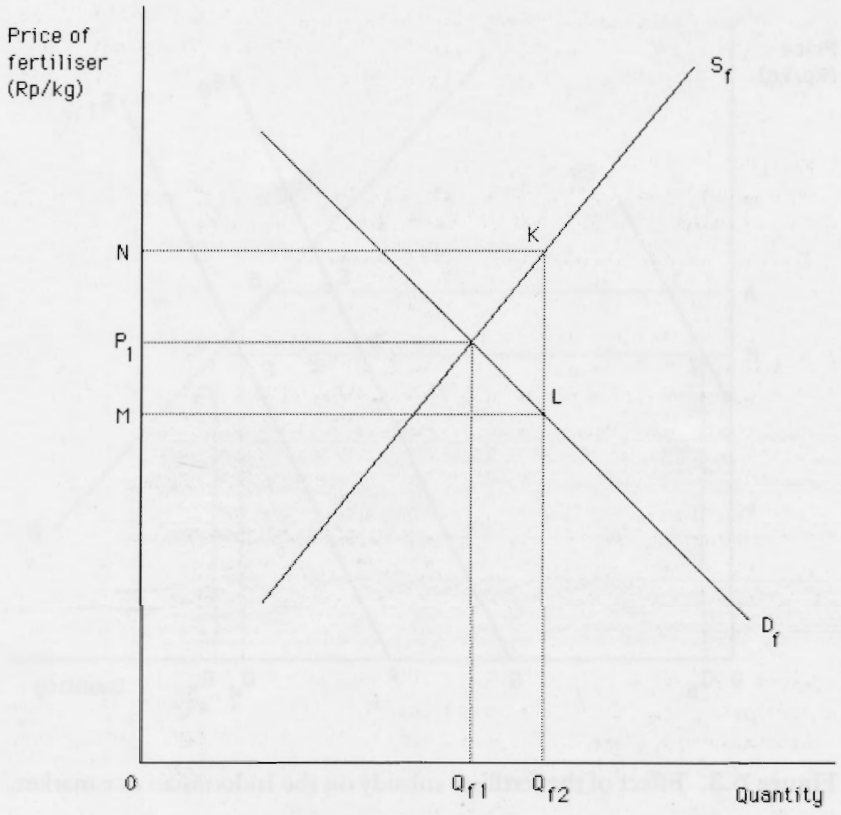

Figure 6.2. The effect of the fertiliser subsidy on the fertiliser market with no price support for rice.

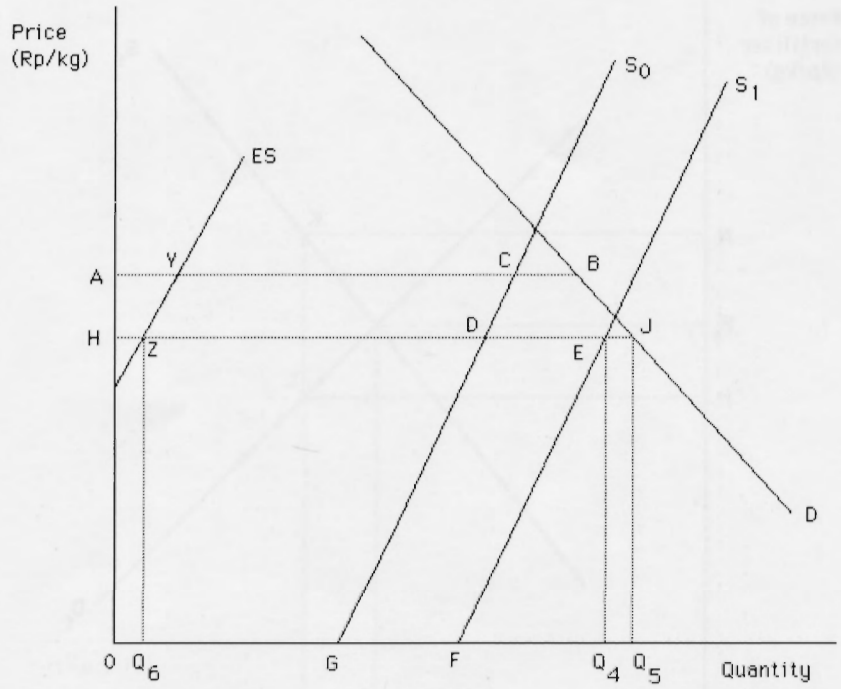

Figure 6.3. Effect of the fertiliser subsidy on the Indonesian rice market.

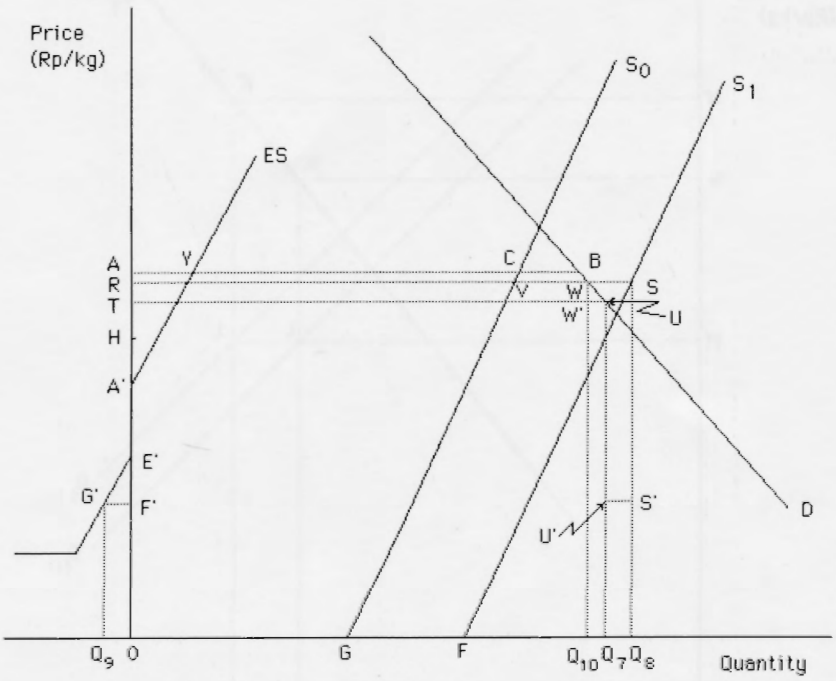

Figure 6.4. The Indonesian rice market with fertiliser subsidy and floor-and-ceiling price policies.

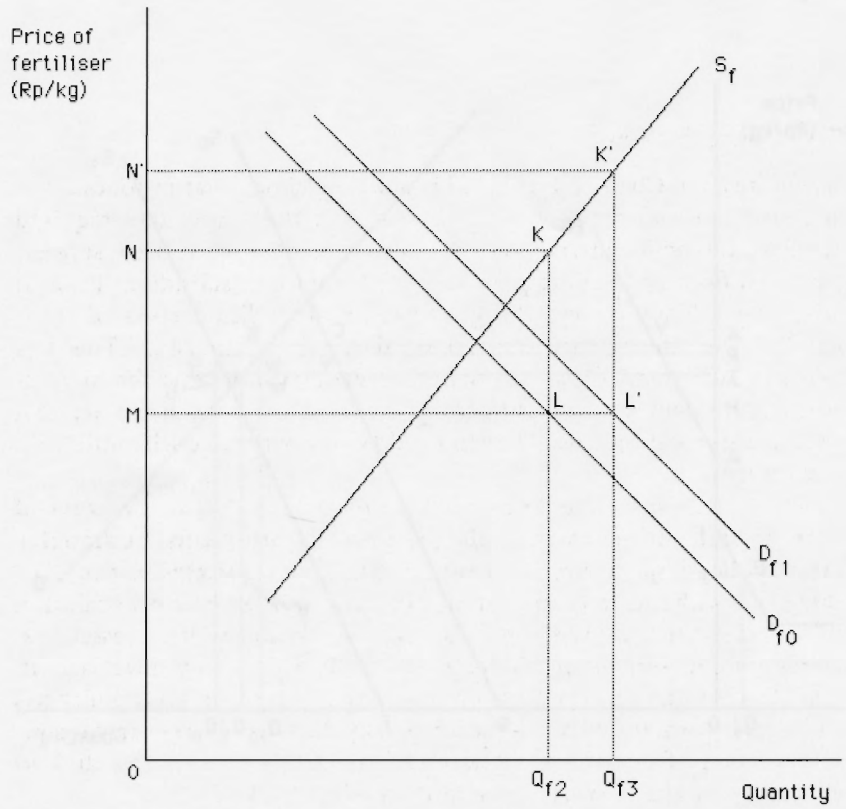

Figure 6.5. The impact in the fertiliser market of a floor-and-ceiling price policy in conjunction with a fertiliser subsidy.

7 Policy Evaluation

7.1 Introduction

As discussed in Chapter 4, in 1985 it was proclaimed that Indonesia had achieved self-sufficiency in rice. To achieve this target had required considerable policy intervention in terms of both output price support (through floor-and-ceiling price schemes) and input subsidies. Prior to achieving self-sufficiency, the government expenditure costs of these policies (and the welfare costs) tended to be overlooked. This was perhaps understandable given the high level of revenues that the Indonesian Government was collecting from taxes on oil and the desire to attain the morale-boosting reward which would come when rice self-sufficiency was achieved.

Since 1985 there has been some introspection about the costs of achieving self-sufficiency using the price policy instruments. Although a prime policy objective remains one of balancing increases in rice consumption with increases in output, emphasis is now given to achieving this at minimum government cost, with minimum welfare losses and with minimum disruption elsewhere in the economy. In this last regard, there has been an acknowledgment that past rice price support policy has had a detrimental effect on the secondary food crops by drawing resources away from them. The desire is now to avoid this and to encourage production and consumption of these crops.

This chapter reports on the application to these issues of the price policy model described in Chapter 6. Of particular interest was discovering a mix of policies which would come closest to achieving the various targets. Given that Indonesia can expect rice consumption to continue to expand for some time to come, a significant finding is that considerable Government expenditure will be required to encourage output expansion in order to match this growth in consumption.

7.2 Background

Since the start of the system of five-year national plans in 1969, the food-producing sector has received special attention. At first this was because growth in agriculture was essential if overall economic growth was to be achieved. Though still a significant sector of the economy, accounting for just over 25% of GDP in 1986 (BPS 1987), alternative goals relating

to employment and self-sufficiency became predominant during the period 1972 to 1985.

The years 1972 and 1973 saw instability in international commodity markets associated with a four-fold increase in crude-oil prices. Although there were gains to Indonesia as an exporter of oil, some turbulence was transmitted to the domestic economy, and especially the Indonesian policy-making process.

First, foreign exchange earnings increased and this led to domestic money supply creation. This would probably have created a larger inflationary problem had the Government not restrained its own fiscal activity by maintaining a budget surplus. Another effect of the international oil price increases was to increase the Indonesian Government's revenue from taxation on oil companies. This was to enable it to increase its development expenditure, especially in agriculture, while maintaining the budget surplus.

Next, the world rice market suffered a severe shortage in 1973 and 1974. Despite having the required foreign exchange from the sales of oil, Indonesia was unable to purchase sufficient imports of rice as its major supplier, Thailand, restricted exports (Timmer 1986, p. 5). A significant effect of this was to stimulate a new drive on the part of policy decision-makers in Indonesia for domestic food security and especially for self-sufficiency in rice. The policy response was to establish both output price supports in the form of higher floor prices for rice producers and input subsidies across a number of purchased inputs. These have continued as the main thrusts of agricultural policy. One consequence of these policies has been the achievement of self-sufficiency in rice in 1985, and the continuation of production at close to self-sufficiency since.

Events of the early 1980s combined to alter the set of policy objectives further. Falling international prices of oil meant that the country faced severe balance of payments problems throughout the decade. In addition, Government expenditure has been constrained as oil revenues have fallen. As a result some development projects have been deferred, and overall economic growth has been less than it would otherwise have been. Sundrum (1988, p. 37) estimates the rate of economic growth as 2.9% per annum between 1981 and 1986. This compares with an annual average growth rate of 7.7% from 1967 to 1981.

Throughout this unstable period, food security and the attainment of self-sufficiency in rice remained a dominant objective. In each year between 1977 and 1984 producer support prices for rice were increased in real terms. In addition, substantial subsidies for fertiliser were continued. These policies were a considerable drain on the budget at a time of restricted Government revenue. It is clear that the attempt to achieve rice self-sufficiency was being given priority.

Since 1985, when rice output first exceeded rice consumption, there has been continuing questioning about the level of support given to rice producers. Apart from the problem of finding the required level of

finance to support the policy, there has been concern that agricultural resources were being drawn away from the production of the *palawija*. The policy stance towards the *palawija* was one of neglect in comparison to the enormous policy efforts devoted to rice. However, following the attainment of self-sufficiency in rice, there have been reductions in real producer prices of rice and in the level of fertiliser subsidies. One effect has been to encourage *palawija* production (EIU 1989, p. 22) while rice output has continued to grow. Another is that Government expenditure, particularly on fertiliser subsidies, is expected to fall considerably.

Currently, there are several sub-strands to the Government's growth policy. There are continuing attempts to reduce dependence on oil both as a foreign exchange earner and as a contributor to the budget. This has achieved partial success as exports of commodities like manufactured timber products have expanded. However, oil remains the dominant export product. Second, the Government has been encouraging foreign investment, and Schwarz (1989, p. 74) argues that the flow of funds from abroad, particularly into investments in the manufacturing sector, has 'helped rescue GDP growth from mid-decade stagnation'.

Such efforts have partly directed attention away from the food production sector. However, with consumption of rice increasing as the population and income levels increase, the self-sufficiency must be regarded as fragile. The policy stance is one of attempting to keep output expanding while keeping Government expenditure on food policy programs to a minimum. This is a fairly difficult path to follow given the size of the food-producing sector. In addition, despite significant recent employment growth in the manufacturing sector, the Government must ensure that farm incomes are kept high enough for agriculture to absorb labour.

7.3 Policy Evaluation

In this section, an evaluation of food price policy based on the food-crop model is described. After describing the base policy situation in 1988, an analysis of the policies pursued by the Indonesian Government from 1985 to 1988 is completed. This policy analysis has three components. First, the net social costs and Government costs are revealed by comparing model solutions with and without the policies that were actually pursued. Second, there is an evaluation of the net social and Government costs of achieving the rice self-sufficiency levels of 1985 to 1988, but by different levels of the policy instruments. Third, the unconstrained maximisation of net social benefit using fertiliser subsidy policy is described.

7.3.1 The policy situation 1985 to 1988

Since proclamation of rice self-sufficiency in 1985 production and con-

sumption have expanded in parallel, with the country maintaining a small deficit or surplus year by year. Except for sweet potatoes, the other food crops considered in the analysis showed an upward trend in production with yields also increasing in general (see Table 7.1). At face value, given that overall production of these food crops has been expanding more rapidly than population growth, this seems a favourable outcome. However, within the Indonesian Government there has been some concern about the fiscal costs of the policies that have been adopted to achieve this outcome. In particular, the fertiliser subsidy policy has received close scrutiny.

In 1985–86 the cost of fertiliser subsidies is estimated to have been about 42% of total development expenditures for agriculture and irrigation (World Bank 1987, p. 16). The actual costs for the fiscal years 1985–86 to 1987–88 were Rp 477 billion, Rp 467 billion and Rp 756 billion respectively (BPS 1989). The response to this problem was threefold. There were some minor attempts to improve the efficiency of fertiliser distribution and marketing. Second, prices to farmers have been increased, but again this was only a marginal change. Third, it was decided to finance the fertiliser subsidy from sources outside the budget. This last adjustment is the one which has the largest potential effect on reducing the budget cost of the fertiliser subsidy. It achieves this by deferring payment of subsidies to the State-run fertiliser factories, and permitting the factories to finance losses by borrowing from the banks (Booth 1988). Thus, given that farmers pay the same price as previously for fertiliser, a component of the Government's current budget deficit is transferred to the fertiliser factories for longer-term financing.

The wholesale market situation for rice, the main food crop, in 1988 is shown in Figure 7.1. The picture is fairly representative of the four years of our survey in which there was either a small surplus or a small deficit in rice production. The domestic demand and supply curves take these positions under the influence of the fertiliser subsidy and price support policies. The quantity A (=25.97 million tonnes) was produced and B (=26.77 million tonnes) was consumed. The difference of 0.79 million tonnes consisted of imports and stock changes. The close-to-self-sufficiency position was maintained by a domestic price regime above the international market, with BULOG importing rice at a price roughly 52% of the average domestic price. This type of relationship between domestic and international prices has been maintained between 1985 and 1988 so that BULOG has been collecting an implicit import tax in the rice-deficit years and paying an implicit export subsidy in the rice-surplus years.

In the first part of the analytical work the effects of the policies that were followed by the Indonesian Government between 1985 and 1988 were estimated. Figure 7.2 provides a comparison in the 1988 rice market between the actual situation and the estimated position if all policy intervention had been removed. As a result of removal of the

fertiliser subsidy the supply curve for rice and the other domestically produced food crops shifts to the left. The domestic demand curve for rice shifts right under the influence of the cross-effect of rising prices of other food commodities. Given that price support is removed also, the domestic and intervention prices are equalised at Rp 487.11/kg. and about 4.85 million tonnes of rice are imported.

More details of the effects of the policies that were followed are shown for rice in Table 7.2 and for the secondary food crops in Table 7.3. The general effects for rice are that output was stimulated significantly by the policies (by about 14% in 1988) while demand was lower. The effect on consumption was stronger in the later years as the gap in price between the higher-priced domestically produced rice and imports increased.

Given that there is some uncertainty about the effect of Indonesia's trading in rice on the international market, some alternative estimates were made to assess the importance of different values for the import elasticity of demand. The results of a sensitivity analysis in which the elasticity of import demand was altered from –3.0 to –6.0 are shown in the last section of Table 7.2. Clearly the magnitude of the impact of the price support and fertiliser subsidy policies is dependent on this elasticity. Nevertheless, using either of the elasticity levels, the analysis shows the effects of the policies to have been to stimulate rice production and to reduce consumption.

Table 7.3 shows the effects of fertiliser subsidies and price support for rice on the secondary food crops. The fertiliser subsidy tends to expand production of these crops, while price support for rice tends to reduce production. The analysis reveals that the first of these influences is stronger for all the crops studied; their output being higher in the solutions with the policies included. The crops most strongly affected are maize and soybean.

On the consumption side the influences of the two policies are more complex. For maize, sugar, groundnut and sweet potato the overall impact of the policies is that consumption increases. The dominant underlying effects are the price reductions following output expansion under the influence of the fertiliser subsidy and the cross-price effect of an increase in consumer price of rice. For cassava and soybean, consumption falls as a result of the policies. This is because there is only a small price-reducing effect of the fertiliser subsidy, with price being largely determined by international market influences. Hence, the consumption level of the two crops is determined by a positive cross-price effect as the price of rice rises, and a negative cross-price effect as the prices of other crops fall. Overall, the second effect is larger than the first.

Estimates of the components of net social benefit of the policies that were followed are shown in Table 7.4. Given the number of interactions among commodities that are embedded within the model it is difficult to describe the underlying commodity-by-commodity elements of each of the aggregates. Nevertheless, some commentary on rice is provided

given that it is by far the dominant crop, and effects in the rice market comprise a large proportion of the overall outcome.

In 1985 the domestic price of rice was lower than it would have been if the fertiliser subsidy and price support policies had not been in place. The converse is the situation in the other three years. As a consequence there is a consumer surplus gain in rice (and across all commodities in aggregate) in 1985, but losses in 1986, 1987 and 1988.

The change in producer surplus is positive in each year. It has two components. The first is the positive effect of the shift to the right in the supply function resulting from the fertiliser subsidy. Second, there is a change in producer surplus as a consequence of a change in the level of rice price support. In 1985 this last effect is negative for rice and positive in substitute commodities as the producer price of rice is lower than it would otherwise have been without the policies. In the remaining years the opposite is the situation.

There are two components of the net Government cost. First, the fertiliser subsidy involves a cost equal to the procurement cost from both domestic manufacturers and importers less the subsidised resale price to farmers. Second, there is an export subsidy on rice in 1985 (a cost) and an import tax in 1986, 1987 and 1988 (a revenue) which enables the domestic price of rice to be maintained.

The sum of changes in producer and consumer surpluses and net Government cost resulting from the fertiliser subsidy and price support policies is the net social benefit in Indonesia. Although small in relation to the redistributional effects of the policies, the estimate of net social benefit is actually positive (see the explanation in Section 7.3.3). This benefit to Indonesia occurs as a result of its domestic policy imposing social costs on rice exporting countries. These social costs are indicated in the final row of Table 7.4. They occur because of the fact that the international rice market is a residual market and Indonesia's trading actions in the market have significant influence on the price.

7.3.2 Maintaining self-sufficiency in rice by means of alternative policies

In order to further appraise the policy options available to the Indonesian Government, the policy space close to the set of policies actually followed was examined. That part of the assessment related to reduced fertiliser subsidies is reported here. The policy alternative described maintains the level of self-sufficiency in rice achieved in each of the four years studied by reducing fertiliser subsidies and increasing price support to rice producers. The fertiliser price was adjusted upward by 20% to represent the effect of the Government's attempting to reduce its budget commitment to subsidy expenditures. The response was a fall in rice output which would have reduced the level of self-sufficiency if the second policy of increasing the producer price of rice had not been introduced. A countervailing price support policy which increased

producer prices by about 10.9% was required to maintain self-sufficiency at its original levels year-by-year.

The impact of these policy changes on net Government cost and other significant aggregates is shown in Table 7.5. While the changes do result in reduced fertiliser subsidy costs, there is overall an increase in net Government cost. In other words the policy mix involving a higher proportion of price support and a lower proportion of fertiliser subsidy, while maintaining rice self-sufficiency, is more costly to the Government.

The other major effect of the policy change is a transfer to producers measured by a considerable increase in producer surplus. Overall the policy change amounts to a transfer from the Government to producers, with consumers and the net social benefit being almost unaffected. Given the pressure on the Indonesian Government to constrain its expenditure over the study period, it is easy to see why this policy alternative is unattractive.

An additional unattractive feature of the policy is its negative effect on production of secondary food crops (see Table 7.6). Maize production is affected the most, falling by about 5.5%. On the consumption side the effects of the policy change are slight. Sugar, groundnut and sweet potato, which have a strong price response to the falling supplies, suffer slight falls in consumption. Meanwhile maize, cassava and soybean which have a limited price response have slight consumption increases.

While there are other policy manipulations of this type which can be analysed, they are, for various reasons, not considered feasible. For example, we did assess the impact of reducing fertiliser subsidies while maintaining rice self-sufficiency by increasing both producer and consumer prices of rice. This does in fact reduce the overall net Government cost, because consumers effectively pay for the price support to producers. However, such a policy is not considered politically feasible because it involves additional consumer price increases at a time when substantial price increases have already occurred.

Next, one could consider the opposite type of policies to these; that is, increases in fertiliser subsidies and reductions in price support. Once again, there are political (and administrative) constraints. Lower prices for rice producers could be achieved only if consumer prices also were lowered. Indeed lower prices for producers would automatically flow on to lower consumer prices. It would be impossible to maintain a regime in which low producer prices co-exist with high consumer prices because the Government does not exercise the necessary control over rice marketing. As a consequence, the type of policy adjustment which involves an increase in fertiliser subsidies is one in which both producer and consumer prices are lower. Such a policy would have higher overall Government costs because the increased costs of fertiliser subsidies would not be offset by significant reductions in the cost of price support for rice.

7.3.3 An optimal policy?

A final issue that arises is the concept of the optimal level of fertiliser subsidy if the objective is the unconstrained maximisation of net social benefit. That is, ignoring the effects on foreign exchange saving, the level of self-sufficiency and distributional consequences, is there a fertiliser subsidy policy that maximises net social benefit? To examine this issue, the fertiliser price in the version of the model for 1988 was parameterised, holding all other policies at their original level.

The results for net social benefit and net Government cost are shown in Figure 7.3. In terms of maximising net social benefit, the best option is a fertiliser subsidy policy which involves a fertiliser price higher by about 30% than the actual price in 1988. The remarkable feature of Figure 7.3 is the size of the gradient of the net-benefits-to-the-Government function. This is explained by the fact that, as the level of fertiliser subsidy is reduced, there are both direct and induced benefits to the budget. The cost of the policy is reduced directly, and the induced benefits flow in terms of higher import taxes collected as domestic production falls.

However, the negative aspects of this optimal policy must also be acknowledged. It involves considerable losses to producers (reduction in producers' surplus = Rp 478 billion), relatively small losses to consumers (reduction in consumer surplus = Rp 14 billion), an increase in foreign exchange cost of Rp 676 billion, and a fall in the level of rice self-sufficiency to 90.7% from 97.0%.

7.4 Summary and Conclusions

The overall objective of the research reported here was to assess the impacts of the food policies followed by Indonesia between 1985 and 1988, and to demonstrate the benefits and costs of some alternatives. There were three components of the work. First, by comparing the actual situation with a no-policy scenario, it was shown that the policies followed produced a net social benefit. This arose principally because, by using policies to encourage domestic output, fewer imports of rice were needed so that the international price was forced down. Thus compared with the no-policy position, Indonesia benefited from the lower priced imports.

Second, if maintaining the level of rice self-sufficiency is imposed as the highest level objective, a variety of policy combinations would achieve it. For example, a reduced fertiliser subsidy could be replaced by higher output price support. The alternatives that were examined had virtually no effect on net social benefit. That is, there is a fairly flat net-social-benefit response function in the vicinity of the policies that were actually pursued when the self-sufficiency constraint is imposed.

Third, under an objective of unconstrained maximisation of net social benefit, it is possible to show both that there is an optimal level of the

fertiliser subsidy policy, and that such a policy may have disadvantages in other dimensions. In 1988, the optimal policy was to increase the price of fertiliser by about 30%.

Taken together, these results suggest that the outcomes actually achieved by Indonesian policy makers were encouraging. A balancing of the various objectives would seem to imply that a level of rice output just below self-sufficiency is appropriate. Such a level was achieved in 1986, 1987 and 1988. In this situation, the foreign exchange costs appear reasonable, revenues from import taxes can be raised to finance part of the fertiliser subsidy, and the support policies do not over-encourage rice producers at the expense of secondary food crops.

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Table 7.1. Indexes of output of the major food crops (means of 1983–85=100).

	1985	1986	1987	1988
Rice	104.12	105.96	106.92	111.23
Maize	88.33	120.77	105.16	135.70
Cassava	104.58	99.03	106.80	115.09
Sugar	105.94	127.86	134.34	137.40
Groundnut	103.94	126.38	104.92	115.94
Soybean	120.00	169.24	160.14	175.17
Sweet potato	99.27	92.74	92.47	99.17

Table 7.2. The effect of fertiliser subsidies and price support for rice on production and consumption of rice.

	1985	1986	1987	1988
		('000 t)		
(a) Actual situation				
Production	24 316	24 744	24 970	25 975
Consumption	23 987	25 162	24 990	26 770
Surplus	329	– 418	–20	–795
(b) Situation without fertiliser subsidy and price support				
Production	21 552	21 912	21 529	22 716
Consumption	24 113	25 594	25 946	27 536
Surplus	–2 561	–3 682	–4 417	–4 820
(c) Sensitivity analysis (Situation without fertiliser subsidy and price support, with import demand elasticity increased from –3.0 to –6.0 at Rp330/kg)				
Production	21 017	21 199	20 710	21 829
Consumption	25 170	27 047	27 586	29 366
Surplus	–4 153	–5 848	–6 876	–7 537

Table 7.3. The effect of fertiliser subsidies and price support for rice on production and consumption of secondary food crops ('000 t).

	Actual situation				With policies removed			
	1985	1986	1987	1988	1985	1986	1987	1988
Maize								
Production	4 330	5 920	5 155	6 652	3 673	5 077	4 353	5 673
Consumption	4 375	5 984	5 373	6 678	4 399	5 976	5 305	6 627
Surplus	–45	–64	–218	–26	–726	–899	–952	–954
Cassava								
Production	14 057	13 312	14 356	15 471	13 518	12 848	13 832	14 926
Consumption	12 496	12 094	13 206	14 552	12 692	12 251	13 351	14 722
Surplus	1 561	1 218	1 150	919	826	597	481	204
Sugar								
Production	1 677	2 024	2 128	2 175	1 545	1 879	1 955	2 010
Consumption	1 854	1 942	2 087	2 133	1 722	1 797	1 916	1 968
Surplus	–177	82	41	42	–177	82	39	42
Groundnut								
Production	528	642	533	589	501	610	502	558
Consumption	545	676	579	617	517	644	549	586
Surplus	–17	–34	–46	–28	–16	–34	–47	–28
Soybean								
Production	870	1 227	1 161	1 270	773	1 079	1 024	1 129
Consumption	1 143	1 602	1 420	1 785	1 156	1 617	1 431	1 799
Surplus	–273	–375	–259	–515	–383	–520	–407	–530
Sweet potato								
Production	2 161	2 091	2 013	2 159	2 123	2 057	1 976	2 122
Consumption	2 161	2 091	2 013	2 159	2 123	2 057	1 976	2 122
Surplus	0	0	0	0	0	0	0	0
Wheat								
Consumption	1 317	1 610	1 688	1 588	1 321	1 612	1 683	1 586

Table 7.4. Effect of price support and fertiliser subsidies on producers, consumers, net Government cost and overseas producers (eight crops).

	1985	1986	1987	1988
			(Rp billion)	
Change in producer surplus	734.07	1 053.79	1 692.89	1 628.54
Change in consumer surplus	39.01	–171.24	–598.77	–446.31
Net Government cost	772.65	754.15	1 043.99	939.56
Net social benefit in Indonesia	0.43	128.40	50.13	242.67
Change in surplus abroad	–180.38	–368.02	–536.52	–621.53

Table 7.5. The effect of reducing fertiliser subsidies and increasing rice price support on producers, consumers and government cost (eight food crops).

	1985	1986	1987	1988
			(Rp billion)	
Change in producer surplus	728.03	886.50	1 011.21	1 063.70
Change in consumer surplus	–12.07	–10.25	–7.79	–10.08
Change in net Government cost	698.17	855.83	1 972.01	1 022.77
Change in net social benefit in Indonesia	17.79	20.42	31.41	30.85
Change in fertiliser subsidy costs	–254.99	–309.21	–360.49	–409.00
Change in surplus abroad[1]	+	+	+	+

[1] A small positive change as a result of increased imports of secondary food crops.

Table 7.6. The effect on secondary food crops of reducing fertiliser subsidies and increasing price support for rice while maintaining the level of rice self-sufficiency ('000 t).

	Actual situation				With policies removed			
	1985	1986	1987	1988	1985	1986	1987	1988
Maize								
Production	4 330	5 920	5 155	6 652	4 094	5 597	4 874	6 289
Consumption	4 375	5 984	5 373	6 678	4 382	5 994	5 382	6 689
Surplus	–45	–64	–218	–26	–288	–497	–408	–400
Cassava								
Production	14 057	13 312	14 356	15 471	13 788	13 056	14 080	15 174
Consumption	12 496	12 094	13 206	14 552	12 554	12 151	13 268	14 621
Surplus	1 561	1 218	1 150	919	1 234	905	812	453
Sugar								
Production	1 677	2 024	2 128	2 175	1 638	1 979	2 081	2 127
Consumption	1 854	1 942	2 087	2 133	1 815	1 897	2 040	2 085
Surplus	–177	82	41	42	–177	82	41	42
Groundnut								
Production	528	642	533	589	520	632	525	580
Consumption	545	676	579	617	537	666	571	608
Surplus	–17	–34	–46	–28	–17	–34	–46	–28
Soybean								
Production	870	1 227	1 161	1 270	842	1 187	1 123	1 229
Consumption	1 143	1 602	1 420	1 785	1 146	1 607	1 424	1 790
Surplus	–273	–375	–259	–515	–304	–420	–301	–561
Sweet potato								
Production	2 161	2 091	2 013	2 159	2 150	2 080	2 002	2 148
Consumption	2 161	2 091	2 013	2 159	2 150	2 080	2 002	2 148
Surplus	0	0	0	0	0	0	0	0
Wheat								
Consumption	1 317	1 610	1 688	1 588	1 318	1 611	1 690	1 590

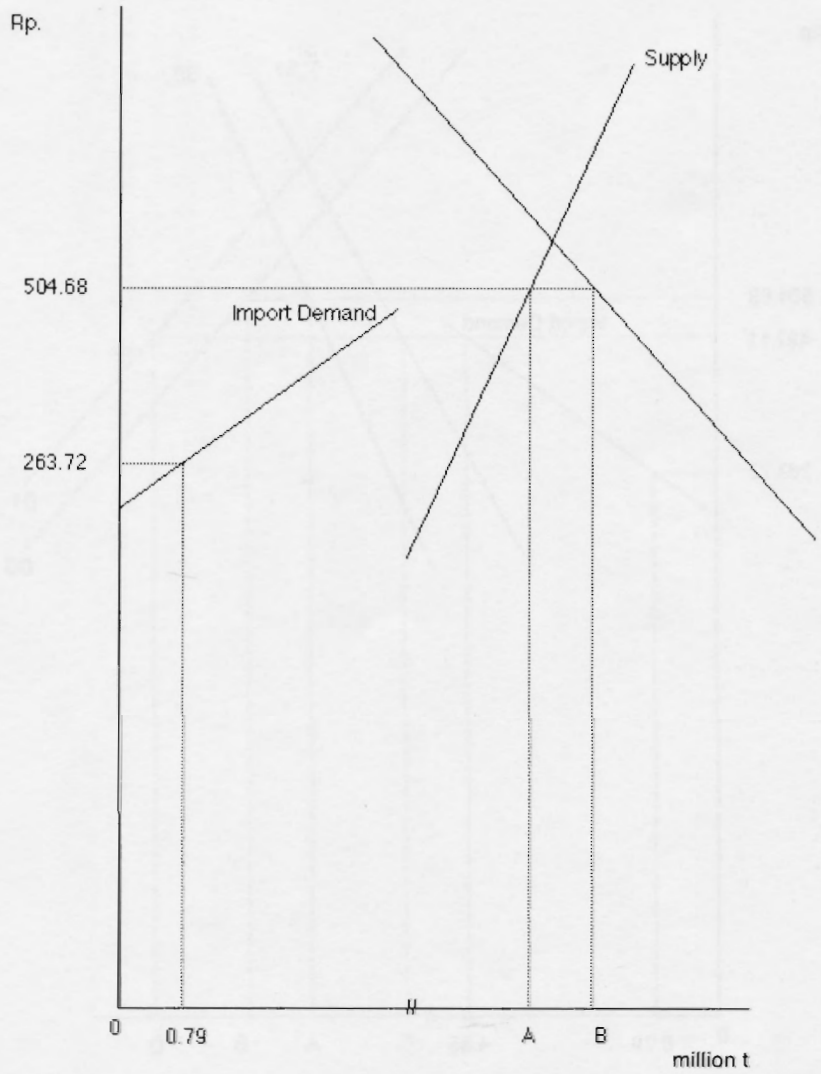

Figure 7.1. The Indonesian rice market in 1988.

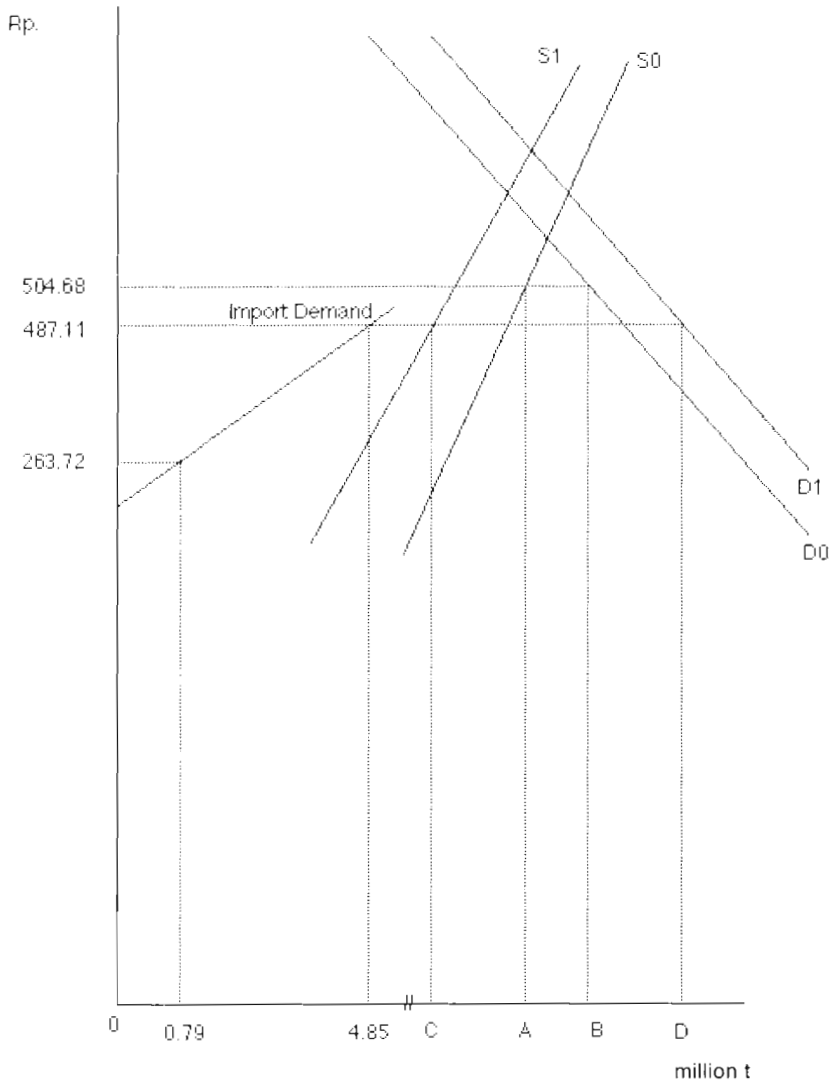

Figure 7.2. Comparison between the actual situation in the rice market in 1988 and a no-policy situation.

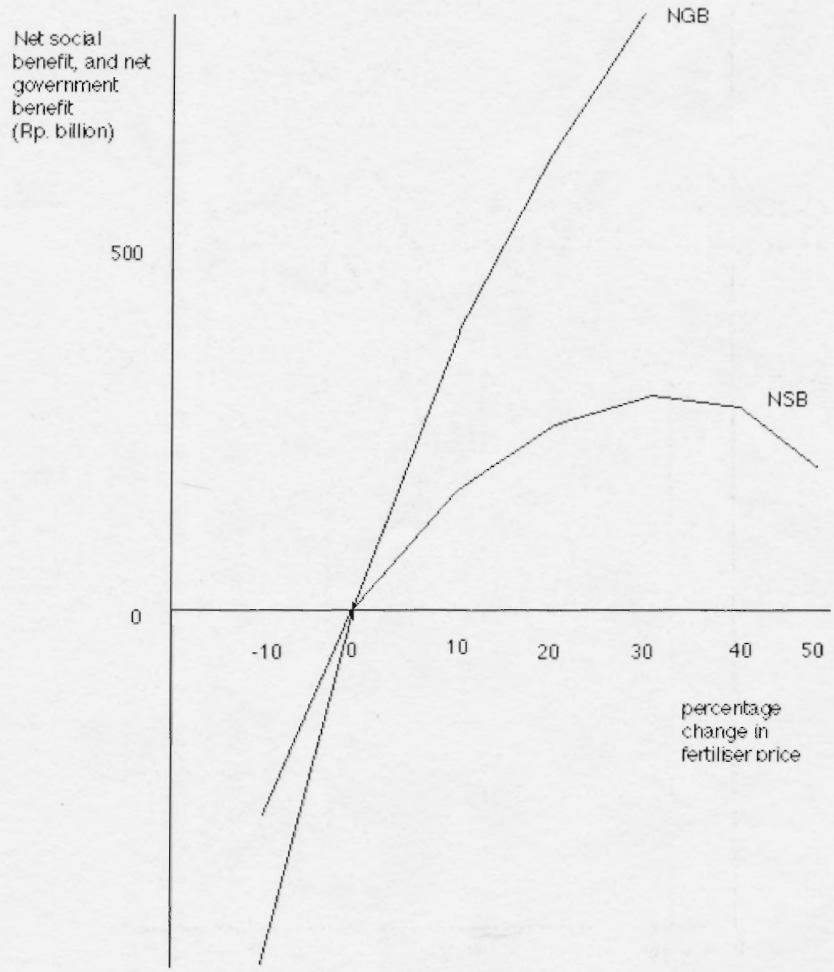

Figure 7.3. Parameterisation of the fertiliser price to find the optimal level of fertiliser subsidy (1988).

8 An Overview

8.1 Summary

The analysis of Chapters 1 and 2 showed that the generally prudent macroeconomic management of the 1970s resulted in steady and substantial growth in the Indonesian economy. The Government's response to the problems of the oil revenue downturn of the 1980s was decisive in terms of tax, trade, financial and investment reform, and reduction in domestic subsidies. This response seemed to maintain economic stability and alter the pace and direction of growth. The longer term will be further influenced by the acknowledgment in Repelita V of the larger role now accorded to the private sector.

Policies directed to the agricultural sector during the 1980s followed the same broad lines as those of the previous decade. There was a growing appreciation of the need to balance rice against secondary crops and initiatives in other sub-sectors, credit policy was restructured, and input policy partially reappraised. While most aspects of macroeconomic policy during the 1980s have been basically sound, there has been some inconsistency between sectoral and macroeconomic policy. Foodgrains and cash crops (smallholder and estate) suffered discrimination and/or benefited from a varying mix of export taxes, exchange rate protection, subsidised inputs, credit and infrastructural support. However, continuing pressure for economy-wide reform is evident, including advocacy of a shift to market-oriented agriculture, and this may ultimately provide for a more coordinated policy approach in the 1990s.

Despite the problems associated with rice in 1986 and 1987, this industry improved its performance in 1988 and 1989, yielding a 3.5% annual growth rate for Repelita IV. This in turn contributed to an annual growth rate of 3.3% for the agricultural sector as a whole for the plan period, a more than adequate result given the circumstances. Within an economy-wide growth target of 5% per annum, Repelita V projects a 3.6% per annum growth rate for the agricultural sector, with cash crops, livestock and fisheries expected to reach between 5.5 and 6.7% per annum, while foodcrops are expected to contribute a more modest 2.8% per annum (rice alone 2.9%).

In Chapter 3 it was shown that each cash crop faces particular restraining factors on either production, export or both. Although there is some use of high-yielding stock and increased awareness of fertiliser (mainly by

estates), there is nowhere near the emphasis on, and usage of, new technology that is now common in rice cultivation.

The livestock sector is unlikely to make significant progress until the forage situation is investigated and improved. Programs of upgrading for both beef and dairy cattle are underway and advice is being sought on all aspects of cattle, sheep, goats and poultry (including overseas advice). However, real progress may await further intensified programs which co-ordinate all the aspects of livestock management (e.g. breeding stock, forage, disease control and marketing).

Timber products have been a large export earner over the years and, although the plywood and veneer industry have just managed to replace the lost revenue from log exports, debate remains about the policy methods chosen to promote the development of the timber industry. Exploitation and appropriate reafforestation policies will be needed if this sector is to continue its contribution well into the future.

Fisheries are providing a small, but growing, contribution to dietary protein and, in addition, one part of the industry (prawns) is contributing strongly to agricultural exports. Provision for future exploitation of this resource, together with appropriate conservation, should ensure that this sector continues to provide for both domestic and export needs. Careful policy coordination will need to be devised to overcome the problems of potential conflict between traditional and modern fishing methods.

Chapter 4 considered at length the relative positions of rice and secondary food crops. The attainment of rice self-sufficiency has brought some appreciation of the need to consider a more diversified food base. The *palawija* crops have been comparatively neglected. Yields are low by neighbouring country standards, and a large number of farmers are reliant solely upon *palawija* for income. Given that the income elasticity of demand for rice in Indonesia has declined and is expected to continue to do so, per capita rice consumption will peak and then decline as consumption diversifies into food with higher income elasticities (e.g. poultry). These foods, in turn, form part of the derived demand for *palawija*, in addition to *palawija's* contribution to basic food needs, nutrition diversity and additional protein. Even so, there are quite challenging problems to be overcome in pressing ahead with foodcrop diversification, while formulating policies which will lead to sustained growth in the rice sector, albeit at a lower level than in the previous decade, and also working within the confines of a substantially reduced budget.

Indonesia has reached the incongruous position where rice yields are among the highest in Asia while *palawija* yields are among the lowest. There are three major constraints involving the *palawija:* (a) socio-economic (consumer resistance and rice preference); (b) infrastructural (roads, shipping, port handling, communications, markets); and (c) technical (seeds, fertilisers, cropping patterns, extension, storage,

drying, credit). Of these three major constraints, the last presents policy-makers with the major challenge.

The review presented in Chapter 5 of recent agricultural sector modelling work showed the complementary relationship between the four models appraised. While different in degree, the general directions of policy prescriptions flowing from these models were similar. However, little information was provided by these previous studies on the relative cost of using alternative policies to achieve self sufficiency targets. The provision of this type of information became the central objective of the ACIAR project. It was the opinion of the leaders of this project that the pioneering work in estimating the underlying demand and supply parameters had progressed far enough, and that a more comprehensive policy analysis was now more appropriate. By integrating the previous estimates into a consistent policy model that measured the impacts of policy changes on (a) social and governmental costs and benefits and (b) the distribution of such costs and benefits, an attempt could be made to obtain a reasonable picture of the trade-offs involved in policy selection.

In Chapters 6 and 7 the modelling work of the current project was described. The overall objective of the economic modelling was to assess the impacts of the food policies that were followed by Indonesia between 1985 and 1988, and to demonstrate the benefits and costs of some alternatives. First, it was shown that the policies followed produced a net social benefit. This arose principally because, by using policies to encourage domestic output, fewer imports of rice were needed so that the international price was forced down. Thus compared with the no policy position, Indonesia benefited from the lower-priced imports.

Second, it was shown that there are a variety of policy combinations that would achieve the self-sufficiency objective. For example, a reduced fertiliser subsidy could be replaced by higher output price support. The alternatives that were examined had virtually no effect on net social benefit. That is, there is a fairly flat net-social-benefit response function in the vicinity of the policies that were actually pursued when the self-sufficiency constraint is imposed.

Third, under an objective of unconstrained maximisation of net social benefit, it is possible to show both that there is an optimal level of the fertiliser subsidy policy, and that such a policy may have disadvantages in other dimensions. In 1988, the optimal policy was to increase the price of fertiliser by about 30%.

Taken together, these results suggest that the outcomes actually achieved by Indonesian policy-makers were encouraging. A balancing of the various objectives would seem to imply that a level of rice output just below self-sufficiency is appropriate. Such a level was achieved in 1986, 1987 and 1988. In this situation, the foreign exchange costs appear reasonable, revenues from import taxes can be raised to finance part of the fertiliser subsidy, and the support policies do not over-encourage rice producers at the expense of secondary food crops.

8.2 Conclusions

There are two significant conclusions of this study related to economic policy in Indonesia, and two significant conclusions related to economic modelling.

With respect to policy, it is clear that, after a period of turbulence during the 1960s, sustained and consistent macroeconomic policy action during the Soeharto period has resulted in economic stability with growth. Even in years when there was instability in oil prices , and hence export revenue, the policy stance successfully prevented instability from adversely affecting the domestic economy.

In general, similar comments can be applied to sectoral policy in agriculture. Over a period from the late 1970s through to 1986 the single goal of self-sufficiency in rice was paramount. Rice price support and fertiliser subsidy policies were applied consistently and self-sufficiency was achieved in 1985. This was a particularly impressive achievement given that Indonesia had been the world's largest net importer only five years earlier.

This leads to the second significant conclusion related to economic policy, namely the difficulty of fine-tuning policy. Since the achievement of rice self-sufficiency at least two other policy considerations have appeared. First, there has been some concern expressed about the government cost of achieving rice self-sufficiency. Second, it has been observed that the secondary food crops have been disadvantaged by the policy support given to rice. Together these concerns led to an attempt to fine-tune the price policy combination during 1986 and 1987. The fertiliser price increased with a reduction in the subsidy afforded it. The problem was that rice output responded more dramatically than expected (perhaps as a result of exogenous effects like pests and the weather in addition to the policy change). As a result, the notion of fine-tuning the policy instruments was called into question. It appears that rice farmers are significantly influenced by price policy, possibly highly responsive to fertiliser prices directly, or to the rice/fertiliser price ratio. Thus, phasing out of subsidies as a first step towards greater economic efficiency in the agricultural sector may need to be more gradual than initially hoped.

Turning to economic modelling issues, two significant conclusions are also observed. First, the situation has been reached where a critical mass of agricultural sector economic modelling has been performed through this project and the others discussed in Chapter 5, so that the basis for sound, pragmatic policy advice based on such models now exists. It would seem reasonable for the Indonesian Ministry of Agriculture to maintain a policy analysis capability based on such models.

The second economic modelling conclusion is an extension of the first. It is that the agricultural sector modelling that has been performed can be usefully augmented both to capture the general equilibrium effects of agricultural policy changes through multisectoral models, and

to show in a more detailed partial equilibrium manner the impacts of policy changes on particular food commodities. Again researchers in the Ministry of Agriculture are well placed to perform such work, given the level of training and experience that many have achieved and given the database that exists.

APPENDIX

Equilibrium Displacement Modelling of the Indonesian Foodcrop Sector

Contents

1. Introduction

The policy analysis outlined in the body of the report is based on an explicit model of supply and demand for a group of Indonesian food commodities. The model was explicit in the sense that a particular functional form was chosen for the supply and demand functions, values for own- and cross-price elasticities were assumed and then parameters of the supply and demand functions were derived utilising base-period price and quantity data. Simulations using the explicit system of equations so derived were then undertaken to explore various policy scenarios.

This approach avoided the need for econometric estimation. Of course, the crucial steps in the approach were assuming that a particular functional form was appropriate and assuming particular elasticity values, although both assumptions were made partly on the basis of previous econometric work. The authors believe that this approach might be used more often in commodity-market analysis in developing countries where the data needed for econometric estimation may be unavailable or, perhaps, highly suspect. In general, the time and resources spent in collecting data and fine-tuning econometric estimates can be a heavy drain on scarce research resources.

A somewhat more general approach to policy evaluation in the absence of a structural econometric model entails making first-order approximations to the quantitative effects of changes in exogenous variables using 'equilibrium displacement modelling'. With this approach, which is essentially comparative static analysis (see, for example, Chiang 1984) one can usually make useful qualitative statements about the effects of policy initiatives and, provided one is content to confine analyses to small (say, 10% or less) changes about an initial equilibrium and provided one is prepared to assume elasticity values, one can make reasonably accurate quantitative estimates of responses to changes in exogenous variables. It differs from the approach adopted in this study in that no assumptions have to be made about functional forms. Rather, the procedure provides a first-order approximation to quantitative effects irrespective of the underlying functional forms.

The procedure is outlined in the next section and a simple numerical example is provided. In the subsequent section the procedure is applied to the Indonesian food-crop model. Some strengths and weaknesses of the procedure are outlined in the final section.

2. The Procedure

Consider the following market model for two commodities, 1 and 2:

$$(1)\quad \begin{cases} D_1 = D_1(P_1, P_2, W) & \text{..... (demand for commodity 1)} \\ S_1 = S_1(P_1, P_2, X) & \text{..... (supply of commodity 1)} \\ D_2 = D_2(P_1, P_2, Y) & \text{..... (demand for commodity 2)} \\ S_2 = S_2(P_1, P_2, Z) & \text{..... (supply of commodity 2)} \\ D_1 = S_1 = Q_1 & \text{..... (commodity 1 market clearance)} \\ D_2 = S_2 = Q_2 & \text{..... (commodity 2 market clearance)} \end{cases}$$

where:

D = quantity demanded;

S = quantity supplied;

P = price;

Q = equilibrium quantity; and

W, X, Y, Z = exogenous influences on supply and demand.

The model defined by equations (1) is a 'general function' model in that no explicit functional forms have been assumed. Too, although there is a unique exogenous variable in each equation, this is merely for convenience and there could in fact be several exogenous variables in each equation, with particular exogenous variables entering into more than one equation.

In equilibrium:

$$(2)\quad \begin{cases} Q_1 = D_1(P_1, P_2, W) \\ Q_1 = S_1(P_1, P_2, X) \\ Q_2 = D_2(P_1, P_2, Y) \\ Q_2 = S_2(P_1, P_2, Z). \end{cases}$$

The system of equations (2) contains four equations and four endogenous variables (Q_1, Q_2, P_1 and P_2).

Equilibrium displacement modelling allows one to examine how changes in exogenous variables affect each endogenous variable after the system has fully adjusted to the changes. In other words, the interest is in general equilibrium impacts. A convenient way of measuring these impacts when only a single exogenous variable changes is through *general equilibrium elasticities*. These elasticities show the percentage change in an endogenous variable associated with a 1% change in an exogenous variable after full adjustment has occurred. They are to be distinguished from Marshallian elasticities which show the percentage change in an endogenous variable associated with a 1% change in an exogenous variable assuming the values of other endogenous variables do not change.

After total differentiation of (2) the following system is obtained:

$$(3)\quad \begin{cases} dQ_1 = (\partial D_1/\partial P_1)\, dP_1 + (\partial D_1/\partial P_2)\, dP_2 + (\partial D_1/\partial W)\, dW \\ dQ_1 = (\partial S_1/\partial P_1)\, dP_1 + (\partial S_1/\partial P_2)\, dP_2 + (\partial S_1/\partial X)\, dX \\ dQ_2 = (\partial D_2/\partial P_1)\, dP_1 + (\partial D_2/\partial P_2)\, dP_2 + (\partial D_2/\partial Y)\, dY \\ dQ_2 = (\partial S_2/\partial P_1)\, dP_1 + (\partial S_2/\partial P_2)\, dP_2 + (\partial S_2/\partial Z)\, dZ. \end{cases}$$

Using the relationship that $dQ_i = Q_i\, d \ln Q_i$, etc. (i.e. the 'ordinary' differential of a variable equals the value of the variable times its log differential), the system can be rewritten as:

$$(4)\quad \begin{cases} Q_1 d \ln Q_1 = (\partial D_1/\partial P_1)\, P_1 d \ln P_1 + (\partial D_1/\partial P_2)\, P_2 d \ln P_2 + (\partial D_1/\partial W)\, W\, d \ln W \\ Q_1 d \ln Q_1 = (\partial S_1/\partial P_1)\, P_1 d \ln P_1 + (\partial S_1/\partial P_2)\, P_2 d \ln P_2 + (\partial S_1/\partial X)\, X\, d \ln X \\ Q_2 d \ln Q_2 = (\partial D_2/\partial P_1)\, P_1 d \ln P_1 + (\partial D_2/\partial P_2)\, P_2 d \ln P_2 + (\partial D_2/\partial Y)\, Y\, d \ln Y \\ Q_2 d \ln Q_2 = (\partial S_2/\partial P_1)\, P_1 d \ln P_1 + (\partial S_2/\partial P_2)\, P_2 d \ln P_2 + (\partial S_2/\partial Z)\, Z\, d \ln Z. \end{cases}$$

Dividing each equation by the Q_i appearing on the LHS and bearing in mind that $(\partial D_i/\partial P_i)\,(P_i/Q_i)$ and $(\partial S_i/\partial P_i)\,(P_i/Q_i)$ are Marshallian demand and supply elasticities, respectively, the system becomes:

$$(5)\quad \begin{cases} d \ln Q_1 = \eta_{11}\, d \ln P_1 + \eta_{12}\, d \ln P_2 + \eta_{1W}\, d \ln W \\ d \ln Q_1 = \varepsilon_{11}\, d \ln P_1 + \varepsilon_{12}\, d \ln P_2 + \varepsilon_{1X}\, d \ln X \\ d \ln Q_2 = \eta_{21}\, d \ln P_1 + \eta_{22}\, d \ln P_2 + \eta_{2Y}\, d \ln Y \\ d \ln Q_2 = \varepsilon_{21}\, d \ln P_1 + \varepsilon_{22}\, d \ln P_2 + \varepsilon_{2Z}\, d \ln Z \end{cases}$$

where:

η_{ij} (ε_{ij}) = price elasticity of demand (supply) for commodity i with respect to commodity j (i, j = 1, 2);

η_{ik}(ε_{ik}) = elasticity of demand (supply) for commodity i with respect to exogenous variable k (i = 1,2; k = W, X, Y, Z).

In matrix form, the system is:

$$(6)\quad \begin{bmatrix} \eta_{12} & \eta_{11} & -1 & 0 \\ \varepsilon_{11} & \varepsilon_{12} & -1 & 0 \\ \eta_{21} & \eta_{22} & 0 & -1 \\ \varepsilon_{21} & \varepsilon_{22} & 0 & -1 \end{bmatrix} \begin{bmatrix} d\ln P_1 \\ d\ln P_2 \\ d\ln Q_1 \\ d\ln Q_2 \end{bmatrix} = \begin{bmatrix} -\eta_{1W} d\ln W \\ -\varepsilon_{1X} d\ln X \\ -\eta_{2Y} d\ln Y \\ -\varepsilon_{2Z} d\ln Z \end{bmatrix}$$

Upon post-multiplying both sides of matrix equation (6) by the vector

$$[1/d\ln W \qquad 1/d\ln X \qquad 1/d\ln Y \qquad 1/d\ln Z]$$

and setting the ratios of log differentials of any two different exogenous variables to zero (e.g. d ln W/d ln X = 0), one obtains[1]

$$(7)\quad E\,G = D$$

where:

$$E = \begin{bmatrix} \eta_{11} & \eta_{12} & -1 & 0 \\ \varepsilon_{11} & \varepsilon_{12} & -1 & 0 \\ \eta_{21} & \eta_{22} & 0 & -1 \\ \varepsilon_{21} & \varepsilon_{22} & 0 & -1 \end{bmatrix}$$

$$G = \begin{bmatrix} d\ln P_1/d\ln W & d\ln P_1/d\ln X & d\ln P_1/d\ln Y & d\ln P_1/d\ln Z \\ d\ln P_2/d\ln W & d\ln P_2/d\ln X & d\ln P_2/d\ln Y & d\ln P_2/d\ln Z \\ d\ln Q_1/d\ln W & d\ln Q_1/d\ln X & d\ln Q_1/d\ln Y & d\ln Q_1/d\ln Z \\ d\ln Q_2/d\ln W & d\ln Q_2/d\ln X & d\ln Q_2/d\ln Y & d\ln Q_2/d\ln Z \end{bmatrix}$$

$$D = \begin{bmatrix} -\eta_{1w} & 0 & 0 & 0 \\ 0 & -\varepsilon_{1x} & 0 & 0 \\ 0 & 0 & -\eta_{2y} & 0 \\ 0 & 0 & 0 & -\varepsilon_{2z} \end{bmatrix}$$

[1] This step is undertaken as an alternative to repeated solution of (6) where each solution is for a change in a single exogenous variable. The general equilibrium elasticities we are seeking show the change in an endogenous variable resulting from a change in a single exogenous variable.

The elements of matrix G are general equilibrium elasticities (recall, for example, that d ln P_1/d ln W = (dP_1/P_1)/(dW/W)). The first now contains the general equilibrium elasticities of P_1 with respect to each of the exogenous variables, where only one exogenous variable changes at a time. Similar interpretations are placed on the elements of the other rows. These general equilibrium elasticities are obtained as:

$$(8) \quad G = E^{-1}D$$

where E^{-1} is the inverse of E.

As an example, suppose the explicit form of the model with equilibrium (market clearing) conditions imposed is:

$$(9) \quad \begin{cases} Q_1 = -0.8\,P_1 + 0.4\,P_2 + 1.4W \\ Q_1 = 0.5\,P_1 - 0.2\,P_2 + 0.7X \\ Q_2 = 0.3\,P_1 - 0.7\,P_2 + 1.4Y \\ Q_2 = -0.4\,P_1 + 0.8\,P_2 + 0.6Z \end{cases}$$

If the initial values of W, X, Y and Z are each 1.0, then in the solution each endogenous variable has a value of 1.0. The Marshallian elasticities computed at the equilibrium values of the endogenous variables and the base values of the exogenous variables are:

η_{11} = –0.8, η_{12} = 0.4, η_{1w} = 1.4;

ε_{11} = 0.5, ε_{12} = –0.2, ε_{1x} = 0.7;

η_{21} = 0.3, η_{22} = –0.7, η_{2y} = 1.4; and

ε_{21} = –0.4, ε_{22} = 0.8, ε_{22} = 0.6.

One could now assume a change in the value of one of the exogenous variables, compute new equilibrium values for the endogenous variables and then compute the general equilibrium elasticity of each endogenous variable with respect to the exogenous variable whose value changed. For example, if W changes from 1.0 to 1.01 (i.e. by 1%) the new solution is:

Q_1 = 1.0056, Q_2 = 0.9996; and

P_1 = 1.0137, P_2 = 1.0064.

The general equilibrium elasticities are therefore:

$$G(P_1,W) = 1.37,\ G(P_2,W) = 0.64;\ \text{and}$$

$$G(Q_1,W) = 0.56,\ G(Q_2,W) = 0.04.$$

This exercise could be repeated for changes in X, Y and Z to build up a complete set of general equilibrium elasticities.

An alternative is to use the comparative static methods outlined in the previous section. By direct substitution of the initial Marshallian elasticities into matrices E and D:

$$E = \begin{bmatrix} -0.8 & 0.4 & -1 & 0 \\ 0.5 & -0.2 & -1 & 0 \\ 0.3 & -0.7 & 0 & -1 \\ -0.4 & 0.8 & 0 & -1 \end{bmatrix}$$

and

$$D = \begin{bmatrix} -1.4 & 0 & 0 & 0 \\ 0 & -0.7 & 0 & 0 \\ 0 & 0 & -1.4 & 0 \\ 0 & 0 & 0 & -0.6 \end{bmatrix}$$

Therefore:

$$G = \begin{bmatrix} 1.3725 & -0.6863 & 0.5490 & 0.2353 \\ 0.6405 & -0.3203 & 1.1995 & -0.5098 \\ 0.5582 & 0.4209 & 0.0366 & -0.0157 \\ 0.0366 & 0.0183 & 0.7320 & 0.2863 \end{bmatrix}$$

$$= \begin{bmatrix} G(P_1,W) & G(P_1,X) & G(P_1,Y) & G(P_1,Z) \\ G(P_2,W) & G(P_2,X) & G(P_2,Y) & G(P_2,Z) \\ G(Q_1,W) & G(Q_1,X) & G(Q_1,Y) & G(Q_1,Z) \\ G(Q_2,W) & G(Q_2,X) & G(Q_2,Y) & G(Q_2,Z) \end{bmatrix}$$

In practice one may need to estimate the change in endogenous variables when several exogenous variables change simultaneously, allowing for general equilibrium effects to occur. For example, how does P_1 change when both W and Y change? In this case it is inappropriate to measure the change in P_1 as an elasticity because more than one exogenous

variable is changing. The alternative is to measure the proportionate change in P_1 (i.e. d ln P_1 or dP_1/P_1) associated with simultaneous proportionate changes in W and Y. This can be approximated as:

$$(10) \qquad dP_1/P_1 = G(P_1,W)(dW/W) + G(P_1,Y)(dY/Y).$$

Returning to the numerical example, suppose the proportionate change in W is .01 and the proportionate change in Y is .03. Setting the values of W at 1.01 and the value of Y at 1.03 in equations (9) and solving the system simultaneously yields a solution set $Q_1 = 1.0067$; $Q_2 = 1.0216$; $P_1 = 1.0302$; and $P_2 = 1.0421$. Hence, the proportionate change in $P_1 = 0.0302$.

It can easily be verified that the proportionate changes in the other endogenous variables can be obtained as the sum of products of total elasticities with proportionate changes (i.e. an equation corresponding to (10) above).

3. The Indonesian Foodcrop Model

The foodcrop model that has been used for policy analysis in this study consists of eight demand functions and seven supply functions as follows:

$$
\begin{aligned}
&D_1 = D_1\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_1 = S_1\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_2 = D_2\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_2 = S_2\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_3 = D_3\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_3 = S_3\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
(11)\qquad &D_4 = D_4\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_4 = S_4\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_5 = D_5\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_5 = S_5\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_6 = D_6\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_6 = S_6\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_7 = D_7\,(P_{1c}, P_2, \ldots, P_8, Y)\\
&S_7 = S_7\,(P_{1p}, P_2, \ldots, P_7, P_9)\\
&D_8 = D_8\,(P_{1c}, P_2, \ldots, P_8, Y)
\end{aligned}
$$

where:

D = quantity demanded; S = quantity supplied; Y = income, P = price; and subscripts 1 to 9 denote commodities (1 = rice; 2 = corn; 3 = cassava; 4 = sugar; 5 = groundnut; 6 = soybean; 7 = sweet potato; 8 = wheat; and 9 = fertiliser).

There are two rice prices: the consumer price (P_{1c}) and the producer price (P_{1p}). Quantities demanded and supplied are determined endogenously, as are the prices of sugar, groundnut and sweet potato. All other variables are treated as being determined exogenously.

The model is closed with the following identities:

$$(12) \quad \begin{cases} D_4 = S_4 = Q_4 \\ D_5 = S_5 = Q_5 \\ D_7 = S_7 = Q_7 \end{cases}$$

The aim is to generate a set of general equilibrium elasticities showing how each endogenous variable responds to a 1% change in each exogenous variable, allowing for general equilibrium effects to occur. The endogenous variables are D_1, S_1, D_2, S_2, D_3, S_3, Q_4, Q_5, D_6, S_6, Q_7, Q_8, P_4, P_5, and P_7 (15 in total) and the exogenous variables are P_{1c}, P_{1p}, P_2, P_3, P_6, P_8, P_9 and Y (8 in total). Having obtained these general equilibrium elasticities, it is a simple matter to derive general equilibrium elasticities for other variables of interest, such as imports and revenues, by appropriate differentiation of identities.

After imposing the equilibrium conditions (12) on (11), total differentiation and conversion to log differentials as in Section 2, the Indonesian foodcrop model can be expressed as :

$$(13) \qquad RS = TU$$

where R (15x15), S (15x1), T (15x8) and U (8x1) are shown in Figures 1 to 4, repectively. Now post-multiply both sides of (13) by V (1x8), where V is as shown in Figure 5, to obtain:

$$(14) \qquad R(SV) = T(UV).$$

After setting the ratio of log differentials of any two different exogenous variables equal to zero, the matrix UV becomes the (8x8) identity matrix. Relative to equation (7), matrix R corresponds to matrix E, matrix SV (15x8) corresponds to matrix G and matrix T corresponds to matrix D. In other words, equation (14) is of the form of equation (7) where E is of dimension (15x15), G is of dimension (15x8) and D is of dimension (15x8).

Values of the Marshallian elasticities needed for equation (14) are obtained from Tables 7.5 and 7.6 in the body of the report. The numerical forms of matrix E (=R), E^{-1}, D (=T) and G (=SV) for the Indonesian foodcrop model are shown in Figures 6 to 9, respectively.

Suppose one wanted to determine the proportionate change in the producer price of rice that would be necessary following some proportionate change in the price of fertiliser assuming the government wished to maintain the same level of rice self-sufficiency, defined as the ratio S_1/D_1 (i.e. the ratio of rice supply to rice demand).

For the self-sufficiency ratio to remain constant, the proportionate changes in rice supply and demand, following changes in producer prices for rice and fertiliser, would need to be equal. That is:

$$(15) \quad dS_1/S_1 = dD_1/D_1$$

where:

$$(16) \quad dS_1/S_1 = G(S_1, P_{1p})\,(dP_{1p}/P_{1p}) + G(S_1,P_9)\,(dP_9/P_9)$$

and

$$(17) \quad dD_1/D_1 = G(D_1, P_{1p})\,(dP_{1p}/P_{1p}) + G(D_1,P_9)\,(dP_9/P_9).$$

After substituting (16) and (17) into (15) and a little manipulation one obtains:

$$(18) \quad dP_{1p}/P_{1p} = [\,|G(D_1,P_9) - G(S_1,P_9)|\,/\,|GS_1, P_{1p}) - G(D_1, P_{1p})|\,]\,(dP_9/P_9).$$

Equation (18) gives the proportionate change in the producer price of rice that is necessary for any proportionate change in the price of fertiliser. From Figure 9:

$$G(S_1, P_{1p}) = 0.29930$$

$$G(S_1, P_9) = -0.15489$$

$$G(D_1, P_{1p}) = 0.00106$$

$$G(D_1, P_9) = 0.00747.$$

Substituting into (18):

$$(19) \quad dP_{1p}/P_{1p} = 0.54439\,(dP_9/P_9).$$

For example, if the government increased the price of fertiliser by 5%, it would have to increase the producer price of rice by 2.72% (= 0.54439 x 0.5 x 100) in order to maintain the existing self-sufficiency ratio. Clearly, many other policy experiments could be conducted using the general equilibrium elasticities provided in Figure 9.

4. Strengths and Weaknesses

Equilibrium displacement modelling is clearly a useful analytical tool that allows the analyst to explore the impacts of changes in exogenous variables. At times the analyst might only be concerned with making qualitative statements about impacts, such as the direction of change in endogenous variables. Sometimes this will be possible just with the usual assumptions about the signs of Marshallian own- and cross-price elasticities and the assumption that Marshallian own-price elasticities exceed (in absolute value) Marshallian cross-price elasticities. Sometimes it will be necessary to make assumptions about the relative sizes of demand and supply elasticities.

To demonstrate, consider applying Cramer's rule to matrix equation (6) assuming W increases (d ln W is positive) while other exogenous variables remain constant (d ln X, d ln Y and d ln Z = 0). It can be easily verified that the solution to d ln P_1 is unambiguously positive assuming η_{1w} is positive, but the sign of d ln Q_2 will be ambiguous unless assumptions are made about the relative sizes of demand and supply elasticities.

Equilibrium displacement modelling can also be used to make quantitative predictions about the impacts of finite changes in exogenous variables in the manner demonstrated in this appendix. Because it is a procedure based on differential calculus, the degree of accuracy of the predictions is inversely related to the size of the exogenous changes being considered. Research by Alston and Wohlgenant (1990) suggests that the predictions will be quite accurate for changes in exogenous variables of 10% or less. If the underlying functional forms are indeed linear then the procedure is exact provided percentage changes in any exogenous variable x are measured as $(x_1 - x_0)/x_0$ where the subscripts 0 and 1 indicate initial and new values, respectively. If percentage changes are measured as d ln x (= ln x_1 – ln x_0) then the procedure will be exact for functional forms that are linear in logs (B. Hurd, pers. comm., 1992).

The authors believe that, given the severity of problems normally encountered in estimating structural econometric models in developing countries, equilibrium displacement modelling provides a convenient alternative which is economical (relative to econometric modelling) in terms of research resources. While it provides only approximations, the same is true for econometric modelling. For example, one never knows 'true' functional forms to use in an econometric model, although one can choose those which appear most appropriate based on any *a priori* information available and statistical tests. The procedures outlined in

this appendix provide first order approximations for any underlying functional form.

Because equilibrium displacement modelling is a form of comparative statics, it can be criticised on the grounds that adjustment paths from one equilibrium to another are ignored. Of course static econometric models also suffer this criticism. The criticism could be overcome to some extent by repeated applications of equilibrium displacement modelling using Marshallian elasticities corresponding to different lengths of run.

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$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\eta_{14} & -\eta_{15} & -\eta_{17} \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{14} & -\varepsilon_{15} & -\varepsilon_{17} \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\eta_{24} & -\eta_{25} & -\eta_{2-} \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{24} & -\varepsilon_{25} & -\varepsilon_{2-} \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\eta_{34} & -\eta_{35} & -\eta_{3-} \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{34} & -\varepsilon_{35} & -\varepsilon_{3-} \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\eta_{44} & -\eta_{45} & -\eta_{4-} \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_{44} & -\varepsilon_{45} & -\varepsilon_{4-} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & -\eta_{54} & -\eta_{55} & -\eta_{57} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & -\varepsilon_{54} & -\varepsilon_{55} & -\varepsilon_{57} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -\eta_{64} & -\eta_{65} & -\eta_{67} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -\varepsilon_{64} & -\varepsilon_{65} & -\varepsilon_{67} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & -\eta_{-4} & -\eta_{-5} & -\eta_{7-} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & -\varepsilon_{-4} & -\varepsilon_{-5} & -\varepsilon_{7-} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -\eta_{84} & -\eta_{85} & -\eta_{8-}
\end{bmatrix}
$$

Figure 1. Matrix R(15 x 15) of equation (13).

$$\begin{bmatrix} d \ln D_1 \\ d \ln S_1 \\ d \ln D_2 \\ d \ln S_2 \\ d \ln D_3 \\ d \ln S_3 \\ d \ln Q_4 \\ d \ln Q_5 \\ d \ln D_6 \\ d \ln S_6 \\ d \ln Q_7 \\ d \ln D_8 \\ d \ln P_4 \\ d \ln P_5 \\ d \ln P_7 \end{bmatrix}$$

Figure 2.
Matrix S(15 x 1)
of equation (13).

$$\begin{bmatrix} \eta_{11} & 0 & \eta_{12} & \eta_{13} & \eta_{16} & \eta_{18} & \eta_{1y} & 0 \\ 0 & \varepsilon_{11} & \varepsilon_{12} & \varepsilon_{13} & \varepsilon_{16} & 0 & 0 & \varepsilon_{19} \\ \eta_{21} & 0 & \eta_{22} & \eta_{23} & \eta_{26} & \eta_{28} & \eta_{2y} & 0 \\ 0 & \varepsilon_{21} & \varepsilon_{22} & \varepsilon_{23} & \varepsilon_{26} & 0 & 0 & \varepsilon_{29} \\ \eta_{31} & 0 & \eta_{32} & \eta_{33} & \eta_{36} & \eta_{38} & \eta_{3y} & 0 \\ 0 & \varepsilon_{31} & \varepsilon_{32} & \varepsilon_{33} & \varepsilon_{36} & 0 & 0 & \varepsilon_{39} \\ \eta_{41} & 0 & \eta_{42} & \eta_{43} & \eta_{46} & \eta_{48} & \eta_{4y} & 0 \\ 0 & \varepsilon_{41} & \varepsilon_{42} & \varepsilon_{43} & \varepsilon_{46} & 0 & 0 & \varepsilon_{49} \\ \eta_{51} & 0 & \eta_{52} & \eta_{53} & \eta_{56} & \eta_{58} & \eta_{5y} & 0 \\ 0 & \varepsilon_{51} & \varepsilon_{52} & \varepsilon_{53} & \varepsilon_{56} & 0 & 0 & \varepsilon_{59} \\ \eta_{61} & 0 & \eta_{62} & \eta_{63} & \eta_{66} & \eta_{68} & \eta_{6y} & 0 \\ 0 & \varepsilon_{61} & \varepsilon_{62} & \varepsilon_{63} & \varepsilon_{66} & 0 & 0 & \varepsilon_{69} \\ \eta_{71} & 0 & \eta_{72} & \eta_{73} & \eta_{76} & \eta_{78} & \eta_{7y} & 0 \\ 0 & \varepsilon_{71} & \varepsilon_{72} & \varepsilon_{73} & \varepsilon_{76} & 0 & 0 & \varepsilon_{79} \\ \eta_{81} & 0 & \eta_{82} & \eta_{83} & \eta_{86} & \eta_{88} & \eta_{8y} & 0 \end{bmatrix}$$

Figure 3. Matrix T(15 x 8) of equation (13).

$$\begin{bmatrix} d\ln P_{1c} \\ d\ln P_{1p} \\ d\ln P_{2} \\ d\ln P_{3} \\ d\ln P_{6} \\ d\ln P_{8} \\ d\ln Y \\ d\ln P_{9} \end{bmatrix}$$

Figure 4.
Matrix U(8 x 1)
of equation (3).

$$\begin{bmatrix} 1/(d\ln P_{1c}) & 1/(d\ln P_{1p}) & 1/(d\ln P_{2}) & 1/(d\ln P_{3}) & 1/(d\ln P_{6}) & 1/(d\ln P_{8}) & 1/(d\ln Y) & 1/(d\ln P_{9}) \end{bmatrix}$$

Figure 5. Matrix V(1 x 8).

1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.02	–0.03	–0.02
0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01
0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.02	–0.02	–0.03
0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.02	–0.05	–0.14
0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.70	–0.02	–0.02
0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	–0.30	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	–0.02	1.00	–0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	–0.40	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	–0.03	–0.12	–0.02
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	–0.01	–0.02	0.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	–0.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	–0.02	–0.01	–0.01

Figure 6. Numerical form of matrix E (15 x 8).

1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02087	−0.02087
0.00000	1.00000	0.00000	0.00000	0.00000	0.00000	−0.02037	0.02037
0.00000	0.00000	1.00000	0.00000	0.00000	0.00000	0.02093	−0.02093
0.00000	0.00000	0.00000	1.00000	0.00000	0.00000	−0.02072	0.02072
0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.02364	−0.02364
0.00000	0.00000	0.00000	0.00000	0.00000	1.00000	−0.00041	0.00041
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.30021	0.69979
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00589	−0.0589
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03220	−0.0322
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	−0.00029	0.00029
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00515	−0.00515
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02037	−0.02037
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.00071	−1.00071
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01474	−0.01474
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02060	−0.02060

(cols 9–15 next table)

Figure 7(a). Columns 1–8 of Matrix E^{-1} (15 x 15).

0.02233	–0.02233	0.00000	0.00000	0.04217	–0.04217	0.00000
–0.00774	0.00774	0.00000	0.00000	–0.02128	0.02128	0.00000
0.01547	–0.01547	0.00000	0.00000	0.06177	–0.06177	0.00000
–0.01518	0.01518	0.00000	0.00000	–0.04174	0.04174	0.00000
0.04010	–0.04010	0.00000	0.00000	0.28335	–0.28335	0.00000
–0.00058	0.00058	0.00000	0.00000	–0.04005	0.04005	0.00000
0.00446	–0.00446	0.00000	0.00000	0.01228	–0.01228	0.00000
0.28605	0.71395	0.00000	0.00000	0.01740	–0.01740	0.00000
0.08684	–0.08684	1.00000	0.00000	0.04650	–0.04650	0.00000
–0.01430	0.01430	0.00000	1.00000	–0.00087	0.00087	0.00000
0.00723	–0.00723	0.00000	0.00000	0.50064	0.49936	0.00000
0.00774	–0.00774	0.00000	0.00000	0.02128	–0.02128	1.00000
0.01488	–0.01488	0.00000	0.00000	0.04092	–0.04092	0.00000
0.71512	–0.71512	0.00000	0.00000	0.04350	–0.04350	0.00000
0.02890	–0.02890	0.00000	0.00000	2.00256	–2.00256	0.00000

Figure 7(b). Columns 9–15 of Matrix E^{1} (15 x 15).

−0.60	0.00	0.04	0.03	0.03	0.04	0.36	0.00
0.00	0.30	−0.05	−0.01	−0.02	0.00	0.00	−0.15
0.34	0.00	−0.80	0.28	0.03	0.04	0.01	0.00
0.00	−0.12	0.50	−0.02	−0.02	0.00	0.00	-0.20
0.10	0.00	0.15	−0.55	0.04	0.02	0.01	0.00
0.00	−0.08	−0.01	0.20	0.00	0.00	0.00	−0.05
0.04	0.00	0.02	0.02	0.04	0.02	0.50	0.00
0.00	−0.02	−0.02	0.00	0.00	0.00	0.00	−0.15
0.05	0.00	0.05	0.05	0.10	0.02	0.65	0.00
0.00	−0.01	−0.02	0.00	−0.02	0.00	0.00	-0.10
0.08	0.00	0.04	0.04	−0.90	0.03	0.50	0.00
0.00	−0.02	−0.02	0.00	0.40	0.00	0.00	−0.15
0.01	0.00	0.05	0.10	0.01	0.01	0.01	0.00
0.00	−0.01	−0.02	−0.02	0.00	0.00	0.00	−0.05
0.12	0.00	0.04	0.01	0.02	−0.80	0.55	0.00

Figure 8. Numerical form of matrix D(15 x 8).

Endogenous variable	Exogenous variable							
	P_{1c}	P_{1p}	P_2	P_3	P_6	P_8	Y	P_9
D_1	−0.59763	0.00106	0.04535	0.03659	0.03394	0.04129	0.38537	0.00747
S_1	−0.00141	0.29930	−0.05285	−0.01335	−0.02196	−0.00077	−0.01543	−0.15489
D_2	0.34223	0.00119	−0.79376	0.28860	0.03331	0.04135	0.03113	0.00777
S_2	−0.00201	−0.12098	0.49519	−0.02618	−0.02307	−0.00114	−0.02064	−0.20671
D_3	0.10578	0.00371	0.17359	−0.51352	0.04859	0.02411	0.05072	0.02172
S_3	−0.00045	−0.08041	−0.01286	0.19516	−0.00049	−0.00042	−0.00098	−0.05212
Q_4	0.01235	−0.01383	−0.00682	0.00770	0.01267	0.00622	0.15313	−0.10391
Q_5	0.01471	−0.00685	0.00148	0.01651	0.01474	0.00601	0.18905	−0.06964
D_6	0.08609	0.00198	0.05062	0.05057	−0.88783	0.03285	0.57301	0.01584
S_6	−0.00074	−0.02016	−0.02107	−0.00083	0.39826	−0.00030	−0.00945	−0.15152
Q_7	0.00557	−0.00482	0.01576	0.04054	0.00608	0.00525	0.01288	−0.02347
D_8	0.12141	0.00070	0.04285	0.01335	0.02196	−0.79923	0.56543	0.00489
P_4	0.04118	0.02057	0.04393	0.02567	0.04222	0.02072	0.51043	0.15364
P_5	0.03678	0.00788	0.05369	0.04127	0.08684	0.01503	0.47263	0.07590
P_7	0.02229	0.02073	0.14303	0.24216	0.02432	0.02102	0.04911	0.10611

Figure 9. General equilibrium elasticities of Matrix G (15 x 8) for the Indonesian Food Model.