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Fertilizer in Indonesian Agriculture: the Subsidy Issue

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Abstract

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Indonesia began subsidizing fertilizer in 1971 to encourage its use as a complement to the new, high-yielding rice varieties that were becoming available. While providing considerable assistance to encouraging farmers to utilize these new HYVs and the associated package of inputs, the subsidy for fertilizer has attracted considerable attention in the light of the increasing budget limitations in Indonesia. The high levels of fertilizer and HYV use, the rapidly changing elasticities and cross elasticities among the major food crops, and the growing intersectoral linkages in the Indonesian economy suggest reasons for re-assessment of the subsidy for fertilizer. The operation of the subsidy is explained, followed by a discussion of changes in the relevant elasticities for demand and supply of commodities and fertilizer. A static welfare analysis of the fertilizer subsidy is presented, showing that the economic subsidy is worth only 42% of the financial subsidy and that farmers are receiving only 7% of the financial subsidy. A simulation of the effects on the food crop sector of removing the subsidy follows the welfare analysis. The paper concludes with an exploration of the policy issues stemming from the results.

Introduction

Indonesia began subsidizing fertilizer in 1971 to encourage its use as a complement to the new, high-yielding rice varieties that were becoming available. The general objective of the subsidy was directed exclusively toward the expansion of the rice supply in Indonesia; in the initial periods, credit for fertilizer at subsidized prices was available only for rice production (Mears, 1981,

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p. 128). As late as 1979, the vast share of fertilizer was used for rice. Since 1971, the amount allocated to the subsidy has grown very substantially, coming to overshadow all other expenditures in the agriculture and irrigation sector. While the declining oil revenues have placed all major expenditure categories under pressure, this paper argues that the unusually strong success in meeting the objectives for fertilizer policy in itself has generated the need for fundamentally rethinking the pricing and subsidy policy regarding fertilizer in Indonesia.

Subsidization of inputs is regarded by some as an unsatisfactory way of fostering agricultural growth (Timmer et al., 1983, p. 288). Some authors, however, have argued that input subsidies may be useful in stimulating the adoption of new techniques of production (Krishna, 1967, p. 526, Dalrymple, 1983, pp. 222–227, World Bank, 1986, p. 95). Arguments for the use of such subsidies range from allowing early adopters and innovators the opportunity to experiment with input combination alternatives, lowering risk to adopters of fertilizer, raising the profitability of the input to encourage use, direct transfer of resources to the farm level, and avoidance of the time lags in product price policy instruments as income transfer mechanisms. Also, the argument has been made that because industrial production of fertilizer exhibits strong economies of scale, the use of subsidies to expand the domestic market can bring forward the development of fertilizer production in a country and lead to more rapid achievement of efficient fertilizer production. Finally, input subsidies are for the most part more efficient than product subsidies in redistributing income in early stages of economic and agricultural development (Krishna, 1967, p. 526). However, these arguments for an input subsidy require the condition that the subsidy is a short-term program, designed to meet specific short-run objectives and subsequently phased out as the development occurs (Krishna, 1967; World Bank, 1986). The reasons for keeping the input subsidies as temporary programs include the skew in cropping patterns that can result, the overuse of fertilizer and the financial burden that the subsidies can create. Specifically, the allocation of budget to subsidy may deprive a sector of badly needed funds to finance continuing technological change (Dalrymple, 1983, pp. 223–226).

Subsidy objectives

Rice self-sufficiency was the dominant goal for Indonesian agricultural policy in the New Order government after 1967. One component of the strategy for self-sufficiency was the subsidization of fertilizer. The specific arguments for subsidizing fertilizer in Indonesia were: (a) to encourage the use of fertilizer as part of the improved production practices associated with the new rice varieties, (b) to stabilize the price to farmers by providing a ceiling price on the dominant cash input, and (c) to provide a relatively efficient transfer of resources from government (tax sources) to farmers to foster rural development.

This last objective is one component of a broader strategy in Indonesia to develop the rural sector as the principal employment growth source.

There is an important political content to the Indonesian fertilizer subsidy which influences decisions regarding the allocation of public resources. The Government's decision to provide fertilizer subsidies was motivated by a broader, political desire to promote domestic stability and security. The provision of rice subsidies, in conjunction with the provision of a controlled floor price and maximum urban rice price, has enabled the Government to fulfill the political imperative of providing satisfactory incentives to producers in order to extract greater surpluses of the main staple food while keeping urban prices, as well as the quantities available on the urban markets, at a level affordable to the growing, fixed-income, poor and middle-income earning population. Subsidies on inputs and output price support, together with other forms of rural investment, have been an important means of securing the loyalty of the rural elite (Collier, 1978) to the overall accumulation process fostered by the state (Robison, 1986). In addition, the development of a relatively efficient system of releasing government rice stocks in urban markets when prices rise (Mears, 1981), has provided a rice pricing system which has largely assuaged the fears of urban populations of rice shortages and consequently has kept the more politically volatile urban constituency relatively pleased with the Government. Keeping the rural elite motivated to produce more rice, and more importantly, producing an adequate surplus for the urban markets, while keeping urban prices stable enough to minimize the risks of deprivation and protest amongst the politically volatile urban fixed-income earners, explains the fairly widespread support for large fertilizer subsidies throughout the military and political arms of the New Order regime.

By any measure, the policy pursued by Indonesia in the period from 1969 to 1986 has been successful. Nitrogen use has increased by 19.7%, phosphate use by 28.7% and potash use by 13.7% per annum over the years 1972 to 1986. For the food crop sector, the percentages are more impressive: 19.2, 31.4 and 32.6%, respectively. *The Economist* labelled this rate of growth "...the biggest increase in the world".[1] The greatest uses of fertilizer are for rice and food crops on Java. In 1986, over 60% of fertilizer went to rice, over 80% went to all food crops, and over 80% of all fertilizer was used on Java.

The complementary inputs and practices have grown by equally high rates (Table 1): extension agents grew in number by 20.5% annually, farmer cooperatives grew by 32.6%, fertilizer kiosks increased 19.8% per annum, the number of rural credit banks tripled, and farmer improvement groups increased

[1]Indonesia Survey. *The Economist*, 15 August 1987, p. 11.
The World Bank has also held up the Indonesian experience as exemplary in the *World Development Report*, 1986. The World Bank, Washington, DC.

TABLE 1

Changes in infrastructure and input use in Indonesia, 1972–1986

Year	Fertilizer consumption[a]					
	Food crops sector			All Indonesia		
	N	P	K	N	P	K
1972	228	21	2	255	33	39
1976	313	99	3	352	111	26
1979	551	130	18	620	151	84
1983	2310	702	92	2495	739	162
1986	2652	980	102	3169	1131	240

Year	Field extension	Farmers coops	Rural credit banks	Fertilizer kiosks	Framer groups
1970	1 584	n.a.	545	n.a.	39 066
1973	3 263	2 557	2 069	1 930	62 025
1976	6 290	3 911	2 988	7 774	82 576
1979	11 228	4 463	3 312	12 485	126 108
1983	14 904	6 141	3 617	18 322	206 076
1986	31 474	7 126	3 646	20 303	225 041

[a]Nutrient equivalent, 1000 t.

Sources: BIMAS Crop Reports, Ministry of Agriculture various (annual) reports; and PUSRI, Annual Offtake Report, various issues.

Note: Field extension agents are defined as farm field extension workers (PPL). Rural credit banks refer to village branches only, cooperatives are the KUDs and the farmer groups are the Kelompok Tani involved in rice production.

11.6% annually. In 1987, high-yielding varieties of rice represented over 95% of the area of rice and over 97% of the production in Indonesia.

The price ratio of rice and fertilizer and its stability have long been regarded as the most critical variables in determining farmers' income and welfare levels in the rural areas generally. However, the changes in the economy and the diversification objective in food crops call into question the single measure of welfare that this variable represents (Hedley, 1987; Tabor et al., 1987a,b). In terms of price stability, the nominal price of fertilizer has increased by 9.16% per year for the period 1974–1987. In real terms, the price of fertilizer has fallen slightly, by 2.53% per year. From 1980 to 1986, the padi (rough rice) to fertilizer price ratio has remained between 1.5 and 1.9. For the rural income support objective, the consistently high profitability of rice, twice as high as any other competing food crop, suggests considerable impact on rural incomes.

Embedded in this success story are the reasons for reviewing the policy. The subsidy cost for fertilizer has burgeoned from virtually nothing in the early

TABLE 2

Fertilizer subsidy budget in relation to aggregate budgets in Indonesia (billion Rp.)

Fiscal year	Routine budget	Development budget	Total agriculture and irrigation sector budget	Fertilizer and pesticide subsidy	Remaining agriculture and irrigation sector budget
1975-76	1,332.6	257.0	257.0	134.5	122.5
1976-77	1,629.8	356.0	356.0	107.3	248.7
1977-78	2,148.9	380.0	380.0	31.8	348.2
1978-79	2,743.7	450.0	450.0	82.6	367.4
1979-80	4,061.8	508.0	508.0	125.0	383.0
1980-81	5,799.9	929.0	929.0	283.6	645.4
1981-82	6,977.6	954.0	954.0	371.4	582.6
1982-83	6,996.3	931.0	931.0	420.1	510.9
1983-84	8,411.8	913.0	913.0	324.2	588.8
1984-85	9,428.9	1,699.1	1,699.1	731.6	967.5
1985-86	11,951.5	1,137.5	1,137.5	477.1	660.4
1986-87	13,125.6	8,296.0	1,105.5	671.5	434.0
1987-88	15,026.5	7,756.7	1,180.7	203.5	977.2

n.a., not applicable.
Gov. Indonesia, several years.

years to two-thirds of the agriculture and irrigation sector budget in 1986–87, and about eight times higher than the expenditures made through the Ministry of Agriculture for research, extension and production programs in food crops, estate crops, fisheries and livestock combined (Table 2). The continued growth of the subsidy in a period of sharp fiscal contraction for agriculture gives rise to serious concern.[2] The success in stimulating use of fertilizer makes the policy increasingly expensive. The sharp decline in available governmental revenues forces policy makers to reconsider major spending programs; since the fertilizer subsidy makes up two-thirds of all spending on the agricultural and irrigation sector in 1986, the fertilizer subsidy is a prime candidate for budgetary savings. An added political concern is that while the economics may suggest lowering or elimination of the subsidy, raising the fertilizer price to farmers as the means to do so is deeply sensitive in the countryside. Finally, the rapid growth in incomes in Indonesia throughout the 1970s has led to con-

[2]Generally, the development budget for the Ministry of Agriculture halved in nominal terms from 1985–86 to 1986–87 (approximately from Rp. 171 billion to Rp. 81 billion) and halved again in the one year 1986–87 to 1987–88 (from Rp. 81 billion to about Rp. 35 billion; this latter amount has been supplemented with extraordinary assistance from the U.S. Government, bringing the total up to Rp. 68 billion). These expenditures do not include the fertilizer subsidy.
billion (US) $= 10^9$.

siderable change in the income and price elasticities for food and between food and non-food goods. These changes dramatically alter the usefulness of the fertilizer price as a policy instrument in the agricultural sector.

Two basic issues emerge. First, who are the beneficiaries of the fertilizer subsidy, and second, what are the impacts on farmers and food crop production of removing the subsidy.

The effect of a price distortion may affect production and consumption patterns of several commodities simultaneously. Second and third-level multiplier effects can be quite important when analyzing the effects of a major price distortion, such as fertilizer subsidies in Indonesia. In order to evaluate the multiplier effects of subsidy removal, policy analysis tools which take into account all inter-commodity and inter-factor corrections simultaneously need to be utilized. A fully-consistent multi-market econometric model was developed in order to assess the 'full' effects of subsidy removal. The model is based on a set of adaptive response equations to model area allocation: a set of profit functions to model factor allocation and productivity and an Almost Ideal Demand System (AIDS) to model consumer budget response. The sector model is linked to a three-sector macroeconomic model through the accumulation of value added in the factor and product markets. Trade is used to clear the market, at fixed commodity prices, for the static simulation. The model is described in more detail in Tabor et al. (1988).

In the remainder of the paper, there is an explanation of the operation of the fertilizer subsidy and the changes in demand and supply as the bases for the welfare analysis given subsequently. Thereafter, simulation results from a supply/demand model for food crops showing the implications of removing the subsidy are presented. Finally, implications for agricultural policy are explored.

Operation of the fertilizer subsidy

The fertilizer producing industry in Indonesia is composed of PUSRI (Perseroan Terbatas Pupuk Sriwijaya, the Government's Fertilizer Enterprise) and several private firms. PUSRI makes about two-fifths of the total supply in the country and the remaining three-fifths is produced by the private firms holding licenses for investment in and production of fertilizer. All private firms sell exclusively to PUSRI; PUSRI in turn distributes the product throughout Indonesia. For urea, the international petroleum companies are in a dominant position in the industry since the primary raw material needed for urea is natural gas. Nonetheless, it should be noted that the natural gas industry supplies natural gas feed stock to the fertilizer industry at less than market prices; this has been the case for some years (Mears, 1981).

PUSRI purchases fertilizer from all suppliers at the suppliers' plant loca-

tions up to an amount agreed upon each year with each supplier. All subsidy for fertilizer is paid to PUSRI, thereby indemnifying PUSRI for the losses incurred from the purchase and sale of fertilizer from private producers as well as the production of fertilizer by PUSRI itself. The price paid by PUSRI to the other firms for the fertilizer is the amount established by agreement between the Government of Indonesia and the private producers, that is, an estimated cost of production plus a percentage for profit. PUSRI in turn sells the fertilizer (both that amount purchased from the private producers and the amount produced by PUSRI itself) to the wholesalers of fertilizer at a price equal to the retail ceiling price (now Rp. 125/kg)[3] less the costs of distribution estimated on the basis of origin and destination of the fertilizer. The estimated costs of production and distribution by supplier differ sharply among plants. Sebayang has argued that both the agreed production and distribution costs are too high (Sebayang et al., 1983; Siam, 1986). Compared to marketing costs in other countries of Asia, the costs do not appear excessive (Mittendorf, 1982). Apart from whether the costs are set too high, it is clear that there are no market-driven forces to hold costs down. Government appears to indemnify producers, distributors and exporters (PUSRI) of any costs incurred.

The amount of the total subsidy budgeted each year by the government, while based on 'expected' costs, in all likelihood deeply affects the calculations regarding distribution costs and the estimated costs of production used in calculating the subsidy requirement during the year. While the data indicate that specific prices and costs are estimated by manufacturer and, in turn, these per-unit amounts are multiplied by volumes made during the year, the amount of subsidy budgeted by government has likely been a major determinant of the amount spent (Sebayang et al., 1983; Siam, 1986).

PUSRI alone imports and exports fertilizer. Since accounting for the subsidy is based entirely on domestic consumption of fertilizer (domestic production plus imports) it is believed that the subsidy does not 'leak' into the international market through exports. In fact, PUSRI's costs of both domestic and export operations cannot be distinguished. The scale and capacity utilization of the plants are driven by the level of production; exports permit a higher level of plant utilization and hence a different set of actual costs than if no exports had occurred. Losses from all operations are assessed against domestic sales to calculate the subsidy.

Domestic production of fertilizer has risen ten-fold in the past decade, mostly urea but some TSP also. In the past 2 or 3 years, there have been major and growing exports of urea, now a quarter to a third of domestic production, partly

[3]US$1 = Rp. 1640 after September 1986. Previously: US$1 = Rp. 1130. This price applies to all fertilizers, regardless of nutrient composition. This practice removes the possibility of substitution among fertilizers in the market place.

as a means of containing the stock holding and financing costs through PUSRI. Imports of phosphatic fertilizers have stabilized over the past 4–5 years.

The growth in fertilizer supply results from the direct investment by the Indonesian government in the fertilizer industry as well as the private investment in fertilizer production (Table 3). Much of this investment has been stimulated from the rise of the petroleum and natural gas industry. Production and distribution costs dominate the cost of producing fertilizer, although subsidies make up 45% of the industry revenues (Tables 4 and 5).

Since 1986, Indonesia has progressively reduced the 'budgetary' subsidy to fertilizer. However, this is more a transitional measure in that domestic fertilizer prices have not been increased enough to offset the loss in revenues from the lower government budgetary subsidy to the fertilizer producers and distributors. The fertilizer industry has been allowed to offset this loss by increasing its debt–equity ratio with public-sector banks; hence a rather transparent budgetary subsidy has shifted to become, at least in the near term, more a question of optimal industry debt management than subsidy or expenditure. As the debt burden increases within the fertilizer industry, the removal of the fertilizer subsidy will become more a question of a strategy to reduce debt arrears rather than to remove a direct subsidy. In either case, government price controls merely shift the subsidy burden, rather than eliminate it. The Indonesian approach to subsidy removal illustrates the importance of looking beyond government budget allocation accounts to an economic assessment of

TABLE 3

Fertilizer production, imports and exports for Indonesia, 1978–1986

Year	Production[a]					Imports[a]					Exports[a]		
	Urea	Ammonium sulfate	TSP	Other	Total	Urea	TSP	Potash	Other	Total	Urea	Other	Total
1986	3920	495	1000	0	5415	1	0	224	78	304	514	0	1514
1985	3585	476	1007	0	5068	85	0	278	150	513	685	0	685
1984	2906	302	1002	0	4210	189	10	164	230	592	218	34	251
1983	2241	208	783	27	3259	0	0	325	287	612	316	30	346
1982	1961	210	577	13	2761	435	438	139	254	1265	0	0	0
1981	2012	195	559	14	2780	150	125	248	382	905	0	0	0
1980	2001	180	465	119	2766	210	160	137	285	792	0	0	0
1979	1828	152	114	5	2100	0	30	122	195	348	0	0	0
1978	1450	129	0	4	1583	0	270	109	172	551	0	0	0

[a]1000 t.

Other production includes natural phosphates, di-ammonium phosphate (DAP) and other blended (two or three nutrient) fertilizers. Other imports include ammonium sulphate, DAP, rock phosphate, magnesium phosphate and other specially blended fertilizers. Other exports refers to triple-superphosphate (TSP) and DAP.

Sources: PUSRI and the Central Bureau of Statistics, Jakarta. Values for 1986 are taken from revised PUSRI trade estimates.

TABLE 4

Distribution of fertilizer supply costs by major product 1986 (supply for domestic distribution)

	Total domestic utilization	Costs (Rp. per t consumed)	Implicit subsidy (Rp. per t consumed	Total subsidy (million Rp.)	Percent of total subsidy
Domestic production					
Urea	2 537 312	203 666	88 666	224 974	39
TSP	1 117 000	322 718	207 718	232 021	41
Ammonium sulphate	581 648	269 607	154 607	89 927	16
Imports					
KCl	224 382	191 248	76 248	17 109	3
Other	78 618	195 906	80 906	6 361	1

Source: Based on data from the Ministry of Industries and Finance.

TABLE 5

Distribution of costs and returns in the Indonesian fertilizer sector (1986/1987)

	(million Rp.)	(%)
Domestic production costs	891 752	71.1
Domestic import costs	58 314	4.6
Distribution costs	304 179	24.3
Revenues		
Domestic sales	522 049	41.6
Exports	161 805	12.9
Subsidies	570 391	45.5

Source: Computations based on estimates from Ministry of Agriculture, PUSRI, and Ministry of Finance.

price distortions in order to understand the role of subsidies in an agricultural economy.

Changes in demand and supply responses

When the subsidy began, the level of fertilizer consumption was low and the technology for rice was equally low. The subsidy appears to have been a powerful tool to induce both the adoption of the new rice technology as well as to provide some transfers of income to the rural poor. Since that time the production surface for rice has shifted outward and upward with substantially greater marginal response to fertilizer than previously (Fig. 1). The effect has been to dramatically shift the fertilizer demand outward over the past two

TABLE 6

Values required for the economic subsidy computation in 1986

	Units	
Total domestic demand[1]	4 539 560	t
Total domestic supply[2]	5 415 000	t
Total imports[3]	303 600	t
Stoch change	−334 588	t
Total exports[4]	1 513 628	t
Weighted domestic supply price[5]	220 856	Rp. per t
Average consumer price[6]	115 000	Rp. per t
Average export price[7]	147 000	Rp. per t
Average weighted import price[8]	192 076	Rp. per t
Fertilizer demand elasticity[9]	−0.45	
Fertilizer demand equation[9]		
intercept	6 582 362	t
coefficient	−17.76	change in tonnes demanded for a Rp. 1 change in price of fertilizer
Average exchange rate:	1,300	Rp./US$
Financial subsidy per t consumed[10]	125,649	Rp.
Economic subsidy per t consumed[11]	53,337	Rp.
Total economic subsidy	242.3	billion Rp.
-of which		
to exporters to Indonesia	23.4	billion Rp.
to exporters from Indonesia	49.3	billion Rp.
to producers and consumers domestically	169.6	billion Rp.
Consumer surplus	580.1	billion Rp.
Producer surplus	1131.8	billion Rp.
Consumer loss	14.2	billion Rp.
Producer loss	3.7	billion Rp.

[1]Based on BIMAS fertilizer use estimates.
[2]Based on PUSRI production and trade estimates.
[3]Based on PUSRI production and trade estimates.
[4]Based on PUSRI production and trade estimates.
[5]Computed as a balance from 1 to 4 and 6 to 10.
[6]Based on a production share weighted average of Rp. 100 and Rp. 125, the prices during the calendar year 1986.
[7]Weighted average of KCl and other imports at farm gate, KCl valued at Rp. 172,000 delivered and others valued at Rp. 249,000, unit costs based on BIMAS import value and IBRD world prices.
[8]Estimated export price equal to US$82.23 based on PUSRI sales reports.
[9]Based on Altemeier et al. 1987b. Demand function derived by linearizing profit function parameters.
[10]Using a subsidy figure of Rp. 671.5 billion from the 1986–87 budget less an estimated Rp. 100 billion for subsidy other than fertilizer. This accords with other data from PUSRI for calendar 1986.
[11]Computations as described in the text.

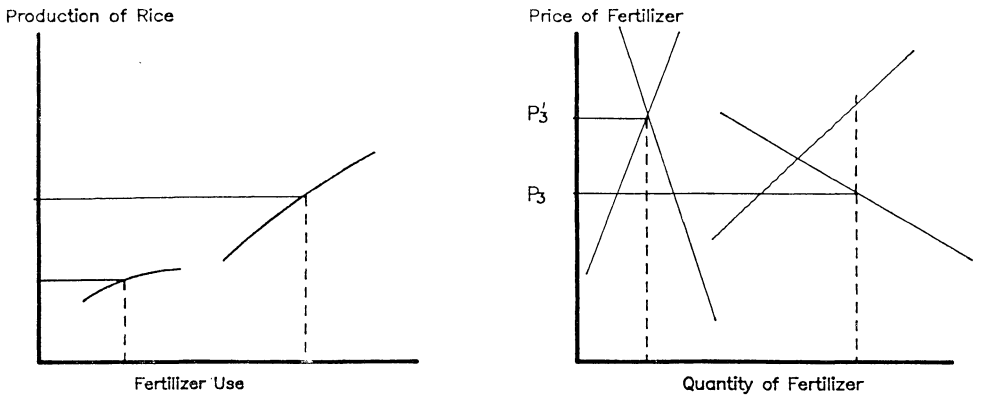

Fig. 1. Schematic change in the fertilizer market in Indonesia over the past 20 years.

decades as a response to governmental spending in agricultural research, extension, irrigation and other infrastructure investment in the sector. Not only has the production function for rice shifted outward, the slope of the function with respect to fertilizer has increased, thereby encouraging the use of the fertilizer in the early adoption years and making the fertilizer demand function relatively more elastic than in earlier periods. The price elasticity of demand for fertilizer has been estimated as three times higher for the modern varieties than for the modern varieties (Pitt, 1983). Since rice farmers are now using high levels of fertilizer and almost exclusively the HYV rices, the demand for fertilizer for rice production is expected to be considerably more elastic than a few years ago. Finally, the production surfaces for other major food crops are beginning to shift upward and outward, adding strength to the growth in fertilizer demand and the more elastic demand for fertilizer.

The elasticities of crop output with respect to fertilizer price are very small compared to the supply elasticities for the food crops. As an example, the rice output–fertilizer price elasticity is estimated at -0.03 while the fertilizer quantity–rice price and the rice supply elasticity are 0.45 or larger (Tabor et al., 1987a). This generalization appears to hold for nearly all food crops with the largest food crop output–fertilizer price elasticity estimated at -0.08 for corn while the supply elasticities for nearly all crops are estimated above that of rice. The two exceptions are mungbeans off-Java (0.37) and cassava on Java (0.29). As a result, food output pricing is a far more important determinant of output levels than fertilizer pricing at the present state of agricultural development in Indonesia. These results suggest that the subsidy on fertilizer as a means of inducing greater food output is relatively weak as a policy tool. Output prices are much more important.

Rice price has been a primary determinant of the welfare of the rural house-

holds in Indonesia. This dominance has been based on rice as the primary wage good and on the high expenditure and price elasticities displayed for rice for some years. In the mid-1970s, the expenditure elasticity for rice was estimated to be between 0.55 and 0.65 (Hedley, 1978a,b; Boediono, 1978; Dixon, 1982). By the early- to mid-1980s the expenditure elasticity had fallen to 0.20 to 0.25 (Johnson et al., 1986, Tabor et al., 1987a). The achievement of rice self-sufficiency, the large growth in incomes and the broadening of the wage good base in rural areas have combined to lower the expenditure elasticity for rice and to make rice considerably more price-inelastic. The cross elasticities among rice price and the demand for other food crops have increased sharply in the past few years (Klumper, 1986; Tabor et al., 1987a). One implication of this is the growing importance of rice price in the diversification of the Indonesian food crop economy and a weakening of the impact of rice price as a policy instrument on rice supply itself. Finally, the demand system results indicate a growing set of cross elasticities among non-food prices and food demands; the interpretation is that the economy is becoming much more tightly linked among macro and sectoral parameters than has been true historically in Indonesia.

The integration among sectors of the economy is transforming the more traditional independence among sectors into an economy demonstrating middle-income characteristics. This increase in the degree of the intermarket and intersectoral linkage in the demand, supply and employment markets transforms the fertilizer subsidies from efficient to a relatively blunt and inefficient instrument for inducing change in the rural sector. The result is that the useful policy parameters are changing; not only do the budgetary pressures limit the availability of expenditures as policy instruments, the intersectoral spill-over from the macro-level or other sectors is limiting the usefulness of existing expenditure and non-expenditure policy instruments.

Economic evaluation of the subsidy

The static equilibrium welfare effects of the fertilizer subsidy are illustrated in Fig. 2. The line at P_0 gives the average revenue required to cover costs in Indonesia for fertilizer from domestic sales (Q_4). Then the average revenues curve turns downward slightly for export sales; this sloped portion of the line represents the averaged revenue requirement from domestic and export sales. The line P_1 then gives the average per unit revenue requirement of fertilizer sold by PUSRI for PUSRI to break even. So long as the export price lies above the domestic price received by PUSRI for fertilizer, the amount of subsidy requirement is reduced on a per-unit basis as exports increase. However, since the export price lies below the average revenue requirement by PUSRI, the aggregate subsidy will continue to grow as exports expand.

The solid demand curve, DD, represents the farmer demand for fertilizer from all sources, both domestic and imported. The dashed demand curve, D_1,

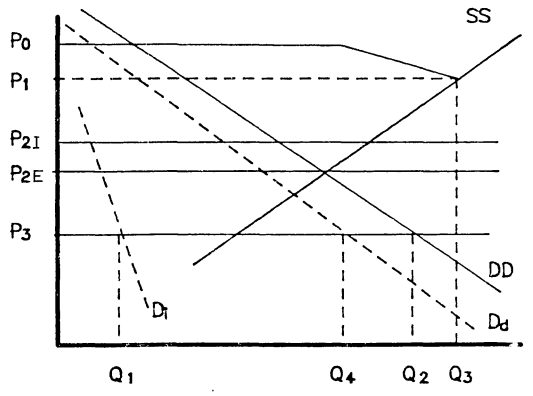

Fig. 2. Schematic representation of fertilizer trade in Indonesia. P_0, average revenue requirement for PUSRI; P_1, procurement price for fertilizer; P_{2I}, price of imported fertilizer; P_{2E}, price of exported fertilizer; P_3, domestic price of fertilizer; Q_1, imports of fertilizer; Q_2, total domestic consumption of fertilizer; Q_3, total production of fertilizer in Indonesia; Q_4, domestic consumption of domestically produced fertilizer.

represents the import demand, highly inelastic because it is the only source for these nutrients. The demand curve, DD, is the addition of the import demand and the demand for domestic product, D_d. The supply curve, SS, represents the procurement costs of fertilizer from all sources faced by PUSRI.

The price established for farmers is given in Fig. 2 as P_3; while distribution cost complicates the price representation, it is unnecessary to demonstrate this since it is part of the difference between costs to fertilizer production and the farm gate price. The price of exports is given as P_{2E} and the price of imports is P_{2I}. The procurement price (or average revenue requirement) for PUSRI is given by P_1. The amount of domestically produced fertilizer is Q_3, while the amount of domestically produced fertilizer consumed by Indonesian farmers is Q_4. The amount of imported fertilizer consumed is Q_1, giving total fertilizer consumption of Q_2 $(=Q_1+Q_4)$. Fertilizer exports then are Q_3-Q_4. From this representation, the financial and economic subsidies can be estimated. The financial subsidy is the amount of money paid by government as subsidy while the economic subsidy represents the actual worth of the subsidy to industry participants. The financial subsidy (FS) and the economic subsidy (ES) can be measured as:

$$\begin{aligned} \text{FS} &= \text{total PUSRI costs minus total PUSRI revenues} \\ &= P_1Q_3 + Q_1P_{2I} - (Q_3-Q_4)\,P_{2E} - Q_2P_3 \end{aligned}$$

$$ES = \text{subsidy to exporters to Indonesia, plus subsidy to exporters from Indonesia, plus subsidy to domestic producers and consumers}$$
$$= (P_{2I}-P_3)Q_1 + (Q_3-Q_4)(P_{2E}-P_3) + (Q_2-Q_1)(P_{2w}-P_3)$$

where P_{2w} are average import and export prices weighted by the proportions of exports and imports.

Of considerable interest is the distribution of the subsidy among the participants. The economic subsidy clearly can be shown above for the importers and exporters of fertilizer. Also, the economic subsidy to the domestic consumers can be divided between the distributors (and/or government) and the farmers. Further, the regional and product type distribution of the economic subsidy to domestic consumers can be traced from data available from the trade.

Using the same representation the consumer and producer surplus can be measured with and without intervention. Figure 3 shows the consumer and producer surplus with the existing interventions in the market by government. From Fig. 3, the consumer surplus is IHW and the producer surplus is SGN. The dead weight losses in consumption are RKW while the losses on the production size are JZM.

The financial subsidy is about Rp. 571 billion (1986) or Rp. 125,649 per tonne for fertilizer, while the economic subsidy is estimated as 42% of this level. The implication is that there are very substantial 'dead weight' losses in efficiency associated with continuation of the fertilizer subsidy; stated differently, the same expenditure could return a far greater amount to the Indonesian economy if spent elsewhere. The multiperiod simulation described below confirms this result.

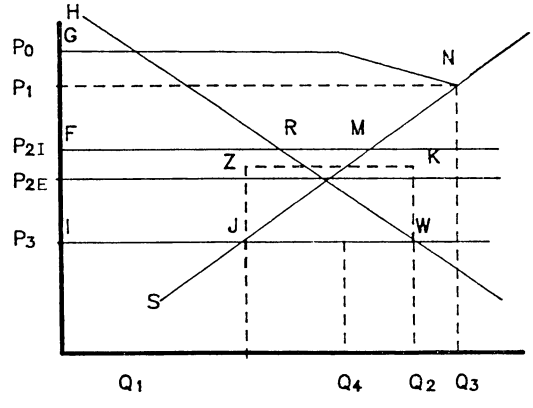

Fig. 3. Producer and consumer surplus with intervention in the fertilizer industry. Same symbols as in Fig. 2.

The fertilizer subsidy is transferring income within the Indonesian economy. However, the transfers do not appear to be going only to the intended recipients. The recipients are the exporters to Indonesia (10%), exporters from Indonesia (20%), and the domestic producers and consumers (70%). By using the proportion of producer to consumer surplus as a breakdown of the allocation of the subsidy to the domestic producers and consumers, the fertilizer producers and distributors are receiving 46%, and the farmers 24% of the economic subsidy. The economic benefits to the producers and distributors of fertilizers are twice as large as those to consumers, i.e., farmers, for whom the subsidy was originally designed. All of these percentages relate to the economic subsidy. Hence for an expenditure by government of Rp. 571 billion, the value reaching the farm level is about Rp. 40 million, 7% of the financial subsidy.

Simulation of changes to the fertilizer subsidy

Because of the increased pressure to reexamine spending programs in the Indonesian government, effects of removing the fertilizer subsidy need to be explored in some detail. Based on the model developed by Altemeier et al. (1987a), the impacts of removing the subsidy in the food crop sector over the period 1988–1992 were simulated. The model utilizes separate lagged adjustment supply equations for area and profit functions for productivity of the major food crops (rice, corn, cassava, soybeans, mungbeans and peanuts). The demand for these crops is obtained from estimates using an Almost Ideal Demand System (AIDS). Supply and demand estimates are linked through balance sheets and the expected excesses or shortages in product are cleared through stock changes and trade movements. The food crop sector is then linked to a simple three-sector Keynesian-type macro-model to link employment, consumption, supply and national income. Prices are set exogenously in the simulation model, as are the governmental targets for food crop production.

To begin, the model was first used to simulate the effects of a continuation of policies that have been followed during recent years to establish a baseline for comparison. Real rice prices were allowed to decline by 2% per year, real fertilizer prices to decline by 3% with economy-wide inflation set at 8%. This scenario results in continued self-sufficiency in rice, other food crops generally satisfy domestic requirements as well as in 1987 and sectoral incomes continue to grow. Fertilizer consumption for food crops is estimated at 3.99 million t in 1992. Aggregate food crop sector income (real 1985 terms) reaches Rp. 15.647 trillion in 1992, a growth of 1.90% annually. However, the distortion between domestic and international prices for fertilizer is maintained; concomitantly, the subsidy is maintained.

The per-unit fertilizer price nominally increases by 5% per year (8% infla-

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trillion (US) = 10^{12}.

tion less 3% real price decline) to Rp. 159/kg from Rp. 125/kg. If one assumes that the subsidy on fertilizer remains at 50% of the cost to PUSRI of producing fertilizer, implying some cost savings found in production or distribution efficiencies, the value of the subsidy on fertilizer used in the food crop sector in 1992 is Rp. 317 billion.

To explore the effects of removal of the fertilizer subsidy using the model, the real price of fertilizer in Indonesia will have to rise by approximately 95% above the 1987 domestic price. This is calculated by taking the current domestic price and comparing it to an effective border price for Indonesia based on World Bank and USDA prices and market shares from PUSRI data. Assuming an average inflation rate of 8% in the general economy from 1988 to 1992, the nominal price will have to rise by approximately 20% per year during this period to eliminate the subsidy prevailing in 1987. Certainly under this second scenario, the magnitude of the subsidy will change as world market prices and the composition of fertilizers in Indonesia change. The World Bank quarterly commodity price forecasts show strength in future fertilizer prices, i.e., the prices used in the simulation. However, over-capacity in fertilizer production, slack petroleum markets and a slowdown in fertilizer demand growth could suggest somewhat lower fertilizer prices than used in the simulation. Nonetheless, the magnitude of the domestic price change to eliminate the subsidy is so large as to overwhelm the variation that could occur in prices from the World Bank forecast levels. Whatever reasonable forecast of fertilizer prices is used, the magnitude of the correction is 90–100% in domestic prices.

For this scenario, real rice prices were allowed to decline by 1%, rather than by 2% in the baseline scenario and inflation was set at 8%, the same as before. Under these circumstances, rice self-sufficiency is maintained over the period, and all other food crops, with the exception of corn, stay near current balances when the subsidy is eliminated. In exploring the simulation results, the production effects on food crops of removing the subsidy can be offsets imply by slowing the decline in real rice prices from 2 to 1% annually. This result obtains from the very low crop output/fertilizer price elasticities combined with the very much higher crop supply elasticities. Food crop sector income would increase by 1.87% annually, to Rp. 15,571 trillion in 1992.

The fertilizer subsidy under this scenario is eliminated compared to a continued nominal subsidy level for the baseline. Interestingly, the loss in food sector income from the elimination of the subsidy is estimated at only Rp. 76 billion in 1992, far less than the simulated subsidy fertilizer for the food crop sector, estimated at Rp. 317 billion. This result is consistent with the static analysis shown earlier. Clearly the use of fertilizer subsidies to transfer income to the farm level has become a very inefficient mechanism of rural income assistance.

Concluding Remarks

The approach taken by Indonesia to foster fertilizer use in the New Order government has met each of the major objectives set out for the policy. Fertilizer use is now an established, common practice of farmers for most food crops, particularly rice both on Java and outside of Java. While Indonesia was trying to achieve self-sufficiency in rice, the fertilizer subsidy appears to have contributed to the adoption and expansion of the new varieties and the associated input use. With the pressure on government expenditures and the large changes in underlying income, price and cross-price elasticities for food, re-evaluation of the policy is clearly necessary. The farmer response to the subsidized fertilizer has been excellent; nonetheless, this response in itself has created very strong pressures for change. The input elasticities have declined, the income and price elasticities for rice have fallen, and the cross-price elasticities among foods and between food and non-food groups increased. The fertilizer demand elasticity has become more elastic although the crop output to fertilizer price elasticities have become quite small. As a result, the subsidy now returns only about 42% of its value to the economy. Farmers, the intended recipients of the subsidy, are receiving about 7% of the financial value. The major recipients of the subsidy are in the fertilizer production, distribution, export and import sectors for fertilizer. Both the static analysis and the simulation for the years 1987–1992 confirm the economic losses to the economy from the subsidy.

Nonetheless, the difficulty in now eliminating the subsidy cannot be underestimated. Increasing the fertilizer price will weaken the ability of Indonesia to maintain rice self-sufficiency slightly under continuation of existing rice price policy or cause Indonesia to increase rice prices slightly faster than has historically been the case. The elimination of the subsidy is likely to create substantial political concern among rural groups in society. Yet it is clear that new and different policy instruments need to be sought to limit the fiscal exposure on the fertilizer subsidy and at the same time meet the objectives of rice self-sufficiency, employment and food crop diversification.

Looking back, the transformation of the Indonesian economy during the past two decades from largely independent sectors in the economy with few intersectoral linkages to one with an increasingly closely-knit economy has resulted in part from the successes in the agricultural sector. But with the transition in the economy, the very policy that stimulated such positive change has become a budgetary limitation for the nation. Indonesia faces the choice confronted by many nations in the agricultural development process of selectively weakening or at least modifying some of the policy support for agriculture as the agricultural sector develops.

At present, the largest share of the fertilizer subsidy is going to the industrial sector. Attention to the policies surrounding the support for the fertilizer in-

dustry need examination as a means of lowering the fiscal exposure and placing the burden of change on the actual recipients of the subsidy.

The success in rice production and fertilizer use has broken the linkage between the rice to fertilizer price ratio as an efficient policy instrument. Consequently, several aspects of fertilizer use in Indonesia need attention and analysis to identify additional policy instruments to foster food crop production and diversification. Clearly, greatest use is made of nitrogen fertilizers by farmers. For the food crops, an improved balance among nutrient use could offer some increases in production. However, the implicit subsidy is greatest for the phosphate and potash fertilizers, the two nutrients that could provide some additional yield growth. Price differentiation among different nutrient fertilizers may be necessary to keep the subsidy in check although assuring supplies of all nutrients to farmers becomes more difficult in this case. Also, while rice and corn varieties that show good response to fertilizers are readily available, the fertilizer response of other food crops is particularly weak. Directing research efforts toward the development of fertilizer responsive varieties across the full spectrum of food crops is of primary importance in continued fertilizer expansion at the farm level and the diversification effort in the sector.

In this text we have argued that heavy fertilizer subsidy has been a prime example of a policy instrument which has to be dismantled, precisely because it has achieved the main objectives that were set for it and is no longer an efficient or effective agent of change. Presuming that Indonesian policy makers also have the benefit of such analysis, what then could dictate against the rapid abolition of fertilizer subsidies. Three factors clearly favor foot-dragging on fertilizer subsidy removal.

The first factor in favor of policy stagnation is that any subsidy develops a client group in favor of continued protection on the grounds that they produce a socially necessary, or merit, good. Such protection provides a source of rents for the client group and the adminstrators that supervise the protection regime. The fertilizer industry and distributors clearly lobby very hard for a continuation of the subsidies.

The second factor that mitigates against the removal of price distortions in the fertilizer market is the relatively poor performance of the Indonesian rice crop in 1986 and 1987. Growth rates in rice supply have been well below growth in demand, and this has necessitated a draw down in public stocks. Although many in the agricultural bureaucracy would agree that a shift of resources out of subsidies and into more productive investments is required to revitalize Indonesian agricultural growth, the question is one of timing. Many are concerned that the investments required to revitalize growth in Indonesian agriculture would pay off in the long run; research being one example, but that the short-term political pressures to increase rice production are so great that any price-induced slippage, no matter how small, would be a risk not worth taking.

Finally, the political forces that govern Indonesia do associate farm input subsidies with the relative tranquility that has dominated the Indonesian rural and low-income urban life since over the last decade. Maintaining fertilizer subsidies, be they efficient or not, is considered by these all powerfull groups, a relatively small price to pay for political tranquility.

In the final analysis, reducing fertilizer subsidies in Indonesia is a question of enlightened economic foresight, the 'right' reform timing (e.g., following a good production year), an ability to overcome the rent-seeking behavior of vested interest groups and, most importantly, an updated political consensus on the role of fertilizer subsidies to the fortunes of the rural elite and to the flash-point of the urban wage earners.

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