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ANALYSIS OF DEMAND AND SUPPLY OF RICE IN INDONESIA

Won W. Koo
Maman H. Karmana
and
Gordon W. Erlandson

Department of Agricultural Economics
North Dakota Agricultural Experiment Station
North Dakota State University
Fargo, North Dakota 58105

FOREWORD

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HIGHLIGHTS

Rice is a major staple food of the Indonesian people. It provides over 50 percent of the calories in the average diet and almost 50 percent of the protein intake. It is also uniquely important in the Indonesian economy, with an annual market value of almost Rp. 2,000 billions, or 3.2 billion U.S. dollars. The demand for rice has increased due to sharp increases in population and higher consumption per capita as rice has been priced relatively cheaper than other carbohydrate foods. The result is that the supply of rice has to be supplemented with large imports. Such imports represent a significant outflow of foreign exchange.

A single equation least squares approach was used to analyze demand for rice. The annual rice demanded in Indonesia is determined by its own price, the price of other carbohydrate foods (mainly maize), and the time trend. Income did not appear to be significant. The demand elasticity with respect to its own price is -0.13. Cross elasticity with respect to the price of maize is 0.30. The coefficient of income elasticity was not statistically significant.

The rice supply function is expressed as a function of 'producer's average paddy price for the current year, lagged average producer paddy price, lagged average maize price, lagged average cassava price, and the time trend. Supply elasticity of rice with respect to its lagged average paddy price is 0.58.

Both consumers and producers of rice respond to price changes. Substitutability among food crops is determined by price as well as tastes and preferences. The supply imbalance may be alleviated by long-run changes in food consumption habits and improvements in the technology of production.

ANALYSIS OF DEMAND AND SUPPLY OF RICE IN INDONESIA

by

Won W. Koo, Maman H. Karmana, and Gordon W. Erlandson*

This study investigates the demand and price situation for rice in Indonesia. It analyzes the impact of economic variables such as income, population, and prices of other cereals on the quantity of rice demanded and supplied and calculates relevant elasticity measures of demand and supply.

Indonesia is a large, diverse country, an archipelago of over 3,000 islands located between Asia and Australia and scattered for about 3,000 miles east and west along the equator. A population of 140 million (1978) makes it the fifth most highly populated nation and the sixth largest country in the world. About three-fourths of the population is supported by agriculture, the major earner of Indonesia's foreign exchange. Agriculture contributed about 30 percent to the domestic product account in 1978 (BPS, "Statistical," 1980/81). Indonesia has the characteristic tropical climate. Temperature is relatively stable throughout the year, with a range between 23° and 32° C. in the lowlands and about 5.5° C. less in the interior highlands. Rainfall is relatively high, amounting to more than 1,000 millimeters per year in most regions. Rainfall may reach more than 3,000 millimeters a year in the "wet region" and about 650 millimeters in the "dry region" (Table 1).

Agricultural land comprises about 8 percent of the geographical area's 200 million hectares, which are mostly mountainous. Food crops are produced on about 6 percent of the total land area, and rice is the most important. Rice-growing areas include Java, Madura, Bali, Lombok, parts of northern and southern Sumatra, and southern Sulawesi. Wet-rice cultivation is predominant on Java and Bali; the other islands grow dryland rice. Java and Madura contain about one-tenth of the country's land, have the most fertile soil, and are well suited for growing rice. More than two-thirds of Indonesia's population live on these two islands.

Since Indonesia's independence, rice yield per hectare has increased significantly, as has total production. The government, through BIMAS (Mass Guidance) and INMAS (Mass Intensification) programs started in 1966, has enormously improved rice production. These programs built up a nationwide agricultural service system which provides farmers with guidance and assistance in doubling their harvests through utilizing high-yield strains of rice, heavy fertilization, application of pesticides, irrigation improvement, and better cultivation (Roekasah and Penny 1976).

Historical Background and Statement of the Problems

Rice is a major staple food of the Indonesian people. It provides over 50 percent of the calories in the average diet and almost 50 percent of the

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*Koo and Erlandson are Professors, Karmana is a former graduate student, Department of Agricultural Economics, North Dakota State University.

TABLE 1. RAINFALL ON SELECTED REGIONS, INDONESIA, 1976

Region	Rainfall	
	Days of Rainfall	Millimeter
Sulawesi		
1. Palu	104	593
2. Kendari	166	2.959
Kalimantan		
3. Pontianak	167	2.483
4. Sintang	117	3.780
East Nusa Tenggara		
5. Waingapu	66	658
West Nusa Tenggara		
6. Sumbawa Besar	42	793
Bali		
7. Tabanan	87	1.317
8. Karengasem	95	1.375
East Java		
9. Mojokerto	71	1.202
10. Lumajang	80	1.265
11. Sumenep	79	1.164
Central Java		
12. Tegal	71	1.434
13. Wonosobo	146	2.605
14. Salatiga	103	1.912
West Java		
15. Bogor	183	3.624
16. Purwakarta	140	3.141
17. Indramayu	102	2.316
Sumatera		
18. Blangbintang	113	1.401
19. Rengat	91	1.552
20. Padangpanjang	183	3.631

SOURCE: BPS, "Statistical," 1976.

protein intake (Mears 1978). It is also uniquely important in the Indonesian economy, with an annual market value of almost Rp. 2,000 billions, or 3.2 billion U.S. dollars.

In Java, where rice cultivation is dominant, the average land area cultivated by each farmer is less than one-half hectare. The "big farmer" who owned more than 5 hectares in 1959 represented only 0.41 percent of the land owners. The majority of Indonesian farmers, especially in Java, still live at subsistence levels (Mubyarto and Fletcher 1966).

The farmers prefer to grow rice to other crops. However, since rice is more sensitive to soil, irrigation, and weather conditions, risks are greater. Poor harvests of rice not only affect the farmer, but also put a serious strain on the country's food economy.

The food balance sheet of the Indonesian Central Bureau of Statistics lists 10.9 million tons of gross rice consumed in 1968 and 17.6 million tons in 1978. Per capita rice consumption has increased from 96.47 kilograms in 1968 to 123.35 kilograms in 1978. The success of BIMAS and INMAS programs during the same period has increased domestic rice production rapidly, from 10.8 million tons in 1968 to 16.3 million tons in 1978. However, as Mears (1978) argued, the increase in rice production is not rapid enough to keep pace with the demand from a growing population and with increased per capita consumption. The result is that the supply of rice has to be supplemented with large imports to meet increased per-capita consumption (Mears 1976).

Rice imports have rapidly increased from an average of only one-half million tons in 1968 to almost two million tons in 1977 (Mears 1978). Over 30 percent of the 8.2 million tons of rice crossing world borders in 1977/78 was imported into Indonesia following a poor harvest in the country (Alderman and Timmer 1980). Some rice needs have been fulfilled by foreign grants of grain in relation to aid programs. Even so, the nation still has to allocate one-half billion dollars for rice and wheat purchased overseas (Hanna 1976).

From the macroeconomic perspective that Alderman and Timmer (1980) argued, it is clear that such a large import of rice represents a significant outflow of foreign exchange. In addition, the domestic policy provides subsidies for domestic production of rice--another potential fiscal drain.

The question is therefore asked: Why do Indonesian people consume so much rice and why is the demand for rice increasing from year to year? Teken and Kuntjoro (1978) argued that rice consumption is difficult to reduce for the following reasons:

1. Rice consumption has few substitutes in some areas. In an area where people consume maize, cassava, or other tuber foods as secondary foods, they will change their diet to consuming more rice as their incomes increase.

2. Family planning has been intensified to reduce the birth rate. In addition, improved health service by the government has lowered the death rate. The results of these programs remain to be seen.

3. One alternative is to let the price of rice increase as determined by market forces, but the government thinks that this alternative is difficult. First, demand for rice is very inelastic. Second, rice is used as a wage good for some groups, such as civil servants, military personnel, and estate and industrial laborers.

The 1976 SUSENAS (National Socio-economic Survey) reported that the poorest 30 perent of the population, to which most of the small farmers belong, spend 37 percent of their budget on rice. Any increase in the price of rice means a greater proportional loss of real income of this group. Yet a higher price is an important factor to stimulate higher production. The conflict of interests certainly presents a hard choice to the Indonesian government when developing a price policy for rice.

The first regime of the Indonesian government after independence tried a curious assortment of simultaneous incentives, both on the production and consumption sides. Sporadic encouragement to produce was given through propaganda and subsidies to farmers. On the other hand, to protect the consumer, the government with its locally purchased and expensively imported rice distributed free rice rations to civil servants and military personnel and also sold "rice injection" to the public market to stabilize supply and demand at a low controlled price. As a result, it did much more to inhibit than to expand production, to encourage rather than to restrict consumption, and to create rather than to suppress a black market (Hanna 1976).

The second regime of the Indonesian government placed top priority on production of foodstuffs. The "two-faces" of the rice-price policy are still being continued by setting a floor price to protect producers and a ceiling price to protect consumers. BULOG[1] in the first year (1969) of the Five-Year Development Plan set a floor price of Rupiah (Rp.) 13.20 per kilogram of husked rice (price at farm gate) which translated into Rp. 36. per kilogram of milled rice and Rp. 47. per kilogram at the grocer level. The ceiling price was set at Rp. 50 at the rice milling level (Mybyarto 1980).

Partadiredja proved for 1970-1971 that BULOG had been able to overcome the problem of increased rice prices in urban areas. However, this institution failed to prevent a decreased rice price during the harvest season in rural areas (Mubyarto 1980).

Mubyarto (1965) argued that even if rice is a subsistence crop, farmers respond to its price. A high price of rice in one year is followed by an increase in production the next year. Conversely, a low price would be followed by decreased production.

Lains (1978) concludes that rice farmers in Indonesia have not responded to the changes in rice price in the short run nor in the long run. This led Mubyarto (1980) to be suspicious of the government's price policy, even though he has no doubt that BULOG has successfully stabilized the rice

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[1]Bureau of Logistics is a nondepartmental institution directly under the control of the President. This institution has authority to purchase rice and sugar, domestically produced or through imports, to maintain floor and ceiling prices of those two commodities.

price for the consumer. Mubyarto contends that the failure of this price policy should be compensated for by other alternative policies, such as irrigation and improved management, intensifying rural cooperatives, accelerating marketing of farm products, and intensifying extension services, which will stimulate rice farmers to increase production.

Objectives

The purpose of this paper is to analyze variables influencing the demand and supply of rice and determine their overall effects on rice prices in Indonesia during the 1960-1980 period.

The specific objectives are to

1. Describe trends of rice prices
2. Estimate the demand and supply functions of rice
3. Examine the pricing behavior of rice

Results of this study will provide a better understanding of the rice situation in Indonesia.

Scope of Study

This study is geographically limited to the Republic of Indonesia. Because some data required for this study are not available, analysis of some factors does not include the entire period 1960-1980.

This report involves analysis of demand and supply for rice as well as the trend of its prices at various market levels. Data on retail prices for rice and other food substitutes, maize and cassava, are based on the average retail prices in some cities in Java. For simplicity of analysis, this study has implicitly assumed that the market is integrated in the whole area. Afif and Timmer documented the extreme independence of prices between various islands of Indonesia. The General Price Index of Jakarta has been used to deflate all prices to eliminate inflation effects in the analysis.

Independent variables (the price of rice, maize, cassava, and income per capita) were regressed with the annual rice consumption per capita to estimate the demand function. For the supply function, the price of rice, maize, and cassava in rural markets of Java and Madura were regressed with the annual total supply of rice. The trend of rice prices is explained by using producer and retail prices during the five years from 1976 to 1980, since available data for this purpose are limited to this period. Price behavior will be explained in the next part of this report.

Data for the study were collected from a number of secondary sources. Most of the data for the analysis were obtained from various publications of Indonesian Central Bureau of Statistics.

Economic Variables of the Demand and Supply of Rice

Rice Consumption

Total annual rice consumption equals the initial stock of rice plus milled production plus imports within the year, less the year-ending inventory of rice. Annual rice consumption per capita equals total rice consumption divided by mid-year population.

This study does not account for the amount of rice utilized for feed, seed, manufacture, and waste because such data are not available. The difference between rice consumption per capita in this study and that in the Food Balance Sheet provided by the Indonesian Central Bureau of Statistics is due to 2 percent waste.

Most rice consumed in Indonesia comes from domestic production. However, the amount produced is less than the amount of rice demanded. As a consequence, the Indonesian government imports rice from such countries as the United States and Thailand.

Rice imports over the last 20 years equalled about 7 percent of the total consumed, but imports vary from year to year. From 1960-1964 rice imports were about a million tons a year. Rice imports dropped sharply in 1965 due to unstable political conditions and economic difficulties in the country. Rice imports in the following years increased again to almost 2 million tons in 1979.

Domestic rice production increased from about 7 million tons in the early 1960s to almost 9 million tons in the late 1970s. Per capita rice consumption also increased, especially during the 1970s. "Gross" rice consumption per capita was 117 kilograms in 1960, then declined to 99 kilograms in 1967, and increased again to reach 134 kilograms in 1979. Any decline in rice consumption from 1960 to 1967 was due not to changes in taste or food habits but to economic difficulties.

Population

Total population is an important factor in determining rice consumption. Data in Table 2 indicate that population increased an average of 3.7 percent annually from 1960 to 1979. Total number of people is important as well as age and geographical (rural/urban) distribution. Table 3 presents the estimated population of Indonesia by age groups in 1981.

Age groups up to the age of 14 and 19 accounted for 39.6 and 50.8 percent of the population, respectively. The largest groups are between 0 and 14 years. The Indonesian population structure might be called a "young age population." This composition probably will not change significantly in future years to 2001.

The composition, size, and growth of the population suggest that two major future problems will be unemployment and consumption. The young age

TABLE 2. ANNUAL RICE PRODUCTION, IMPORTS AND CONSUMPTION IN INDONESIA, 1960-1979

Year	Area Harvested	Yield	Rough Production	Beginning Stock	Milled Production	Total Imports	Total Consumption	Mid-year Population	Consumption Per Capita
	1000 HA	MT/HA	1000 MT	1000 MT	1000 MT	1000 MT	1000 MT	Million	KG/Year
1960	7,285	2.05	14,953	850	10,168	891	11,091	94.8	117
1961	6,857	2.06	14,096	818	9,585	1,064	10,666	96.4	111
1962	7,283	2.08	15,124	801	10,284	1,025	11,281	98.6	114
1963	6,731	2.00	13,468	829	9,158	1,043	10,167	100.8	101
1964	6,980	2.02	14,134	863	9,611	1,010	10,582	102.3	103
1965	7,328	2.06	15,063	902	10,243	203	10,498	104.3	101
1966	7,691	2.06	15,812	850	10,752	308	10,929	106.5	103
1967	7,516	2.04	15,297	981	10,402	354	10,806	108.8	99
1968	8,021	2.14	17,156	931	11,666	628	11,854	111.2	107
1969	8,014	2.25	18,013	1,371	12,249	604	13,042	113.6	115
1970	8,135	2.38	19,324	1,182	13,140	956	13,763	116.2	118
1971	8,324	2.42	20,182	1,515	13,724	503	14,181	118.8	119
1972	7,898	2.45	19,387	1,561	13,183	748	14,334	121.6	118
1973	8,404	2.56	21,481	1,158	14,607	1,660	15,751	124.6	126
1974	8,537	2.63	22,463	1,674	15,276	1,070	16,373	127.6	128
1975	8,495	2.63	22,331	1,647	15,185	673	16,850	130.6	129
1976	8,369	2.78	23,301	655	15,845	1,293	16,977	133.7	127
1977	8,360	2.79	23,347	816	15,876	1,989	18,010	136.8	132
1978	8,929	2.89	25,772	671	17,525	1,845	18,714	140.0	134
1979	8,850	2.98	26,350	1,327	17,918	1,953	20,157	143.2	141

SOURCE: USDA 1980; Mears 1976.

TABLE 3. ESTIMATED AGE DISTRIBUTION OF INDONESIAN POPULATION IN 1981

Age Group	Population	Composition
Years	Numbers	Percent
0- 4	20,977,000	14.46
5- 9	18,457,600	12.73
10-14	17,951,900	12.38
15-19	16,240,700	11.20
20-24	13,714,200	9.46
25-29	11,453,200	7.46
30-34	8,133,500	5.61
35-39	7,329,400	5.05
40-44	7,561,000	5.21
45-49	6,282,900	4.33
50-54	5,112,500	3.52
55-59	4,067,800	2.80
60-64	3,114,300	2.15
65-69	2,159,600	1.49
70 over	2,483,000	1.71
TOTAL	145,038,600	100.00

SOURCE: BPS, "Population," 1978.

groups are also known as "consumptive groups" in the sense that they consume a large part of what they produce.

The figures above show that the demand for rice will increase from year to year. First, the rate of rice consumption for the young age groups will increase as they grow in years. Second, there is no indication of a shift in food consumption from rice to substitutes.

Another population problem is that most of the people live on Java and Madura island, which account for only one-tenth of the Indonesian land area. The population distribution by islands is shown in Table 4.

Java is densely populated and was developed long before the other islands. Existing government control, education, and economic institutions give Java a relatively better infrastructure. Java is more attractive for people to live on than other islands. This explains why transmigration, a major Indonesian government program, faces difficulties. Hull et al., as cited

TABLE 4. DISTRIBUTION OF INDONESIAN POPULATION AMONG ISLANDS, 1971-1977

Year	Java and Madura	Outer Java	Indonesia
	percentages		
1971	63.8	36.2	100
1972	63.6	36.4	100
1973	63.5	36.5	100
1974	63.3	36.7	100
1975	63.2	36.8	100
1976	63.1	36.9	100
1977	62.9	37.1	100

SOURCE: BPS, "Population," 1978.

by Mubyarto (1980), argued that even if family planning were successful, there would be 215 million people in Java by the year 2000, and 17 million would live in Jakarta, the capital city. There will be 96 million needing jobs.

Rice Production

Rice production in Indonesia is from two sources, wet and dry land paddies. Water from irrigation or rainfall permits farmers to grow rice by wet cultivation, which produces greater yields than dry land cultivation. Irrigation permits farmers to plant rice twice, even three times a year. The new high-yielding varieties (HYV) grow in a relatively short period of 110 days.

Irrigation developments and resultant increased rice production occurred in Java and Bali long before the Dutch arrived. Before the farmers knew about such modern inputs as HYV, fertilizers, and pesticides, soil minerals required by rice plants to grow were provided in the irrigation water. The water which temporarily stood in the rice field provided a good media for certain algae to live and capture nitrogen from the air through a fixation process. The nitrate element, as a product of this process, became available to the rice plant. At that time the farmers only realized that rice yields improved through irrigation. The only other factor needed to expand rice production was more labor. This was the link between the expansion of irrigation, wet land paddy cultivation, and the increase in population. Geertz (1963) intensively studied this phenomena and concluded that agricultural involution (a retrograde or degenerative change) had occurred among Java's rice farmers. More detailed information and the negative cultural impacts of the involution will not be explained in this paper. The study by Geertz helps to explain why Java is so densely populated and why irrigated and wet land rice fields are predominant on the island.

The Dutch colonialism in the mid 19th century started developing irrigation on Java by building dams and primary canals. They provided supplementary water needed by plantations owned by the private Dutch

companies. One dam, on the average, irrigated 34,000 hectares of rice (Booth 1977). During this period farmers were not applying commerical fertilizer, so rice yields per hectare were relatively constant, as shown in Table 5.

TABLE 5. HARVESTED AREA, PRODUCTION AND YIELD PER HECTARE OF PADDY IN JAVA AND MADURA, BY FIVE YEAR PERIODS, 1916-1940

Year	Production	Harvested Area	Yields
	1000 quintals	1000 hectares	qwt/ha
1916-1920	61,085	2,806	21.77
1921-1925	60,013	2,887	20.79
1926-1930	64,689	3,033	21.33
1931-1935	68,448	3,279	20.87
1936-1940	78,362	3,780	20.73

SOURCE: Booth 1977.

Increase in total rice production initially came from the increase in cultivated area and in the harvested area. Booth (1977) argued that rice yields during those periods were relatively constant because they included figures on the lower-yielding dryland paddy.

Rice yields per hectare from 1960 to 1967 did not greatly increase. The rice intensification programs were started in 1965 and showed increased yields in three years. Rice yield after 1968 increased every year from 2.14 tons to 2.98 tons per hectare in 1979. More figures on harvested area, production, and yield per hectare from wetland and dryland paddy are presented in Table 6.

Data from 1968 to 1973 indicate that about 60 percent of the harvested area is in Java and 40 percent is in Outer-Java. Paddy production is about 64 percent of the total on Java and 36 percent on Outer-Java. The yields of wetland paddies on Java are higher than in Outer-Java; Java's yield was 3.37 tons per hectare in 1968 and 3.89 tons per hectare in 1973. The difference in yield between Java and Outer-Java is due to a higher level of technology, better irrigation and infrastructure, and the abundance of labor in Java to help intensification.

The harvested area of dryland paddy in Java is only 24.1 percent of the total dryland harvested area, which is less than on Outer-Java. Even then, yield per hectare of dryland paddy in Java is higher than in Outer-Java.

Harvested area of dryland paddy equals cultivated area because this paddy land is planted only once a year during the rainy season. Harvested area of dryland paddy on Java declined by 18.4 percent, from 407,000 hectares in 1968 to 332,000 hectares in 1973. This indicates a conversion of dryland for paddy into wetland or other purposes, such as for living area. A similar decline happened in Outer-Java.

TABLE 6. HARVESTED AREA, PRODUCTION AND YIELD RATE OF WETLAND AND DRYLAND PADDY, INDONESIA, 1968-1973

Item	Unit	Java							Outer Java						
		1968	1969	1970	1971	1972	1973	Avg.	1968	1969	1970	1971	1972	1973	Avg.
Wetland Paddy															
Harvested area	hectare	3,857	3,947	3,959	4,050	4,006	4,235		2,506	2,596	2,720	2,843	2,596	2,828	
Percent of Total		60.6	60.3	59.3	58.8	60.7	60.0	59.9	39.4	39.7	40.7	41.2	39.3	40.0	40.1
Production	metric ton	13,013	13,925	14,647	15,675	15,056	16,471		7,060	7,549	8,502	8,633	8,345	9,431	
Percent of Total		64.8	64.8	63.3	64.5	64.3	63.6	64.2	35.2	35.2	36.7	35.5	35.7	36.4	35.8
Yield	ton/ha.	3.37	3.53	3.70	3.87	3.76	3.89		2.82	2.91	3.13	2.94	3.21	3.33	
Dryland Paddy															
Harvested area	hectare	407	347	343	366	326	332		1,250	1,123	1,113	1,066	970	1,108	
Percent of Total		24.6	23.6	23.6	25.5	25.2	23.1	24.1	75.4	76.4	76.4	74.4	74.8	76.9	75.7
Production	metric ton	590	506	519	554	532	576		1,764	1,576	1,602	1,531	1,418	1,613	
Percent of Total		25.1	24.3	24.5	26.6	27.3	26.3	25.7	74.9	75.7	75.5	73.4	72.7	73.7	74.3
Yield	ton/ha.	1.45	1.46	1.51	1.51	1.63	1.74		1.41	1.40	1.44	1.44	1.46	1.60	

SOURCE: BPS, "Statistical" 1977/78.

The difference in yield between wetland and dryland paddy is a major reason why farmers have shifted to more wetland cultivation. The cropping intensity of wetland could be increased, especially with irrigation available.

Prices of Rice, Maize, and Cassava

Changes in the relative prices of rice and its close carbohydrate-food substitutes influence the relative per capita consumption. Consumers shift their consumption away from rice and help foster rice self-sufficiency when the prices of maize and cassava are relatively cheaper than the price of rice. A relatively lower price of rice shifts in the other direction so people will consume more rice. Mears used price to explain relative changes in prices of food substitutes and their trend. The prices of rice, maize, and cassava from 1960 to 1979 are presented in Table 7. The market prices reflect an increase from year to year partly due to inflation. All prices in this study are

TABLE 7. PRICES OF RICE, MAIZE, AND CASSAVA, INDONESIA, 1960-1979

Year	Current Price			Relative Price to Rice	
	Rice	Maize	Cassava	Maize	Cassava
	---------Rp./Kilogram---------				
1960	7.62	3.70	0.88	.49	.12
1961	12.63	6.05	1.90	.48	.15
1962	38.10	17.92	6.98	.47	.18
1963	76.28	39.80	11.20	.52	.15
1964	202.28	79.20	24.50	.39	.12
1965*	726.04	267.45	58.95	.37	.08
1966*	5.96	2.66	1.22	.45	.20
1967	16.64	7.26	2.84	.44	.17
1968	48.13	19.11	7.26	.40	.15
1969	38.26	20.17	6.28	.53	.16
1970	43.47	19.60	8.08	.45	.19
1971	39.80	20.44	7.58	.51	.19
1972	45.90	27.32	9.80	.60	.21
1973	71.34	35.62	16.85	.50	.24
1974	76.30	46.73	13.46	.62	.18
1975	97.10	59.91	17.55	.58	.17
1976	116.22	76.87	28.02	.66	.24
1977	115.53	77.92	29.15	.67	.25
1978	119.85	77.82	28.61	.64	.23
1979	133.30	103.92	33.34	.77	.25

*Since 1966 prices are in new Rupiah (1,000 old Rupiah = 1 new Rupiah).

SOURCE: Mears 1976; BPS "Statistical," 1977/78, 78/79, 79/80; BPS "Indikator," 1975-1979.

deflated by the cost of living index of Jakarta. Rice prices were based on retail rice prices of a cheap quality of rice in Jakarta. Prices for maize and cassava were based on their retail prices in rural markets in Java.

Prices of maize and cassava increased relative to rice after 1965. Annual per capita consumption of maize from 1960 to 1965 was 26 kilograms. From 1970 to 1975 it declined to an average of 20 kilograms. In a similar way, annual consumption of cassava was 103 kilograms in the first period and declined to 73 kilograms in the next period. Partially due to relative price changes but also to the negative income elasticities involved, per-capita consumptions of maize, cassava, and other carbohydrate foods have declined. Mears (1976) concluded that there was a net substitution of rice for the other carbohydrates. Also, the increase of maize and cassava production was slower than that for rice, although large potential export markets exist for both crops.

The difference of rice prices between "farm gate" and rural markets from 1970 to 1975 is presented in Table 8. Differences between the two prices have been widening, although the overall trend is very erratic. Years of poor harvest, such as 1972, show a narrower differential between farm gate and rural market prices than in such favorable years as 1971 and 1975. Booth (1979) stated that the price differences between the farm gate and the rural market are likely due to poor transportation. If so, it would reduce competitiveness of the farmers; if not, middlemen would dominate the marketing system.

TABLE 8. FARM GATE AND RURAL MARKET PADDY PRICES, JAVA, 1970-1975
(Rupiah/Kilogram)

Year	West Java		Central Java		Yogyakarta		East Java	
	Price	Ratio	Price	Ratio	Price	Ratio	Price	Ratio
	Rp.		Rp.		Rp.		Rp.	
1970	22.2	109	19.9	108	19.7	106	18.8	106
1971	18.9	119	15.4	134	18.1	114	15.7	121
1972	29.2	93	26.6	100	30.5	79	23.1	102
1973	35.7	115	32.0	123	34.8	97	31.1	117
1974	40.5	109	35.9	121	39.7	106	38.3	104
1975	44.9	113	44.1	120	45.0	114	40.5	126

Note: $\text{Ratio} = \frac{\text{Rural Market Prices}}{\text{Farm Gate Prices}} \times 100$

SOURCE: Booth 1979.

Income

Income herein is based on data from the Indonesian Central Bureau of Statistics. National income or net national product at factor cost is the

value of gross national product (GNP) after subtracting net indirect taxes and depreciation. Income per capita equals national income divided by population. This analysis had all income or money income figures deflated by the cost of living index of Jakarta to avoid the effects of inflation.

Use of GNP as a measurement of income has been criticized since GNP does not reflect how the national income was distributed among the population. Aware of these weaknesses, we assumed that the national income was equally distributed. Annual money income and adjusted money income per capita figures from 1960 to 1979 are presented in Table 9.

TABLE 9. ANNUAL INCOME PER CAPITA, INDONESIA, 1960-1979

Year	Money Income	Cost of Living Index-Jakarta	Adjusted Money Income	Change in Adjusted Money Income
	----Rp.-----		----Rp.-----	
1960	3,589	112	320	--
1961	4,254	101	421	+31.6
1962	12,212	356	343	-18.5
1963	28,444	652	436	+27.1
1964	62,195	1,757	354	-18.8
1965	206,731	9,950	208	-41.2
1966	2,687	76	354	+70.2
1967	6,916	206	336	- 5.1
1968	15,706	464	338	+ 0.6
1969	20,880	545	383	+13.3
1970	24,811	612	405	+ 5.7
1971	27,348	639	428	+ 5.7
1972	31,841	680	468	+ 9.3
1973	46,073	891	517	+10.5
1974	70,987	1,253	567	+ 9.7
1975	82,280	1,492	551	- 2.8
1976	99,758	1,788	558	+ 1.3
1977	118,793	1,985	598	+ 7.2
1978	133,275	1,146	621	+ 3.8
1979	182,991	2,146	657	+ 5.8

SOURCE: BPS, "Statistical," 1970, 1974, 1977/1978, 1980.

Money income rose from 1965 to 1966 because of devaluation. One thousand of old-Rupiah were changed into one new-Rupiah. This was reflected in the cost of living index. The rate of change in real income from 1960 to 1966 was very erratic. Real income steadily increased from 1967 to 1979 except for 1975.

Analytical Framework

The original hypothesis of this study concerns factors influencing the demand for rice in Indonesia. In general, demand for rice is determined by the price of rice and related commodities; income; consumer's taste, preferences, and expectations; and the size of the population.

Rice, maize, and cassava are three important foodstuffs for most Indoneisan consumers, and the price of each commodity will affect the demand of the others, directly or indirectly.

An increase in income of consumers results in an increase in the demand for most products. For consumers at high income levels, an increase in income may not increase rice consumption. For some whose diets shift from carbohydrates to food with more protein, an increase in income may even decrease their consumption of rice.

Food habits (taste and preferences) of consumers may not change in the short-run period. In his study of consumption in Indonesia, Timmer (1971) stated there was no evidence to suggest a substantial shift to other food substitutes in the next few years. It was assumed that the shifts will be gradual and be captured by the trend.

Expectations are not included in this study. It is assumed that there will be no shift in demand due to a change in consumers' expectations or taste.

Since the market demand for rice is made up of the sum of individual demand curves, the greater the number of individuals in the market, the greater will be the market demand. Therefore, the size and growth of the population are very important in shifting the demand for rice.

The hypothesis in this study is based upon the concept of pure competition, which involves many small individual farmers and merchants supplying rice. Lacking governmental price control in the market, the price of rice is relatively free to move in response to changes in supply and demand.

As an analytical model, multiple regression provides detailed analysis concerning relationships between dependent and independent variables. The single equation least squares approach was used to analyze demand and price of rice. The general model of demand for rice is

$$Q_{dt} = f\ (P_{rt}, P_{mt}, P_{ct}, Y_t) \qquad (1)$$

where: Q_d = quantity of rice demanded per capita, per year

P_r = retail price of rice per kilogram

P_m = retail price of maize per kilogram

P_c = retail price of cassava per kilogram

$Y \doteq$ net annual income per capita

t = index for year

Quantity demanded and net income are calculated based on per capita basis. Foote (1958) suggested that per capita data will avoid confusing the time trend for population with one that might reflect other effects.

Linear and logarithmic equations are the principal functional forms used in economic analyses (Foote 1958). An advantage of using logarithmic equations is that it implies demand is accounted for in positive terms and will be analyzed in the postive quadrant. This type of equation is also convenient because it has the mechanical advantage of yielding curves that have a constant elasticity, even if that is not a valid criterion for deciding on their use. The multiplicative effects of independent variables on dependent variables in this functional form will smoothen variability.

Foote (1958) stated that logarithmic equations should be used when (1) the relationships between the variables are believed to be multiplicative rather than additive, (2) the relations are believed to be more stable in percentage than in absolute terms, and (3) the unexplained residuals are believed to be more uniform over the range of independent variables when expressed in percentage rather than absolute terms.

The supply function for rice is measured with respect to the price of paddy (threshed unmilled rice, also the wet land in which rice is grown) and prices of other competing food crops, maize and cassava. Other exogenous variables could not be included in the model because the data were not available.

The supply equation for rice was specified as follows:

$$Q_{st} = g(P_{pt-1}, P_{mt-1}, P_{ct-1}, e_t) \qquad (2)$$

where: Q_{st} = annual paddy production

P_{pt} = producer paddy prices per kilogram

P_{mt} = rural maize prices per kilogram

P_{ct} = rural cassava prices per kilogram

e = disturbance term

Results

Demand for and supply of rice are estimated by using time series data for relevant variables from 1960 to 1980.

Demand Analysis

The annual quantity of rice demanded in Indonesia is hypothesized to be determined by its own price, the price of other carbohydrate foods (mainly maize), and the time trend. The data used for the demand analysis are shown in Table 10. A trend variable is included to capture changes in consumer's

TABLE 10. RICE CONSUMPTION, PRICE OF RICE, MAIZE, AND ADJUSTED MONEY INCOME FOR INDONESIA, 1960-1979

Year	Rice Consumption Per Capita	Price of Rice	Price of Maize	Adjusted Money Income
	----Kilogram----	----------deflated----------		
1960	117	7.17	3.48	320
1961	111	10.13	4.99	421
1962	114	11.28	5.31	343
1963	101	9.18	4.79	436
1964	103	11.33	4.44	354
1965	101	12.39	4.56	208
1966	103	7.84	3.50	354
1967	99	8.08	3.52	336
1968	107	10.26	4.12	338
1969	115	7.02	3.70	383
1970	118	7.10	3.20	405
1971	119	6.23	3.20	428
1972	118	6.75	4.02	468
1973	126	8.01	4.00	517
1974	128	6.09	3.73	567
1975	129	6.50	4.02	551
1976	127	6.50	4.30	558
1977	132	5.82	3.93	598
1978	134	5.58	3.63	621
1979	141	4.79	3.73	657

taste and preference. An income variable is not included because the portion of per capita income for rice consumption is relatively small. Based on the preliminary results, the income variable is not significant. All price and income variables are deflated by consumer price index. The estimated demand models are as follows:

$$Q_{dt} = \underset{(13.99)}{68.252} - \underset{(1.54)}{0.045P_{rt}} + \underset{(4.16)}{3.276P_{mt}} + \underset{(0.028)}{0.0494Y_t} + \underset{(0.49)}{1.329T} \qquad (3)$$

$R^2 = 0.885$ $\qquad$ DW = 1.662

$$Q_{dt} = \underset{(13.597)}{78.102} - \underset{(1.148)}{1.854}P_{rt} + \underset{(2.918)}{8.679}P_{mt} + \underset{(0.396)}{1.884}T \qquad (4)$$

$$R^2 = .8203 \qquad DW = 1.819$$

where numbers in parenthesis are standard errors associated with the corresponding variables. All variables are previously defined.

Model 3 includes an income variable. As shown in equation (3) the income variable is not significant at all and provides a multicollinearity problem. Consequently, another model is specified without the income variable (model 4). All variables in model 4 are significant (R^2 is 0.83) indicating that the model is well fitted with actual data.

Based on the above equation, demand elasticity with respect to its own price is -0.13. This means that for each 10 percent increase in the price of rice, the annual demand for rice would decrease by 270,000 tons, given an annual consumption rate of 20 million tons.

The value of price elasticity of demand for rice from this study is consistent with the results of other studies, which estimated the value of demand elasticity between -0.1 and -0.3 (Mears 1976).

Cross elasticity with respect to the price of maize is 0.30. This means that each 10 percent increase in the price of maize contributes to the annual increase in demand for rice by approximately 600,000 tons.

The coefficient of income elasticity will not be discussed because the significance of its coefficient is so low. Other studies have estimated expenditure elasticity of food for Java to be 0.65 (Timmer 1971) and that of Indonesia to be approximately 0.6.[2] Mears (1976) explained that, as real incomes rise, the income elasticity of demand for rice tends to decline. The decline by 1985 could be as much as 0.2 from the two previous estimates. Table 11 provides comparative income elasticities for food in other countries in Asia and the Far East.

This study, utilizing net income based on GNP, is in fact over-estimating the real income. Todaro (1977) stated that the calculation of the rate of GNP growth is in reality largely a calculation of the rate of growth of the incomes of the upper 40 percent of the population who receive a disproportionately large share of the national product. Therefore, GNP should not be used as an index of improved welfare.

Supply Analysis

When estimating the supply function of rice or agricultural products in general by using a single least squares equation, the assumption is made that

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[2]This result is based on the previous study conducted by Suhady which is cited by Mears in his paper "Indonesia's Food Problems, PELITA II/III," Economics and Finance in Indonesia, Vol. XXIV, No. 2, June 1976, p. 100.

TABLE 11. INCOME ELASTICITY OF DEMAND FOR FOOD IN SELECTED COUNTRIES IN ASIA AND THE FAR EAST

Country	Income Elasticity
India	.81
Ceylon	.81
Japan	.60
Philippines	.76
Burma	.79
China (mainland)	.60

SOURCE: Mubyarto and Fletcher 1966.

all independent variables are predetermined and the quantity supplied within the year is not affected by the current year's price (Todaro 1969).

Price of rice in the current year is included in the model because rice is planted during the rainy season in almost the entire region starting in October-November every year. If irrigation is available, the farmers can plant rice twice or even three times a year. This means that several months before the rainy season the farmers may have some rice price information from earlier marketings. Frequent marketings throughout the year improve the information upon which planting decisions are made. Farmers who cultivate dry land may adjust their decision of whether to plant rice or other crops, even farmers whose decisions have been based upon the traditional pattern of planting only rice without regard to price.

The rice supply equation is estimated by utilizing a ten-year time series from 1966 to 1975. All price variables are deflated by consumer price index. The data are shown in Table 12.

The rice supply function is expressed as a function of producer's average paddy price for the current year, lagged average producer paddy price, lagged average maize price, lagged average cassava price, and time trend.

The estimated rice supply function is as follows:

$$\log Q_s = 0.87 + \underset{(1.176)}{0.20 \log P_{pt}} + \underset{(2.32)}{0.58 \log P_{pt-1}} - \underset{(0.909)}{0.30\, P_{mt-1}}$$

$$- \underset{(1.78)}{0.25 \log P_{ct-1}} + \underset{(7.8)}{0.39 \log T}$$

$$R^2 = 0.98 \qquad DW = 1.93$$

TABLE 12. RICE PRODUCTION, DEFLATED PRICE OF PADDY, MAIZE AND CASSAVA, JAVA, 1966-1975

Year	Production	Price of Paddy	Price of Maize	Price of Cassava
	1000 kb.	Rupiah/Kilogram		
1966	4.66	2.50	2.66	1.22
1967	5.12	7.28	7.26	2.84
1968	7.08	21.60	19.11	7.26
1969	7.50	16.32	20.17	6.28
1970	7.89	20.10	19.60	8.08
1971	8.43	18.10	20.44	7.58
1972	8.10	22.53	27.32	9.80
1973	8.87	33.56	35.62	16.85
1974	9.44	37.66	46.73	13.46
1975	9.43	45.10	59.91	17.55

SOURCE: BPS, "Indikator," 1970-78.

All of the coefficients of the above equation have the expected sign. The value of R^2 is 0.98. Numbers in parentheses represent the t-values of the corresponding variable. However, the current producer paddy price (P_{pt}) and lagged average maize price (P_{mt-1}) have a low t-value. The low significance of farmers' response may be due to several reasons. First, the data for producers' paddy prices are for the entire current year and may not reflect the price before the rainy season when planting decisions are made. Second, most of the rice farmers have a small area of land, and the failure of their crop is of great consequence. To avoid risk, the farmers will not react to the current price, but will adopt a wait-and-see attitude. Mubyarto (1980) stated that in spite of the fact that rice is a subsistence crop for most of the farmers, the farmers still respond to its price; the low price of rice in one year will be followed by declining rice production the next year. With reference to this statement, the result of this study also has shown the greater response of the farmers to the lagged average producer paddy price.

Supply elasticity of rice with respect to its lagged average paddy price is 0.58, which means that a 10 percent increase in paddy prices would result in increased production of 928,000 tons based on paddy production in Java of about 16 million tons. The paddy price elasticity value from this study (0.58) is higher than the elasticity value of the previous study by Mubyarto (1980) for the period 1951-1962, which was 0.33 for wetland and 0.25 for dryland

cultivation. This is understandable because the elasticity value from this study includes data taken from the period when the rice intensification program through BIMAS and INMAS was launched. Another reason is that the conversion of rice fields from dryland to wetland, which occurred in the 1960s and 1970s, also affected the increase in rice production. The results of this study clearly indicate that farmers will respond with an increase in rice production whenever its price is attractive to them and the opportunity is favorable.

Time trend is highly significant as an independent variable. It captures the effect of changes in technology or consistent government programs to improve farm practices.

Supply cross elasticity with respect to maize has a low significance, perhaps because maize is grown in mixed stands with other crops. Therefore its price has little effect on rice production.

There is an indication that farmers will respond to a change in price of cassava. This can be true especially for the farmers who own or cultivate dry land, for they can choose to plant rice or cassava or both together (intercropping). The problem is that the marketing infrastructure for both maize and cassava is relatively poorer than it is for rice, especially transportation and information. Besides, the risk of low rice prices during harvest season may be prevented through the mechanism of a floor price system. Unfortunately, this price mechanism is still unavailable for maize and cassava. Comparison of farmgate and rural market prices for maize and cassava is illustrated in Table 13. A comparison of the ratios in Table 13 with those in Table 8 reveals that a smaller differential exists for rice than for maize and cassava.

TABLE 13. COMPARISON OF FARMGATE AND RURAL MARKET PRICES FOR MAIZE AND CASSAVA, 1970-1975

Year	Maize	Ratio	Cassava	Ratio
	Rp./kg.			
1970	15.4	127	5.3	152
1971	13.9	148	5.3	143
1972	26.0	105	9.2	107
1973	28.9	123	9.1	185
1974	38.1	123	11.7	116
1975	50.6	118	14.8	119

Note: $\text{Ratio} = \frac{\text{Rural Market Prices}}{\text{Farmgate Prices}} \times 100$

SOURCE: Booth 1979.

Conclusions

Administering prices in Indonesia by setting floor and ceiling prices essentially keeps the price of rice low and prevents its free adjustment by market forces. Any increase in the price of rice has significant impacts. First, the low-income group accounts for about one-third of the population and they suffer a great loss of real income since rice purchases are a large proportion of their budget. Second, since rice is used as a wage commodity, an increase in its price will mean an increase in production costs. The commodity produced will become less competitive, especially in the export market. However, the dilemma becomes more apparent as the price falls, since people will consume more and it becomes more difficult to attract consumers away from rice.

Intensification programs have been undertaken by the government to stimulate rice production. However, even though these efforts have been successful, self sufficiency in rice has still not been achieved because population and per capita rice consumption have been steadily increasing. The gap between the amount of rice demanded and domestic production has been fulfilled through imports. Such large imports represent a significant outflow of foreign exchange.

It is clear that solutions concerning the demand and supply of rice should be better integrated. A long run effort should be undertaken to encourage people to change their food habits so that they will not identify rice as the only basic staple food. Rice self-sufficiency goals, therefore, should be changed into food-grain self sufficiency. Based on the results of this study, consumers and producers of rice both respond to a change in its price. Substitutability among food crops is determined not only by the consumer's tastes and preferences, but also by price. The prices of food crops other than rice tend to be more expensive for consumers but cheaper for farm producers. This problem clearly indicates that the marketing of food products needs improvement. If the government desires to keep the price of rice low to consumers, similar activities should be undertaken for other food crops. On the other hand, higher prices at the producer level would stimulate production. In other words, if the government wants to administer prices, it should provide similar treatment for all food crops.

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