

# COMPARATIVE ADVANTAGE IN RICE PRODUCTION IN JAVA

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## Ringkasan

Tujuan studi ini adalah menilai keuntungan komparatif produksi beras di Jawa. Lokasi dan sistem produksi yang diteliti adalah produksi padi sawah irigasi (konvensional) dan padi ladang dan provinsi Jawa Barat, Jawa Tengah dan Jawa Timur serta padi sawah beririgasi sumur pompa di Jawa Timur. Analisa biaya sumberdaya domestik (BSD) digunakan untuk menilai keuntungan komparatif.

Hasil studi menunjukkan bahwa produksi beras di Jawa efisien dalam menghemat devisa. Ini berarti Jawa mempunyai keuntungan komparatif dalam produksi beras. Produksi yang paling efisien adalah padi sawah beririgasi di Jawa Timur dengan BSD = 575.77 dan yang efisiensinya paling rendah adalah padi sawah irigasi di Jawa Barat dengan BSD = 880.63. Besarnya elasticitas BSD terhadap harga beras, produktivitas, harga tanah, dan upah masing-masing adalah -1.15 sampai dengan -1.25, -0.77 sampai dengan -0.87, 0.30 sampai dengan 0.47 dan 0.24 sampai dengan 0.38. Sedangkan titik impas harga beras berkisar antara Rp230.751 atau US\$263.77 per ton (padi sawah beririgasi Jawa Barat) dan Rp156,101. atau US\$171.67 per ton (padi sawah beririgasi di Jawa Timur).

## Abstract

The objective of this study was to assess comparative advantage in rice production in Java. The Study analyzed rice production under gravity irrigation and dryland in 3 provinces, i.e. West Java, Central Java, and East Java, and under tubewell irrigation in East Java. The concept of the domestic resource cost of foreign exchange (DRC) was used to measure the comparative advantage of the region in rice production.

The study showed that rice production in Java was efficient in saving foreign exchange. This meant that Java had a comparative advantage in rice production. The Most efficient one was rice production under gravity irrigation in East Java with the DRC = 575.77 while the least efficient was that in west Java with the DRC = 880.63. The DRC's elasticity to shadow price of rice, yield, shadow price of land, shadow price of wage ranged from -1.15 to -1.25; -0.77 to -0.87; 0.30 to 0.47 and 0.24 to 0.38, respectively. The break even point of shadow price of rice ranged from Rp230,751 or US\$263.77 per ton (rice production under gravity irrigation in West Java) and Rp156,101. or US\$171.87 per ton (rice production under gravity irrigation in East Java).

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## I. Introduction

Up to 1983, as net rice production has remained less than the effective demand since the Indonesian independence, imports have been required continuously although they varied widely from year to year. In order to control foreign exchange use for this critical staple food and to stabilize domestic prices in the face of fluctuating world prices, the government through the National Board of Logistics called BULOD,<sup>1</sup> became the sole official importer of rice after independence.

From 1955 to 1965, imports were estimated at two percent of consumption, but in 1977, imports rose to 12 percent of consumption and remained around that level until 1980 (Mears, 1981). Before 1973, the foreign exchange drain as a result of rice imports was a priority concern of the government, but with oil revenues after the Organization of Petroleum Exporter Countries (OPEC) series of petroleum price increases, redirection of emphasis has been permitted to allow for increased imports so as to permit lower domestic prices that would help to curtail inflation.

The government has been continuously exerting efforts to increase production. As early as 1965 — 1966, a nation wide rice intensification program, the Bimbingan Masal (BIMAS), was undertaken by the government. To encourage further production, the government subsidized fertilizers, insecticides and herbicides, provides relatively low interest rate credit and intensive extension activities. Consequently, rice production increased from 23.3 million tons in 1977 to 32.7 million tons in 1981 (Mears, 1981). During this period, the average rate of increase in rice production was 10 percent per year. The increase was attributed to increases in harvest area and in yield.

In line with the efforts to reduce rice imports, the increase in domestic production is likely to continue since the government drive is to conserve foreign exchange and achieve self-sufficiency in rice. This implies that the expected increase in demand corresponding to population increase and per capita income growth will put pressure on the expansion of domestic rice production. The question of whether import substitution activities are economically efficient or not, must be answered. This question can be addressed by assessing the comparative advantages in the rice industry in Indonesia.

In order to increase rice production, the government has several alternatives regarding location and system of production, which might have different production and marketing costs owing to differences in factor availability. The present study evaluated rice pro-

duction under gravity irrigation and upland rice in West Java, Central Java and East Java, and under tubewell irrigation in East Java.

In view of the country's resource limitations, it will be economically rational to promote only the production activities that are efficient in saving foreign exchange. This means that economic policies should protect the activities that are comparatively advantageous and at the same time discourage the activities that are comparatively disadvantageous to the country.

The objectives of this study was to assess comparative advantage in rice production.

## II. Conceptual Framework

Government intervention may distort the operation of the market and produce a set of prices that may differ from the free market price. Consequently, relative output and input prices within and across industries are altered, affecting the pattern of productive incentives and resource allocation.

Using partial equilibrium framework, the short run (static) price effects resulting from intervention is shown in Figure. The horizontal axis indicates the quantity of rice, while the curves A and D are the supply and demand curves respectively. In a closed economy without the possibility of international trade, domestic price,  $P_e$ , will be determined by domestic demand and supply conditions. On the other hand, in a small country engaged in international trade, the domestic price will necessarily be the same as the world price (border price)  $P_b$ . Domestic production will be at  $Q_1$  and because demand at price  $P_b$  is  $Q_2$ , imports will be  $Q_1Q_2$ . Suppose government intervention (e.g., price support or import tariff) increases the domestic price of the output to  $P_d$  leaving the world supply price unaltered. Since producers now face a higher price, domestic production will expand ( $Q_3$ ) and consumption will decrease to  $Q_4$ .

We can analyze the welfare implication of intervention, using the concepts of consumers's surplus and producers surplus. The area AFHB is the increase in producers surplus. The area HCDE is the net benefit of the government, which is the difference between the amount of money to acquire imports  $Q_3Q_4$  quantity of rice at border price and the value of those imports sold to domestic consumers at domestic price. On the other hand, if the price become higher, there will be a decrease in consumers surplus by a magnitude indicated by the area AFIE. Consequently, there will be a net loss to society by area  $BHC + DIF$ . In case where intervention decreases price, there will be different results, i.e., a net transfer loss from producers to consumers, but the magnitude of the net loss remains the same.

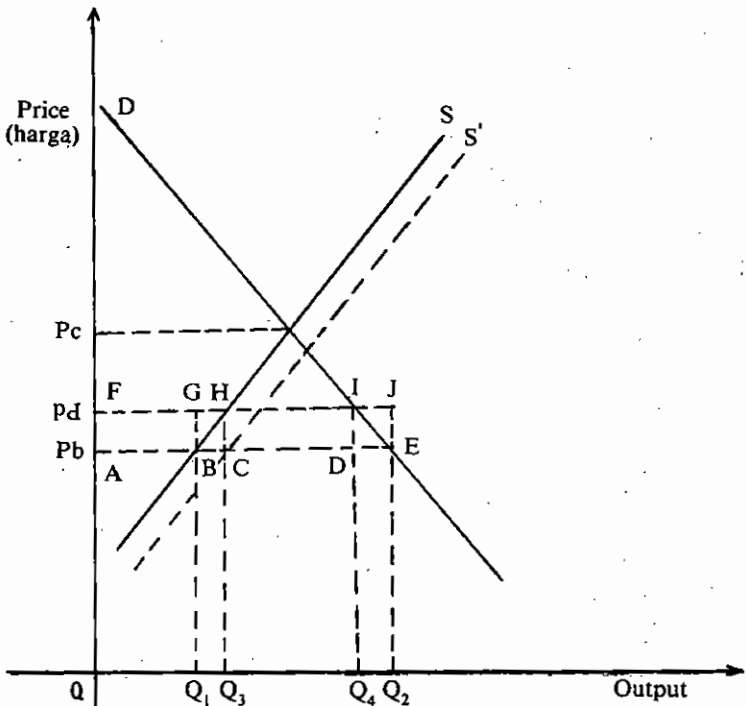


Figure 1. Partial Equilibrium effects of a tariff/price support

Now suppose there is government intervention to decrease the price of input. The supply curve will shift to the right, that is, it will decrease the marginal private cost of rice production. Consequently, the producers surplus will increase and imports will decrease. This will have a different effect on the net loss to society.

The above analysis assume that the country is still net importer, but it can be extended to the situation that the country have achieved self sufficiency. And the result will be similar.

The foregoing analysis brings to the fore two important issues. First is the issue of efficiency. It will be notes that the intervention considered above afforded protection to rice production. As a result of intervention, resource will flow towards rice production from other production undertakings. In this connection, it would be necessary to ask whether or not the industry has comparative advantage relative to the others.

Second is the issue on income distribution which encompasses three dimensions, i.e., income distribution effects among producers, among consumers, and between producers and consumers.

It will be noted, however, that his study relates more to the efficiency than the equity issue. Hence, in the following discussion, we present our empirical measures of comparative advantage of the rice production.

### III. Methodology

#### 3.1. *Measure of Comparative Advantage*

The concept of the domestic resource cost of foreign exchange (DRC) is used to measure the comparative advantage of the country in rice production. The concept has been used by the World Bank to determine the comparative advantage of countries that are engaged in the production of commodities, particularly of agricultural commodities.

DRC is the ratio of the real social cost of domestic factors of production used in producing an output to the net foreign exchange earned (for an exportable) or saved (for an importable commodity) in the domestic economy. In the DRC estimation, all outputs and inputs are valued in term of social prices. As stated by Bruno (1972), and activity is comparatively advantageous to the country if the ratio of DRC and the shadow exchange rate (SER) is less than one.

#### 3.2. *Social Valuation*

As indicated earlier, the DRC calculation involves the valuation of resources in terms of social prices. In case of government intervention and other market distortions, there is divergent between market price and social price. Thus in social or economic analysis, all resources were evaluated at shadow prices which represent the true opportunity costs.

#### 3.3. *Shadow price of output*

The shadow price of rice is its border price. This presupposes that the best alternative source of import substitutes is the border, hence, its price at the border represents its social opportunity cost. In 1983, Indonesia was a rice-importing country, the border price was the cif price.

#### 3.4. *Shadow price of inputs*

*Intermediate Inputs.* In rice production, the direct intermediate inputs are fertilizers, pesticides and seeds. Indirect inputs required to

produce the domestic portion of the direct intermediate input were estimated up to the second round of production process only, by going down one step further. This second round of production process was calculated from the Indonesian input-output table.

These inputs can be broadly grouped into traded and nontraded intermediate inputs. Non-tradeable inputs also have tradeable components in the sense that materials need to be imported in order to produce them. The social opportunity costs of the tradeable inputs were assumed to be the border values at the farm site. Thus, it was necessary to estimate their transportation/marketing cost from the port to the farm site. The derivation of appropriate accounting prices for non-traded inputs is presented along with the ensuing discussion on cost allocation.

*Primary factors.* The primary factors consist of capital, labor and land.

Fixed capital is generally defined as physical inputs which can be used for more than a production period, such as irrigation facilities, buildings, tractors, etc. The service cost of these inputs for a given production period consists of depreciation of fixed capital assets involves the calculation of the replacement value of these assets by adjusting their original acquisition cost to reflect inflation and productivity change over time. The economic price of depreciation can be found from its allocation into foreign and domestic costs which will be discussed at the end of this section.

The shadow or social rate of interest is equal to the real rate of return on marginal public sector investments when they are evaluated using accounting prices. The repair and maintenance expenses can be broken down into primary inputs such as labor and intermediate inputs. Thus, their shadow prices are discussed in those inputs.

### 3.5. *Cost Allocation by Sources*

Two alternative cost allocation procedures were followed: historical source allocation and fully traded assumption. In the first procedure, the historical source of supply of tradeable (direct and indirect) inputs was taken as weights in the allocation process. In the fully traded assumption, all tradeable inputs (direct and indirect costs) were considered as foreign costs.

### 3.6. *Sensitivity Analysis*

The underlying assumptions behind the measurement of the DRC as outline in this section presuppose that there would be no dynamic elements within the economic system. In other words, the

measurement was based on a static partial equilibrium analysis. It is very difficult to incorporate the effects of dynamic changes or the coefficient of the above measures. Furthermore, some of the empirical procedures and assumptions adopted here are arbitrary.

To approximate the effects of dynamic changes and/or changes in assumptions a sensitivity analysis was undertaken on major variables affecting the value of DRC. The sensitivity of the DRC value to a given change in parameter was in the form of an elasticity concepts called DRC elasticity.

### *3.7. Scope and Source of Data*

Three alternative rice production systems were analyzed, i.e. rice production under gravity irrigation system, under tubewell irrigation, and dryland or upland paddy. Data on rice production under gravity irrigation and upland paddy taken from all major rice-producing provinces, i.e. West Java, Central Java, and East Java, were used. For the tubewell irrigation system, however, data from East Java were considered, especially from the Kediri-Nganjuk tubewell irrigation project area which is the first and the major area developed by the systems.

Data used in this study come from secondary sources. The input-output coefficients at the farmers/field for upland paddy and wetland paddy under gravity irrigation were obtained from the cost structure of data published by the Central Bureau of Statistics (1985). The land rent was obtained from the Directorate General of Food Crops (1984).

Cost structure for the tubewell irrigation rice farm was obtained from the survey conducted by the Gadjah Mada University in 1981. This survey was originally intended to monitor the benefit from the tubewell irrigation project. These data were valued at 1983 prices.

Other information items relevant to economic/social valuation of inputs and output, like subsidies imposed on several commodities and industries affecting rice production, prices and pricing policies for these commodities, marketing costs and so on were gathered from various agencies in the country and several publications. The input-output table of Indonesia was the main source for computing social valuation. Any data on prices for years other than 1983 were converted to 1983 prices using the corresponding wholesale price index.

#### IV. Results and Discussion

DRC represents the social cost of converting domestic resources into foreign exchange through production for export or import substitution. Two sets of DRC estimates are presented. One, the historical source allocation, allocates inputs to domestic and foreign sources as they actually occurred. The other, the fully traded assumption, treats all potentially tradeable inputs as foreign cost. Conceptually, the two estimates have implications on the future expansions of rice production. The historical source allocation presupposes that inputs for expanding production will come from their present sources, while in the fully traded assumption, all tradeable inputs are imported. The DRC estimates are shown in table 1 below.

**Table 1. Domestic resource cost (DRC) estimates of rice production, Java, 1983.**

System	DRC		DRC/SER	
	Historical Assumption	Fully Traded Assumption	Historical Assumption	Fully Traded
Gravity irrigation				
West Java	880.63	876.79	0.932	0.928
Central Java	651.98	619.77	0.690	0.658
East Java	575.77	535.16	0.609	0.566
Tubewell irrigation				
East Java	684.74	643.15	0.725	0.681
Upland Rice				
West Java	658.42	634.15	0.695	0.672
Central Java	722.74	704.73	0.765	0.746
East Java	707.16	684.66	0.748	0.725

Table 1 shows that all rice production systems have lower DRCs than the shadow exchange rate. Hence, rice production had comparative advantage. In other words, the import substitution activities, i.e., rice production in all studied systems, were efficient in saving foreign exchange.

It is interesting to note that rice production under gravity irrigation in West Java was the least efficient since it had the highest DRC, while the system in East Java with the lowest DRC was the most efficient in saving foreign exchange. This is because the shadow price of land and labor in West Java was highest among those in other provinces, while the yield per hectare was lower than that in other provinces under the same irrigation system. One possible explanation is that West Java is the nearest to the capital city of Jakarta.



ta, where the opportunity costs of land and labor are higher. However, the explanation is not applicable to the dryland rice production. The dryland fields are located in remote areas suitable only for limited crops and are thus less productive, so the opportunity cost of land is small. The values of the opportunity costs are determined based on the supply of and demand for labor locally.

If we compare the systems in the same province, it appears that tubewell irrigation was less efficient than the gravity irrigation in East Java. This is because the social cost of the tubewell irrigation is higher than the cost of gravity irrigation.

In all cases, the DRCs under the fully traded assumption have smaller than those under the historical source assumption. This is because the fully traded assumption treats all traded goods as foreign cost, therefore, it has a bigger foreign cost component or smaller domestic cost component than the latter assumption. In latter analysis, DRC refers to the value under the historical source assumption.

From the above analysis, it appears that the country had comparative advantage in rice production. From the policies, it also appears that the government had afforded protection to rice farmers. Therefore, it can be concluded that the incentive structure is consistent with the promoting rice production activities that are comparatively advantageous to the country. The change of the DRC as a result of decrease in price can be described in the sensitivity analysis along with other parameter changes.

### *Sensitivity Analysis of the DRC*

In order to estimate the sensitivity of the DRCs as affected by the change in the price structure and other variables, the elasticities for the different parameters were calculated. DRC elasticity is defined as a percent change in the DRC with respect to a given percent change in specified parameters, all factors held constant. The positive sign of the results signifies an increase in the percentage change in the DRC if the stated parameter or variable increases by one percent. The opposite, negative sign, signifies a decrease in the percentage change in the DRC.

The DRC elasticities are presented in table 2. It appears that the DRC results were very sensitive to changes in CIF price of rice as shown by coefficients of DRC elasticity with respect to CIF price of rice of more than one, ranging from  $-1.15$  to  $1.25$ .

Table 2. Elasticity of DRC with respect to stated parameters, Java, 1983.

System	CPR	Y	SPL	SWR	SPF	SPP	SPI
Gravity irrigation							
West Java	-1.21	-0.84	0.43	0.28	0.08	0.02	0.07
Central Java	-1.20	-0.82	0.36	0.27	0.11	0.02	0.09
East Java	-1.19	-0.82	0.31	0.28	0.13	0.02	0.09
Tubewell irrigation							
East Java	-1.25	-0.87	0.33	0.28	0.17	0.03	0.15
Dryland rice							
West Java	-1.15	-0.77	0.30	0.38	0.07	0.01	—
Central Java	-1.15	-0.81	0.47	0.24	0.09	0.01	—
East Java	-1.16	-0.82	0.37	0.30	0.12	0.02	—

Note: CPR = cif price of rice  
 Y = Yield of rice  
 SPL = Shadow price of land  
 SWR = Shadow wage rate  
 SPF = Shadow price of fertilizer  
 SPP = Shadow price of pesticide  
 SPI = Shadow price of irrigation

The break even point (BEP) of the CIF price of rice in which the DRC is equal to the shadow exchange rate was Rp230,751 or US\$253.77 for rice production under gravity irrigation in West Java. This BEP was the highest among those of other systems of production and locations (Table 3). The lowest was Rp156.101 or US\$171.67 in rice production under gravity irrigation in East Java. The other number of BEP can be seen in the table 3 below.

The analysis of BEP is very important, because the world price of rice usually fluctuates and the price at a later time might decrease. In the previous analysis, it was pointed out that the world price fluctuated very much. Because the weakness of import demand and ample supplies, international price of rice fell steeply in 1982. This price decrease continued until 1986. In terms domestic currency, the 1985 border price of Rp231,000/ton is the lowest during that period. In that year, rice production under gravity irrigation in West Java was very critical. However, with the poor weather in several Asian countries in 1967, the world price again went up even higher than the 1983 level. Therefore, Indonesia still continued to have comparative advantage in rice production in all studied systems and location.

Other important factors are changes in yield, shadow price of land and shadow price of wage rate, with the DRC elasticity ranging from -0.77 to -0.87, 0.30 to 0.47, and 0.24 to 0.38, respectively. The

Table 3. The Break-even point (BEP) of CIF price of Indonesian rice, 1983

System	CIF Price/Ton	
	Rp	US\$
Gravity irrigation		
West Java	230,751	253.77
Central Java	175,099	192.56
East Java	156,101	171.67
Tubewell irrigation		
East Java	185,179	203.65
Dryland		
West Java	173,432	190.73
Central Java	190,292	209.27
East Java	186,479	205.08

highest sensitivity of the shadow price of land and of wage rate are due to the fact that those inputs comprise the biggest amount of the production cost. Other factors such as shadow price of fertilizers, pesticides and irrigation cost had little impact on the DRC results.

## V. Conclusion and Policy Implication

### 5.1. Conclusion

The domestic resource cost (DRC) analysis indicates that rice production in all studied systems, i.e., rice production under gravity irrigation in West Java, Central Java, and East Java, dryland rice production in the three provinces, and rice production under tubewell irrigation in East Java, were efficient in saving foreign exchange. The most efficient system was rice production under gravity irrigation in East Java with a DRC of 575.77, while that in West Java was the least efficient with a DRC of 880.63. In other words, rice production in Indonesia particularly in Java during recent years had a comparative advantage.

The DRC results were very sensitive to changes in cif price of rice, yield, shadow price of land and wage, with the DRC elasticity ranging from  $-1.15$  to  $-1.25$ ,  $-0.77$  to  $-0.87$ ,  $0.30$  to  $0.47$ , and  $0.24$  to  $0.38$ , respectively. The break-even point of the cif price of rice

at which the DRC is equal to the shadow exchange rate ranged from Rp230.751 or US\$253.77 per ton for rice production under gravity irrigation in West Java to Rp156.101 or US\$171.67 per ton for that system of rice production in East Java.

## 5.2. Policy Implication

The study revealed that the country/region had a comparative advantage in rice production in all studied system/locations. Thus, there is an adequate economic ground for increasing domestic rice production to meet growing domestic demand.

Government policies in the rice industry had been favourable to farmers. Incentives were thus consistent with economic efficiency. These policies may be continued to maintain self-sufficiency in rice. Moreover, rice production employs a big number of laborers and small farmers, thus any policy favourable to them will increase employment and income distribution.

However, further study on other commodities production/industries is needed to enable policymakers to compare the degree of protection and comparative advantage across industries, and thus, to evaluate the efficiency by which resources are allocated. To optimize the use of limited resources, it would be necessary that the policies promote more efficient activities. In the long run, however, the protection may be phased out. The government can then improve competitiveness of domestic production activities through agricultural research and development, extension and provision of better infrastructures.

By improving irrigation infrastructures, both rice yield and effective crop area can be increased, thus, enabling the country to expand rice production. In the study areas, for example, rehabilitation and improvement of the operation and maintenance of the present irrigation systems will go along way toward attaining higher rice production levels.

## VI. Literature

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