SUPPLY AND DEMAND ANALYSIS OF RICE IN INDONESIA (1950-1972)

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CHAPTER I

INTRODUCTION

Indonesia is an agrarian country with more than seventy per cent of her population living in rural areas. The population of Indonesia was 119.2 million in 1971 with a very high growth rate (2.4 per cent annually).[1] This population is not evenly distributed, with 63.8 per cent of the population concentrated in the Java and Bali Islands, which is only about seven per cent of the total area of Indonesia. The national average population density is 132 people per square mile, but Java is the most densely populated island with 1,235 people per square mile. Java is recognized by its crowded rural region, high unemployment and therefore low standard of living for the rural area.[2]

Indonesian economy is still an agrarian economy, with more than fifty per cent of national income from agriculture, with low productivity in traditional techniques of production and very small holding size (0.5 Ha). Farm holding size has become smaller and smaller due to fragmentation, so that even the subsistence level cannot be maintained on Java Island. But Sumatra, Kalimantan and the Sulawesies have vast

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[1] Hasibuan, Sayuti, "Population growth, Manpower, and Employment, 1961-1971," Economic and Finance in Indonesia, No. 2 (June, 1973).

[2] Dwight, Y. King, "Social Development in Indonesia, A Macro Analysis," Central Bureau of Statistics Jakarta, Indonesia, 1973.

areas of land as yet unoccupied. However, the people who live in Java, Bali are reluctant to move unless they can have a better life in new surroundings. People's roots and traditions, as well as legal, political, and economic constraints, make their location and the conditions prevailing there seem preferable to jungle and remote areas, where land is available in absolute sense, but where conditions are primitive and far from the amenities of civilization.[3]

Rice holds a dominant position in both production and consumption in the economies of Indonesia and most Asian countries. One cannot point to any other single commodity in the Western World that has such far-reaching impacts on the functioning of the national economy such as rice.[4] Higher rice production may mean a saving in foreign exchange for rice imports. Failure to increase rice production in the decade ahead will create a very serious problem or situation. Higher rice prices can lead to higher wages and higher prices for goods other than rice. This will place inflationary pressure on the economy. For a long time rice has been the main food in Indonesia. The most important agricultural policy objective is to fulfill the increasing demand of the very vast growing population. However, domestic production has never reached it. The only way in the short run is to import rice, but rice imports may discourage domestic production and divert foreign exchange that is

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[3]U.S.D.A., "The World Food Situation and Prospects to 1985." Economic Research Service, U.S. Department of Agriculture, Foreign Economic Report No. 98 (December, 1974).

[4]International Rice Research Institute, Annual Report, 1967, Los Bamos, Philippine Islands.

needed for financing development programs. Self sufficiency in rice production is the goal of the government of Indonesia and primary objectives of the most of the agricultural support programs. Self sufficiency may be achieved by 1) decreasing rice imports gradually, 2) transferring hectarage from other crops to rice, 3) opening up new land, and 4) increasing rice yield per hectare.

The first alternative would normally be politically unacceptable. The second alternative, transferring hectarage from other crops (export or import crops) to rice, may reduce foreign exchange earning or increase spending on agriculture imports. The third alternative is very costly and carries a low rate of return,[5] due to the need to improve or build new infrastructure such as irrigation, roads, communication facilities, institutions such as for credit, education, health, cooperatives, extension and other government and private services. Thus, in the mind of most people, self sufficiency in rice implies achieving adequate increase in production through a sustained increase in yield per hectare.[6] Schultz says: "Traditional agriculture consists of farming under a long established economic equilibrium, which is attained during generations of farming, and the critical conditions on which it depends have remained virtually constant for generations. Theoretically when a sector of an economy is at idealized equilibrium, it is producing

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[5]Mellor, John W., Economics of Agricultural Development, Cornell University Press, Itacha and London, 1970, p. 187.

[6]Schultz, T. W., Economic Crisis in World Agriculture, The University of Michigan Press, Ann Arbor, 1966, p. 49.

at an optimum, the implication is that it is producing precisely the right products in the right amount and that it is using the agricultural factors of production in the right proportion and amounts and, therefore, it is contributing maximum to the national product."[7] He said the irony here is that traditional agriculture, which produces so little, cannot produce more as things now stand and that modern agriculture, which produces so abundantly, can render even more to economic growth than it is already contributing. While the problem in the case of modern agriculture can be resolved by means of better "resource allocation," the problems that must be faced in coping with traditional agriculture requires a search for ways of breaking the established economic equilibrium and creating a disequilibrium. This approach introduces a theory of investment which concentrates on high pay off new inputs, and a theory of investment in both material and human capital to improve the state of the arts, which is the only real source of new profitable investment opportunities. According to Schultz, the economic equilibrium is relevant in underdeveloped economies, and for the peasant economies, it is in equilibrium at present prices and technology. He argues that in traditional agriculture, the crucial feature is the rate of return to investment on available inputs. Thus, he says, the way to transform this type of agriculture is to develop new, more productive inputs.

Indonesia is a country of traditional agriculture, which needs more modernization in technology and more new factor input supplies,

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[7] Schultz, T. W., Transforming Traditional Agriculture, Yale University Press, 1964, p. 49.

in order to increase the production and the return to the farmers. Aware of this approach, in 1963/64, Bogor College of Agriculture conducted a small action research project which had very gratifying results. New technology was introduced, called "PANCHA USAHA" (five ways for better farming and better living) where new high pay-off inputs were recommended as follows:[8]

1. Use of selected or improved seeds (High Yielding Varieties)
2. Use of fertilizers and pesticides
3. Better cultivation methods
4. Improved water management
5. Stronger cooperatives

Since 1964/65 this package program has been undertaken by the Department of Agriculture and since then the program expanded very rapidly, as well as has production.[9] While the expansion of production is encouraging, it creates a number of marketing problems and controversies. A large number of farmers wish to sell at a high price, but a large number of consumers wish to buy at a low price. Change in rice price will affect both farmers and consumers. For farmers a high price may mean more income and greater incentives to grow rice. In contrast, for consumers, a higher price of rice means a higher cost of living, since about

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[8]Roekasah, E. A. and D. H. Penny, "Bimas: A New Approach to Agriculture Extension in Indonesia." Bulletin of Indonesian Economic Studies, No. 7 (June, 1967), pp. 60-69.

[9]Birowo, A. T., "Bimas: A Package Program for Intensification of Food Crop Production in Indonesia." The Asia Society SEADAG, New York, N. Y., 1975.

twenty-five to thirty per cent of consumer budget is for rice. In short, a change in price of rice benefits some of the segments of the economy at the expense of others.

Since these two groups are in conflict, the introduction of rice price policy designed to satisfy all groups in the economy requires careful evaluation of the factors concerned. Moreover, there exists various a priori hypotheses about the supply responsiveness of underdeveloped agriculture to price changes. These hypotheses may be divided into three major categories:[10] 1) The hypothesis that farmers in underdeveloped agriculture respond quickly, normally and efficiently to relative price changes, 2) The hypothesis that the marketed production of subsistence farmers is inversely related to price, and 3) The hypothesis that institutional constraints are so limiting that any price response is insignificant.

A major proponent of the first hypothesis is Theodore W. Schultz. Schultz repeatedly and emphatically presents this hypothesis:

> The rate at which farmers who have settled into a traditional agriculture accept a new factor of production depends on its profit, with due allowance for risk and uncertainty and, in this respect, the response is similar to that observed in modern agriculture.[11]

> The doctrine that farmers in poor countries either are indifferent or respond perversely to change in price

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[10] Behrman, Jere Richard, Supply response in underdeveloped agriculture; A case study of four major annual crops in Thailand. Ph.D. Thesis. Massachusetts Institute of Technology, September, 1966.

[11] Op. cit., p. 33.

> . . . is patently false and harmful. Price policies based on it always impair the efficiency of the agriculture.[12]

Schultz concedes that some institutional and cultural constraints may have adverse effects on production. He insists, however, that such restraints leave considerable leeway for responses to economic variables and that in economic equilibrium of "traditional agriculture," these responses result in the efficient utilization of existing factors of production.[13]

One might note, however, that Schultz's hypothesis about traditional agriculture seems tautological. He assumed a constant state of technology and of preferences and the passage of sufficient time so that farmers have "arrived at the relatively efficient allocation of the agricultural factors at their disposal" and then he derives the critical hypothesis that "there are comparatively few significant inefficiencies in the allocation of factors of production in traditional agriculture." A number of economists agree with Schultz that underdeveloped agriculture responds significantly and normally to price changes. For example, Walter Falcon emphasized that the composition of the output responds to price changes.[14] Clifton Wharton suggests

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[12] Op. cit., p. 49.

[13] Op. cit., pp. 22 and 39.

[14] Walter P. Falcon, "Farmers Response to Price in an Underdeveloped Area: A Case Study of West Pakistan," p. 33.

as an example the expansion of world coffee production after the high prices in the early 1950's.[15]

The second hypothesis that the marketed surplus of subsistance farmers is inversely related to price is advocated by D. R. Khatkhate.[16] He argues that subsistence farmers may have fixed or relatively fixed money obligations and, therefore, only sell as much of their production as necessary to obtain the desired money income. The relatively fixed monetary charges for rent, debt services, and an inescapably small amount of consumption of non-agricultural goods. Whatever production that need not be sold to obtain the desired money income has a very high utility at the margin in the non-farm consumption because of its higher marginal utility for on-farm consumption by subsistence producers. The subsistence producing unit, therefore, maximizes its production, sells whatever is needed to obtain its necessary monetary income, and consumes the remainder. The marketed surplus, thus, varies inversely with the market price of the subsistence crop of concern. The other argument for this inverse relationship between marketed surplus of a subsistence crop and the market price is presented by T. N. Krishnan.[17]

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[15]Wharton, Jr., Clifton R., "Research on Agricultural Development in Southeast Asia." The Journal of Farm Economics, XLV (December, 1963).

[16]Khatkhate, Deena R., "Some Notes on the Real Effects of Surplus Disposal in Underdeveloped Economies." The Quarterly Journal of Economics, LXXVI (May, 1962), pp. 186-196.

[17]Krishnan, T. N., "The Marketed Surplus of Foodgrains: Is It Inversely Related to Price"? The Economic Weekly, XVII (Annual Number, February, 1965), pp. 325-328.

He is concerned with the fixed demand for monetary income, but merely argues that an increase in price for a subsistence crop may produce an increase in real income sufficiently so that the income effect on his demand for consumption of this crop outweighs the price effects on production and consumption. The marketed surplus, therefore, may vary inversely with the market price.

Note that both formulations which have been presented to support the hypothesis of an inverse relationship between price and marketed surpluses may be consistent with efficient, maximizing behavior.

In some cases in Indonesia, the inverse relationship between marketed surplus and the market price may be because the subsistence farmers can sell less of their product when the price is high (farmers usually use it to buy other basic necessities such as clothing, sugar, and some other expenses) and they respond by eating more. Rice is a luxury good in some areas in Indonesia, such as in Central Java.

The result of a study conducted by Mubyarto and Fletcher as reported by G. T. Jones and Willet[18] "that under the condition existing in the period of 1951-1962, there was not strong positive response of acreages and yields of rice to the higher prices in the short run, since higher prices for rice raise farmers real income, and they respond by eating more." Studies in other parts of the world have also indicated that higher price alone may not have much effect on the output. In his conclusion he said, "this analysis does not, however, indicate that the

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[18]Jones, G. T. and Willet, J. W., A Proposed Price Policy for Rice in Indonesia. Direktorat Pertanian Rakyat, Djakarta, 1967.

higher price for rice cannot be powerful stimulant to production, but only that higher price must be accompanied by other factors which make it possible for farmers to respond." In Krawang, Indonesia,[19] where fertilizers and special cultivation methods were applied, the response of output to price was strong. Based on the result of this study, the government encouraged the expansion of rice production by input subsidies (fertilizer, pesticides, high yielding varieties and credit) through BIMAS program (Mass-Guidance in rice intensification).

The proponents of the third hypothesis, contend that institutional and cultural constraints severely limit the responses which are implied by generally accepted economic theory. The subset of such constraints which is most often emphasized may be subsumed under what Wharton has termed "human inelasticity."[20] Aspects of this inelasticity include limited knowledge of "the possible," limited tastes, limited inquisitiveness, and a natural conservatism, and a set of social values which grant considerable prestige to the sponsors of certain social ceremonies and to the holders of large amounts of certain factors.

A second subset of institutional restraints which has received considerable emphasis includes the various hypothesized market imperfections which prevent underdeveloped agriculture from exhibiting

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[19] Roekasah and D. H. Penny, "BIMAS: A New Approach to Agricultural Extension in Indonesia." Bulletin of Indonesian Economic Studies, No. 7, June, 1967.

[20] Wharton, Clifton R., Jr., "The Inelasticity of Southeast Asian Agriculture: Problems of Monocultural Economic Export Dominance." Thailand Agricultural Economic Society, Bangkok, November, 1972.

significant price responses. The credit market is also imperfect. Perhaps the most important of all, knowledge of new factors and/or new techniques is said to be considerably less than perfect. Transportation and storage facilities are said to be inadequate.

Some clarifying distinctions:

The first distinction is between total production and market surplus. Produced quantities and marketed quantities need not respond identically to various incentives. The relevant question to this distinction is whether or not the product may be consumed on the farm. The more limited are the possibilities for on-farm consumption, the less relevant is this distinction.

The second distinction is between total agricultural production and the production of any single crop.

The third distinction is concerned with the relevant time period. For most agricultural products, the very short response is limited to a great degree by the length of gestation period. The shorter the gestation periods, the quantities produced by annual crops tend to respond more quickly to incentives than the quantity produced of perennials. Short run response is defined here to be the response after one production period is allowed for adjustment. A long run response is defined to be the response after all expectational variables have adjusted to once and for all changes.

Objectives of the study

The primary purpose of this paper stemmed from the interest of these series of problems surrounding rice. It is not the purpose

here to examine specific policies, but rather to study the general principles and factors considered of primary importance in the supply and demand of rice.

At this stage, however, the result of the analysis is not complete and may not provide any policy decision, since the analysis is restricted to the supply and demand with rather crude and inaccurate data.

More specifically, the purposes of this study are:

1. to examine some important economic variables that affected the supply of and demand for rice.
2. to shed some light on the projection of supply and demand for rice, so some guidelines can be used for planning both production and consumption of rice and, if possible, with relation to other close substitutes.
3. to predict the effect of various policies on production and consumption and necessity for rice stock program (domestic procurement and import of rice).

CHAPTER II

A REVIEW OF INDONESIAN RICE ECONOMY

Rice production

Agriculture contributed about fifty per cent to the National Product and about 63.7 per cent of the labor force in agriculture (1971). Rice production has been the major activity from a long time ago and from generation to generation. Rice fields covered 6.8 million hectares and occupied about 37.8 per cent of the total cultivated area of land in 1969. The main producing area is Java, with 56.9 per cent of the total production of rice in Indonesia, as can be seen from the following table.

Table 1. Regional contribution of paddy production in Indonesia in 1968.

Region/Area	Hectarage (1,000 Ha)	Production	Contribution (%)
Java & Madura	4,468	11,630	56.9
Sumatra	1,836	4,713	23.1
Borneo	718	1,127	5.5
Sulawesi	700	1,764	8.6
Eastern Part	465	1,204	5.9
Indonesia	8,187	20,438	100.0

Source: Department of Agriculture, Jakarta, Indonesia.

Rice production in Indonesia has increased substantially since 1968 as the result of the harvested area expansion, but mostly by rice intensification (BIMAS PROGRAM), which is aimed at increasing rice production, as can be seen from the following table.

Table 2. Harvested area, production, and yield (1968-1973).

YEAR	Harvested (1,000 Ha)	Production (1,000 M.T.)	Yield (qt/Ha paddy)	(qt/Ha rice)
1968	8,020	12,249		
1969	8,014	12,249	23.39	15.28
1970	8,135	13,140	31.06	16.15
1971	8,324	13,724	31.70	16.49
1972	7,987	13,291	32.00	16.83
1973	8,383	14,702	33.73	17.53

Source: Central Bureau of Statistics, Jakarta, Indonesia.

The total output of rice under intensification program resulted not only from the area expansion, but also from increased yields. During the first PELITA I (1968/69-1972/73), the yield level in the intensification area was 1.886 tons of rice per hectare. By 1973, it rose to 2.373 tons, or an annual rate of 5.7 per cent. These figures indicate that the intensification program has been instrumental indeed in increasing total supply of food in Indonesia.

The following table indicates the role of intensification.

Table 3. Total output, area, and yield of rice in Indonesia in 1969-1973.

No.	Item	Unit	1969	1973	Annual Increase (%)
1.	Total rice output	1,000 M.T.	12,249	14,702	4.7
	From intensification		3,783	9,462	26.9
	Per cent of Total output		30.9	64.4	
2.	Paddy total area	1,000 HA	8,014	8,388	1.2
	From intensification		2,005	3,986	18.5
	Per cent of total area		25.0	47.5	
3.	Average yield level	100	15.28	17.52	3.5
	From intensification		23.4	35.4	

Source: Department of Agriculture, Jakarta, Indonesia.

Production and yield

Rice production depends on acreage and yield. Production increases as either planting area and/or yield increases, and to some extent fluctuates depending on weather conditions. Rice production in Indonesia has steadily increased, though in 1956 production was lower than in 1955 due to weather and in 1967 an increase was not significant compared to the year before. Again in 1972 rice production was lower than in 1971. See Table 8.

For comparison, contribution of yield and acreage to production in various countries in Southeast Asia can be seen from the following table.

Table 4. Production of rough rice and contribution of area and yield to production increase for selected areas, 1960-64 and 1968-69.

Area	Annual production (1,000 M.T.)		Increase (%)	Change in production due to change in	
	1960-64	1968/69		Area (%)	Yield (%)
Burma	7,925	8,187	3	100	0
Ceylon	963	1.346	40	87	13
Malaysia	840	1,344	60	77	23
India	53,105	61,351	16	39	61
Indonesia	12,718	16,577	30	40	60
E. Pakistan	14,702	17,259	17	69	31
Philippines	3,883	4,857	25	20	80
W. Pakistan	1,837	3,417	86	34	66
Thailand	10,074	12,300	22	89	11

Source: IRRI, Annual Report for 1970, p. 175.

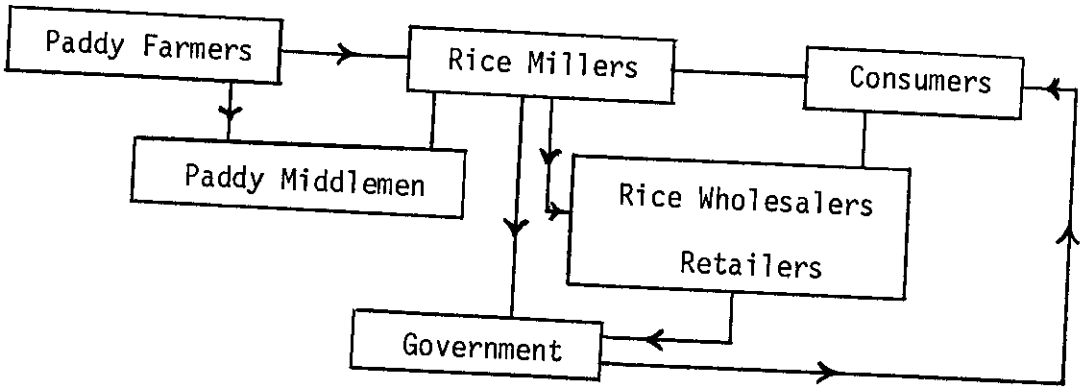
The increase in production of rice in the Philippines, West Pakistan, India and Indonesia due to increase in yield was 80, 66, 61 and 60 per cent; and the increase due to expansion in acreage was 20, 34, 39 and 40 per cent, respectively.

In Indonesia after 1968 the contribution of yield to total production of rice was more and more as the program expanded. Production from the area under the intensification program increased from 30.9 per cent of total production in 1969 to 45.7 per cent in 1973. Of this substantial increase in production forty per cent was due to the expansion of the harvested area. Expansion in the irrigated area that permitted double cropping and an increase in fertilizer use (especially in the Bimas area) contributed sixty per cent to the increase in total production.

Domestic rice marketing

A large supply of rice comes to market immediately after harvest, resulting in relatively low prices of rice during this period compared to other periods especially at "paceklik" (season of food scarcity), just prior to the harvesting time. Basically there are four economic units in Indonesia concerned with rice market activities; namely, the paddy farmers, the rice mills (particularly if rice millers perform functions as domestic wholesalers and retailers), and the consumers. Farmers sell their paddy to the rice millers and the rice millers sell their rice directly to the consumers or to wholesalers, retailers, or to the government. On many occasions, the farmers may sell their paddy to the middlemen before the paddy is bought by the

millers. The basic structure of rice marketing in Indonesia can be illustrated in the following diagram.



Farmers and the rice supply to the market.

Paddy is a subsistence crop in Indonesia. Only a small part (20-30 per cent) of the total production goes to the market and is used to buy other basic necessities such as clothing, sugar and to pay some other expenses. A response in the supply of rice to market price may exist for three a priori hypotheses; namely, 1) that farmers respond quickly, normally and efficiently to relative price changes, 2) that marketed surplus production of subsistence farmers is inversely related to price, and 3) that institutional constraints are so limiting that any price response is insignificant. These three cases may exist when the farmers vary greatly in their progressiveness, such as in Indonesia. Most farmers sell their surplus within a relatively short period of time after harvest, so that they receive low prices for their product and thereby low earnings.

The middlemen

Whenever paddy has moved out from the farm, many middlemen are involved. Local middlemen are located in the farm areas or adjacent to towns and often play an important role in the paddy marketing. They have many advantages compared to the regional middlemen who are located in the towns or in the central market. Most of the local middlemen assemble paddy in local areas and sell part or all of the amount purchased to the rice millers or to other buyers.

Thus, it is found that most marketable paddy surplus flows into the hands of the local middlemen. Regional middlemen purchase paddy from local middlemen or directly from farmers. Most of them own their transportation facilities such as trucks. Many provide credit facilities to the farmers. Sometimes they act as speculators storing paddy for the purpose of making a profit from a price rise.

Rice mill industries

According to the study and estimates by Dr. Timmer[21] the role of rice mills in Indonesia increased tremendously after 1969. Before 1969, eighty per cent of the total production in Java was hand pounded, but in 1974 only eight to ten per cent. This activity has been taken over by the rice millers. In this period the milling capacity increased 9,000 tons of "gabah" (dry paddy ready for milling). Of the total paddy production in Java of twelve million tons in 1971, the increased milling

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[21] Timmer, Peter C., Choice of Technique in Rice Milling on Java in Research and Training Network, ADC, New York, September, 1974.

capacity alone would be capable of milling eight to ten million tons of gabah, or seventy to eighty per cent of the entire crop in Java. ADB Rice Processing Report estimates hand-pounding accounts for only five per cent of rice processing on all Java and perhaps eight per cent to ten per cent for all Indonesia. The following table shows two dramatic changes, first in the installation of nearly 3,000 units rubber roler huskers (RRH) from one supplier alone. The number of total installed for all Java during this period, counting other suppliers, was 6,000, apparently increasing the milling capacity by 9,000 tons of gabah per hour.

Table 5. Sales of rice milling equipment on Java and Bali by a major supplier, 1970 to July, 1972.

Type	Year			Total
	1970	1971	1972	
Thresher; paddy output				
900 kg/hr	522	53	266	841
Rice Milling Unit (RMU)				
200 kg/hr rice	621	107	65	793
400 kg/hr rice	450	4	10	464
700 kg/hr rice	69	11	11	91
Rubber Roll Huller (RRH)				
Paddy input				
1,500 kg/hr	1,144	782	692	2,618
Separator; brown rice output				
1,000 kg/hr	59	61	10	130
Rice Milling Plants				
2,000 kg/hr paddy	4			4
4,000 kg/hr paddy	2			2

Source: ADB Rice Processing Report.

Storage facilities

Generally, the majority of the farmers do not hold paddy stock for higher prices. Though some of them store paddy stock, it is very difficult to know the figure, as data are not available. In contrast, most of the millers hold larger stocks of paddy and rice, but data for this are not available.

Rice grading

Grading is usually done by the millers, and there is no need to enforce classification, because consumers can judge the value of rice for themselves before buying it. The reason is that it is customary for people to associate rice with the location where it is grown, such as Tjianjur rice being the best quality, Krawang the second quality, IRRI variety is the third quality. To some extent, the percentage broken is recognized directly as the distinguishing feature of quality.

Transportation

Paddy and rice can be transported by the same kind of transportation facilities such as trucks, railroad, ships or boats. River and sea transportation is the cheapest.

Rice imports

As the consequence of rice policies to maintain a low price of rice, much lower than world market price, the government has to import rice in order to meet demand and to maintain a certain stock of about 1.0-1.3 million tons of rice. About 0.6 million tons of rice has to be imported each year on the average, as can be seen from Table 6.

Table 6. Rice production and import 1968-1972.

Year	Production (1,000 M.T.)	Import (1,000 M.T.)	Total (1,000 M.T.)
1968	10,960	600	11,540
1969	11,420	440	11,860
1970	12,710	960	13,670
1971	13,020	490	13,510
1972	12,540	730	13,270

From the above table can be seen that there is no pattern of relationship between domestic production and import.

Domestic demand for rice

It is desirable to consider the food consumption pattern of Indonesian people in order to generalize about the demand for rice in the whole country. There are differences in the type of food consumed in the Western part (Sumatra, Java, Sulawesi and Kalimantan), as compared to the Eastern part of Indonesia (Moluccas, West Irian and others). In the West, which consists of about 85.5 per cent of the total population, rice is the staple food and they take rice at every meal. In the East, they take sweet corn mixed with rice. There are also differences in the consumption patterns with regard to income levels, where lower income (i.e., farm workers) mostly take more sweet corn and cassava and sweet potatoes in their meal during paceklik period (period near harvesting), especially in Java and the Eastern part of Indonesia.

In general, for every daily meal, rice is an indispensable base; fish, meat and vegetables are embellishments, used for flavoring rice and to make it more palatable. In urban areas, especially in the higher income class areas, there is a tendency to consume more meat products and fish and more vegetables. But rice still retains its important place. Energy intake on the average was 52.9 per cent from rice, as can be seen from Table 7.

Table 7. Calorie consumption in Indonesia per capita per day, 1969-72.

No.	Item	Composition of Calorie Consumption 1969 Calories	1969 Percent	1972 Calories	1972 Percent	Change Percent
1.	Cereals:					
	Rice	1,030	52.9	1,040	52.9	
	Other	251	12.9	253	12.8	-0.1
2.	Rootcrops	251	12.9	226	11.4	-1.5
3.	Pulses	105	5.4	114	5.7	0.3
4.	Meat	19	1.0	23	1.2	0.2
5.	Fish	23	1.2	21	1.1	-0.1
6.	Milk	3	0.15	5	0.25	0.1
7.	Eggs	1	0.05	3	0.15	0.1
8.	Fruits & Vegetables	47	2.4	65	3.2	0.8
9.	Sugar	116	5.9	123	6.2	0.3
10.	Fats & Oil	99	5.1	99	5.0	-0.1
11.	Beverages	2	0.1	2	0.1	-
	Total	1,947	100.0	1,974	100.0	-

Source: Food Supply Analysis, 1969, B.P.S.

CHAPTER III

SUPPLY AND DEMAND ANALYSIS

In a market economy supply and demand determine the price of any specific commodity. Statistical analysis of supply and demand for farm products has been developed since the 1920's.[22] Analysis involved the statistical measurement of supply and demand for a particular farm product for purposes of theoretical application and for public policy decisions. The knowledge of supply and demand is also valuable for production planning and orderly marketing of farm products. The analysis is designed to measure price-quantity relationships of a particular commodity under specified economic assumptions.

This chapter will be devoted to statistical and economic models for measuring relationships between supply and demand. We considered it necessary to explain the justification of the variables or relevant factors to the model, the sources of data and data itself, the period covered and the assumptions.

The data

Secondary data will be used in this analysis from various sources: Government of Indonesia, Food and Agriculture Organization

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[22]Karl A. Fox; Econometric Analysis for Public Policy. Ames, Iowa, The Iowa State University Press, 1953, p. 3.

of the United Nations, U.S. Department of Agriculture, both Pacific Studies of the National University of Australia, Bulletin of Indonesian Economics Studies publications and other sources.

Many of the series, and especially the price series, have been spliced together from various sources. There are no continuous price series for either rice or corn through the period covered here. On the other hand, it has been possible to do splicing with some overlap, so the margin of error has been kept relatively small.

A further difficulty is that the prices are unweighted averages of monthly figures.

The calculation of rice consumption is subject to a number of possible errors. The import figures themselves are somewhat questionable. Even if import figures are accurate, consumption cannot be calculated unless changes in stocks are taken into account. On the other hand, there are no available data at all on the size of stocks held by private traders. Although since BULOG (National Logistic Agency) has been formed, their year-end stock changes have not been taken into account in calculating consumption.

Method or technique

The technique used will be formal econometric analysis of historical data presented in Table 8.

The means of discovering the "economic regularities" is through statistical analysis of the historical data, identification and specification of equations, and computer calculation of regressions.

1960	966	775	250	890	330	952	1415	382	3902
1961	886	1327	228	1010	644	975	1099	600	4701
1962	971	4619	324	1020	1680	996	623	1633	13351
1963	831	8077	236	1070	3370	1020	730	4333	32088
1964	952	18709	337	1020	8870	1044	319	7454	71355
1965	983	74119	237	140	61400	1070	324	35111	237000
1966	1013	671000	372	240	152200	1096	473	244000	3159000
1967	1019	2047000	370	350	649480	1122	1527	674000	8478000
1968	1096	5310000	317	600	1478000	1149	3674	1742000	19939000
1969	1142	3688000	219	440	2733398	1174	3270	2017000	25939000
1970	1271	4640000	283	960	2733938	1199	3850	1960000	31962000
1971	1302	4530000	263	490	3272335	1230	4420	2044000	35639000
1972	1254	4940000	227	730	4317526	1264	5060	2732000	40976760

Sources: FAO: Production Year Book 1958, 1969.
FAO: Agricultural Commodities Projection for 1975 and 1985, Vol. I, Rome, 1967.
National University of Australia: Bulletin of Indonesian Economic Studies No. 2/ July 1974, No. 1/March 1974, No. 2/July 1973, No. 1/March 1971, No. 10/June 1968.

The statistical estimations were obtained by using ordinary least squares procedure for the demand equation and ordinary least squares for the supply equation. Underlying the procedures are the following statistical assumptions for the multiple regression model:[23]

$$Y_t = b_o + b_1 X_{1t} + b_2 X_t + \ldots\ldots + b_k X_{kt} + U_t$$

1. The expected or mean value of the disturbance term is zero

$$E(U_t) = 0 \qquad \text{(unbiased)}$$

2. The variance of the disturbance term is constant and therefore is independent of t:

$$E(U_t)^2 = \sigma^2_u \qquad \text{(homoscedasticity)}$$

3. The values of the disturbance terms are independent of one another so that the covariance between the disturbance terms corresponding to any two observations, u_s and u_t, is zero.

$$\text{Cov}\ (u_t, u_s) = E(u_t u_s) = 0 \quad \text{(serial independence)}$$

4. The disturbance term is independent of all the values of the regressors. More specifically, we assume that u_t is independent of all X_{1s} ....., X_{ks} for all t and s. It follows that the covariance between the disturbance term u_t and each of the independent variables (regressors) of our regression equation is zero.

$$\text{Cov}\ (u_t, X_t) = E(u_t X_t) = 0$$

5. We don't have perfect multicollinearity among the regressions. That is, none of the independent variables is a linear combination

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[23] Kelejian, Harry H. and Oates, Wallace E., Introduction to Econometrics, Principles and Applications, Harper and Row Publisher, New York, Evanston, San Francisco, London, 1974, pp. 121-122.

of others; for example, we rule out the relationships such as:

a. $X_{1t} = 3 - 2 X_{2t} + 17 X_{3t}$;

b. $X_{4t} = (X_{1t} + X_{2t} + X_{3t})/3$; or

c. $X_{2t} = 3 X_{8t}$

Non linear relationships, however, are not ruled out; for instance, if $X_{1t} = X_{2t}^2$, or if $X_{3t} = X_{5t} X_{6t}$, our assumptions would not be violated.

And also there is no measurement error in the independent variables.

6. The disturbance term is normally distributed.

$$U = N(0, Q^2 I)$$

This is not necessary for estimation, but needed for hypothesis testing.

A. Supply analysis

As in conventional analysis, a distributed lag model was tried. Production was uaually highly correlated with production in previous years. Considering this, the dependent variable was lagged one time period as an independent variable (Qt is dependent, then Qt-1 is independent).[24] This simply says that current production is influenced by the level of production in the previous period, and current production may be viewed as changing from the previous level in response to various price and cost factors.

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[24] Tomek, William G. and Robinson, Kenneth L., Agricultural Product Price, Cornell University Press, Ithaca and London, 1972, p. 326.

Kelejian and Oates; op. cit., pp. 108-111.

Foote, Richard J., Analytical Tools for Studying Demand and Price Structures (Agricultural Handbook #146).

Supply schedules for many agricultural commodities have shifted because of technological change. In fact, changes of technology often seemed to be a dominant factor in explaining supply changes, but unfortunately there is no direct measure of "changes in technology." We must resort to the rather unsatisfactory device of a proxy variable, e.g. the number 1,2 ... T. This specification assumes a smooth change in technology of equal amount in each period. Production plans are also based on price at the period of planning.

The area planted to rice competes with the area planted to corn, so that the more acres there are devoted to corn, the less the acreage will be planted for rice production. When corn production increases then the production of rice will decrease.

From the above considerations the appropriate functional relationship is as follows:

$$QRT = f\ (QRT\text{-}1,\ PRT\text{-}1,\ QCT\text{-}1,\ T)^{25}$$

where:

QRT = Production of rice in t period

QRT-1 = Production of rice in t-1 period

PRT-1 = Price of rice in t-1 period

T = Time trend 1,2, ... T

QCT-1 = Corn production in t-1 period

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[25] U.S.D.A., The World Food Situation and Prospects to 1985. Many factors affect the supply of food such as 1) the availability and the use of land and other resources, 2) technology for raising yields and increasing the efficiency of the crop, 3) weather, and 4) incentives to produce. The efficiency of food marketing and distribution system and the size, organization, and management of agricultural enterprise also influence food supply. p. 58.

Basic assumptions:

In constructing any economic model designed to analyze trends in demand and supply, it is generally assumed that certain basic factors will be either remaining constant, or they can change only in a certain defined way:[26]

Basic assumptions are made as follows:

1. Constant rate of growth of population, constant elasticities.
2. Constant marketing margin and proportion of production marketed.
3. Constant agricultural and commercial policies such as government subsidies, price policies, etc.
4. Planned production is equal to the actual production.
5. There is no very close substitute for rice, except corn to some extent.

In constructing the model, a double-log formulation will be used as follows:[27]

$$\text{LOG QRT} = a + b \text{ LOG. QRT-1} + c \text{ LOG. PRT-1} + d \text{ LOG. QCT-1} + eT + \mu$$

Indonesia faced hyperinflation in 1956-1969, as can be seen from Table 8. The General Price Index rose from 133 in 1956 to 2,733,398 in 1969. All price variables were deflated directly with the General Price Index. Corn production in previous years is used as an independent

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[26] F.A.O., Agricultural Commodities Projection for 1975 and 1985, Volume I, Rome, 1967.

[27] The reasons for double log are: a) to keep consistent with demand equation estimation, and b) to keep the parameters constant along the period of analysis.

variable rather than the price of corn in the previous year, because as we have assumed that rice planted is competing with the area devoted to corn planted rather than the price of corn. Corn is more competitive with rice in production rather than on the consumption side.

Result and discussion

Some other equations have been tried as can be seen from the table. By using regression analysis, the computation gave the results as can be seen in Table 9. An equation was selected from various equations estimated, based on the correctness of the relationship between dependent variable and independent variables and the significance of the relationship.

The following equation was selected:

$$\text{LOG QRT} = 2.399 + \underset{(0.091)}{0.242}\ \text{LOG QCT-1} + \underset{(0.046)}{0.062}\ \text{LOG}\ \frac{\text{PRT-1}}{\text{GPI-1}} - \underset{(0.003)}{0.012}\ T$$

$$R^2 = 0.935 \quad SE = 0.023 \quad D.W = 2.247$$

(Values in the parenthesis are standard error of regression coefficients.)

This equation shows a correct relationship between dependent variable and independent variables, although statistically not so significant for price variables of rice and for previous rice production coefficients, but these two variables were retained in the equation. Corn production has a significant and negative relationship with rice production. Trend factor is very significant and positive effect. A striking result is, the statistical fit to this equation is very good, has $R^2 = 0.935$, which is to say that 93.5 per cent of the variation in

Table 9. Estimated regression coefficients.

Equation Number	Dependent Variable	Regression Coefficients for Independent Variables (Standard Deviation in Parenthesis)								
		LOG Const.	LOG QRT-1	LOG $\frac{PRT-1}{GPI-1}$	LOG QCT-1	LOG $\frac{PCT-1}{GPI-1}$	LOG QWT	LOGT	R^2	D.W
1.	LOG QRT	2.399 (0.555)	0.325 (0.198)	0.062 (0.046)	-0.242 (0.091)	--	--	0.012 (0.003)	0.935	2.247
2.	LOG QRT	2.007 (0.537)	0.262 (0.200)	--	--	0.018 (0.06)	--	0.117 (0.051)	0.922	2.14
3.	LOG QRT	2.444 (0.567)	0.259 (0.196)	--	-0.166 (0.072)	--	--	0.012	0.932	1.971
4.	LOG QRT	1.013 (0.387)	0.639 (0.140)	0.017 (0.007)	--	--	--	--	0.900	2.732

Number of observation = 23

Method of estimation = Ordinary Least Square

$t = \frac{b}{sb}$, value over 2 can be considered highly significant

the supply/production of rice in the period of analysis can be explained by the variables used in the model. The Durbin Watson Statistics (D.W = 2.247), a test for serially correlated residual shows no problems.

Interpreting the results of the equation, that present rice production is influenced by previous rice production, a ten per cent change in production last year, will affect the rice production this year by 3.2, while holding other variables in the equation constant. A ten per cent change in previous year rice price (deflated price) will influence the rice production this year by 0.6 per cent while holding other variables in the equation constant. A ten per cent change in corn production last year will have an effect on rice production by 2.4 per cent this year in the reverse direction, while holding other variables in the equation constant. The trend factor (technological changes and others) has had a very significant effect on rice production; the increase in production by the trend factor is about 1.0 per cent each year. As noted before, rice harvested acreage expanded continuously through new irrigation schemes and the rehabilitation of the old irrigation system. Rice yields also increased through the use of improved seeds, fertilizers and pesticides.

Package technology was introduced since 1967 through BIMAS program (Mass-guidance). It has a very significant contribution to rice production since 1967. The BIMAS program increased rice production by 5.7 per cent annually during REPELITA I (First Five Year Development Plan, 1968-1973).

Another test for the equation is how well it performs in predicting turning points. The following table shows actual production,

Table 10. Actual, estimate, and difference of rice production period, 1950-1972.

Year	Actual (in 1,000 Ton)	Estimate	Difference (1,000 Ton)	Percentage (%)
1950	609	--	--	--
1951	6,140	6,743	-333	5.4
1952	6,620	7,096	-476	7.2
1953	7,230	7,263	77	1.0
1954	8,120	7,516	704	7.4
1955	7,560	7,767	-207	2.7
1956	7,850	7,652	198	2.5
1957	8,070	7,825	245	3.0
1958	8,290	8,277	63	0.8
1959	8,610	8,542	68	0.8
1960	9,660	8,850	810	8.4
1961	8,860	9,162	-302	3.4
1962	9,710	9,298	412	4.0
1963	8,370	9,215	-905	10.9
1964	9,520	9,650	-130	1.4
1965	9,830	9,447	383	3.9
1966	10,130	10,335	-205	2.0
1967	10,190	10,428	-238	2.3
1968	10,960	10,545	415	0.4
1969	11,420	11,628	-208	1.8
1970	12,710	12,485	225	1.8
1971	13,020	12.680	340	2.6
1972	12,540	13,218	-678	5.4
Total differences without regarding to sign				79.1
Average differences in per cent				3.6

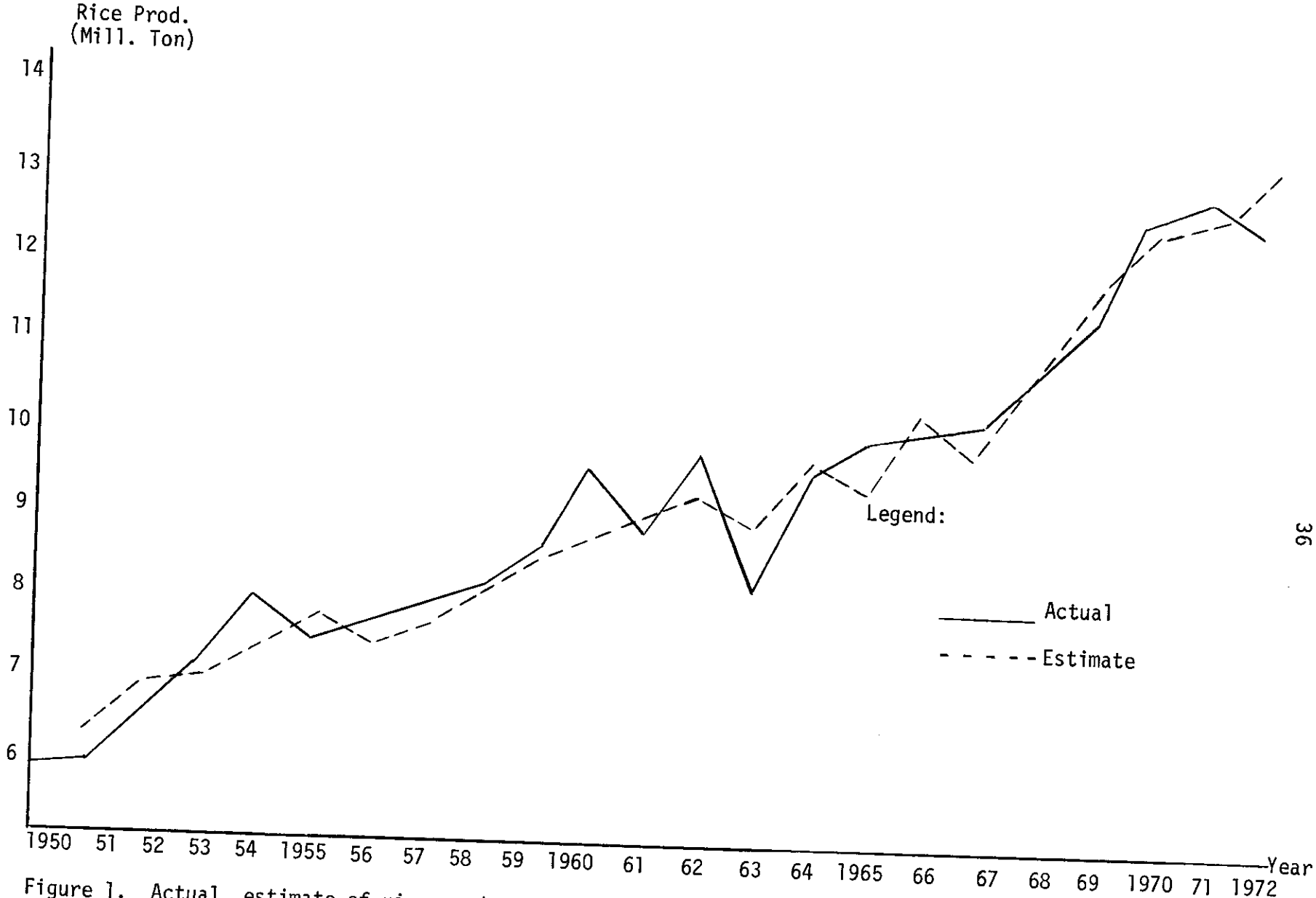

Figure 1. Actual, estimate of rice production in Indonesia (1950-1972).

estimated rice production and the difference of estimates and actual observations (Table 10). In Figure 1, we can see the graph presentation. The equation failed to predict most of the turning points.

B. Demand analysis

The demand estimate may be broken down into three components:[28]

a. estimation of demand for domestic food consumption

b. estimation of domestic industrial demand for agricultural raw materials

c. estimation of external demand for agricultural commodities, e.g., export

In Indonesia demand for rice is merely for domestic food consumption, so that the analysis of demand for rice is simpler.

Demand for food is dependent principally on the rate of population growth and the rate of growth of per capita income.[29] The distribution of population by age and geographic area also has a significant effect on demand for rice. In the East part of Indonesia, sweet corn is a major food, even more important than rice itself. The distribution of

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[28] F.A.O., Statistics and Studies for Agricultural Development Planning: A Phased Program, p. 3.

[29] U.S.D.A. Op. cit., p. 75. In developing countries, population growth is the major factor explaining increasing demand for grain, and the demand for grain is principally for direct consumption. Throughout the developing countries the income elasticities of demand for grain are substantial, varying from .3 to .5 in most areas. Thus, the higher income has added additional strength to the vigorous expansion in demand for grain in developing countries that result from rapid population growth.

population between urban and rural areas is also an important influence. It has a considerable effect on the level of aggregate demand. In the very short run analysis, there is no significant change in population distribution and population growth rate. Income distribution has also affected demand for food. In developing countries, when income increases and at the same time becomes more evenly distributed, the demand for food will be strongly influenced by lower income groups, and this demand will be largely for grain for direct consumption. In case of Indonesia, in the first stage of development (PEPELITA I), the distribution of income has not materially changed; therefore, the effect of income increases has not expanded the demand for food by lower income groups as much as if the increase in income was more evenly distributed.

If quantity produced is indeed determined recursively, then price is the logical dependent variable in the demand equation while the quantity of the commodity as well as quantities of major substitutes are specified as independent variables.[30]

Changes in population have a direct effect on the market demand relation. The population variable is commonly taken into account by putting the quantity and income on per capita basis. Changes in population distribution by age, occupation, or geographical distribution may have an impact on demand over time.

Substitutes and complements probably have an important impact on demand, but these are often difficult to measure. The common practice is to include one or two variables representing major substitutes.

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[30]Tomek, op. cit., p. 327.

If price is a dependent variable, then the quantity variable for the substitute is usually used.

Changes of taste and preferences may influence demand and such changes are perhaps the most difficult to handle in statistical and demand analysis, hence assume there is no change in taste and preferences during the period of analysis.

Marketing margins might also be considered as a variable if the demand equation is derived from farm level prices.

Other analyses might depend on changes of relative prices and real income, so a common practice is to deflate the observed price and income series by the General Price Index (GPI). Particularly when deflating retail prices, the Consumer Price Index (CPI) is used as a deflator.

Demand model

Summary of the basic assumptions for rice demand analysis here to be made are as follows:

a. No changes in population distribution
b. No changes in taste and preferences
c. Corn and wheat flour are only considered as substitutes
d. Constant marketing margin, no advertising on rice
e. No changes in income distribution
f. No change in inventory at the end of each year

Based on the assumptions, the general demand function for rice can be specified as follows:

$$PRT = f\ (QRT, Q1, \ldots\ldots\ldots Qn, Y, T)$$

where:

QRT = Per capita demand for rice

PRT = Price of rice

Q1 . . . . . Qn = Quantity of other goods, i.e., substitutes

Y = Per capita income

T = Time trend

In constructing the model, double-log formulations will be used. The reason for double logs are: a) to keep consistent with supply equation estimation, and b) to keep the parameters constant along the period of analysis. The estimated equation from the above functional form is as follows:

$$\text{LOG PRT} = \underset{(0.717)}{3.183} - \underset{(0.868)}{0.953}\ \text{LOG}\ \frac{QRT}{POP} + \underset{(0.246)}{0.495}\ \text{LOG}\ \frac{QCT}{POP}$$

$$- \underset{(0.070)}{0.094}\ \text{LOG}\ \frac{QWT}{POP} + \underset{(0.310)}{0.982}\ \text{LOG}\ \frac{GNP}{POP} + \underset{(0.009)}{0.004}\ T$$

$$R^2 = .998 \qquad \text{S.E.} = 0.078 \qquad \text{DW} = 1.893$$

(Values in the parentheses are standard error of regression coefficients.)

All signs (relationships) are consistent with expectation, except for the relationship between price of rice with the quantity of corn (as substitutes), but it is insignificant. We notice that the relationship between price of rice with the quantity of rice supplied is significant at twenty-seven per cent (not significant at five per cent level). The relationship of the price of rice with the quantity of wheat flour supplied is not significant at all, but the sign is correct. The larger

quantity of wheat flour supplied to the market will decrease the price of rice. The relationship between the price of rice and the average income of the population is positive and highly significant. An increase in income per capita will increase the demand for rice. The trend factor (time) effect was not significant at all.

Alternative model

We are not satisfied with the above model due to three variables which are not significant at the five per cent level, and with one variable having a sign contradictory to our expectations. Corn is considered as a rice substitute. The relationship between rice price and the quantity of corn supplied should be negative instead of positive.

Therefore, we examined another model by dropping out all substitutes of rice (corn and wheat). As has been said earlier, our assumption is that there are no close substitutes for rice. Then the model is as follows:

$$\text{LOG PRT} = a + b \ \text{LOG} \frac{QRT}{POP} + c \ \frac{GNP}{POP} + dT$$

Here we only considered factors affecting the price of rice as follows: quantity of rice per capita supplied, the average level of income of the population and the trend factor.

Results and discussion

The result from the regression analysis (consumption) is as follows:

$$\text{LOG PRT} = \underset{(0.745)}{3.858} - \underset{(0.811)}{1.613}\ \text{LOG}\frac{\text{QRT}}{\text{POP}} + \underset{(0.035)}{0.953}\ \text{LOG}\frac{\text{GNP}}{\text{POP}} + \underset{(0.070)}{0.012}\text{T}$$

$$R^2 = 0.997 \qquad \text{S.E.} = 0.093 \qquad \text{DW} = 1.795$$

(Values in the parentheses are standard error of regression coefficients.)

This model shows the expected relationship between dependent variables and the independent variables. All relationships are significant except for the trend factor which is significant only at twenty-four per cent (not significant at five per cent level).

A striking result was that after all rice substitutes (corn and wheat flour) were cancelled out from the first model, the explanatory power of the new model did not change (only a very small change) or remained very high with $R^2 = 0.997$, indicating that 99.7 per cent of the variation in the price of rice can be explained by the two factors, i.e., quantity of rice per capita supplied and the per capita income.

The trend factors again did not significantly explain the variation of the price of rice. The price flexibility of rice is very high (-1.613). So as the supply of rice per capita is increased by one per cent, the price of rice will be pressed down by 1.6 per cent. A very powerful policy would be to inject rice into the market or to remove it. This has an important implication to the price stabilization policy, by keeping the price of rice moving between the floor price and the ceiling price of rice. Failure in production will push the price of rice very high (unless special effort is made, e.g., rice import).

Table 11. Estimated regression coefficients.

Eq. No.	Dependent Variable	Regression Coefficients for Independent Variables (Standard Deviation in Parenthesis)							
		LOG Const.	LOG $\frac{QRT}{POP}$	LOG $\frac{QCT}{POP}$	LOG $\frac{QWT}{POP}$	LOG $\frac{GNP}{POP}$	T	R^2	D.W
1.	LOG PRT	3.641 (0.643)	-1.604 (0.694)	0.629 (0.229)	--	0.971 (0.031)	0.007 (0.009)	0.998	2.263
2.	LOG PRT	3.183 (0.717)	-0.953 (0.838)	0.495 (0.247)	-0.094 (0.070)	0.982 (0.310)	0.004 (0.009)	0.998	1.893
3.	LOG PRT	3.857 (0.745)	-1.613 (0.811)	--	--	0.953 (0.035)	0.012 (0.104)	0.997	1.795
4.	LOG PRT	3.476 (0.599)	-1.396 (0.633)	0.668 (0.221)	--	0.993 (0.012)	--	0.998	2.220
5.	LOG PRT	3.038 (0.775)	-0.554 (0.884)	--	-0.152 (0.070)	0.976 (0.034)	0.006 (0.010)	0.997	1.882

Number of observations = 23

Method of estimation = Ordinary Least Square

$t = \frac{b}{sb}$, value over 2 can be considered highly significant

With a one per cent decrease in rice production/supplied per capita, the price of rice will increase by 1.6 per cent, while holding other variables constant. By keeping other variables constant, increasing income per capita by one per cent will increase the price of rice by 0.9 per cent. So if the income per capita increases by five per cent as targeted in the Second Five Year Plan (REPELITA II), this will increase the price of rice by 4.5 per cent, holding other variables constant. This will affect the price stabilization program. Demand for rice will steadily increase due to increasing income per capita, if the Five Year Plan of Indonesia is successful in reaching the target. Increases in income will influence people to divert eating habits (especially in the Eastern part of Indonesia) to rice. This will increase pressure on the demand and the price of rice. Income increases have a great effect on demand for rice in Indonesia, due to the fact that in some areas rice is considered as a luxury for the lowest income group of the population, especially in the most populated area of Java.

The trend in the price of rice seems to be positive and this will likely continue. Many factors support this trend, such as the high rate of population growth, slow increase in production, an increasing income level. If the Five Year Plan of Indonesia is successful in achieving its target to increase income per capita of the population, especially income of the lower group of the population, this upward trend in prices on rice will be particularly strong.

Another test for the model is how well it performs in predicting the turning points. Table 12 shows the actual price of rice, estimated rice price, and the difference of the estimate and actual

Table 12. Actual, estimate, and difference of rice price period, 1950-1972.

Year	Actual (Rp per 100 Kg)	Estimate	Difference	Percentage
1950	110	--	--	--
1951	241	263	-22	9.1
1952	288	279	9	3.1
1953	250	245	5	2.0
1954	245	225	19	7.8
1955	284	359	-75	26.4
1956	344	403	-59	17.2
1957	441	470	-29	6.6
1958	773	614	158	20.4
1959	923	801	-78	10.8
1960	775	904	-129	16.6
1961	1,327	1,297	30	2.3
1962	4,619	3,159	1,460	31.6
1963	8,077	9,791	1,714	21.2
1964	18,709	17,601	1,109	5.9
1965	74,117	54,880	19,237	25.9
1966	671,000	645,025	25,975	3.9
1967	2,047,000	1,710,944	336,056	16.4
1968	5,310,000	3,593,010	1,716,990	32.3
1969	3,688,000	4,510,446	-822,446	22.3
1970	4,640,000	4,832,977	-192,997	4.2
1971	4,530,000	5,398,101	-868,101	19.2
1972	4,940,000	6,865,309	-1,925,309	28.0
Total differences without regarding to sign				333.2
Average differences				15.1

observation. The average differences between rice prices observed and estimates (without regard to sign) is very high (15.1 per cent). Rice price estimation is very difficult due to the very unstable economy with hyperinflation from 1955 through 1969, so that our estimate of rice price is not accurate.

CHAPTER IV

PROJECTION OF SUPPLY AND DEMAND OF RICE (1973-1980)

A. Supply/production projection

Production of rice in Indonesia is likely to increase steadily between 1973 and 1980. This increase may occur due to an increase in acreage harvested, by improvement in irrigation systems and by acreage expansion, and in increasing yield per hectare. We make the following assumptions in order to project the import requirements between 1973 and 1980.

1. The production of rice will increase by four per cent per year, in line with past trends (REPELITA I).
2. All prices will be constant or they will change in the same direction and of the same proportions.
3. Population will increase from 129.0 million in 1973 to 149.3 million in 1980 (2.1 per cent annually).
4. Other variables will remain constant, such as government policies and weather conditions.

B. Demand projection

For a product with a double-logarithmic demand function, the projection can be made with the following formula:

$$QRT = QRo\ (1 + ng)^t$$

where:

QRT = projected per capita consumption of rice under year t

QRo = per capita consumption at the base period

n = income elasticity derived from demand function

g = growth rate of real per capita income

t = number of years from the base year to the target year

This projection is made based on the assumption that all prices remain constant or they change in the same proportion and at the same direction.

From the model we have developed, we can find the price elasticity of demand and the income elasticity of demand for rice, by transforming the equation as follows:

$$\text{LOG } \frac{QRT}{POP} = \frac{3.858}{1.613} - \frac{1}{1.613} \text{ LOG PRT} + \frac{0.953}{1.613} \text{ LOG } \frac{GNP}{POP} + \frac{0.012}{1.613} T$$

$$\text{LOG } \frac{QRT}{POP} = 2.389 - 0.620 \text{ LOG PRT} + 0.591 \text{ LOG } \frac{GNP}{POP} + 0.007 T$$

From the transform equation, we found that price elasticity of demand for rice was -0.62 and income elasticity of demand for rice was about 0.59. This is near the conclusion by Dr. Timmer that income elasticity of demand for rice in Java was about 0.65 or the result of the study conducted by Dr. Mubyarto where he found income elasticity of demand for rice between 0.5 and 0.7. Increase in demand for rice is about one per cent due to time trend factor.

C. Projection of required import

Based on the previous discussion, the following table shows the results of our calculation.

Table 13. Supply and demand projections of rice in Indonesia (1973-1980).

Year	Consumption per capita (KG)	Population (Million)	Total demand (Mill.T)	Supply/ production (Mill. T)	Required import (Mill. T)
1973	110.0	129.0	14.2	13.5	0.7
1974	113.3	131.8	15.0	14.0	1.1
1975	16.7	134.5	15.8	14.6	1.2
1976	120.2	137.4	16.5	15.2	1.3
1977	123.8	140.2	17.4	15.8	1.6
1978	127.5	143.2	18.2	16.4	1.8
1979	131.1	146.2	19.2	17.1	2.1
1980	135.3	149.3	20.2	17.8	2.4

REQUIRED RICE Import for eight years = 12.1

Average import of rice annually will be = 1.5 Mill. Ton.

Note: population growth rate : 2.1 per cent annually

income per capita growth : 5.0 per cent annually

income elasticity of demand for rice : 0.6

rate of increase of rice production : four per cent/year

If the trends in production and consumption continued, then rice imports required will be increasing over time. The average imports of rice required during the projection period is about 1.5 million metric tons of rice annually. This projection may be high due to the possibility that the target increase in income per capita (five per cent annually) may not be fulfilled. Increase in income may have the

effect on income elasticity of demand for rice (food). As income increases, then the proportion of income spent on rice (food) will decrease. In other words, as income increases, income elasticity of demand for food becomes smaller. Also, the trend in the first stage of development seems to be toward more inequality in income distribution, so the effect of an increase in national income may not reach the lower income groups of the population. If family planning programs are effective, then the growth rate of population may be less than two per cent. So our projection of demand for rice should be even lower than has been projected.

CHAPTER V

CONCLUSION AND POLICY IMPLICATION

General conclusion

The objective of this analysis is to identify and measure the factors that influence the supply and demand of rice in the Indonesian economy. The estimation of production of rice and the price of rice are of particular interest. The analysis hopefully sheds some light on policies needed to encourage rice production, while at the same time control the price of rice (varies between floor and ceiling price) which is much lower than world rice price.

A supply equation and demand equation for rice were developed and estimated by using the ordinary least squares estimation procedure. The supply model used a geometric distributed lag. Supply and demand models both are in double-logarithmic form to assure constant elasticities during the period of analysis, and each is based on a set of assumptions that the author thinks appropriate to the rice economy in Indonesia.

The results of the demand analysis for rice are: 1) That about ninety-nine per cent of the variability in the price of rice can be explained by the quantity of rice per capita supplied/produced, level of income per capita and a trend factor. The results of the analysis show that there is no close substitutes for rice, as we can

see from the first equation in which we considered corn and wheat flour as substitutes for rice and then dropped it in the second equation. The second equation has about the same explanatory power (R^2 = .99) as the first equation. It means that the price of rice is not materially affected by the quantity of corn and wheat flour supplied to the market. This may be true in the case of Indonesia, because rice is considered as a luxury good in some areas, especially in Java, the very densely populated area.

Price flexibility of rice is very high (-1.613), so that an increase in the rice supplied to the market has a great effect on the price of rice. It means that rice imports have a great effect on the domestic price of rice. On the other hand, increases in income per capita of the population will increase the price of rice about the same proportion. Therefore, if the REPELITA (Five Year Plan) succeeds in achieving its targets to increase income per capita by five per cent per year, it will place great pressure on rice demand and price of rice, particularly with the assumption of a more evenly distributed income as the result of development.

The supply equation is less reliable as several estimates of the relationships are insignificant, but it shows the expected signs on the relationships between the dependent variable (quantity of rice produced) and the independent variables (previous rice production, previous rice price, General Price Index) and the trend factor. In terms of explanatory power it gave a striking result, the statistical fit to the equation being quite acceptable (R^2 = .93), which is to say

the increase in rice production. Other measures should accompany the price policy such as improved infrastructure and marketing facilities and increased availability of inputs such as fertilizers, insecticides, credit and extension services.

Rice has a dominant position in both production and consumption in the Indonesian economy, so that an increase in rice price will increase prices of other goods. Higher rice prices can lead to higher wages and this will place an inflationary pressure on the economy. General price index increase has a negative effect on rice production, as can be seen from the model we have developed. From the above discussion, rice price increases will not have a full effect on production as expected, but will be discounted by the effect of the rice price increase on the General Price Index. For rice price stabilization, rice injection into the market has a very great effect on price, as can be seen from the model we have developed; that a one per cent increase in rice per capita injected will depress the price of rice by nearly 1.6 per cent. Hence, it would appear that the role of rice stocks is very powerful in effecting rice price stabilization policy. So, it is important to purchase rice from the farmers immediately after harvest (lowest price of rice) and to store it for a period of time releasing it in the right time, when the price of rice tends to increase. But, since domestic production cannot fulfill the domestic demand for rice at that low price, rice imports cannot be avoided in maintaining low rice prices for the consumers.

An analysis of the contradictory objectives of encouraging production on the one hand and maintaining rice price lower than the

world market price, on the other hand, is beyond the scope of this study. The benefit and the cost of this policy cannot be shown by our analysis, but the analysis has thrown some light on the complexity of the problem in the rice price policy faced by the government of Indonesia.

CHAPTER VI

SUMMARY AND SUGGESTIONS FOR FURTHER STUDY

Summary

The Indonesian economy is still agrarian, with more than fifty per cent of the National Income from agriculture. Low agricultural productivity is characteristic with traditional techniques of production on very small size farms--subsistence farming. Rice is the staple food and has the dominant position in both production and consumption in the economics of Indonesia. One cannot point to any other single commodity in the Western World that has such far-reaching impacts on the functioning of the National economy such as rice. Higher rice production may mean a saving in foreign exchange for rice imports. Failure to increase rice production a decade ahead will create a very serious problem. Higher rice prices can lead to a higher wage and higher prices of other goods. This will have an inflationary and unstabilizing effect on the political situation and the economy of Indonesia.

Self-sufficiency in rice is the goal of the government of Indonesia and the primary objective of most support programs. While expansion of production is encouraged, a number of marketing problems are created. Rice policies are designed to satisfy all groups in the economy, with low prices of rice so that most/all people can afford it,

while at the same time prices high enough to encourage farmers to produce it. It seems these policy objectives are contradictory.

The main purpose of this paper stemmed from the interest in these series of problems surrounding rice. It is not the purpose here to examine specific policies but rather to study the general principles and factors of primary importance in the supply of and demand for rice. However, the result of the analysis is not complete and may not provide specific policy decisions since the analysis is restricted by the availability of data. What is available is crude and inaccurate for definitive research on the supply of and demand for rice in Indonesia. But hopefully, this analysis will shed some light on the complexity of the problem surrounding rice policy now facing the government of Indonesia.

Methods or techniques of analysis used were formal econometric analysis of historical data from 1950 through 1972. Statistical estimation by using ordinary least square estimation procedure for extimating demand equations and ordinary least square for estimating supply equations. A conventional distributed lag model was used for supply analysis. Both supply and demand models were based on a set of assumptions that we feel relevant to the rice economy of Indonesia.

The result of demand analysis shows that ninety-nine per cent of the variability in the price of rice can be explained by the quantity of rice per capita supplied, level of income per capita and the trend factor. The analysis shows that there is no close substitute for rice. The price of rice is apparently not affected by the supply of corn or wheat flour to the market. In Indonesia, taste and preference for

rice have not yet changed very much. Rice is considered as a luxury good in some areas, especially in Java, the very densely populated area.

The price flexibility of rice is very high at about -1.6, so that an increase in rice supplied to the market has a great effect on the price of rice. But, on the other hand, if failure in production occurred, say a five per cent decrease in production, this will increase the price of rice by about eight per cent.

Income elasticity of demand for rice is about 0.6. So, if REPELITA succeeds in achieving the five per cent target in increasing income per capita, it will push the price of rice by about three per cent.

The supply equation is less reliable, though it shows an expected relationship, but many of the estimates of the coefficients are not significant. In terms of explanatory power, it gave a striking result: ninety-three per cent of the variation in the supply/production of rice can be explained by the previous production, previous rice price, general price index, and the trend factor. But this is not so reliable since the problem of multicollinearity may be present. From the analysis we can conclude that rice production is responsive to market price, though this is not so significant from the statistical point of view.

The second model shows that rice production is inversely related with corn production. This may be true, due to the fact that rice and corn compete for the same area. Corn is planted in the rice field. We suspect that the allocation of the acreage devoted to rice

or corn by farmers is affected by the weather conditions and from farmers' experience in making certain they will have adequate food supplies.

Our projection shows that Indonesia will have to import rice on the average of 1.5 million metric tons annually from 1973-1980 if her rice policy continues to maintain low price of rice for the benefit of the consumers.

In conclusion, this paper has shed some light on the complexity of rice price policy/program now facing the government of Indonesia.

Suggestions for further study

Further study on the supply response to the market price is needed. It is still a source of confusion and controversy between scientists as to whether rice farmers in Indonesia are responsive or not to price changes.

Since weather conditions and price expectations are affecting rice production and farmers' decision for allocating acreage to rice or corn, these variables are necessarily taken into account for improvement of our model. The effect of technology changes should also be analyzed through the variation in the yield per unit of land.

However, the statistical method of analysis will not guarantee the accuracy of the analysis without the use of accurate data.

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