

The Rice Market and Its Management in Indonesia

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Introduction

This paper describes the experience of food security interventions in the Indonesian rice market. It covers, first, trends in production, consumption and the aggregate balance of the rice market; second, the mechanisms and record of price stabilisation and public stock management; and third, emerging pressures and problems in the rice intervention system. The paper concludes with a consideration of future constraints and options for rice market management in Indonesia.

The focus in this paper is on aggregate dimensions of food security — total rice output, national rice balance sheet, nationwide price trends, national rice stocks — not on spatial or interpersonal distributional aspects. The picture that the paper presents is therefore incomplete with respect to important aspects of food security in Indonesia, especially those related to the command over food purchase of vulnerable groups like the urban poor or rural landless.

As is fairly well known, Indonesia represents a relative success story in food production and food price stabilisation. In the decade spanning the mid-1970s to the mid-1980s, the country went from being the world's largest food deficit country — importing up to two million tons of rice per year — to becoming self-sufficient in rice at a production level of 25 million tons in 1984. At the same time, and as detailed further below, rice prices were held virtually constant in real terms at a level broadly compatible with import parity criteria, and average rice consumption per person increased by about 30 per cent.¹

It is tempting to suppose that other countries could learn a lot from the Indonesian experience. However, there are several reasons which restrict the likely replicability of the Indonesian model to other situations. One is the crop itself, wetland rice, which has proved much more amenable to sustained and stable increases in yield than have other staple food crops in tropical settings. A second is the sustained political priority which was attached to the achievement of rice self-sufficiency from the mid-

¹ For the interested reader, a fairly encyclopaedic economic account of rice marketing and market management in Indonesia up to the end of the 1970s is provided by Mears (1981).

1960s onwards, which in the Indonesian context of a strong state and a somewhat command style approach to agricultural development implied a quite unusual speed and uniformity in the adoption of new varieties and new farm inputs by farmers.² A third special feature of the Indonesian case was the high level of resources available for rice intensification programmes resulting from the country's position as an oil exporter in the era of windfall gains in state oil revenues in the 1970s.

Thus although the Indonesian case has many features of interest for food security analysis — and doubtless some aspects of relevance for the management of food security elsewhere — the claim is not made in this paper that it represents a model for food security interventions in other parts of the world, and especially not for resource-poor African countries which confront an entire array of different constraints and difficulties.

Rice Market Developments in the 1970s and 1980s

This section is concerned mainly with the production side of Indonesia's drive towards rice self-sufficiency, and with issues in the interpretation of the sources of output growth. The section concludes, however, with a brief review of the consumption side of the rice market and the overall rice balance sheet for Indonesia.

Table 1 summarises the growth of production, area and yield of rice in Indonesia over a period spanned by four 5-year plans (called Repelitas I-IV). Rice output more than doubled from 13 to 27 million tons; the area under rice increased from 8.1 to 9.9 million hectares, a 20 per cent increase; and yields rose from 2.4 to 4.0 tons per hectare, a 65 per cent increase. Some main factors underlying these trends were as follows:

² The use of the term 'command-style' here means that the Indonesian government is sometimes able to achieve by administrative decree what in other countries would not occur in quite the same way if left to variations in individual farmer decisions. An example of this is some 150,000 ha of prime irrigated rice land in Central and East Java which is obligatorily cultivated by farmers to sugarcane even though net returns to this crop are about one fifth of that of rice multi-cropped over the same period [Heytens 1988a: 1988c].

Table 1

Summary Data on Rice Production 1969-87^a

5-Year Plan	Years	Paddy Output '000t	Harvest Area '000 ha	Paddy Yield tons/ha	Rice ^b Output '000t	Rice Yield tons/ha
REPELITA I	1969-73	19,677	8,155	2.41	13,381	1.64
REPELITA II	1974-78	23,443	8,532	2.75	15,941	1.87
REPELITA III	1979-83	31,519	9,068	3.47	21,433	2.36
REPELITA IV ^c	1984-88	39,672	9,915	4.00	26,977	2.72
Per Cent Increase (Rep I-Rep IV)		101.6%	21.6%	66.0%	101.6%	66.0%

^a Average data for each 5-year plan period.

^b The conversion factor of rice from paddy is 0.68.

^c Based on provisional data for 1988.

Source: Biro Pusat Statistik, *Luas Panen, Hasil per Hektar dan Produksi Padi di Indonesia*, data tables.

(a) HYV Adoption. The spread and diffusion of high yielding varieties of rice was very rapid over this historical period, such that by 1987 about 90 per cent of the wetland rice area and 83 per cent of the total rice area was cultivated to HYVs [Heytens 1988b:2]. Moreover, the dominant varieties of HYVs sown have changed several times in this period, for reasons of pest resistance and yield improvement. The maturation period of HYVs currently sown in Indonesia varies between 90 and 115 days, as compared to 150 days and upwards for previously sown rice varieties [Indonesia, Departemen Pertanian 1987].

(b) Multiple Cropping Ratio. This refers to the average number of sequential crops grown over a calendar year and it is equal to the total annual harvested area of rice divided by the net stock of land devoted to rice production. On the basis of figures cited by Heytens [1988b:22], it is estimated that the average rice MCR in Indonesia rose from 1.20 to 1.68 between 1969 and 1987. In effect the 20 per cent increase in gross harvested area resulted from the opposing trends of (i) a 10 per cent fall in net area devoted to rice and (ii) a 40 per cent rise in the average degree of multiple cropping practised by farmers.

(c) Irrigation Improvement. During the 1970s and early 1980s, the Indonesian government made massive public investments in irrigation schemes [Rosegrant 1987:Ch. 8]. Many of these investments were dual purpose, involving dam construction for hydroelectric power generation as well as irrigation infrastructure. The evolving picture of rice land under different types of irrigation is complex to derive from published data, but it would appear that the net rice area under full technical irrigation³ was increased from 1.2 to 2.2 million ha in this period. When taken in conjunction with areas under other types of irrigation,

this meant that by 1987 about 75 per cent of wetland rice area was under irrigation as compared to 40 per cent two decades earlier.

(d) Fertilizer Use. This period witnessed a phenomenal rate of increase in the volume of artificial fertilizers used by Indonesian rice farmers, estimated to have risen from 250,000 to 3.2 million tons between 1969 and 1986 [BIMAS 1987].⁴ On wetland rice it would appear that total fertilizer use rose from 40 kg per ha in the early 1970s to nearly 300 kg in 1986, while that for urea on its own rose from 30 kg to 180 kg per ha. A powerful incentive to fertilizer adoption was provided by an input subsidy which on average reduced the fertilizer price to Indonesian farmers to about half world market price levels [Rosegrant 1987:Ch. 6].

Analysing the relative contribution of these various factors in rice production growth is no simple matter, but is of central interest for food policy analysis [Timmer 1986]. The introduction of HYVs both directly raises yields and raises the potential MCR due to the shorter growing season of the HYVs. Likewise an expansion of irrigated area works both on yields and the MCR. Increased variable input use, mainly urea fertilizer, has a direct impact on yields, but the size of this impact is interdependent with HYV yield potential and water availability. Finally there is the impact of the fertilizer: paddy price ratio on input use and yields via the response curve of yields to different

³ Rice irrigation in Indonesia is denominated 'technical' if it possesses permanent canals, flow control and measurement devices, up to the level of tertiary canals.

⁴ These figures assume that 70 per cent of fertilisers allocated to foodcrops are used on rice.

⁵ The comparison here is between the Jakarta wholesale price of the variety Saigon Bandung I and the world price of Thai 5 per cent Broken, both deflated by the Indonesian CPI for comparative purposes.

levels of fertilizer application.

The key issue for policy analysis is to distinguish the impact of prices as opposed to technical and exogenous factors in explaining rice output trends. Given existing state controls, the floor price for paddy and the fertilizer input price are variables which are easily adjusted from one year to the next, whereas technical change factors like irrigation investment have high capital costs and a long gestation period before their output effect is realised. Of particular recent concern is the impact of changes in the fertilizer: paddy price ratio on output, because this determines the scope for, and advisability of, reducing the burden on state resources of the fertilizer subsidy.

Econometric studies have produced conflicting evidence on this and other issues in Indonesian rice policy [Ellis 1988]. Those based on time-series data have suggested a high sensitivity of yields and output to changes in the fertilizer: paddy price ratio [Timmer 1986; Rosegrant 1987; World Bank 1987a]. By contrast, analysis based on 1980s cross-section data suggests much lower sensitivity [Tabor 1988; Altmeier 1988]. The policy implication of the former is that great caution must be exercised towards making even minor adjustments to fertilizer prices; that of the latter is that fertilizer subsidies could be phased out over a three or four year period with negligible effects on yields or output.

While this debate remains unresolved at the econometric level, two commonsense observations would come down on the side of relatively low sensitivity:

(i) With average urea use in the region of 180 kg per ha per crop, and many farmers using greatly in excess of this quantity, the majority of rice farmers are operating in a low marginal productivity zone of the fertilizer response function [Mitchell and Ellis 1987]. Both the physical response of yields to increased fertilizer use and the price elasticity of demand for fertilizer are low in the region of the biological maximum level of fertilizer use.

(ii) Cash outlays on fertilizer are in the region of 5 per cent of gross returns to rice production [Heytens 1988a:5-11]. It seems improbable that at this level of cost, farmers would sharply reduce purchases as fertilizer prices increased, especially if the total rise to the full economic price were phased over three or four years.

This digression on the fertilizer subsidy debate in Indonesia reinforces an earlier point about the comparability of food security concerns in Indonesia with those, say, in sub-Saharan African countries. After nearly two decades of fertilizer being available to farmers in unlimited quantities at subsidised fixed prices, the debate in Indonesia is about 'fine-tuning' price ratios in order to phase out the subsidy while

maintaining a certain rate of rice output growth. This debate would seem rather surreal for countries in which supplying any artificial fertilizer at all to farmers is fraught with budgetary, foreign exchange, transport, distribution and other constraints.

Turning now to the demand side of the rice market, the trend rate of increase in rice consumption is more stable and predictable than that of production, as is to be expected for a food grain which is the staple diet of the country's population. As shown in Table 2 consumption grew somewhat less fast than production over these two decades (average growth rates between 1969 and 1987 were 5.0 and 4.4 per cent respectively), and this is what permitted the closing of the import gap and the achievement of self-sufficiency in the mid-1980s.

A main reason for steadily rising rice consumption is population growth, latterly occurring at around 2.1 per cent per annum in Indonesia. In addition rising per capita incomes have resulted in increases in rice consumption per capita, estimated via the national rice balance sheet to have increased from 100 kg per person in the late 1960s to around 145 kg per person in the late 1980s. The overall increase of rice consumption shown in Table 2 divides more or less equally between the increase required to keep up with population growth and the increase involved in rising rice consumption per person.

Indonesia has officially been self-sufficient in rice since 1984, and did not import any rice between 1984 and 1989. However given the natural fluctuations of farm output the country was not strictly self-sufficient in all years, and, indeed, experienced quite large deficits in 1987 and 1988. This explains why the average balance of the rice market remained in small deficit in the Repelita IV period (Table 2) despite annual surpluses in 1984 and 1985. It was price pressure in the internal market caused by these latter deficits which resulted in some imports being permitted in 1989. However, rice self-sufficiency remains a major objective of agricultural policy in Indonesia and is an ideal strongly adhered to by the country's leadership.

Food Security Stocks and Price Stabilisation

The agency of government responsible for implementing the food security and price stabilisation aspects of rice policy in Indonesia is called BULOG, the National Logistics Agency. This organisation was created in 1967 and has three main roles in the food security domain:

(a) It is the state provisioning agent of rice rations to the armed forces and civil service, a task which currently requires a rice supply from public stock amounting to 1.7 million tons per year. This rice ration

Table 2

Summary Rice Balance Sheet 1969-1987^a

5-Year Plan	Years	Rice ^b Supply '000t	Rice ^c Consumption '000t	(Deficit) '000	Population '000	Per Capita Consumption kg/year
REPELITA I	1969-73	11,909	12,758	(848)	120,167	106
REPELITA II	1974-78	14,188	15,465	(1,278)	134,632	115
REPELITA III	1979-83	19,075	20,132	(1,057)	150,933	133
REPELITA IV ^d	1984-88	24,018	24,190	(153)	168,685	143
Per Cent Increase Rep I-Rep IV		101.6%	89.6%	-81.9%	40.4%	35.0%

^a Average data for each 5-year plan period.

^b Production x 0.89.

^c Supply +/- net BULOG operations.

^d Based on provisional data for 1988.

Source: Biro Pusat Statistik and BULOG

is delivered free to its recipients but its value is taken into account in public service wage decisions. BULOG is reimbursed from central government according to a 'book price' calculated in relation to its purchase price from farmers and traders (the floor price discussed below).

(b) It is a food security agent in the more conventional sense of being responsible for a national reserve stock designed to meet local and provincial emergency and disaster food relief, and in this context tries to maintain a minimum carryover stock of one million tons from one year to the next.

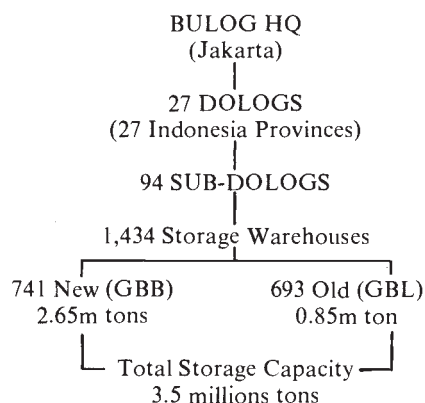
(c) It is a price stabilisation agent responsible for ironing out inter-seasonal and inter-year fluctuations in rice prices.

With respect to the last of these BULOG operates as a classic buffer stock authority, using a *floor* producer price and a *ceiling* consumer price as triggers either to purchase rice from an oversupplied market or to sell rice in order to keep price rises in check. The margin between the ceiling price and floor price has traditionally been kept wide enough to permit private trade to have a major role in the inter-seasonal storage of rice. BULOG has only once, in 1984, purchased as much as 10 per cent of domestic rice output and typically handles about six per cent. In the era of rice imports up to 1984, BULOG was the sole agent permitted to import rice for storage and release into the domestic market, and it remains legally the sole agent for rice imports or exports.

BULOG is a big logistics operation, the size and spread of its operations being dictated in part by the regional geography of Indonesia. As shown in Table 3, BULOG owns rice godowns with a total storage

capacity of 3.5 million tons. These are distributed across the length and breadth of Indonesia, but with particular concentration in major rice surplus locations (e.g. East Java) and rice deficit urban areas (e.g. Jakarta). The procurement and distribution of rice is handled by 27 provincial logistics depots (DOLOGS), and by 94 Sub-DOLOGS which are district units operating in surplus or deficit areas away from provincial centres.

Table 3

BULOG Rice Intervention
Infrastructure 1987

Source: BULOG (1987)

During two decades of operation, BULOG has gained a reputation for success in the technical storage, handling, and movement of large quantities of rice

over the extensive geographical area of Indonesia. These technical capabilities need to be set apart from the cost of running BULOG about which relatively little is known. The problem with the latter is that BULOG's threefold food security role has never been differentiated for accounting or financing purposes. Thus the cost of having a government quartermaster for rice is not distinguished from the cost of carrying a minimum national reserve stock, and neither of these are in turn distinguished from the cost of operating a buffer stock authority for price stabilisation in the rice market.

Data on selected aspects of BULOG operation is summarised, again by 5-year plan period, in Table 4 below. A main point observed in this table is that in the 1980s BULOG procurement has averaged 6-7 per cent of domestic rice production. Unlike its counterpart institutions in many other developing countries, BULOG does not exercise monopoly in the Indonesian rice market. A second feature is the increase in average year-end carryover stocks which occurred in this period. This reflects in part the increasing reliance on domestic, as opposed to imported, supplies for achieving balance in the rice market as Indonesia moved into a self-sufficient position.

Rice price stabilisation in Indonesia has been oriented towards two main aspects: inter-seasonal stabilisation and inter-year stabilisation. The first of these arises because the rice harvest does not occur evenly through the year. The first, or main, harvest season (February-May) accounts for about 60 per cent of annual production; the second harvest season (June-September) about 30 per cent; and the third harvest

season (October-January) just 10 per cent of annual output. In the absence of a stabilisation mechanism prices drop steeply as the main harvest comes in, level out during the middle of the calendar year and rise sharply in the lean season (called *paceklik* in Indonesia).

Time-series data on retail and wholesale rice prices in Indonesia suggest that the floor and ceiling price system has worked well as a means of eliminating the extremes of downward and upward price cycles [Timmer and Silitonga 1985]. With few exceptions, recorded prices have been kept within the official band, and where a breach of the floor or ceiling price has occurred this has been of short duration. One instance of such a breach occurred during the peak harvest period of 1985 when BULOG's warehouse capacity in rice surplus areas became full to overflowing. Another occurred in late 1987 when BULOG did not have enough stock to defend the consumer price.

The second aspect of price stabilisation is inter-year stability, and this relates also to domestic inflation and to the comparative trend and stability of world prices. Domestic rice prices to both producers and consumers were held roughly constant in real terms for a run of about 12 years from 1974 to 1986. In the first half of this period they were slightly below import parity world prices, and in the second half slightly above. With respect to relative price stability the coefficient of variation for annual prices between 1969 and 1987 was 12.6 per cent for the Jakarta wholesale price and 42.2 per cent for import parity world prices.⁶

⁶ This figure was cited in an article entitled 'Rice field expansion outside Java urgently needed'. *Jakarta Post*, 29 July 1988.

Table 4

Summary Data on BULOG Operations 1969-87^a

5-Year Plan	Years	PROCUREMENT		DISTRIBUTION		STOCK Carryover March 31 ^d
		'000 tons	per cent prod ^b	Budget Groups ^c	Market Ops	
REPELITA I	1969-73	348	2.6	783	364	305
REPELITA II	1974-78	550	3.4	751	995	584
REPELITA III	1979-83	1,389	6.5	1,054	1,327	1,058
REPELITA IV ^c	1984-88	1,851	6.9	1,522	291	1,927

^a Average data for each 5-year plan period.

^b Procurement as per cent production.

^c Army and civil service.

^d Stock carryover is influenced by imports as well as domestic procurement and therefore this trend may appear to bear little relation to other series.

^e 4-year average 1984-87.

Source: BULOG

Emerging Problems in the Indonesian Rice Economy

In the latter half of the 1980s several events and trends occurred which posed new and different pressures on the rice economy from those which prevailed over the preceding decade. Some of these were external to the rice economy, others were internal to it.

An important external factor was the low price of oil through the late 1980s, causing a sharp decline in government revenues and a fall off in the rate of economic growth. This resulted in a cut-back in government expenditure on the rice sector — especially in the areas of research funding and irrigation investment — as well as calls from external agencies for Indonesia to eliminate the fertilizer subsidy and to reduce the budgetary costs of BULOG (e.g. World Bank 1987b).

Internal to the rice economy, the annual rate of increase in production and yields declined sharply in the period 1983 to 1987, having peaked in the early years of the decade. In effect, the joint productivity gains of HYVs, irrigation and fertilizers reached their zenith at the turn of the 1980s, after which they have inevitably tended to tail off. In the absence of a new breakthrough in HYV technology (perhaps due to bio-genetics), any further yield gains to be obtained from the existing technology are likely to be small by comparison to the rates at the peak of previous adoption.

A further factor influencing production prospects is pressure for other uses of wetland rice area, especially on Java. It has been estimated that on Java about 35,000 ha of net wetland rice area is lost to urban, industrial, and service uses each year.⁶ In addition a currently popular slogan in policy discussion in Indonesia is that of 'agricultural diversification', the view in some quarters of government being that the country should be moving forward in non-rice food or feed crops such as pulses, animal feeds, and high value fruits and vegetables [Hedley *et al.* 1987]. The validity of this view is strongly contradicted by the evidence on relative social profitabilities of alternative crops, in which wetland rice grown under a wide range of different circumstances is by far the most efficient crop for Indonesia to cultivate in those parts of the country suited to its cultivation.

Events in 1987 and 1988 revealed the fragility of self-sufficiency as a strict zero import concept given the levels of rice production and consumption involved in the Indonesian case. At a consumption level of 25 million tons, and with a price elasticity of demand of about 0.2, a mere 4 per cent shortfall in production causes either a one million tons draw down of national stocks, or a 20 per cent rise in rice prices, or some combination of those two results. In the dynamic

context of a future rice consumption growth rate estimated at 2.5 per cent per year, quite a small deviation below this in the annual growth rate of production can soon result in large cumulative market deficits.

It is in the context of these considerations that self-sufficiency under an import ban in Indonesia has been described as a 'knife-edge' [Gray and Mitchell 1986]. Even small departures from the strict self-sufficiency trend cause either unacceptably large price fluctuations for farmers or consumers, or require large and costly intervention operations by BULOG.

In 1987 there was a drought, and a shortfall of production from the self-sufficiency trend estimated at about one million tons. Rice imports were not permitted, and BULOG was unable to defend its ceiling price due to its stock falling substantially below the minimum carryover maintained for national and food security purposes. A particular problem for BULOG in this situation was its continuing commitment to supply state rations as stocks dwindled, at the rate of 140,000 tons rice per month. The outcome of this situation was that both inter-seasonal and inter-year price instability sharply increased. The difference between lean season and harvest season retail rice prices was 50 per cent in 1987/88 compared to 20 per cent as the norm in preceding years; while the calendar year average price rose in nominal terms by 35 per cent between 1987 and 1988 (20 per cent in real terms).⁷

The comparative advantage of Indonesia in growing wetland rice, at import parity prices, has been demonstrated unequivocally in several economic studies [Heytens 1988c; Rosegrant 1987], as has also the high private and social profitability of rice cultivation compared to other crops. Indonesia is not however competitive as a potential exporter of rice to the world market, mainly because its internal rice quality norms differ substantially from those which pertain in world rice trade. The conclusion is that self-sufficiency on trend is broadly the correct strategy for Indonesia to follow, but that flexible use of the world market to compensate for production shortfalls below self-sufficient trend should be built into the normal operation of the internal rice market.

For the future, the following adjustments to policy seem feasible or desirable within the context of a long run strategy of rice self-sufficiency erring on the side of imports rather than exports [see also Damardjati *et al.* 1988].

(a) elimination of the fertilizer subsidy over a four-year period is unlikely to have an adverse impact on rice production, and would accrue positive benefits for government resources, and for the efficiency of the

⁷ These variations refer to the retail price of rice variety Cisadane II in Jakarta.

fertilizer manufacturing industry [Hedley and Tabor 1988];

(b) phasing out of paddy areas at present compulsorily sown to sugarcane production on Java (see footnote (2)) would compensate for recurrent losses of wetland rice area and release additional land for intensive multi-cropping of rice, as well as raising farm incomes of affected farmers;

(c) a reduction in the state rationing obligations of BULOG would directly diminish the necessary minimum size of the national rice stock, and the use of imports for price stabilisation would do so still further, resulting in a long term reduction in the size and cost of state food security operations undertaken by BULOG;

(d) a reinstatement in real terms of resources committed to agricultural research, together with a revival of irrigation investment, would seem the most promising use of resources released by other savings suggested;

(e) allied to this, continued experimentation at farm level with refinements in the balance of inputs used in rice production, and the management of such inputs, would seem to offer the most hopeful prospects for achieving such potential yield increases as are still possible with the current rice varieties under cultivation.

Conclusions

Indonesia has undergone a veritable revolution in rice production over the past two decades, a revolution which was not remotely envisaged in earlier pessimistic forecasts about the potential productivity of Javanese agriculture (the most famous of which was Geertz 1963).

This rice revolution was based on the rapid adoption, in the context of a somewhat command-style approach to agricultural sector management, of the entire array of elements in the 'Green Revolution' package, viz. HYVs, irrigation, subsidised modern inputs, credit for input purchase, and so on. At the same time, rice prices were stabilised — in real terms across years, and within a given band across seasons — by the advent of a floor and ceiling price system linked to buffer stocks.

The pursuit of rice self-sufficiency was made possible to an important degree by the revenues accruing to Indonesia as an oil exporter in the oil boom times of the 1970s. It was these revenues which permitted sustained expenditure across a broad front on (i) a succession of countrywide rice intensification programmes, (ii) massive irrigation investment, (iii) variable input subsidies, and (iv) the operation of the national logistics agency, BULOG. The recognition of Indonesia's good fortune as an oil exporter should

not, however, detract from its food policy achievement. Other countries just as favoured by oil money in the 1970s experienced indifferent or even disastrous farm sector performances (see for example the comparison between Nigeria and Indonesia given in Pinto 1987).

The kind of agricultural innovation cycle experienced by Indonesia does not last forever. In the mid- to late-1980s events seemed to suggest that production growth was falling off. This coincided also with a fall in the price of oil and more constrained government resources. Due to the political significance attached to self-sufficiency by the Indonesian leadership, rice imports were not permitted even when a drought caused production to fall below the consumption trend. This caused a degree of price instability in the rice market in 1987 and 1988 such as had not been experienced in Indonesia since the early 1970s.

It is the conclusion of this paper that these late 1980s difficulties in the management of the Indonesian rice market were relatively minor and of a correctable nature. The price instability problem would vanish through the simple expedient of permitting rice imports at the margin, when necessary, to help balance the domestic market. Meanwhile continued rice self-sufficiency — as a broad food security objective — remains feasible if resources to rice R&D are increased, continued improvement in the efficacy of input use are sought, and farmers in certain locations are given freedom of choice concerning what to grow and when to grow it.

In the longer term, say towards the turn of the century, Indonesia is likely to come up against absolute constraints on the yield potential of the current generation of HYVs, and will also confront more severe pressure, on Java, for alternative uses of land which is amongst the highest productivity rice land in the world. However, by then also Indonesia may have made significant advances in manufacturing exports along the lines of neighbouring South East Asian states, and the imperative of rice self-sufficiency may then be less strong than it was in the 1970s and 1980s.

References

- Altemeier, K., S. R. Tabor and B. Adinugroho, 1988, 'Supply Parameters for Indonesian Agricultural Policy Analysis', *Ekonomi Dan Kenangan Indonesia (EKI)*, Vol. 36, No. 1
- Badan Urusan Logistik (BULOG). 1987, 'Food/Rice Price Stabilisation in Indonesia', *Annual Report 1986/87*, Jakarta
- BIMAS, 1987, *Pelestarian Swasembada Pangan Pada Tahun 2000 Dan Seterusnya*, Jakarta: BIMAS Sekretariat

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- Damardjati, D. S. *et al.*, 1988, 'Emerging Problems Arising from the Indonesian Success in Rice Production', *Indonesian Agricultural Research and Development Journal*, Vol. 10, No. 1
- Ellis, F., 1988, *Workshop on Issues in Research Methodology for Indonesian Agriculture*, Report on Proceedings, Jakarta: World Bank, mimeo
- Geertz, C., 1963, *Agricultural Involution: The Processes of Ecological Change in Indonesia*, Berkeley: University of California Press
- Gray, J. and M. Mitchell, 1986, *Indonesia Rice Production Targets*, BULOG/TDRI Development Project, August
- Hedley, D., S. Hadiwigeno and M. Sarkaniputra (eds), 1987, *Round Table on Indonesian Agricultural Development for Repelita V*, Jakarta: Bureau of Planning, Ministry of Agriculture
- and S. R. Tabor, 1988, *Fertilizer in Indonesian Agriculture: The Subsidy Issue*, mimeo
- Heytens, P., 1988a, 'Rice Production Systems', Ch. 4 in Pearson *et al. op cit*
- 1988b, 'Technical Change in Wetland Rice Agriculture', Ch. 6 in Pearson *et al. op cit*
- 1988c, 'Alternative Future Rice Production Strategies', Ch. 7 in Pearson *et al. op cit*
- Indonesia, Departemen Pertanian, 1987, *Varietas Unggul Tanaman Pangan*, Bogor: Badan Penelitian dan Pengembangan Pertanian
- Mears, L. A., 1981, *The New Rice Economy of Indonesia*, Yogyakarta, Indonesia: Gadjah Mada University Press
- Mitchell, M. and F. Ellis, 1987, 'Rice: Yield Response to Fertilizer Use on Java', *IPU Technical Paper*, No. 1, Jakarta: BULOG
- Pearson, S. *et al.*, 1988, *Rural Income and Employment Effects of Rice Policy in Indonesia*, Final Report, Stanford University, Food Research Institute, October
- Pinto, B., 1987, Nigeria During and After the Oil Boom: A Policy Comparison with Indonesia', *The World Bank Economic Review*, Vol. 1, No. 3
- Rosegrant, M. W. *et al.*, 1987, *Price and Investment Policies in the Indonesian Food Crop Sector*, Report to Asian Development Bank, Washington DC: IFPRI and Bogor, Indonesia: CAER
- Tabor, S. R. *et al.*, 1988, *Supply and Demand for Foodcrops in Indonesia*, Jakarta: Directorate of Foodcrop Economics, Ministry of Agriculture
- Timmer, C. P., 1986, 'The Role of Price Policy in Rice Production in Indonesia 1968-1982', in R. A. Goldberg (ed), *Research in Domestic and International Agribusiness Management*, Vol. 6, Greenwich, Conn.: JAI Press
- and C. Silitonga, 1985, 'The Interplay of Seasonal Stabilisation of Rice and Corn Prices in Indonesia', paper given at IFPRI/FAO/AID *Workshop on Seasonal Causes of Household Food Insecurity*, Maryland
- World Bank, 1987a, *Indonesia: Agricultural Policy Issues and Options*, Washington DC
- 1987b, *Indonesia: Strategy for Economic Recovery*, Report No. 6694-IND, Washington DC, May