THESIS

AN ECONOMETRIC ANALYSIS OF CASSAVA SUPPLY RESPONSE IN INDONESIA

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เรื่อง An Econometric Analysis of Cassava Supply Response in Indonesia

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AN ECONOMETRIC ANALYSIS OF CASSAVA SUPPLY RESPONSE IN INDONESIA

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ABSTRACT

Title : An Econometric Analysis of Cassava Supply Response in Indonesia

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The study is an attempt to determine the cassava supply response to the variables based on time series data in Indonesia. The main objectives of these are (1) to identify the factors affecting the supply response of cassava in regional and national levels;(2) to determine long run and short run elasticities of output; and (3) to forecast cassava supply for a five year period.

The equations were obtained by employing the Ordinary Least Square (OLS) method. They were area, yield and production equations. These were acceptable in terms of economic and statistical requirements. The estimated production of cassava was determined by its lagged price, competing crop, amount of rainfall, lagged planted area and yield.

The short run elasticities of output were 0.1010 (Indonesia), 0.2204 (East Java), 0.1454 (Central Java) and 0.0555 (West Java). The long run elasticities of output were 0.2118 (Indonesia), 0.5386 (East Java), 0.4308 (Central Java) and 0.0704 (West Java).

The supply projections in 1993 will achieve 16344878 tons (Indonesia), 3807476 tons (East Java), 3567216 tons (Central Java) and 1954762 tons (West Java).

The policy implication is that cassava production improvement policy should be emphasized on the main economics factors . The main economic factors such as prices require to be controlled by the government to avoid the fluctuation in prices and farmers losses. The limitation in import is required in order to stabilize cassava price at farm level. The cassava planted area could be increased through the transmigration project in other islands. The other ways are (1) to improve the marketing system; (2) to form cassava estate farm and (3) to realize farmer to use the recommended inputs.

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I am alone fully responsible for any mistakes in this study.

Bangkok, February 1991

R. Bambang Budhijana.

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CHAPTER I

INTRODUCTION

Problem and significance of the study

The government has begun to diversify food crop programs to produce secondary food crops. One of them is Cassava. Campaigns for cassava were mounted in 1989. As the secondary crop, Cassava is consumed as an important staple food. As a food stuff, it plays a role in Indonesian diet and ranks second after rice.

Cassava covers about 11 percent of the total area planted to food crop in Indonesia. Around 77 percent of the total harvested area, it is produced in Java and Madura, The other islands account for the remaining 23 percent. They include Sumatera (7 percent), West Irian (8 percent), Sulawesi (6 percent), and Kalimantan (2 percent) (ESCAP CGRGT,1984).

On the national basis, cassava has had the lowest rate of growth among the four commodities i.e. cassava, sugar, soybean and corn. During 1975-1980, the annual rate of growth was 2.3 percent. From 1980-1987, the rate decreased to 0.7 percent. The yield growth was less than 3 percent per year.

The harvested area expansion, production and productivity of cassava during 1969-1987 shows that harvested area trends have a decrease rate of 0.86 percent every year (Table 1). There was a significant decrease of 3.14 percent per tear in the period of 1984-1987. Possibly, harvested area of paddy, corn, and soyabean were more positively affected by favourable government policies to them rather than to cassava.

Researchers try to discover high yielding varieties and improve the techniques of production. Fertilizer application is also neccesary to increase the production due to fertilizer prices. A lack of understanding about environmental variables will affect farmers' decisions.

Several high yielding varieties of cassava have been released, but the production and productivity of cassava since 1969-1987 had not increased sufficiently. The rate of growth of cassava production and productivity every year increases by as much as 1.85 percent and 2.62 percent respectively but these results are still lower than the target by as much as 2 percent and 2.82 percent respectively (MOA,1988).

Table 1 Area harvested, yield, production of cassava in Indonesia, period 1969-1987.

Year	Area Harvested (000 Ha)	Yield (Tons/Ha)	Production (Million Tons)
1969	1,461	7.47	10.92
1970	1,398	7.49	10.47
1971	1,406	7.60	10.69
1972	1,468	7.66	11.25
1973	1,428	7.83	11.18
1974	1,509	8.63	13.03
1975	1,410	8.90	12.55
1976	1,353	9.01	12.20
1977	1,364	9.16	12.50
1978	1,383	9.33	12.90
1979	1,439	9.55	13.75
1980	1,413	9.72	13.72
1981	1,388	9.56	13.32
1982	1,324	9.96	14.50
1983	1,220	9.54	12.10
1984	1,350	10.49	14.17
1985	1,292	10.88	14.06
1986	1,170	11.27	13.31
1987	1,222	11.75	14.36
Average Annual Growth Rate:			
1975-1980	0.10	2.20	2.30
1969-1987	-0.86	2.62	1.85
1984-1987	-3.14	3.84	0.59
1980-1987	-2.10	2.70	0.70

Source : Ministry of Agriculture, 1988

Various constraints to encouragement of cassava production are (a) limited post harvest technology such as harvesting, handling, and processing at farm level; (b) availability of transportation and marketing system for production area; (c) government policy which emphasizes cassava production (MOA,1988).

Indonesia has imported cassava products from Thailand. The country had sporadically imported small cassava products. Cassava imports peaked in 1987, 1988, and 1989 at 66,311; 289,774 and 993,725 Metric tons as shown in Table 2.

Table 2 Imported quantity of cassava product to Indonesia 1983-1987 from Thailand.

Year	Imported Quantity of			
	Flour (MT)	Chips (MT)	Hard Pellet (MT)	Total (MT)
1983 1/	64	0	0	64
1984 1/	0	0	0	0
1985 1/	0	0	0	0
1986	NA	NA	NA	NA
1987 2/	10111	56200	0	66311
1988 2/	20114	267660	2000	289774
1989 2/	993725	0	0	993725

Sources : 1/ Ministry of Agriculture, 1988
2/ TTTA 1988; 1989

The economic forces that affect farmers' decisions on cassava production are the price of cassava, the price of competing crops, the price of input, and the non-economic factors such as weather or rainfall. The price of cassava might be one of the major factors which causes the fluctuation in cassava production in order to reach cassava self sufficiency.

However, which variables mentioned above are really the important factors, determining cassava production are still unknown.

Cassava's role in information about the Indonesia economy is rarely found, but an attempt to investigate the supply response of cassava makes it neccesary to know the information required for planning and policy.

The study is an attempt to determine the cassava supply response to the variables based on time series data.

Objectives of the study

The principle objectives of the study are as follows:

1. to identify factors affecting supply response of cassava both regional and national levels.
2. to determine long run and the short run elasticities of cassava regional and national levels.
3. to forecast cassava supply for a five year period.

Benefits of the study

The study has benefits for :

1. Providing some basic information to implement government policy on cassava production in Indonesia.
2. Explaining factors affecting the supply of cassava.
3. Forecasting the future supply of cassava in Indonesia.

Hyphothesis

The hyphothesis is based on the theory of supply. The cassava farmers are response to the changing price Their production planning this current year is based on the previous year price. The price elasticities are inelastic in short run and more elastic in long run.

Scope of the study

The coverages of this study are as follows :

1. Data used are time series data which covers the years of 1970-1988 for national and regional level.
2. The study focused on domestically produced supply and is designed to provide quantitative analysis of the cassava supply response in Indonesia by using the Nerlove model.

Review of the literature

Marc Nerlove (1956) hypothesized that farmers react not to previous year's price but rather to the price they expect and this expected price depends only to a limited extent on what previous year's price was.

Marc Nerlove (1958) stated that it was necessary in supply response studies to approximate plan output by realized output. The formulation was an expectation model for output response and yield response assumed to be similar to that for acreage response.

Mubyarto and Fletcher (1973) explained further that the price elasticity of output can be estimated directly through the output function or indirectly through area and yield function. It was thought that intended output, rather than realized output, should be used as the dependent variable in the output function response. However, this variable could not the always be observed, If some planted area is abandoned total planted area maybe an over statement of actual harvested areas. Hence, a considerable discrepancy between the planned output and realized out put may result.

In agricultural supply analysis, important structural changes have often reflected the impacts of government farm program changes in crop supply response model and they have received considerable attention in previous research (Houck et al, 1976).

Government policies which affect agricultural production in Indonesia, since the determinants of production are area and yield. Changes in area harvested maybe influenced by newly opened land,cropping patterns, irrigation development, short duration of new seeds, and relative prices. Changes in yield maybe the result of improvements in the quality of irrigation and water management, fertilizer use and crops management. Input subsidies and technological breakthrough are also very important (Prabowo, 1989).

Agriculture production is the product of acreage and average yield, so the price elasticity of output can be disaggregated into an area and a yield price elasticities (Allen,1972).

Yotopoulus and Nugent (1976) stated that the expected price in the coming year can not be observed but is assumed that farmers adjust their expected price for the current year in proportion to the error that they have made in predicting the previous years' price .

Sanderson, Quilkey and Freebairn (1980) estimated the supply response of Australian wheat growers. The implication were considered in term of existence and nature of production lags and the choice between expected prices and expected gross return as the prefered explanator of producer response to changing economics conditions. The analysis indicated that there were lags which were due to difficulties and costs of rapid adjustment rather than to the time required to revise expectations. The statistical results were similar for the alternative specification of gross margins and prices as the economic decision variables. The Nerlovian adjustment model was used on this study.

Supply function expresses the relationship between the commodity offered and its price variables, other factors are held constant. It can be classified by static and dynamic supply. The static supply function concerns a change in the amount supplied as price changes at a point of time. While the dynamics supply, involved the adjustments in supply over time.(Tomek, 1982) .

FAO (1987) had studied about supply response in Pakistan Agriculture. This study used a Nerlovian adaptive response model . From this study specifically for rice supply, the yield response exceeds area response in the short run in Pakistan, where as area response exceeds yield response to price in the long run. Area and yield elasticities were estimated respectively at 0.08, 0.12 in the short run and at 0.40, 0.20 in the long run.

Instead of rice, FAO (1987) concerned about the wheat supply response. It found the area response that he found greater than yield response in all regions. Both area and yield elasticities in Pakistan were respectively at 0.10 and 0.05, in the short run and at 0.25, and 0.15 in the long run respectively.

Altemeier, Tabor and Adinugroho (1988) determined supply parameters for Indonesian agricultural policy analysis. In this study , they introduced a model of supply for indonesian agriculture economic. The supply was a Nerlovian adaptive response model. The commodities included in the analysis were wet land rice, dry land rice, corn, cassava, soybean, mungbeans and peanuts. Area and yield response functions were estimated by applying OLS regression to a seventeen year time series data. The estimate on short term area planted and yield per unit area response for soybean were respectively at 1.10, 0.19 and the effect of corn, cassava and peanut prices on the area planted response to soybean were at -0.16, -0.15, -0.12 and -0.05 respectively.

Gazali (1989) estimated the supply response of soybean in Indonesia. It covers 19 observations (1969-1987). He used the Nerlovian partial model to develop a supply response model. By using this, the supply elasticities could be estimated indirectly through area and yield response functions. The findings showed that area and yield elasticities were estimated respectively at 0.55, 0.50 in the long run and 1.25, 1.56 in the long run with respect to lagged soybean price.

CHAPTER II

METHODOLOGY

Conceptual frameworks.

Theoretical basis of supply function

A static supply schedule shows how much of a given commodity, will be offered for sale per unit of time, as its price varies, other factors held constant. In theory a static supply function can be derived from a knowledge of the underlying input-output relationship or cost function, in a manner analogus to deriving a demand curve from an individual utility function. A theoretical supply curve is based on the assumption that producers seek to maximize their net income. Under the assumption of perfect competition, the individual supply curve will be determined by the shape of the marginal cost curve. At any point above the lowest point of the average variable cost curve, the supply schedule coincides with the marginal cost curve. The aggregate supply curve for any commodity can be obtained simply by summing the marginal cost curves for all farms.

Since Marc Nerlove introduced his book in the late 1950's , there have been many studies on supply response of various crops in various countries around the world. Discussion of issue remained largely theoretical until the early 1960's the bulk of supply response studies came into existence after this time, especially after Behrman's dissertation was published.

Supply response function is different from the traditional supply function. The traditional supply curve specifies a price-quantity relationship, all other factors held constant. The response curve is more general: it specifies the output response to price change, not holding all other factors constant. Thus, the supply response function may involve both movements along a supply curve and shifts in supply. Another distinction is that the response relation is not a reversible function. The supply response elasticity is likely to be different for an increase in price than for a subsequent reduction in price. The traditional supply curve specifies that if price increases, and then decreases, the quantity supplied will return to its original level; therefore, it is reversible.

The response concept is based on the hypothesis that when price changes, there are likely to be correlated changes in supply shifters. In particular, when price increases, new techniques of production are more likely to be introduced. Under conditions of rising prices, firms may be induced to adopt new techniques at a somewhat faster rate than with constant or declining prices. Once the technology has been adopted, improved production practices are usually retained even though the price of the product subsequently declines.

Farmers are not likely to discard new technology and thereby supply function does not shift to the left once it has moved to the right. Hence, the supply response to a subsequent decline in price is likely to be less than to the previous increase in price. Under these circumstances, the response of price elasticity is likely to be higher for a price increase than for a price decrease.

A hypothetical response relation of this type is shown in Figure 1. At a price of P1, producers offer an output of Q1, but as the price increase to P2, output expands along the diagonal between S1 and S2 , ultimately reaching Q2. If the price, therefore, declines to P3 , output will decline along the new supply curve S2, resulting in the reduction of output to Q3 .

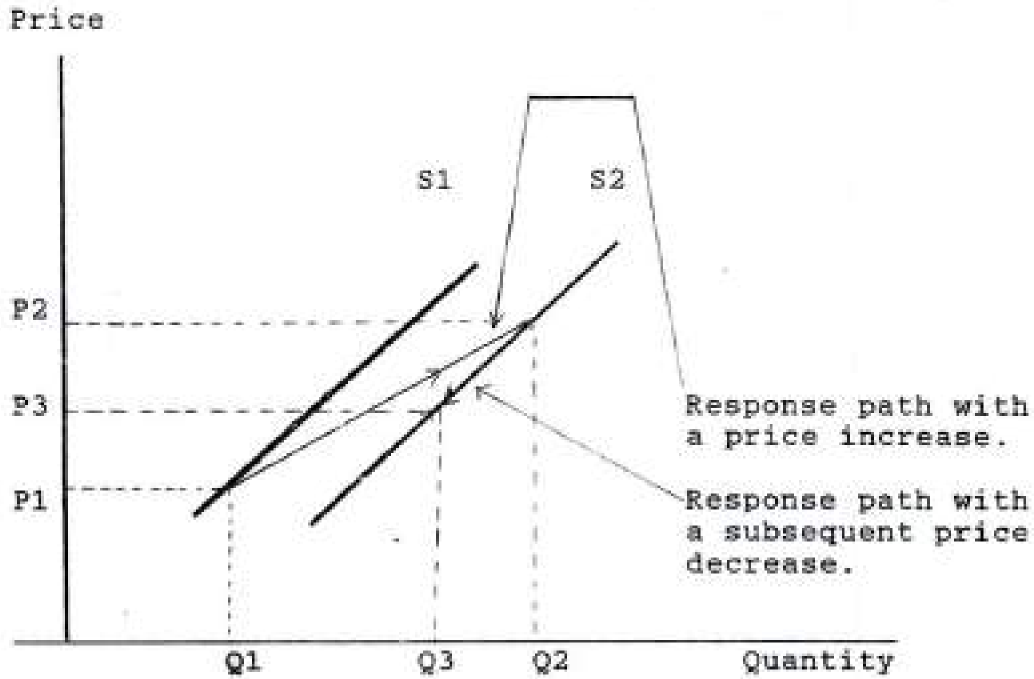


Figure 1 Hyphothetical supply response path.

Model Used in the Study

The expected price

Expected price in the coming year can not be observed but it is assumed that farmers adjust their expected price for the current year in proportion to the error that they have made the previous year. It can be seen below :

$$P_t^* - P_{t-1}^* = B[(P_{t-1})-(P_{t-1}^*)] \qquad (6)$$

Where : P_t* = Expected price of the current year

$P_{t-1}*$ = Expected price for the last year

P_{t-1} = Actual price for the last year

B = Coefficient of adjustment

If the coefficient of adjusment (B) were equal to zero, the expected price for the current year would be equal to the expected price for the last year, $P_t*=P_{t-1}*$. It indicates the actual price for the last year price has no effect on farmers' decision making in the current year. On the other hand, if the cofficient of adjustment is equal to one the expected price for the current year would be equal to the actual price for the previous year, $P_t* = P_{t-1}$. It indicates the farmers' decision making in the current year depends on the actual price for the last year. How ever, it is assumed that farmers revise their expected price in proportion to the error they have made in predicting the last years' price . Hence, the coefficient of adjustment lie between zero and one, $(0 < B < 1)$.

Since Marc Nerlove has developed and used his model in estimating the supply response functions there are many works that modified their model by making use of Nerlove's model as their basic model. The purpose of this section is to review the supply response model.

Since Q* as well as P* are unobserved variables, we must specify some assumptions and then develop a supply response model in such a way that all variables can be observed.

In practice, the dynamic supply relationship developed by Nerlove is used to explain the supply response of the commodity. The assumption of the adjustment model is based on the producer decisions, which depend on expected price and planned or desired output, and remain the farm size does not affect yield. The expectation model is specified as

$$Q^*_t = a + bP_t + cX_t + U_t \quad (1)$$

where :

Q^*_t = desired quantity of output.

P_t = supply inducing price which may be in the form of expected or desired price (P^*_t). Usually, supply inducing price is to some extent based on the past price.

X_t = supply shifter such as input price, technology, ecological and institutional factors.

U_t = error term.

a,b,c, = structural parameters of the equation.

Given the quantity adjustment model

$$Q_t - Q_{t-1} = B\ (Q^*_t - Q_{t-1}) \qquad (2)$$

Where:

Q_t = actual output in year t (this year).

Q_{t-1} = actual output in year t-1 (last year).

Q^*_t = desired output in year t.

B = coefficient of adjustment.

The model states that the difference between the actual output this year and last year is related to the difference between the desired output this year and last year's output.

The model also implies that complete adjustment in output is achieved if this year's output equal last year's actual output.

By combining equations (1) and (2), the terms are rearranged. The result is a quantity adjustment model which is expressed in observed variables are as follows,

$$Q_t = aB + bB\ P_{t-1} + cB\ X_t + (1-B)\ Q_{t-1} \quad (3)$$

this equation states output is determined by the price in the previous year, supply shifter such as input price, technology, ecological change, institutional factors and the out put in the previous year. In the case, the farmer once planning the production will expect the same areas as that in the previous year.

Similarly, given price expectation model :

$$P^*_t - P^*_{t-1} = B\ (P_{t-1} - P^*_{t-1}) \quad (4)$$

The supply relation is expressed by :

$$Q_t = a + b\ P^*_t + c\ X_t + U_t \quad (5)$$

Then (4) and (5) can be combined and the terms rearranged to obtain the price expectation model expressed in term of observable variables as follows :

$$Q_t = aB + bB\ P_{t-1} + cB\ X_t + (1-B)\ Q_{t-1} \quad (6)$$

which quantity production yields the same type of relationships as in (3).

There is another point about the distinction between the expectation model and adjustment model. The expectation model is supposed to reflect the manner in which past experience determines the expected values of variables such as price and yield. These, in turn, determine the levels of output and input intended by producers. The adjustment model is supposed to reflect either technological or institutional constraints, or both. These constraints permit only a fraction of intended levels to be realized during a given short period (Rumahorbo, 1984).

Area and yield elasticities as well as the equation (3), the supply response function the short run and long run supply can be estimated by using the following expressions :

Short run elasticity

$$E_{SR} = bB \; \frac{P_{t-1}}{Q_t} \qquad (7)$$

Long run elasticity

$$E_{LR} = \frac{bB}{B} \cdot \frac{P_{t-1}}{Q_t} = \frac{E_{SR}}{1-B} \qquad (8)$$

Where :

ESR = the price elasticity of short run supply.

ELR = the price elasticity of long run supply.

Area Response

Derived output and expected prices are not usually directly observable and proxy variables must be used. Nerlove (1956; 1958; 1979) and Behrman (1968) suggest that planned output can be measured by area planted times planned yield per unit area planted. Planned output can best be measured by area, since alternative variables such as actual output are under much less control by the farmer than it the area planted.

Vesdapunt (1984) stated that lagged area planted is viewed as a composite explanatory force which captures the influence of fixed factors in production. Such factors include specialized equipment, technical expertise, and other facilities. The total effect of such forces may induce farmers to plant a level of area which is relate to the area they planted in the previous year.

Since expected price can not be observed, an alternative method of estimation is needed. It can be assumed that hectarage planted is a function of expected price, then it is posible to relate acreage planted in year t to actual price in year t-1 and acreage planted in year t-1. Nerlove used the lag distribution method along with a one year lag equation to estimate the elasticity of hectarage response to expected price. Nerlove's a distribution lag one year acreage adjustment can be expressed as follows :

$$A_t - A_{t-1} = B \; (A_{t*} - A_{t-1}) \ldots\ldots(9)$$

Where : A_{t*} is desired hectarage

A_t is actual hectarage

B is the coefficient of adjustment

This equation states that the change in actual hectarage is proportional to the difference between desired and actual hectarage.

Since A_{t*} is a function of last year price of cassava (P_{c-1}), price of competitive crops (P_{cc-1}), government policy (G), or it can be expressed as :

$$A_{t*} = f \; (P_{c-1}, P_{cc-1}, G)$$

$$= a + b \; {}_{Pc-1} + c \; {}_{Pcc-1} + d \; G + Ut \ldots(10)$$

by substituting (10) into (9) can be found :

$$A_t - A_{t-1} = B \{[a + b\ P_{c-1} + c\ P_{cc-1} + d\ G + Ut] - A_{t-1}\}$$

$$A_t = aB + bB\ P_{c-1} + cB\ P_{cc-1} + dB\ G + B\ Ut + (1-B)\ A_{t-1}$$

$$= V_1 + V_2\ P_{c-1} + V_3\ P_{cc-1} + V_4\ G + V_5\ A_{t-1} + Vt$$

Where : $V_1 = aB$, $V_2 = bB$, $V_3 = cB$, $V_4 = dB$, $V_5 = 1-B$,

and $Vt = B\ Ut$ = error term.

It can be formularized in general form as follows :

$$A_t = h\{ P_{c-1}, P_{cc-1}, G, A_{t-1}, Ut\} \quad \ldots\ldots\ldots\ldots\ldots (11)$$

Yield Response

The factors that might affect the yield planning are the expected price of cassava (P_c), expected price of inputs (P_f), expected rainfall (W) and expected government policy (G). The relationship among these variables would be :

$$Y_{t*} = y\ \{ P_c, P_f, W, G \} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Since the planted area estimated, the assumption will create the yield per unit area planted equation,then become :

$$Y_{t*} = y\ \{ P_{c-1}, P_{f-1}, W, G, Ut \}$$

$$= a1 + b1\ P_{c-1} + c1\ P_{f-1} + d1\ W + e1\ G + Ut \quad \ldots\ldots (13)$$

by using Nerlove's adjustment model :

$$Y_t - Y_{t-1} = B\ (Y_{t*} - Y_{t-1}) \ldots\ldots\ldots\ldots\ldots\ldots(14)$$

the estimation yield per unit area response can be determined by substituting (13) into (14) :

$$Y_t - Y_{t-1} = B_1\{[\ a_1 + b_1\ P_{c-1} + c_1\ P_{f-1} + d_1\ W + e_1\ G + f_1\ U_t] + Y_{t-1}\}$$

$$Yt = a_1B_1 + B_1b_1\ P_{c-1} + B_1c_1\ P_{f-1} + B_1d_1\ W + B_1e_1\ G + B_1f_1\ Ut + (1-B_1)(Y_{t-1})$$

$$Yt = N_1 + N_2\ P_{c-1} + N_3\ P_{f-1} + N_4\ W + N_5\ G + N_6\ Y_{t-1} + N_7\ U_t \ldots(15)$$

Where : $N_1 = a_1B_1$, $N_2 = B_1b_1$, $N_3 = B_1c_1$, $N_4 = B_1d_1$, $N_5 = B_1e_1$

$N_6 = 1 - B_1$ $N_7 = B_1f_1$

$$= a_1B_1 + B_1b_1\ P_{c-1} + B_1c_1\ P_{f-1} + B_1d_1\ G + B_1e_1\ Ut + (1-B_1)(Y_{t-1})$$

This estimation can be put in general form to be :

$$Y_t = y\{\ P_{c-1},\ P_{f-1},\ G,\ Y_{t-1},\ Ut\ \} \ldots\ldots\ldots\ldots\ldots(16)$$

Cassava production

In general, the supply function can be specified as follows :

$$Q_c = f\ (\ Area,\ Yield\ )$$

it can be extended to :

$$Q_c = f\ (P_c,\ P_{cc},\ P_f,\ W,\ G,\ Ut) \ldots(17)$$

Where :

Q_c = quantity supplied of commodity cassava (Kgs)

P_c = price of commodity cassava (Rp/Kgs)

P_f = price of fertilizer for producing cassava (Rp/Kgs)

P_{cc}= price competitive commodities (ground nut, mungbean, rice, corn, soybean) which can be produced by using the same input (Rp/Kgs)

W = amount of rainfall (m.m)

G = government policy, using dummy (D=0, if there is no government policy from 1970 to 1978 and D=1, if there is government policy from 1979 to 1988). The kinds of policies that will be taken into account such as intensification, credits, introducing post harvest technology or others.

Ut = other factors that might affect quantity supplied of commodity cassava.

Since Q, A, Y, are assumed as functions of price, then by taking total differentials results

$$dQ = \frac{\delta Q}{\delta A} dA + \frac{\delta Q}{\delta Y} dY$$

$$\frac{dQ}{dP} = \frac{\delta Q}{\delta A} \frac{dA}{dP} + \frac{\delta Q}{\delta Y} \frac{dY}{dP} =$$

since $\frac{\delta Q}{\delta A} = Y$ and $\frac{\delta Q}{\delta Y} = A$, results

$$\frac{dQ}{dP} = Y \frac{dA}{dP} + A \frac{dY}{dP}$$

then multiplied by $\frac{P}{Q}$

$$\frac{dQ}{dP} \frac{P}{Q} = \frac{P}{A} \frac{dA}{dP} + \frac{P}{Y} \frac{dY}{dP}$$

In term of elasticities (E),

$$E_O = E_A + E_Y \qquad (18)$$

The price elasticity of output E_O can be estimated directly through the output function or directly through area and yield. It is thought that intended output should be used as the dependent variable in the output function rather than realized output. However, this variable can not be observed. For this reason, it is necessary in the supply response studies to approximate planned output by realized output (Nerlove,1958)

The projection of cassava supply in Indonesia

The Projection is made to cover the period from 1989 to 1993. Both area and yield equations above consider the previous year price and time lag between hectarage planted and yield, hence, the calculation used is the following equation :

$$X^* = X (1 + r_1)^t \qquad (19)$$

Where : X*, X are dependent variables in cassava area and yield function, at year t and the base year 1970 respectively. r_1 are average growth rates of X*. t is Time (year 1,2,3,4,5), for 1989-1993. The projection of cassava production assumed that only these variables influenced area and yield equations.

The data

The data needed for this study were time series data 1970 - 1988. Data used in this study was gathered from the Directorate General of Food Crops, the Central Bureau of Statistic, the Mass Guidance Agency, the Meteorology and Geophysics Agency, the Centre for Agro-Economic Research, the BULOG (National Food Agency) and other related agencies.

The data covered three provinces which mainly produce cassava and the national level. The three are East Java, Central Java and West Java.

CHAPTER III

CASSAVA DEVELOPMENT IN INDONESIA

Economic scene

There is an urgent need to monitor and assess the performance of food production and adjust the policy instrument to face constraint on resource use. In the past five years major shift have taken place in the economic environment which have had direct effects on the availability of government resources for continuing development of the economy.

In addition to having tighter development budget the economy has also gone through three major devaluations of its currency in 1978, 1983, and 1986. These devaluations were executed to promote export markets for all sectors of the economy. However, the positive effects of these actions were reduced because of generally receding world economic conditions.

The total value of exports did not increase as much as originally expected. The agricultural sector not only provides approximately one fourth of the total GDP as shown in Figure 2, but also currently provides employment to about 28 million people or 57 percent of the labor force. Food expenditure for the lower income groups is even higher. Therefore, the agricultural sector can be considered the single most important economic sector in Indonesia.

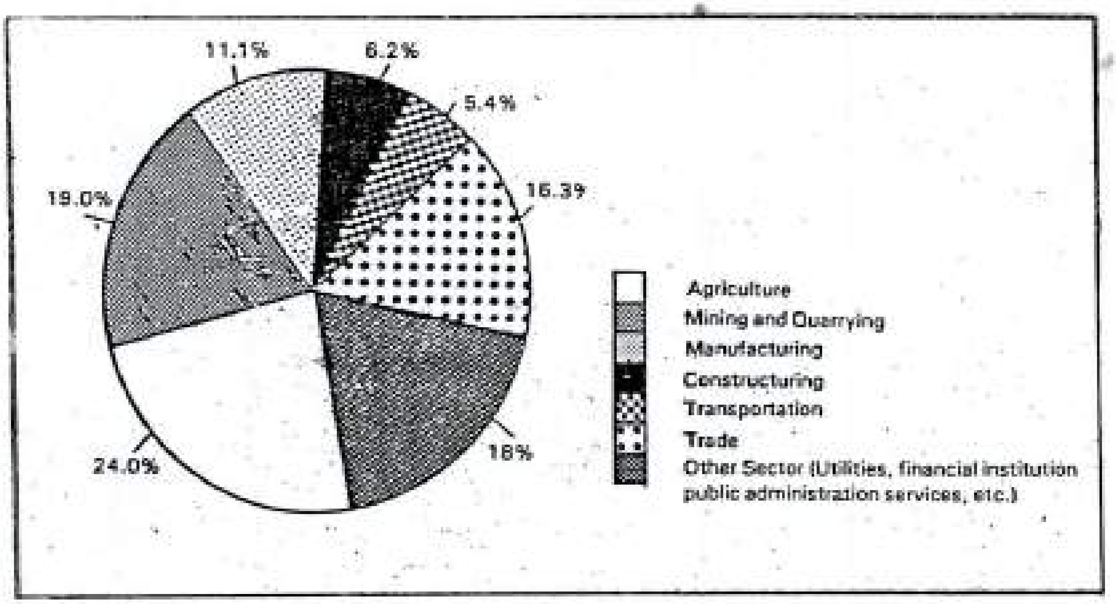


Figure 2 Composition Indonesia's Gross Domestic Product in 1983-1984.

Source : AARD, 1987

In 1970, based on the food balance sheet per capita consumption of cassava, consumption reached its highest level at 75 kg per capita per year but then started to decline. Over the past five years it has stabilized at about 65 kg (MOA,1987).

The highest per capita consumption of cassava is in the lowest expenditure class. As income and expenditures increase, cassava consumption decreases steadily.

Cassava is mainly consumed in rural areas with per capita consumption three or four times larger in rural areas than in urban areas (MOA,1986). Per capita consumption of cassava also declines over time. This occurence as a result of increasing income and expenditure (MOA,1988). The relationship can be illustrated in Figure 3.

<u>Role of cassava</u>

Cassava plays an important role as a source of carbohydrates for the Indonesian people, especially those who live in rural areas. In addition, it is also used as animal feed and provide raw material for industrial uses. However, during the past five years the area planted with these crops has declined although the yields per hectar increased. This is due mainly to unstable prices as a result of marketing problems. Special efforts are needed to meet projected demands such as developing higher yielding varieties, generating technology suitable for different farming conditions and pricing policy, and encouraging farmers to produce commodities.

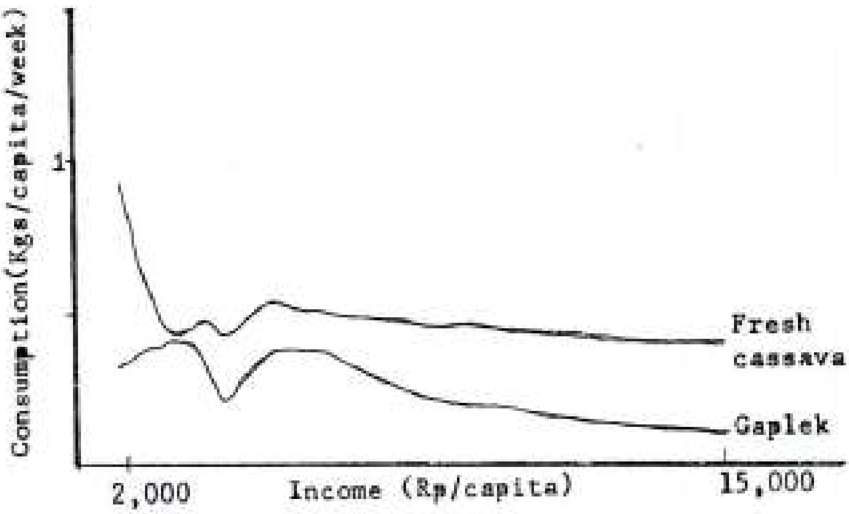


Figure 3 a.

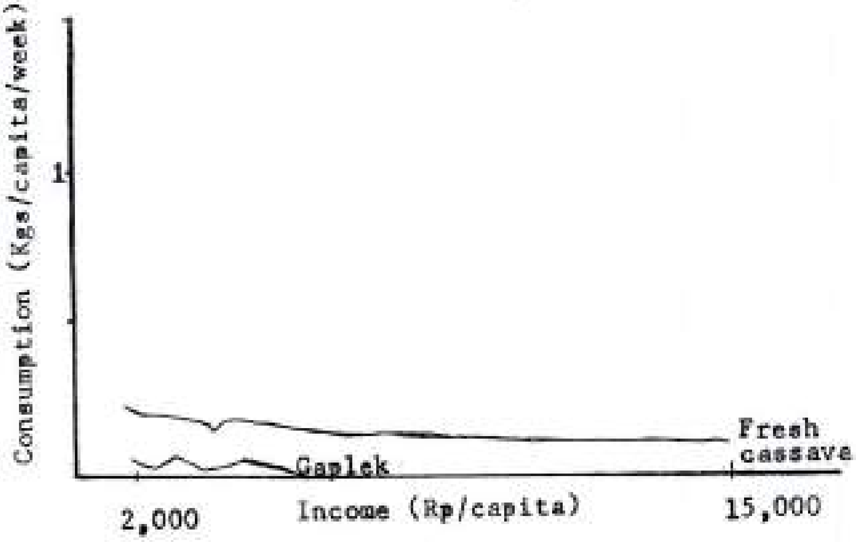


Figure 3 b.

Figure 3 Consumption per capita of cassava and income in Indonesia, 1978

a. Rural Consumption

b. Urban Consumtion

Source : Dixon, 1982.

During a period in which rice production has experienced dramatic growth, production of cassava has been relatively stagnant. Cassava production increased from 10.5 million tons in 1970 to 13 million tons in 1974. From 1974 to 1978, cassava production declined to 12.2 million tons. Between 1979 and 1981, cassava production, however, increased to between 13.3 and 13.7 million tons before falling again to 12.1 million tons in 1983. In 1984, cassava production rose sharply to 14.1 million tons before declining again to 12.8 million tons in 1986. On the average, between 1974 and 1986, cassava production has varied between 12 to 14 million tons (MOA,1987).

Peaks in cassava production have traditionally come after high off-trend peaks in world market chip and pellet prices. For example, in 1983 Bangkok wholesale pellet prices reached 109 dollars per ton. In 1984, production rose by 17 percent from 12.1 million tons to 14.1 million tons although prices had already fallen to 73 dollars on the world market.

Domestically, cassava is used as a foodstuff, in both fresh and dried form. Increasingly cassava is also used as a starch product for manufacture of crakers, cakes, other snack foods as well as for industrial uses (textiles, plywood). Total use of cassava for starch is estimated to have reached fifty-two percent of total domestic utilization by 1986.

Indonesia has also traded smaller quantities of cassava flour on the world market. Before 1975, Indonesia was a net exporter of cassava flour and cassava meal. Cassava flour exports averaged 324,000 tons between 1970 and 1974. In fresh cassava equivalent terms, this would be equal to 1.5 million tons or approximately fourteen percent of domestic production.

Cassava flour supply is highly dependent on the supply of the raw material to the factories. Cassava flour is used to make crakers (krupuk), starch, starch balls, and cakes. In 1985, 176,000 tons of cassava flour was consumed in Jakarta. Of this, eighty percent was supplied from Lampung and the balance from Java. Cassava flour is distributed from the factories directly to wholesalers and to the one government appointed distributor. The wholesalers sell the cassava flour to the small-scale food processors and to retailers.

Cassava producing areas in Java

The specific region of cassava production is concentrated in East Java, Central Java and West Java as shown in Table 3 and Figure 4. Cassava exhibits the least degree of regional concentration of any of the secondary crops. Cassava production is concentrated between July and October. During this period nearly seventy percent of the total harvest take place. Cassava can be harvested year round and in Malang for example, the bulk is harvested during the dry period from June to September .

Typical cropping patterns are as shown in Figure 5 (a,b,c). In general, the cropping season is from October to August every year, except in East Java when it starts a month earlier.

Table 3 The cassava producing areas in East Java, Central Java and West Java based on 1986.

Province	Harvested Area (Ha)	Average Yield (Tons/Ha)	Production (Tons)
East Java			
1. Tuban	11192	10.8	12061.9
2. Ngawi	11379	10.6	12013.3
3. Ponorogo	31544	10.5	33144.7
4. Pacitan	30804	10.7	33101.7
5. Trenggalek	12562	11.5	11467.0
6. Malang	21842	12.5	26941.8
7. Probolinggo	12544	11.8	14760.7
8. Pasuruan	12270	10.9	13327.5
9. Pamekasan	16637	10.9	18202.5
10. Sampang	36019	10.8	38881.9
11. Sumenep	15018	11.8	17735.1
Central Java			
1. Semarang	10472	11.4	11919.7
2. Pati	11591	14.2	16466.3
3. Jepara	10078	10.8	10850.0
4. Cilacap	11296	13.0	14707.1
5. Banjarnegara	14348	12.6	18148.6
6. Kebumen	11100	14.6	16220.1
7. Karanganyar	13465	12.4	16738.5
8. Wonogiri	61926	10.4	64396.9
9. Sragen	11211	11.6	12949.6
10. Boyolali	12194	12.3	15059.0
West Java			
1. Bogor	13345	13.2	17568.0
2. Cianjur	10037	12.1	12170.7
3. Bandung	10890	12.6	13696.8
4. Garut	18659	11.8	21960.8
5. Tasikmalaya	18737	10.9	20421.0
6. Ciamis	22140	12.0	26600.7

Source : Directorate General of Food Crops, 1987

Figure 4a.

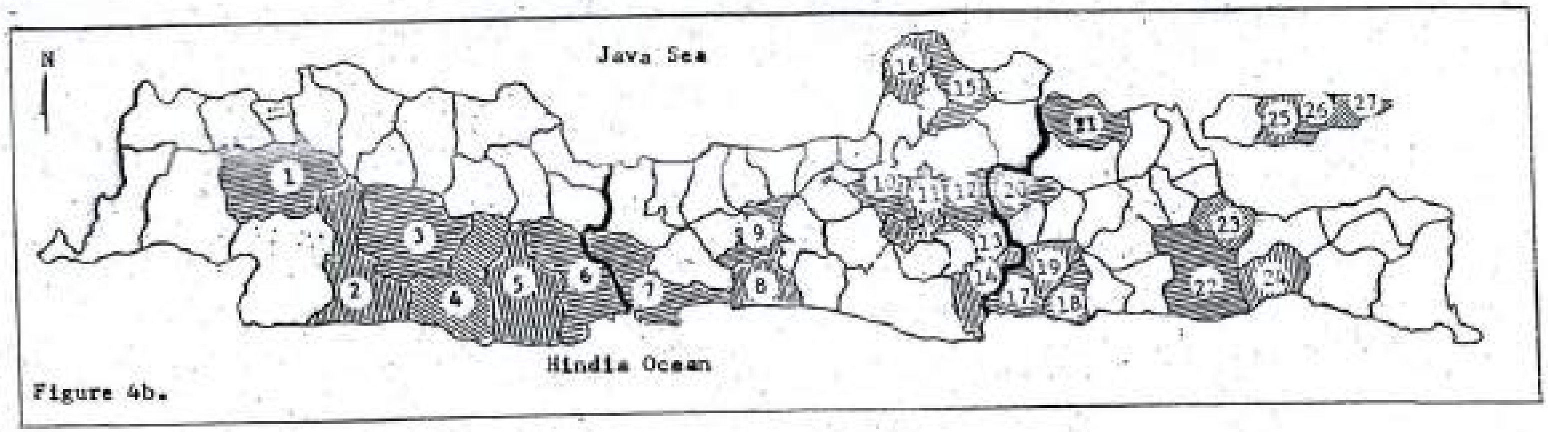


Figure 4b.

Note :

1-6 are districts in West Java
7-16 are districts in Central Java
17-27 are districts in East Java
1 is Bogor
2 is Cianjur
3 is Bandung
4 is Garut
5 is Tasikmalaya
6 is Ciamis
7 is Cilacap
8 is Kebumen
9 is Banjarnegara
10 is Semarang
11 is Boyolali
12 is Sragen
13 is Karanganyar
14 is Wonogiri
15 is Pati
16 is Jepara
17 is Pacitan
18 is Ponorogo
19 is Trenggalek
20 is Ngawi
21 is Tuban
22 is Malang
23 is Pasuruan
24 is Lumajang
25 is Sampang
26 is Pamekasan
27 is Sumenep
▬ is Border line between provinces

Figure 4 Cassava's producing areas in Java island

a. Indonesia archipelago
b. Specific districts of cassava in Java

Source : Ministry of Agriculture, 1989

Figure 5 a.

Note:
X,Y are rainfed soil
I is irrigated soil
r is upland rice
c is cassava
C is corn
M are months name in abbreviation

```
X          cccccccccccccccccccccccccccccccccccccccccccccc
Y          CCCCCCCCCCCCCCCCCCCCC
           ccccccccccccccccccccccccccccccccccccccc
I.                   rrrrrrrrrrrrrrrrr   ccccccccccccccc

M. Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
```

Figure 5 b.

Note :
E is eroded hillside
V is level valley soil
C is corn
1C is Combination of legumes and corn
c is cassava
r is upland rice
l is legumes crop
M is months name abbreviation

```
E.              1111111111111111
                 cccccccccccccccccccccccccccccccccccc
V.       CCCCCCCCCCCCCC     11111111111
         rrrrrrrrrrrrrrrrrrrr
               cccccccccccccccccccccccccccccccccccccc
               1C1C1C1C1C

M. Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
```

Figure 5 c.

Note :
X, Y are rainfed soil
M are months name in abbreviation
l is legumes crops
c is cassava
r is upland rice

```
X               cccccccccccccccccccccccccccccccccccc
Y               11111111111
                rrrrrrrrrrrrrrrrr
                    cccccccccccccccccccccccccccccccccccc
M. Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
```

Figure 5 Cropping pattern for East Java, Central Java and West Java.

a. Annual cropping system in Kediri, East Java

b. Annual cropping system in Gunung Kidul, East Java.

c. Annual cropping system in Garut, West Java.

Source : Roche, 1984

Input uses

Varieties

The government has attempted to promote cassava production through a number of programs including breeding and releasing an improved varieties.

For several years agronomist have been experimenting with the Adira 1 and Adira 2. They are crosses of clones from Brazil and Maluku in Indonesia. Adira 1 is sweeter, lower HCN (cyanida acid) content is nonbranching and has shorter harvested periods than Adira 2. Both have shown resistance to cassava bacterial blight and red spider mites (Roche, 1984).

The three improved varieties of cassava released since 1978 carry degrees of resistance to withering. These varieties have improved the potential yields of cassava, with yields of 25-40 ton per hectar as shown in Table 4.

Table 4 High yielding varieties released in Indonesia, since 1978.

Varieties	Released Year	Harvested (days)	Average Yield (Tons/Ha)	Resistant to
Adira 1	1978	215	25	Withered
Adira 2	1978	250	30	Withered
Adira 4	1987	215	40	Withered

Source : AARD, 1987

Commonly cultivated cassava varieties include Valenca, Muara, Gading and Bogor. Valenca matures in 12 months and has a production potential of 15 to 20 tons per hectare. The other varieties mature in 7 to 10 months and have a production potential of 20 to 30 tons per hectare. Average farmer yeilds are below ten tons per hectare.

By 1987, around 30 percent of farmers had adopted the high yielding varieties . The Ministry of Agriculture estimated that a decreasing in the adoption of using high yielding varieties by 10 percent and without area expansion will increase the production to 20 tons per hectar within 10 years.

Fertilizer and pesticides

Economically optimal levels of nitrogen will probably be within the range of 70 to 135 kg per hectar, depending on the cassava variety and soil condition. Effendie (1980) recommended potasium (K2O) dosages of between 50 and 100 kg per hectar for cassava depending on soil type. By improving the varieties and increasing fertilizer application, the potential yield appears to be about 20 ton per hectar of fresh cassava or nearly double the current farm level yield. However the government has made only limited efforts to boost cassava production.

The Ministry of Agriculture estimated the effective inputs required per hectar of cassava production as presented on Table 5. From 1989 up to 1993 government expect that there will be an increase in the inputs used for pesticides and fertilizers.

Table 5 Pesticides and fertilizers are required per hectar cassava production in Indonesia, 1989-1993.

Year	Pesticides (lt/Ha)	Fertilizers (kg/Ha)
1989	0.04	86.26
1990	0.04	94.10
1991	0.04	101.93
1992	0.05	109.77
1993	0.05	117.60

Source : Ministry of Agriculture, 1988

The price of fertilizer has been highly subsidized as an incentive to increase cassava production. Fertilizer prices for cassava refer to price ratio between urea and rice gradually decrease overtime as a result of the government policy to phase out fertilizer subsidy as shown in Table 6.

Marketing

The cassava marketing is structured as a wholesale supply source for overseas, Javanese and

Table 6 The price of fertilizer, price of rice and fertilizer-rice price ratio, 1973-1988.

Year	Urea	TSP	ZA	KCL	Rice	Fertilizer-Rice Price Ratio
	---------	(Rp/Kg)	----	----	----	
1973	26	26	-	-	21.00	1.24
1974	40	40	-	-	30.00	1.34
1975	60	60	-	-	41.50	1.44
1976	80	80	-	-	58.50	1.37
1977	70	70	-	-	68.50	1.02
1978	70	70	-	-	70.70	0.99
1979	70	70	-	-	75.00	0.93
1980	70	70	-	-	88.00	0.79
1981	70	70	-	-	105.00	0.67
1982	70	70	70	70	120.00	0.58
1983	90	90	90	90	135.00	0.67
1984	90	90	90	90	145.00	0.62
1985	100	100	100	100	167.00	0.60
1986	100	100	100	100	175.00	0.57
1987	125	125	125	125	175.00	0.71
1988	135	135	135	135	190.00	0.71
1989	165	170	165	165	250.00	0.66

Source: Ministry of Agriculture, 1989

Sumateran consumption. Cassava processing is undertaken before the final product is sold, but total cassava production is consumed in final form.

From Figure 6, the farmers engage in contract harvesting (tebasan) by village collector at the farm gate. The harvesting of fresh cassava can be either contracted out or sold directly to village collectors. They bring the cassava to the starch (tapioca) factories for processing. Then, the starch may be stored for over a year, or sold directly to krupuk , textile, plywood, noodle and snack industries in Java or Sumatera.

The chip and pellet industry absorbs the residual supplies which the starch factories cannot absorb during the main harvest season . The cassava is dried in the fields with drying floors of small-scale village collectors. Lots are assembled by these collectors and sold to provincial wholesalers. The provincial wholesalers provide these collectors with working capital to make such procurements and sell the dried cassava to factories . The factories process the dried cassava and export it to the European market

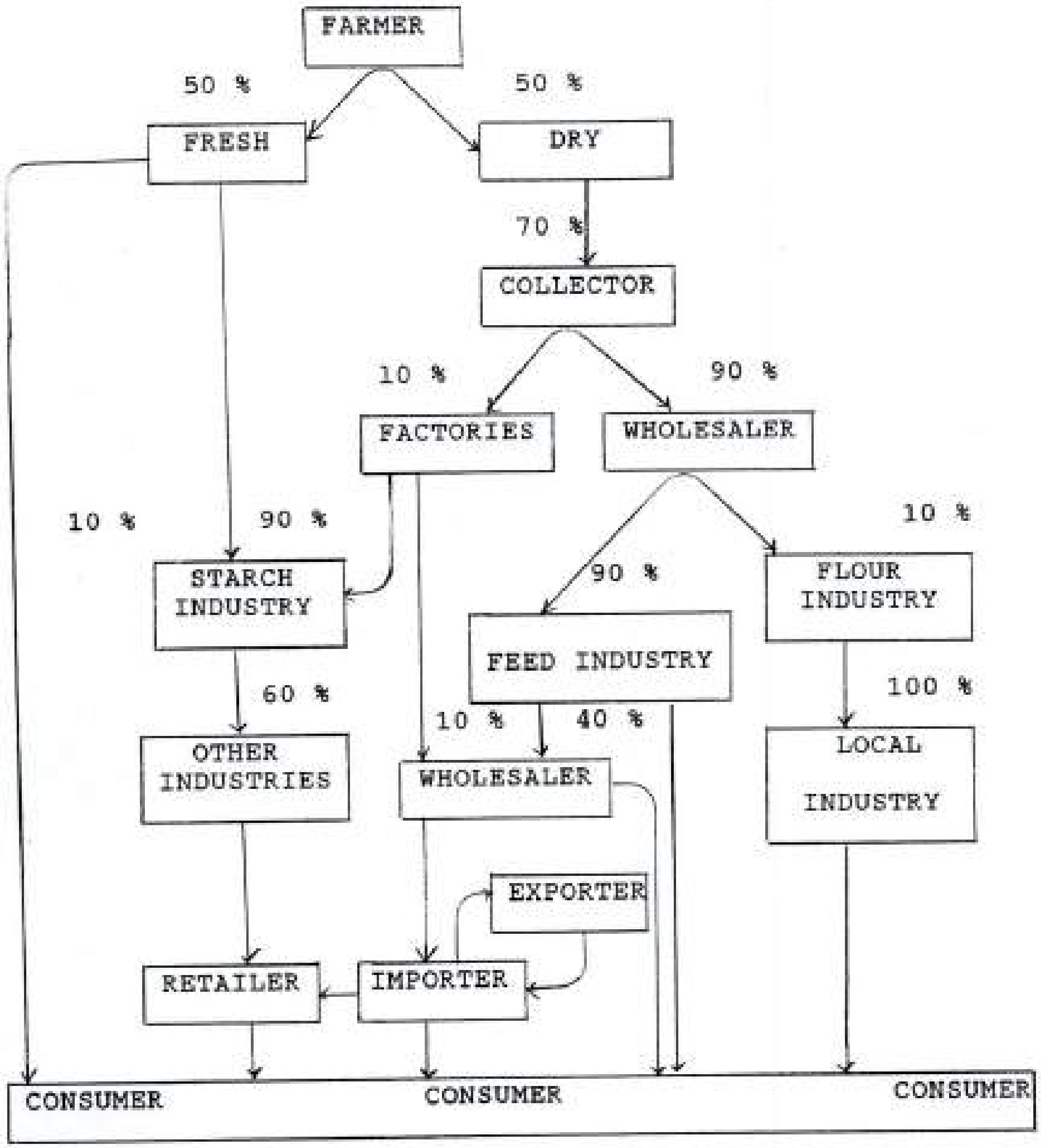


Figure 6 Cassava marketing structure in Indonesia .

Source : Ministry of Agriculture, 1987

The fresh cassava market is dominated by large factories which control nearly to 90 percent of the starch market The factories regulate their supply sources and provide credit to key village collectors in order to inspire procurement loyalty .

Related to the seasonality in production starch factories were operating at approximately fifty percent of installed capacity and chip or pellet manufacturers at near thirty percent . In order to regulate the cassava supply throughout the year, cassava estates would have to be established by the factories. The starch factories have generally resisted efforts to expand their area cultivated because their unit production costs at Rp 25.-per kg. are above those of non-estate farmers at Rp 17.- per kg.

Price formation

Prices for fresh and dried cassava exhibit strong variability from year to year. The most dramatic change has been between near historical low prices in 1984 and peak prices in August to November 1987- 1988 presented in Table 7. Factory procurement prices for cassava tend to follow interseasonal variability

Table 7 Monthly wholesale price average of cassava in Indonesia, 1984-1988.

(Unit:Rp/Kg)

Months	Years 1984	1985	1986	1987	1988
January	87	77	104	90	120
February	98	73	112	98	126
March	92	72	121	85	110
April	91	81	99	86	110
May	93	80	84	88	107
June	90	88	91	80	103
July	84	99	86	89	131
August	85	91	90	153	124
September	82	107	98	146	173
October	81	102	97	146	142
November	87	100	96	149	134
December	82	100	86	122	130

Source : Ministry of Agriculture, 1988

regional prices . Dried cassava prices are determined by domestic supply/demand as a price ceiling. In the pellet and chip market, procurement prices tend to rise in August and November as the companies try to increase their exports.

For fresh cassava, transport costs plus the waste penalty are the major pre-factory distribution costs. The waste penalty is a cost levied partly at the discretion of the starch factories and serves to influence prices offered at the factory gate. It was reported that at off-peak periods, the factories would not levy any waste penalty in order to attract fresh cassava supplies whereby at surplus periods (availability above capacity) waste penalties of up to thirty percent costs are again the major cost components. Transport costs are higher for the dried cassava products because the processing capacity is located far and is costly, rather than in the producing areas as is the case for the starch industry .

Floor price

Urban cassava prices vary widely from year to year. The prices in Surabaya ranged from a low of Rp 37.-/kg in Febuary of 1982 to a high of Rp 115.-/kg in

May 1983 and then down to Rp 36.-/kg in December of 1984. In October of 1986 Surabaya gaplek prices reached a high of Rp 185.- following the devaluation of the rupiah . It should be noted that the periods of sharp price increases and depressed pricing periods did not correspond with the main domestic harvest can be clearly attributed to a drop in world market price. Inter-seasonal variation is far more pronounced in urban than in rural market price. Rural market prices tend to move according to the trend in annual prices.

The cassava industry suffers from highly unstable year-to-year prices. At the farm level, prices for cassava reached historic lows in 1984 at Rp 5.- per kg. On an annual basis this would be equivalent to gross farm returns of fifty thousand rupiah per hectare. In 1986, farm gate prices increased more than twelve fold, to Rp 65.- per kg. Even at these very high prices, gross annual farm returns amount to little more than Rp 600,000.0 per hectare. The high volatility in year-to-year cassava prices, and the generally low farm gate returns, acts to discourage farmers from intensifying production.

The Ministry of Agriculture has developed a set of minimum price guidelines which are intended to set a floor under cassava prices. Under these guidelines, chip/pellet firms would pay at least 70percent of the job price to produce the dried cassava. Starch factories would pay 13.6 percent of the sale price for starch or Rp 35.- per kilo, whichever is greater, for the fresh cassava roots.

Intensification program

From Table 8 it is shown that the productivity of cassava which is planted in up (dry) land is about 3 percent higher than in low (wet) land. The intensification has improved the annual cassava production from 10.3-11.4 tons/Ha. The yield level is about 8.8 percent higher than in the non intensification program. The harvested area for the intensification program tends to increase overtime, in contrarary effect to non intensification as shown in Table 8.

The both had a trend to decrease even though the cassava intensification program had been implemented, is still limited almost entirely to Java. On a national basis, just over 35 percent of the cassava area is under intensification, as shown in Table 9.

The lack of proven improved cassava technology in any case limits the effectiveness of the intensification program.

Table 8 Cassava productivity and type area non intensification and under intensification in Java, 1981-1984.

(Unit : Tons/Hectare)

Year	Non inten sification	inten sifica tion	field land (dry)	field land (wet)	Average of field land
1981	9.35	10.27	9.85	9.55	9.73
1982	9.24	10.46	9.96	9.75	9.86
1983	9.08	10.75	10.19	9.95	9.97
1984	8.91	11.39	10.42	10.15	10.29

Source: Ministry of Agriculture, 1987

Table 9 Cassava and type areas in Java island under intensification, 1981-1984.

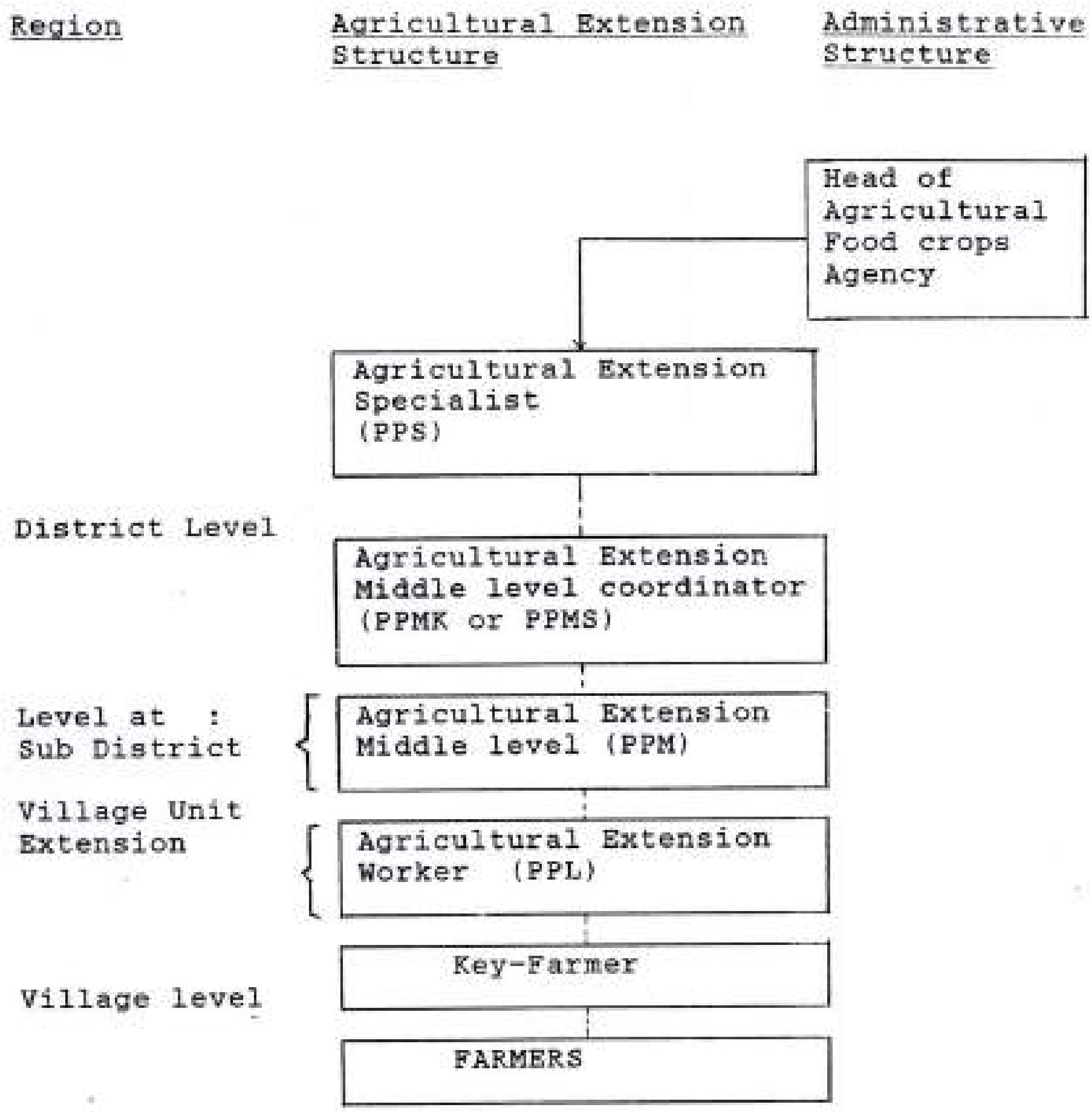
(Unit: Hectares)

Year	Intensification	Non intensification	Low land (wet)	Up land (dry)	Total land
1981	136128	850995	45993	941130	987123
1982	149896	770243	37740	882399	920139
1983	149746	689804	34691	804849	839550
1984	168671	738859	36443	871087	907530

Source : Ministry of Agriculture, 1987

Extension program

Structure, functions and organization extension for cassava crop are presented in some details in Figure 7. The function of agricultural extension could be distinguished from the structure of administrative arrangement. However, they should go along together. Organizational structure of agricultural extension could be illustrated by its structure at a district level. Functionally, agricultural extension workers at districts are subordinates of



Note : ____________ : Instructive channel
_ _ _ _ _ _ _: Consultative/information channel

Figure 7 Structure function and organization of the agricultural extension.

Source : Ministry of Agriculture, 1988

agricultural extension office at provincial level, but in organization it has to be responsible to the Head of Agricultural Food Crops Agency at district level. The function of Agricultural Extension Specialist (PPS) is mainly assigned to train Agricultural Extension Worker, planning for agricultural extension activities throughout the district level. The function of Middle Level of Agricultural Extension (PPM) could be grouped into two : a Coordinator (PPMK) who is assigned to help PPS in agricultural extension planning, and a Supervisor (PPMS) whose job is to supervise member of PPM periodically. One PPMK, however could carry out double function in practice due to lack of number of the existing personnal.

Similar different functions are also applied for PPM within sub districts area (WKBPP). PPM is also assigned to set program of extension activities together with Agricultural Extension Worker (PPL) at the beginning of every planting season within respective WKPP. PPL is also periodically supervised by PPM in the implementation of "training and visiting" system of extension. Twice every week, discussion among PPM and PPL has to be conducted at BPP to find solutions to problems encountered in the field. Any experiment conducted at BPP has to be managed by PPM.

Aside from conducting any seasonal program activities at Village Level Extension (WKPP), PPL has to train and visit key-farmers from Monday to Thursday (four days a week). Each PPL is responsible for managing 16 key-farmers with the same manner of "training and visit" method of extension system. As a matter of fact, it seems that PPL has not been able to meet the constraints of lack of facility and heavy field condition.

Prospective cassava products for the future

Various speculations, concerning the potential for cassava in the future, have been mode. Dixon (1982) concluded that, although consumption of gaplek is likely to decrease, the demand for fresh cassava in both rural and urban areas is still high. Gaplek flour might have use in bread and snack production if the initial quality of the dried cassava can be improved. Both Dixon and Lynam (1983) claim that the most potential market for Indonesia may be the domestic starch market. Expansion in starch utilization is highly possible, in particular if starch manufacturers are able to diversify and produce modified starches in addition to raw starch. In addition to the expansion of the domestic starch market, creation of a more intensive domestic animal food production system would provide another outlet for both cassava tubers and leaves.

Relatively new cassava products being proposed such as alcohol high fructose syrup (HFS) and single cell protein (SCP) have potential, but they must be viewed in relation to similar products produced from other commodities. For example, although production of high fructose syrup from cassava is technically feasible, it is at the present not valid economically, as production of HFS from molasses is much less expensive. Therefore, these new products must be evaluated from a socio-economic viewpoint prior to production initiation.

Potential for cassava utilization in Indonesia

The whole cassava plant, is economically valuable. In addition, various schemes have been devised for the utilization of all by-products of the cassava starch industry.

Starch itself is used primarily in the food industry (as a thickener, filler, binder or stabilizer). the pharmaceutical industry, paper and beard industry, textile industry and the building, metal and chemical industries. Modified starches are also used by the food industry and the textile industry (Booth, 1978)

Sweeteners, or such products as glucose syrup, fructose syrup and dextrose, are produced on hydrolysis of starch. These products have been produced from corn starch for many years and may also produced high fructose syrup from starch. This product has grown substantially in importance, particularly in the USA, since first being commercially produced in 1988.

In addition to sweetener, other products which are feasible to produce from fresh cassava any or cassava starch include alcohol and single cell proteins (SCP). Both are produced through starch hydrolysis and fermentation.

Present utilization of cassava on Indonesia

Cassava utilization in Indonesia differs throughout the country. On Java, where 62 percent of the population resides, cassava is consumed primarily as a human food. Rural inhabitants, the producers and major consumers of cassava, utilize approximately 62 percent of the fresh cassava and 45 percent of the dried cassava (gaplek) they produce for their family's needs. In addition to the fresh and dried cassava which may be utilized by the rural family a fairly large percentage of cassava produced on Java goes to starch for domestic consumption and to gaplek for export. In the Lampung province of South Sumatera, cassava is destined for industrial consumption for both starch and animal feed production. Lynam (1983) has compiled data from all parts of Indonesia on cassava consumption, that shows on a nation wide basis, utilization of cassava is quite diverse, especially when compared to other Asian nations.

A great diversity of techniques have developed for production of snacks and staple food from cassava. Some techniques are merely general methods of preparation which may be applied to any starchy food, while others would appear to have specific objectives such as HCN reduction or increased storability. In Indonesia, human food products are created from both fresh and dried cassava. Fresh cassava may be consumed raw, following cooking (boiling,stewing,frying,roasting, shaking, etc) in the form of whole tubers tuber pieces, chips or grated cassava, or following fermentation

A multitude of Products, namely "getuk", "lemet", "ciping", and "balung kuwuk" are commonly produced from fresh cassava in Java. Tapioca starch, which is a major product of fresh cassava is presently used by the food, pharmaceutical, textile, and paper industries in Indonesia. Modified starches are not produced in abundance and would be an area of potential expansion for the domestic market.

Dried cassava or gaplek is used as a food product, in addition to its primary use an animal feed .

"Tiwul" , "gatot" and other products produced from dried cassava are consumed primarily by the Javanese, both with the recent transmigration efforts, these products are being introduced to other parts of Indonesia. Utilization of gaplek flour for cakes or sweets or as a mixture with wheat and other flours for bread is minimal and could be increased. Practically all of the gaplek marketed is exported to the EEC. Although the quota for gaplek or pellet exports allowed to Indonesia is far from being filled, processors are discouraged by low prices received and by poor quality gaplek. It might be advantageous to re-direct part of the gaplek produced for use in domestic animal feed.

Cassava leaves are usually processed simply and consumed as a vegetable . It is possible to expand the used of leaves . In particulars leaves have tremendous potential as a source of protein (usually 4-8 percent dry weight) for animal feed. In addition, cassava stalks, which are currently used only as a planting material, may serve additional purposes as mixes with leaves as ruminant feed or particle board. Obviously cassava and its secondary products are underutilized in Indonesia.

CHAPTER IV

FINDINGS AND EMPERICAL RESULTS

The equations are estimated by using 19 observations from 1970-1988 of time series data. The independent variables are used in the double logarithmic linear form. They are log lagged area, log policy, log lagged prices of sweet potatoes, cassava, ground nut, mungbean, corn, rice, soybean, to estimate area response functions, national and provincial level They are shown in Table 10.

In estimating the yield functions use the independent variables are used as log lagged yield, log amount of rainfall, log policy, log lagged prices of fertilizer and cassava as shown in Table 11. They are used before eliminating up to suitable explanatory variables found for three provinces and at national level.

The estimation employ the Ordinary Least Squares method (OLS). The results are accompanied by the coefficient of determination standard eror of regression, Durbin Watson value (DW), T-value and F - statistic value.

Table 10 Cassava area estimated function with all exogenous variables and statistical values, 19 observations (1970-1988) in Indonesia.

Region	tech-niques	constant term	LAL	LPSPN	LPCSN	LPGNN	LPMBN	LPCNN	LPRN	LPSBN	LPOL	S.E of Regression	R^2	DW	F statistic
			Lagged one year coefficient of log of												
Indonesia	OLS	8.0646 (1.2222)	0.4461 (0.9584)	-0.0602 (-0.3738)	0.0309 (0.2631)	0.0085 (0.2791)	-0.0590 (-0.3124)	-0.0765 (-1.5261)	0.1603 (0.4813)	-0.0473 (-0.1980)	0.0000 (0.0481)	0.0481	0.7621	-1.5913	2.8472
East Java	OLS	5.8601 (1.7356)	0.5960 (2.3458)	0.0369 (0.3824)	0.0283 (0.2807)	-0.4072 (-1.3244)	-0.0333 (-0.1280)	-0.0954 (-0.5795)	0.4408 (1.4607)	0.0403 (0.1168)	0.0000 (-0.1880)	0.0750	0.8578	2.3085	5.3607 **
Central Java	OLS	8.8541 (1.1350)	0.3626 (0.6247)	-	0.0266 (0.2119)	-0.2174 (-0.8871)	-0.4104 (-1.4171)	-0.2065 (-0.9303)	0.2281 (0.3040)	-	0.0000 (0.2676)	0.0989	0.7769	2.0277	4.9751 **
West Java	OLS	9.1612 (1.1253)	0.2203 (3.6580)	-0.3375 (1.1627)	0.0598 (-3.0208)	0.0304 (1.2528)	0.2975 (1.7223)	-0.0792 (-0.7773)	-0.0118 (0.0881)	-0.0254 (-0.1170)	0.0000 (-0.6903)	0.0612	0.9338	2.5166	12.5462 **

Note : 1. The values in parenthesis are t-values.
2. ** indicates significant at 95 percent.
3. * indicates significant at 90 percent.
4. LAL is log of lagged area
5. LPSPN is log of lagged price of sweet potatoes
6. LPCSW is log of lagged price of cassava
7. LPGNN is log of lagged price of ground nut.
8. LPMBN is log of lagged price of mungbean
9. LPCNN is log of lagged price of corn
10. LPRNN is log of lagged price of rice
11. LPSBN is log of lagged price of soybean
12. LPOL is log of dummy values for government policy
13. R^2 is coefficient of determination
14. DW is Durbin Watson value critical point at 1.69 (k=3) or 1.53 (k=4).

Table 11 Cassava yield estimated functions with all exogenous variables and statistical values, 19 observations (1970-1988) in Indonesia

Region	Tech-niques	Constant Term	Lagged One Year of Coefficient of LYL	LPCSN	LPFL	LRF	LPOL	S.E of Regression	R^2	DW	F statistic
Indonesia	OLS	-0.1752 (-0.2901)	0.6117 (1.9399)	0.0446 (1.4408)	0.0543 (0.7387)	0.0887 (1.2522)	0.0000 (-0.2999)	0.0389	0.9487	2.0465	44.4041 **
East Java	OLS	1.4956 (2.9120)	0.0341 (0.1334)	0.0430 (0.8966)	0.1677 (2.3709)	-0.0272 (-0.5276)	0.0000 (1.6912)	0.0415	0.9561	2.1830	52.2082 **
Central Java	OLS	-7.2608 (-14.6391)	0.7679 (3.4639)	0.0342 (1.2448)	0.0395 (0.6235)	0.0801 (1.5982)	0.0000 (-0.1988)	0.0387	0.9574	1.7814	71.2731 **
West Java	OLS	0.7905 (2.9185)	0.3989 (3.1934)	-0.0265 (-1.8982)	0.1968 (5.6686)	-0.0175 (-0.5360)	0.0000 (-0.0517)	0.0277	0.9745	1.6056	91.7452 **

Note : 1. The values in parenthesis are t-values.
2. ** indicates significant at 95 percent.
3. * indicates significant at 90 percent.
4. LYL is log of lagged yield.
5. LPCSN is log of lagged price of cassava.
6. LPFL is log of lagged price of fertilizer.
7. LRF is log of amount of rainfall.
8. LPOL is log of dummy values for government policy
9. R^2 is coefficient of determination.
10. DW is Durbin Watson value, critical point at 1.69 (k=3) or 1.53 (k=4).

By using eliminating steps, from the first finding the unexpected sign which appear in each equation for both levels and later delete them one by one. If the sign will be alternating to log lagged price of the cassava, it is tried by the best omission by seeking the insignificant variable and trying to eliminate it. This is done to get the positive sign from the log lagged cassava price.

The statistical indicators are neccesary to gain the R square and F statistic as high as possible. The result is backed up by the Durbin Watson value and kept to be little bit higher than 1.69 (k=3) and 1.53 (k=4), where k indicates the number of variable that being used in the model.

The final equations of area and yield are presented on Table 12 and Table 13 . They are included only the suitable explanatory variables for each of the three provinces and national level.

The short run elasticities for each level can be predicted from the corresponding coefficient estimated. In the long run elasticities can be found by dividing the coefficient with the respective coefficient of adjustment.

Area response functions of cassava

The statistical finding of the area response function is shown in Table 12. Mostly the competing crops have 90-95 percent significant for the exogenous variables coefficient, except Indonesia.

In term of F statistic, they have a range equal to 8.5233-29.3379. It means that as a whole the exogenous variables significantly affect dependent variable.

Dropping out some variables which have the high R square among two or more independent variables are carried out to avoid multicollinearity. It can be seen from the covariance matrix of the independent variables.

From the Table 12 in national level, the area response functions depend on its lagged price, ground nut lagged price and its lagged area planted. In East Java area response depends on lagged price of groundnut its price and area lagged. In Central Java the area response depends on the lagged of mungbean price, its price and its area lagged. In West Java the area response depends on the lagged price of sweet potatoes, cassava and its area lagged.

The exogenous variables are in national level the equation around 65 percent of the variation can be explaned to enfluence the area planted of cassava by these exogenous variables. The variation from the province can be explaned the effects around 85 percent for the East Java, 90 percent for Central Java and 86 percent for West Java.

Standard eror of regression lies between 0.31-0.55 percent which are rather small.

The values of Durbin Watson statistic range between 1.9293-2.3084, Durbin Watson values show that the estimation results are free from the serial correlation problems. The critical upper level values of Durbin Watson statistic are 1.69 (k=3) and 1.53 (k=4).

The positive sign for coefficient lagged price of cassava is consistent with economic meaning. The area planted moves in the same direction as its price change. An increase or decrease in lagged price will also lead to increase or decrease of the area in the current year.

Appendix Table 4 Variables were used in the analysis of West Java, 1970-1988

YEAR	PCNN	PSPN	PCSN	PGNN	PRNN	PSBN	PMBN	RF	POL	A	Y
1970	30.15	6.75	55.50	58.80	24.09	56.90	56.90	1,910.00	0.00	266,093.00	7.60
1971	23.45	7.40	6.00	77.50	24.43	58.75	58.00	2,066.00	0.00	219,441.00	8.05
1972	31.45	8.15	8.60	97.40	29.54	68.95	57.00	1,967.00	0.00	212,967.00	8.07
1973	41.55	9.20	17.85	97.15	46.22	70.60	69.00	2,373.00	0.00	216,442.00	8.30
1974	42.85	11.20	19.70	206.75	45.03	146.35	146.60	2,274.00	0.00	248,484.00	9.81
1975	60.10	22.30	22.20	251.70	56.25	201.85	170.50	2,090.00	0.00	211,922.00	10.42
1976	76.30	28.90	24.70	269.50	71.10	189.15	231.35	2,043.00	0.00	199,399.00	10.60
1977	70.80	28.25	25.70	330.20	75.75	199.05	239.45	1,971.00	0.00	204,026.00	10.15
1978	70.50	26.10	23.00	327.85	66.45	198.55	230.00	2,574.00	0.00	196,077.00	10.15
1979	110.95	40.00	31.55	626.55	115.65	339.35	420.00	1,966.00	1.00	187,881.00	10.86
1980	80.00	52.65	36.90	605.00	120.60	344.13	359.43	2,090.00	1.00	180,812.00	10.92
1981	84.00	51.00	38.00	629.00	166.00	340.00	366.00	2,043.00	1.00	182,548.00	10.59
1982	129.00	69.00	50.00	709.00	194.00	334.00	435.00	937.00	1.00	179,043.00	10.97
1983	118.00	98.00	80.00	804.00	154.00	463.00	563.00	2,534.00	1.00	160,343.00	10.98
1984	180.00	82.00	57.00	913.00	161.00	499.00	640.00	1,984.00	1.00	192,354.00	10.83
1985	174.00	75.00	41.00	958.00	177.00	528.00	566.00	2,036.00	1.00	169,721.00	11.40
1986	218.00	108.00	65.00	1,127.00	212.00	607.00	693.00	2,663.00	1.00	151,297.00	12.12
1987	235.00	122.00	70.00	1,994.00	256.00	738.00	808.00	1,974.00	1.00	138,475.00	12.83
1988	326.00	186.00	136.00	1,660.00	326.00	926.00	1,093.00	1,122.00	1.00	91,837.00	13.00

Competitiveness of the crops are indicated by the negative sign of the coefficient. At the national level, the price of ground nut (pgnn) competes with the price of cassava. An increase in the lagged price of ground nut will reduce the area planted for cassava in the current year. The area planted of cassava moves in opposite direction as the prices of competing crops change.

As well as at national level the coefficients of competing crops in regional provinces, there are a negative correlation with area of cassava. There are : i) cassava area and lagged price of ground nut in East Java ii) cassava area and lagged price of sweet potatoes in West Java iii) cassava area and the lagged price of mungbean in Central Java.

The coefficient of adjustment is equal to one minus the coefficient of the lagged area planted of cassava. Thus the higher cofficient of adjustment of area will result lower the coefficient of area adjusted. The coefficient of adjustment is found to be in a range of 0.3082 to 0.7703.

In general, government policy does not have strong or special interest to the area response. It implies that the government carried out policy for rice or others crop rather than cassava. As mentioned by Bambang Guritno and SM Sitompul in ESCAP (1984) the increase in production had been achieved without any direct government program for cassava.

Estimated yield response functions

The yield response functions are estimated by using the OLS method. The estimated functions can be shown in Table 13.

The statistical finding of yield per unit area response functions indicate that the variation in the yield per unit area of cassava in Indonesia, East Java, Central Java and West Java can be explained by lagged prices of cassava, lagged yield and amount of rainfall in the current year around 96 percent for Indonesia, 93 percent for East Java, 97 percent for Central Java and 91 percent for West Java. These are indicated by the coefficient of determination (R^2), low values of the standard error of regression (lies between 1.35-2.19 percent) and high significant of the F-values range between 50.1149-132.1142 .

In other words all of these can show the significant effects the explanatory variables on yield response function of cassava.

Table 13 Estimated yield functions of cassava in Indonesia.

Region	Tech niques	constant term	Lagged one year of coefficient of			SE of Regression	R^2	DW	F statistic
			LYL	LPCSN	LRF				
Indonesia	OLS	-0.2421 (-0.5814)	0.5993 (4.4390)**	0.0666 (3.109)**	0.1218 (2.3570)**	0.0306	0.9630	1.7300	121.4771 **
East Java	OLS	0.6628 (1.5835)	0.3886 (1.6200)	0.1097 (2.372)**	0.0415 (0.0491)	0.0472	0.9338	2.4427	65.8277 **
Central Java	OLS	-0.3701 (-0.8277)	0.8511 (7.3580)**	0.0372 (1.4901)	1.6851 (1.6851)*	0.0367	0.9658	1.7974	132.1142 **
West Java	OLS	-0.6521 (-0.7204)	0.9092 (6.7962)**	0.0081 (0.3671)	0.1048 (0.7692)*	0.0468	0.9148	1.9326	50.1149 **

Note :
1. The values in parenthesis are t-values
2. ** indicates significant at 95 percent.
3. * indicates significant at 90 percent
4. LYL is log of lagged yield.
5. LPCSN is log of lagged price of cassava.
6. LRF is log of amount of rainfall.
7. R^2 is coefficient of determination.
8. DW is Durbin Watson value, critical point at 1.69 (k=3) or 1.53 (k=4).

The positive sign for the amount of rainfall is consistent with economic meaning. Moreover, cassava yield can be affected by dry season.

In the dry season cassava bacterial blight (CBB) can attack the cassava plant. It is caused by Xanthomonas campestris var manihotis. Another type is the wild disease, Pseudomonas solanocearum which can also reduce the yield by up to 90 percent. Hence it can be simple to imagine that the amount of rainfall can reduce the cassava bacterial disease problem and increase the yield.

There can be minor economic losses if cassava is cultivated in an intensive way. In fact, farmers generally apply little or no fertilizer and no pesticides at all.

The positive sign for the lagged price of cassava is also consistent with the economic reasoning. The yield will move in the same direction as its price change. An increase or decrease in lagged price of cassava will lead to increase or decrease in the yield in the current year.

The short run elasticities of area response

The elasticities for the area response of cassava can be shown in detail in Table 14. Table 14 shows that the short run (SR) area elasticities of cassava is estimated directly from the coefficient of its lagged price as presented in Table 12.

The elasticities of area planted with respect to lagged price of cassava for indonesia level is 0.0344. It implies that when the price of cassava increase by one percent, the area will respond to the increase by 0.0344 percent.

The elasticities are lesser than one, meaning it is inelastic, or the farmers are not responsive to the price change in the short run. It can be intepreted that the area is relatively fixed in the short run.

At the provincial level East Java has higher area response elasticity than the other two provinces. It is equal to 0.1107. This is followed by Central Java (0.1082) and West Java (0.0474) .

Table 14 Area elasticities of cassava in Indonesia

Region	Coefficient of adjustment	Area Elasticity With Respect to Lagged Price of			
		Cassava (SR)	Cassava (LR)	Competing Crop (SR)	Competing Crop (LR)
Indonesia	0.7536	0.0344	0.0456	0.0779	0.1060
East Java	0.3082	0.1107	0.3592	0.0122	0.0397
Central Java	0.5976	0.1082	0.1811	0.1778	0.2975
West Java	0.7703	0.0474	0.0615	0.1347	0.1748

*)derived from Table 12

SR = Short run
LR = Long run

The lower response of area elasticities might be due to the that farmers in West Java and Central Java still prefer to grow the other alternative crops such as sweet potatoes and mungbean better than cassava or they are still rice oriented.

The farmers who have risk averse characteristic will not grow the cassava. They will consider other crops in this case the mungbean price might be more profitable. These are indicated by the area elasticity with respect to the competing crop. The higher elasticity leads to be risk averse to grow cassava. Thus, the risk averse farmers are greater number in Central Java (0.1778), followed by West Java (0.1347) and East Java (0.0122).

The long run elasticities of area response

In the long run farmers are easily to adjust their resources rather than in the short run, or the elasticity in the long run will be more elastic than the short run. The farmers are more responsive to the price change in the long run rather than in short run.

The long run elasticies of area response are calculated from the the short run elasticity divided by the coefficient of adjustment. The interpretation of the long run elasticities of the selected exogenous variables looks similar with the short run elasticities.

All values in the long run have been calculated greater than the values in the short run. They are 0.0456 (Indonesia), 0.359 (East Java), 0.1811 (Central Java) and 0.0615 (West Java). An increase one percent in price of cassava will cause an increase the area planted for cassava by 0.0456 percent in Indonesia.

In the East Java has higher long run elasticity than the two other provinces. This indicates that the farmer in East Java are responsive to the price change compared to other two provinces.

Concerning about the competing crops, in the long run Central Java has the highest elasticity. The meaning is the farmers tend to be risk averse farmers or when the previous year's price of cassava dropped the area planted of cassava in the current year would be reduced.

In detailed, the long run elasticities regional are 0.1060 (Indonesia), 0.0397 (East Java), 0.2975 (Central Java) and 0.1749 (West Java).

<u>The short run yield elasticities</u>

Table 15 presents the detailed features of the short run and long run elasticities which are consisted of national and regional levels.

The short run yield elasticities with respect to the lagged price of cassava are equal to 0.0666(Indonesia), 0.1097 (East Java), 0.0372 (Central Java) and 0.0081 (West Java).

The findings indicate the short run yield elasticities of cassava what has been found to be less than one. It implies that the short run yield elasticities are inelastic. In other word it can be said that the yield per unit area will change lesser than the price change.

Fluctuation in price is greater in West Java, if it is compared with among two others provinces and Indonesia level. The least fluctuation in price is found only in East Java (0.1097). The fluctuation in price might be due to weather, seasons, inadequate infrastructures, storage facilities and lack of price informations .

It can be said that farmers in East Java are more responsive to the price changes than Central Java and West Java.

Table 15 Yield elasticity of cassava in Indonesia

Region	Coefficient of Adjustment	Yield Elasticity With Respect to Lagged Price of Cassava (SR)	Cassava (LR)
Indonesia	0.4007	0.0666	0.1662
East Java	0.6114	0.1097	0.1794
Central Java	0.1490	0.0372	0.2497
West Java	0.0908	0.0081	0.0089

*)derived from Table 13

SR=Short run
LR=Long run

There is an adjustment proccess between the actual yield and the desired yield . The adjusment can be seen from the coefficient of adjusment. The highest coefficient of adjusment is in East Java (0.6114) and followed by Indonesia (0.4007), Central Java (0.149) and West Java (0.0081). The coefficients are consistent with the economic meaning and ranged zero to one. The high value of coefficient of adjustment implies that the farmer rather difficult to adjust the yield. For example the farmers in East Java do not adjust the desired yield as easily as the farmers in the Central Java.

The long run yield elasticities of cassava

The long run yield elasticities are found by dividing the short run yield elasticities with the coefficients of adjustment. The elasticities are more elastic if compared with the short run yield elasticities and ranged between 0.0089-0.2497. The Central Java has 0.2497 the highest yield long run yield elasticity and followed by East Java (0.1794), Indonesia (0.1662) and West Java (0.0089).

Even in the short run East Java farmers show more responsive to the price changes but it is rather difficult for them to adjust the yield in the long run like the Central Java farmers`.

Estimated output elasticities

The cassava output elasticities are calculated indirectly from estimated elasticities of area and yield. The detail result is presented on Table 16.

In the short run the estimated output elasticities have a range of between 0.0555-0.2204. The highest output elasticity is in East Java equal to 0.2204 and followed respectively by Indonesia (0.1010), Central Java (0.1454) and West Java (0.0555).

In the long run output elasticities are more elastic than the short run. The elasticity is ranged between 0.0704 - 0.5386. The greatest is East Java (0.5386) and followed by Central Java (0.4308), Indonesia (0.2118) and West Java (0.0704)..

Both in short run and long run output elasticities are less than one, the meanings are inelastic. It means the supply of cassava at the national.

Table 16 Output elasticities of cassava in Indonesia

Region	Output Elasticity With Respect to Lagged Price of Cassava (SR)	Cassava (LR)
Indonesia	0.1010	0.2118
East Java	0.2204	0.5386
Central Java	0.1454	0.4308
West Java	0.0555	0.0704

*)derived from Table 14 and 15

SR=Short run
LR=Long run

level or at the provincials level are not responsive to the price changes in the short run and long run.

Supply projection

The supply projection of cassava is calculated from the area and yield function. By using the constant growth rate of the selected suitable explanatory variables has been tried to estimate the area and yield projection. Estimated explanatory variables are substituted into the area and yield functions.

The assumption that has been employed to assume the rainfall is fixed, based on year 1988.

Presentation of the projected cassava supply is shown in Table 17. The projected area for the national level and provincial level tend to decrease over time . On the other hand the projected yield increase , but change in yield is greater than change in area. So it is clear if the production increase over time even the area slightly decreases.

According to the Agriculture Research Agency keeping the production as high as possible could still increase the yield up to 25-30 ton per ha.

Table 17 Supply Projection of Cassava in Indonesia (1989-1993).

National or Regional	Year	Area (Ha)	Yield (Tons/Ha)	Production (Tons)
Indonesia				
	1989	1,250,135	12.13	15,161,390
	1990	1,240,255	12.46	15,448,744
	1991	1,230,453	12.79	15,741,806
	1992	1,220,729	13.14	16,040,503
	1993	1,211,082	13.50	16,344,878
East Java				
	1989	324,099	11.34	3,675,731
	1990	317,507	11.68	3,708,327
	1991	311,050	12.03	3,741,095
	1992	304,724	12.39	3,774,134
	1993	298,527	12.75	3,807,476
Central Java				
	1989	264,111	12.60	3,327,299
	1990	259,730	13.04	3,385,628
	1991	255,435	13.49	3,445,155
	1992	251,204	13.96	3,505,659
	1993	247,044	14.44	3,567,216
West Java				
	1989	153,460	12.51	1,920,343
	1990	149,647	12.88	1,928,173
	1991	145,986	13.27	1,936,807
	1992	142,443	13.66	1,945,863
	1993	138,973	14.07	1,954,762

Table 18 Supply projection from the other study and comparation with the actual production and this study in 1989.

Region	Actual 1/ Production (Tons)	The study Projection (Tons)	Percentage	The MOA2/ Projection (Tons)	Percentage
E. Java	3,988,830	3,675,731	92.15	-	-
C. Java	3,530,154	3,327,299	94.25	-	-
W. Java	2,203,240	1,920,342	87.16	-	-
Indonesia	17,117,249	15,161,389	88.57	15,011,000	87.69

Sources : 1/ Directorate General of Food Crops, 1990
2/ Agency for Agriculture Research Development (AARD), 1987

The highest yield reached by Central Java is only 14.4396 tons/ha. This is still lower than the result research above.

Due to the actual production as shown in Table 18, the estimated production gave better result than the previous study which conducted by Ministry of Agriculture to project production in 1989. This study pointed out at 17,117,249 tons (88.57 percent) of the production in 1989 while another study at 15,011,000 tons (87.65 percent). For provincial level no specific study can be compared, in general this study showed the estimated production between 87.16-94.25 percent of the total actual production in 1989.

CHAPTER V

CONCLUSION AND RECOMMENDATION

Cassava as a food stuff plays a role in the Indonesian economy. It is produced mostly in Java and Madura and accounts for 77 percent of the total production. A Government policy for cassava development is needed to emphasize and specific information is required for planning in order to reach cassava self sufficiency in the future.

The objectives of the study were a) to identify the factors affecting the supply response function b) to determine long run and short run elasticities c) to forecast cassava production from 1989-1993.

The basic components for predicting the cassava output are planted area and yield. There are two kinds of factor affected area and yield. They are price and non price factors.

The price factors are cassava lagged price, and competing crops lagged prices. The non price factors are its lagged area and yield, government policy and weather as represented by rainfall.

The quantity of cassava production depends on its price, competing crop price, rainfall and output in the previous year. The planted area positively correlated to its price and previous planted area but negatively correlated to competing price in the previous year.

The yield of cassava depends on its previous price, amount of the rainfall and its previous yield. Yield has a positive correlation among those variables.

The area elasticities of Indonesia, East Java, Central Java and West Java with respect to lagged price of cassava in the short run are 0.0344,0.1107, 0.1082 and 0.0474 respectively.

In the long run area elasticities of cassava in Indonesia are more elastic equal to 0.0456, 0.3592, 0.1811 and 0.0615 respectively.

The yield elasticities of Indonesia , East Java, Central Java and West Java with respect to lagged price of cassava in the short run are 0.0666 , 0.1097, 0.0372 and 0.0081 respectively.

In the long run yield elasticities of cassava in Indonesia, East Java, Central Java and West Java are more elastic equal to 0.1662, 0.1794, 0.2497 and 0.0089 respectively.

Concerning the estimated area function for national level, around 64.62 percent of the variation is explained by the explanatory variables consisting of lagged price of cassava lagged price of ground nut and lagged of its planted area. For East Java province, around 85.07 percent of variation is explained by the lagged price of cassava, the lagged price of cassava, the lagged price of ground nut and its last year planted area.

In Central Java, around 90.31 percent of variation is explained by the lagged price of cassava, the lagged price of mungbean and its last year planted area.

In West Java, around 86.28 percent of variation is explained by the lagged price of cassava the lagged price of sweet potatoes and its last year planted area.

Concerning the estimated yield function for Indonesia and the provincial level, about 91.48-96.58 percent of the variation can be explained by amount of rainfall, previous year cassava price and its last year yield.

The responsiveness to rainfall indicate the technology used by the farmers. The farmers in Central Java depend on the rainfall rather than the other places. The responsiveness ranges of 0.0415-1.6851.

The planted area of cassava trends to decrease overtime in national and provincial level. The yield likely increase greater than the planted area decrease and the production trends to increase.

Policy and recomendation

1. Concerning the cassava price, it was found to be significant in the determination of cassava area and yield. Anyway, the cassava price seems to fluctuate year to year. The way to handle this problem should be to reduce the fluctuation of the cassava price by more emphasizing the government regulations such as floor price and ceiling price. This thing can guarrantee the production and income for the farmers . In order to be effective the regulations should be combined with good marketing system.

2. Concerning the price of fertilizer, the price is not the farmer interest. It can be imagined that only

some farmers apply fertilizer for cassava production. The promotion can be conducted effectively by extension worker in every region.

3. Concerning the decreasing in planted area of cassava in Java and Indonesia as a whole, extensification is needed in order to eliminate this problem. Even up to now production tend to increase . The program can be possibly carried out in outer Java island. The program can be joined with the transmigration program simultaneously.

4. Limitation of import is required to stimulate farmers to grow cassava. By doing this, they will have better price and their production will be save.

5. From the projection could be suggested that area of production will be better to be located outside of Java.

6. It is required to improve the marketing information system in area production to stimulate the response in the long run specifically for West Java and Central Java.

7. Regulating the production along the year is needed to reduce the risk of production by forming estate farmers.

8. In order to have an increase in yield the high yielding varieties that had been realesed and other inputs used should have a strong recommendation to the farmers.

REFERENCES

AARD. 1987. Five Years of Agricultural Research 1981-1986 : Its Contribution to Agricultural Development in Indonesia. Jakarta : Agency for Agricultural Research and Development, MOA.

Allen, R. G. D. 1972. Mathematical Analysis for Economists. London : The Mac Millan Ltd.

Altemeier, K. S.R.Tabor and B. Adinugroho. 1988."Supply Parameter for Indonesian Agricultural Policy Analysis." Ekonomi dan Keuangan Indonesia. 36 (May 1988) : 111-121.

Berhman, J. R. 1968. Supply Response in Underdeveloped Agriculture : A Case Study of Four Major Annual Crops in Thailand 1937-1963. Amsterdam : North Holland Publishing Co.

Booth, R. H. and D. W. Wholey. 1978. " Cassava Processing in Southeast Asia".pp 7-11. Cassava Harvesting and Processing. Proceedings of a Workshop held at CIAT, Cali, Colombia, 24-28 April 1978 : IDRC-114c.

Dixon, J.A. 1982. Food consumption patterns and related demand parameters in Indonesia : a review of available evidence. Working Paper No. 6. Washington, D.C. : International Food Policy Research Institute, International Fertilizer development Center and the International Rice Research Institute.

ESCAP CGRGT. 1984." Cassava in Asia Its Potential and Research Development Needs". Proceeding of Regional Workshop. Bangkok.

FAO. 1987. Supply Response in Pakistan Agriculture a System Approach. Rome.

Gazali, F. 1990. An Analysis of Supply Response of Soybean in Indonesia. Bangkok : Unpublished Master's Thesis, Kasetsart University.

Houck, J. P. and M. Eryan. 1972." Supply Analysis for Corn in the United States : The Impact of Changing Government Programs". American Journal Agriculture Economics. 54 (August 1972) : 184-191.

Lynam, J. 1983. "Cassava in Asia". pp 66-146.Trends in CIAT Commodities. Internal Document Economics. Colombia : CIAT.

Ministry of Agriculture. 1987. Investment Requirement for Food Crops Areal Extention in Fifth Year Development Plan. Jakarta : Indeco.

Ministry of Agriculture. 1987. Round Table Indonesia Agriculture Development for Pelita V. Bureau of Planning. Jakarta: MOA-USAID.

________________________. 1988a Price and Quality of Food Crops Agriculture in Indonesia. Jakarta : MOA-DGF.

________________________. 1988b Supply and Demand for Food Crops in Indonesia. Jakarta : MOA-DGF.

________________________. 1989a Marketing of Secondary Crops in East Java. Jakarta : MOA-DGF.

________________________. 1989b Production Estimated for Food Crops and Estates Crops Commodities. Jakarta : MOA-DGF.

________________________. 1989c Vademecum of Cassava Development. Jakarta : MOA-DGF.

Mubyarto and L.B. Fletcher. 1975. The Marketable Surplus of Rice in Indonesia, A Study in Java Madura. Reprinted in Microeconomics and Economics Theory and Practice in the Asian Setting. New Delhi, India : WEL.

Nerlove, M. 1956. "Estimates of The Elasticities of Supply of Selected Agricultural Commodities". Journal of Farm Economics.38 (Oct 1956) : 496-509.

Nerlove, M. 1958. The Dynamic of Supply.Baltimore : John Hopkins Press.

________________. 1979. "The Dynamic of Supply : Retrospect and Prospect". American Journal of Agricultural Economics. 61 (May 1979) : 874-888.

Prabowo,D. 1989. Production and Supply of Agriculture Commodities. Un Published (Draft), Jakarta : MOA.

Roche, F. C. 1984. Cassava production in Java : The Cassava Economy of Java. California, USA : Stanford University Press.

Rumahorbo, M. 1988. An Analysis of Supply Response of Rice . Bangkok : Unpublished Master's Thesis, Kasetsart University.

Sanderson, B. A., J. J. Quilkey and J. W. Freebairn. 1980. Supply Response of Australian Wheat Growers. Bundoora : La Trobe University.

Tomek, W.G. 1972. "Distributed Lagged Model of Cotton Acreage Response a Further Result". American Journal of Agricultural Economics. 54 (July 1972) : 237-245.

TTTA. 1988. Tapioca The Answer to Lower Feed Cost. Bangkok : Thai Tapioca Trade Association (TTTA).

TTTA. 1989. Eurasian (Bangkok) Corporation. Bangkok : Thai Tapioca Trade Association.

Vesdapunt, K. 1984. Thailand Rice Policy Model : A Simulation Analysis. Diliman : PhD. Disertation, University of the Phillipines.

Yotopoulus, P. A and J. B. Nugent. 1976. Economics of Development Emperical Investigations. New York : Harper and Row co.

APPENDICES

Appendix Table 1 Variables were used in the analysis of national level, 1970-1988

YEAR	PCKN	PSPN	PCSN	PGNN	PRNN	PSBK	PMBN	PF	POL	A	T
1970	19.55	7.00	15.70	28.55	14.40	32.00	41.00	1,950.00	0.00	1,398,070.00	7.49
1971	19.55	7.55	16.00	29.30	14.87	32.25	41.40	2,384.00	0.00	1,406,093.00	7.60
1972	17.40	9.80	15.30	50.98	18.67	43.25	55.15	1,593.00	0.00	1,468,412.00	7.07
1973	35.90	14.60	15.75	78.85	29.43	66.85	72.40	1,693.00	0.00	1,428,813.00	7.81
1974	23.70	22.52	21.65	136.65	36.41	93.13	79.75	1,699.00	0.00	1,599,440.00	8.63
1975	41.45	20.16	28.80	147.65	36.25	90.00	131.10	2,422.00	0.00	1,410,025.00	8.90
1976	68.47	27.78	18.93	190.60	55.48	107.25	131.35	1,429.00	0.00	1,353,328.00	9.01
1977	61.13	35.01	24.45	231.43	69.35	139.99	190.90	1,457.00	0.00	1,363,350.00	9.18
1978	55.58	34.42	27.23	288.73	74.08	142.80	196.65	1,752.00	0.00	1,382,902.00	9.33
1979	51.83	33.35	24.45	292.47	74.59	159.99	191.15	1,795.00	1.00	1,439,315.00	9.55
1980	77.02	45.00	25.27	403.28	107.59	177.20	299.15	1,912.00	1.00	1,412,481.00	9.72
1981	92.51	59.78	36.58	494.18	129.27	264.72	320.38	1,982.00	1.00	1,387,536.00	9.59
1982	107.58	64.24	48.25	695.17	136.73	308.95	343.00	1,945.00	1.00	1,323,709.00	9.81
1983	192.55	70.46	73.42	722.88	154.89	335.98	446.00	1,404.00	1.00	1,220,608.00	9.91
1984	157.42	90.88	87.33	743.92	177.51	374.25	457.00	1,773.00	1.00	1,350,448.00	10.49
1985	165.08	83.88	77.33	919.50	190.57	435.83	506.00	1,897.00	1.00	1,292,845.00	10.87
1986	167.75	112.30	74.75	987.08	215.53	467.50	545.00	1,745.00	1.00	1,169,866.00	11.38
1987	173.42	90.53	82.33	1,068.50	264.28	580.08	664.00	1,742.00	1.00	1,222,151.00	11.75
1988	223.42	71.15	106.33	1,176.50	323.93	597.00	752.00	1,917.00	1.00	1,302,581.00	11.90

Appendix Tabel 2 Variables were used in the the analysis of East Java, 1970-1988

YEAR	PCNN	PSPN	PCBN	PGNN	PRNN	PSBN	PMBN	BP	POL	A	Y
1970	16.20	4.75	5.00	66.80	15.66	36.25	38.25	1,972.00	0.00	453,852.00	6.96
1971	19.00	3.65	5.40	88.90	18.26	45.96	46.35	1,952.00	0.00	455,568.00	7.32
1972	27.55	8.05	5.60	101.15	22.64	55.25	51.90	1,070.30	0.00	501,932.00	6.80
1973	29.30	11.20	8.30	143.65	35.75	93.70	96.75	1,729.00	0.00	420,529.00	7.40
1974	43.95	11.65	10.40	207.05	37.85	116.70	116.25	2,300.00	0.00	495,283.00	7.87
1975	59.15	15.05	16.65	224.60	55.10	163.50	172.05	1,650.00	0.00	456,236.00	8.63
1976	72.25	21.70	23.45	267.60	66.55	149.55	192.75	1,500.00	0.00	434,136.00	8.67
1977	56.65	22.20	18.75	318.15	68.35	169.20	180.95	1,227.00	0.00	416,888.00	8.64
1978	54.60	21.15	19.40	331.75	69.10	173.00	318.56	2,201.00	0.00	431,487.00	9.11
1979	97.75	28.25	27.65	493.85	96.96	259.25	363.62	1,765.00	1.00	445,251.00	9.25
1980	89.90	40.75	35.95	626.00	109.40	311.00	372.00	1,569.00	1.00	437,597.00	9.58
1981	96.00	37.00	40.00	658.50	118.00	395.00	374.00	1,705.00	1.00	423,486.00	9.54
1982	124.00	39.00	41.00	661.00	132.00	355.00	517.00	713.00	1.00	380,599.00	10.61
1983	130.00	82.00	62.00	725.00	137.00	457.00	522.00	1,637.00	1.00	363,234.00	9.76
1984	127.00	61.00	51.00	856.00	154.00	489.00	401.00	1,711.00	1.00	358,426.00	10.36
1985	139.00	49.00	40.00	906.00	144.00	495.00	606.00	1,483.00	1.00	337,619.00	11.12
1986	137.00	75.00	69.00	1,035.00	164.00	586.00	727.00	1,680.00	1.00	312,201.00	11.30
1987	175.00	80.00	78.00	1,234.00	185.00	680.00	858.00	1,773.00	1.00	300,936.00	11.91
1988	197.00	119.00	104.00	1,680.00	197.00	690.00	932.00	1,511.00	1.00	155,416.00	13.50

Appendix Table 3 Variables were used in the analysis of Central Java, 1970-1988

YEAR	PCNS	PSPN	PCSN	PGNK	PRNN	PMBN	RF	POL	A	Y
1970	19.20	6.20	6.25	73.00	21.26	61.80	2,656.00	0.00	347,802.00	6.91
1971	26.45	9.25	9.35	88.05	26.52	84.65	2,210.00	0.00	357,518.00	6.39
1972	33.60	16.25	15.95	141.70	40.43	131.95	2,077.00	0.00	357,953.00	6.77
1973	35.05	9.30	9.60	220.00	41.28	109.50	3,353.00	0.00	359,758.00	7.60
1974	56.10	15.05	14.35	212.45	56.18	174.40	3,094.00	0.00	345,990.00	8.26
1975	71.10	24.05	24.00	279.35	72.55	204.45	2,019.00	0.00	326,450.00	8.25
1976	55.55	22.95	22.90	289.05	75.65	217.20	2,750.00	0.00	301,764.00	8.60
1977	56.25	20.05	17.90	329.85	71.60	187.20	2,987.00	0.00	310,071.00	9.34
1978	93.25	25.50	23.50	442.15	104.45	323.55	3,887.00	0.00	313,188.00	9.40
1979	92.30	37.55	33.95	606.52	115.60	396.65	2,565.00	1.00	318,701.00	9.83
1980	89.00	39.00	31.00	664.00	125.00	381.00	2,322.00	1.00	324,768.00	9.75
1981	118.00	49.00	51.00	653.00	136.00	425.00	2,960.00	1.00	311,957.00	9.64
1982	117.00	87.00	61.00	763.00	142.00	501.00	1,980.00	1.00	291,773.00	9.69
1983	132.00	81.00	42.00	903.00	163.00	533.00	1,938.00	1.00	276,890.00	10.01
1984	124.00	91.00	30.00	952.00	139.00	533.00	2,001.00	1.00	299,813.00	10.45
1985	135.00	87.00	78.00	1,198.00	161.00	655.00	2,412.00	1.00	266,487.00	11.30
1986	229.00	117.00	88.00	1,290.00	194.00	843.00	2,220.00	1.00	256,174.00	11.98
1987	250.00	137.00	106.00	1,480.00	213.00	879.00	1,642.00	1.00	265,290.00	12.08
1988	218.00	139.00	106.00	1,284.00	265.00	865.00	1,824.00	1.00	182,551.00	12.60

Appendix Table 4 Variables were used in the analysis of West Java, 1970-1988

YEAR	PCNN	PSPN	PCSN	PGNN	PRNN	PSBN	PNBN	RF	POL	A	Y
1970	20.15	6.75	55.50	58.80	24.09	56.50	56.93	1,810.00	0.00	266,093.00	7.60
1971	23.45	7.40	6.00	77.50	24.43	58.75	58.00	2,066.00	0.00	219,441.00	8.05
1972	31.45	8.15	6.60	97.40	29.54	58.55	57.00	1,967.00	0.00	212,967.00	8.07
1973	41.55	9.20	17.85	97.15	46.22	70.60	69.00	2,373.00	0.00	216,442.00	8.30
1974	42.05	11.20	10.70	206.75	45.03	166.35	144.60	2,274.00	0.00	248,484.00	9.81
1975	60.10	22.30	22.20	251.70	56.25	201.85	170.50	2,090.00	0.00	211,922.00	10.42
1976	76.20	28.90	24.70	269.50	71.10	189.15	231.35	2,043.00	0.00	199,399.00	10.60
1977	70.80	28.25	25.70	330.20	75.75	190.05	239.45	1,971.00	0.00	204,026.00	10.15
1978	70.50	26.10	23.00	327.85	66.45	198.55	230.00	2,574.00	0.00	196,077.00	10.15
1979	110.85	40.00	31.55	626.55	115.65	335.35	420.00	1,966.00	1.00	187,881.00	10.66
1980	80.00	52.85	36.90	605.00	120.60	344.13	359.43	2,090.00	1.00	180,812.00	10.92
1981	84.00	51.00	38.00	629.00	166.00	340.00	366.00	2,043.00	1.00	182,548.00	10.59
1982	129.00	69.00	50.00	709.00	194.00	334.00	435.00	937.00	1.00	179,043.00	10.97
1983	118.00	98.00	88.00	804.00	154.00	483.00	563.00	2,534.00	1.00	160,343.00	10.90
1984	180.00	82.00	57.00	913.00	161.00	499.00	640.00	1,984.00	1.00	192,364.00	10.83
1985	174.00	75.00	41.00	958.00	177.00	528.00	566.00	2,036.00	1.00	169,721.00	11.40
1986	218.00	108.00	65.00	1,127.00	212.00	607.00	693.00	2,663.00	1.00	151,297.00	12.12
1987	235.00	122.00	70.00	1,994.00	256.00	738.00	808.00	1,974.00	1.00	138,475.00	12.83
1988	326.00	186.00	136.00	1,660.00	326.00	926.00	1,093.00	1,122.00	1.00	91,837.00	13.00