AGRICULTURAL HOUSEHOLD INCOME AND EMPLOYMENT*
A preliminary analysis for Rural Java

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I. Introduction

The Problem

The economy of Indonesia has expanded rapidly over the past two decades. Macro level data indicate an improvement in the standard of living (GNP per capita) and a reduction in the number persons below the poverty line. However, there is very little information at the household level on the impacts of development on income and employment level hence these is only a limited basis for evaluating the overall success the government development program. Without an understanding of the effect at the micro level there is also the danger that future program may not be soundly based.

Rural households in Java, like those in many other developing countries, earn their incomes from many activities (agriculture, farm labour, and non-agriculture). In agriculture they produce multi-crops (food crops and cash crops), fish and livestock during a year. Part of their agricultural production, especially food crops (rice and palawija as secondary crops), is consumed by the family and part is sold to the market.

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This is also true of household labour which is used on their farms but is often also engaged in a wide range of other activities. Households part of their labour requirement is bought from the labour market while part is provided by the family. The households face complex decissions concerning production, allocation of family labour and consumption. However, most studies concerning agricultural households in Indonesia, have assumed that households behave either as pure consumers or pure producers[3] as postulated by neoclassical economics. For example, on the production side, see among others: Kasryno (1985), Hutabarat (1986); Simatupang (1986); and on the consumption side, see among others: Suryana and Rachman (1986), Sudaryanto (1990).

The usual analyses, do not provide a sufficient framework to understand the complexity of rural household behaviour in Java where the household is both a producer and consumer in several markets.

The intention of this paper is to intergrate both the production and consumption units of rural households into a theoretical framework as developed by Lau, Lin and Yotopoulos (1978), and Barnum and Squire(1979). The main purpose of this paper is to evaluate the effects alternative pricing policies for inputs and outputs on different household types. The analysis examines: (i) household income, (ii) household labour supply, (iii)

3 Pure consumers mean that they purchase almost all commodities from the market, while pure producers mean that they buy all inputs and sell almost all output to the market.

household agricultural demand and marketable surplus of agricultural product.

Study Area and The Data

The Cimanuk River Basin (CRB) is one of the largest river basins in Java, and the largest river basin in West Java. Like other river basins in Indonesia, the area is heterogeneous, not only in terms of bio-physical conditions such as elevation, temperature, rainfall, soil type but also in terms socio-economic factors.

In 1976, the province of West Java consisted of 3,910 villages of wich twenty percent were in the CRB. The CRB includes five districs (Garut, Sumedang, Majalengka, Cirebon and Indramayu). The data used in this analysis come from 313 rural households spread across six villages in each of the five districts of West Java. In this paper only 169 owner-operators and tenant farmers are analyzed. Share-croppers are excluded in the analysis.

The data which were collected in 1984, includes information on agricultural production: food crops, non-food crops, livestock and fishpond; labour used both in agricultural and non-agricultural activities; non-agricultural income; household consumption of both its own production and market goods; and land-tenure. The study is a preliminary analysis and concentrates on one crop, rice, (as the important food crop in many parts of rural Java), and one crop-season (the dry season, 1983).

Household Production Theory

The rural household is assumed to maximise the value of its utility function (equation 1) subject to three constraints namely: production (equation 2), time (equation 3) and income (equation 4).

The household utility function is:

$$U = U(R,C,M;a_i) \qquad \ldots 1$$

Subject to three constraints are:

$$Q = Q(L,F;A,K) \qquad \ldots 2$$

$$D = R + F_1 \qquad \ldots 3$$

$$qM = p(Q-C) - w_1(L-F_1) - w_f F + O \qquad \ldots 4$$

where:

C,M = commodities consumed by members of the family: own/agricultural product (C) and purchased commodity(M).
R = leisure (time consumed by household members) or non working time.
Q = agricultural output produced by the household
L,F = variable inputs: labour(L) and fertilizer(F) used in production.
K,A = fixed inputs: capital(K) and area of land cultivated(A)

p = price of agricultural output
q = price of market commodity
w = price of labour (wages)
w_f = price of fertilizer

D = total time available for household
F_1 = family labour work on their farm
O = other income received by the household such as remittances, rent etc.
a_i = household characteristics such as family workers(a_1), dependent(a_2) and age of head of household (a_3)

The three constraints can be reduced to one constraint by substituting equation 2 and 3 into equations 4. Then the Lagrangian (G) function becomes:

$$G = U(R,C,M;a_i) + \Gamma(pQ(L,F;A,K) - pC - w_1 L + w_1(D-R) - w_f F + O - qM) \qquad \ldots 5$$

Differentiating equation 5 with respect to R, M, C, L and F and setting each of them equal to zero yields six equations with six unknown variables:

$$\delta U/\delta R \ -\Gamma w_1 \ =0 \qquad \text{...6}$$

$$\delta U/\delta C \ -\Gamma p \ =0 \qquad \text{...7}$$

$$\delta U/\delta M \ -\Gamma q \ =0 \qquad \text{...8}$$

$$p\delta Q/\delta L - w_1=0 \qquad \text{...9}$$

$$p\delta Q/\delta F - w_f=0 \qquad \text{...10}$$

$$pQ(L,F;A,K) \ -pC \ -w_1L+w_1(D-R)-w_fF+O-qM =0 \qquad \text{...11}$$

If it is assumed that second order conditions for maximisation hold for equation 5, then equations 6, 7 and 8 are the standard forms of the demand equations for each commodity. Equations 9 and 10 are the standard forms of input demand functions under profit maximizing conditions. Equation 6, 7 and 8, give:

$$U_r/U_m=w/q \qquad \text{...12}$$

$$U_c/U_m=p/q \qquad \text{...13}$$

Where $U_i=\delta U/\delta i$ (for i=R,C and M)

Rearranging equation 11 gives

$$pQ(L,F;A,K)-wL-w_fF+wD+O = E = qM+pC+wR \qquad \text{...14}$$

where E = expenditure

The left hand side of equation 14 can be written as

$$E= \Pi +wD+O \qquad \text{...15}$$

where: $\Pi = pQ(L,F;A,K)- wL- w_fF$

The right hand side of equation 15 is "full income" as introduced by Becker (1965). Full income consists of profit (Π), imputed value of household stock of time (wD), and other income (O). The right-hand side of equation 14 is total expenditure (E) for three commodities including leisure time (R). The variable E is not constant as assumed in the standard demand theory. This variable becomes a function of profit and total time available for household (D) or as a function of output price, price of inputs, output level and time. These may be formulated as:

$$E=E(\Pi,D), \quad \text{or} \quad E=E(Q,p,w,w_f,D) \quad ...16$$

The household demand function for each commodity is

$$i=i(w,p,q,E) \quad \text{for } i=R,C \text{ and } M \quad ...17$$

where E is allowed to vary.

From the equilibrium position of households, (both in consumption and production sides), changes in household behaviour can be predicted in response to changes in the economic environment or economic variables, using comparative static analysis. The important feature of the household production theory is changes in exogenous variables such as output prices or technology, which can influence the production and consumption side in different ways (Barnum and Squire, 1979). Consumption behaviour is not independent of production behaviour. Changes either in input-output prices or production (technology) will influence the profit which then alters the consumption behaviour. By contrast, changes in commodity preferences and income do not affect household production decisions.

II. Profit Function Model

In this study, Cobb-Douglas and Translog profit functions are estimated. However, only the results for the best model, as supported by econometric estimates from the data set is presented.

The Cobb Douglas Case

The normalized C-D profit function with m variable inputs and n fixed inputs may be written in log form as

$$\ln \Pi^* = \ln \alpha_0 + \Sigma\, \alpha_i \ln w^*_i + \Sigma\, \beta_k \ln K_k \quad \ldots 18$$

for i=1,2...n and k=1,2...,m

where: $\Pi^* = \Pi/p$, $w^*_i = w_i/p$ and K is fixed input.

The input demand function can be derived using Hotelling's lemma:

$$x_i = - \delta\Pi^*/\delta w^*_i \quad \ldots 19$$

The factor share of the i^{th} input to total profit is:

$$(w^*_i\, x_i)/(\Pi^*) = - \alpha_i \quad \text{for } i=1,2\ldots n \quad \ldots 20$$

Rewriting equation 20 in log terms, the input demand function becomes

$$\ln x_i = \ln(-\alpha_i) + \ln \Pi^* - \ln w^*_i \quad (\text{for } i=1,\ldots,n) \quad \ldots 21$$

The output supply function can also be derived from the C-D profit function. As we know that

$$\Pi^* = Q^*_s - \Sigma w^*_i X_i$$

then the output supply[4] can be written in log terms:

$$\ln Q^*_s = \ln \Pi^* + \ln(1 - \Sigma\alpha_i) \ (\text{for } i=1,\ldots,n)\ R \quad \ldots 22$$

The Translog Case

The general case of a normalized restricted translog profit function in log terms for a single output is

$$\ln\Pi^* = \alpha_0 + \Sigma\alpha_i \ln w^*_i + \tfrac{1}{2}\Sigma\Sigma\tau_{ih} \ln w^*_i \ln w^*_h + \tfrac{1}{2}\Sigma\Sigma\phi_{ik} \ln w^*_i \ln Z_k + \Sigma\beta_k \ln Z_k + \tfrac{1}{2}\Sigma\Sigma\Phi_{kj} \ln Z_k \ln Z_j \quad \ldots 23$$

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4 This equation is derived after estimating profit and factor share equations (equation 18 and 20).

where:

Π^* = restricted profit (total revenue less total variable cost) normalized by output price (p)
w^* = price of variable input normalized by output price(p)

The input demand function can be derived using Hotelling's lemma:

$$x_i=-\delta\Pi^*/\delta w_i \qquad ...24$$

Factor share for input i (S_i) becomes

$$S_i=\alpha_i+\Sigma\tau_{ih}\ \ln w^*_h+\Sigma\phi_{ik}\ \ln K_k \qquad ...25$$

The input demand function from the Translog profit function, may be written in log terms, it is:

$$\ln x_i=\ln\Pi^*-\ln w^*_i+\ln(-\delta\ln\Pi^*/\ln w_i) \qquad ...26$$

The output supply is

$$Q_s=\Pi^*\ (1-\Sigma\delta\ln\Pi^*/\delta\ln w_i) \qquad ...27$$

The output supply function can be expressed in log terms as:

$$\ln Q_s=\ln\Pi^*+\ln(1-\Sigma\delta\ln\Pi^*/\delta\ln w_i) \qquad ...28$$

For estimating purposes, like C-D model, the Traslog profit function also has only two equations (profit and factor share equations) to be estimated, whilst the output supply equation is derived from them.

Estimated Profit Function

Firstly, the translog profit function was estimated. This function becomes the C-D case if all the second coefficients of equation 23 are zero. An F-test was conducted to test the hypothesis that $\tau_{ih}=\phi_{ik}=\Phi_{kj}=0$. The computed F^* was $F^*=0.523$ while the critical F value was $F_{0.05}(10,290)=1.83$. Therefore it was concluded that the data support the C-D profit function specification.

The normalized C-D profit function estimated in this study is of the form:

$$\ln \Pi^* = \ln\alpha_0 + \alpha_1 \ln w^* + \alpha_f \ln w_f^* + \beta_a \ln A + \beta_k \ln K + e_1 \qquad \ldots 29$$

where:

- Π^* is total revenue less variable cost (cost of labour and fertilizer) then normalized by paddy price.
- w^* is wages per hour normalized by paddy price.
- w_f^* is price per kg of fertilizer (nitrogen and phosphate) normalized by paddy price.
- A is area of sawah land cultivated (Ha)
- K is value of capital (in Rp). This includes bullock/tractor, seed, pesticide, interest
- e_1 is error terms

Factor shares equation for two variable inputs: Labour(L) and Fertilizer(F) are:

$$-w^*.L/\Pi^* = \alpha_1 + e_2 \qquad \ldots 30$$

$$-w_f^*.F/\Pi^* = \alpha_f + e_3 \qquad \ldots 31$$

where:

- L is labour used (male and female) both family and hired labour in production (in hours)
- F is fertilizer used (nitrogen and phosphate) in kg
- e_2, e_3: are error terms

Coefficient α_1 appears in both the profit function (equation 29) and the factor share for labour equation (equation 30), and α_f appears in the profit function (equation 29) and factor share for fertilizer equation (equation 31). In order to get efficient estimator, both equations (29 and 30 or 29 and 31) have to be estimated jointly using Zellner's Method or SURE (seemingly unrelated equation model). SURE was estimated with unrestricted and restricted estimations. For restricted estimation, the profit maximum was tested first for two variable inputs. The conclusion was that both fertilizer and labour were used under profit maximizing conditions. Secondly, constant return to scale (CRTS) was also tested, and this test lead to the acceptance of the hypothesis that CRTS occurs ($F^*=0.952 < F_{0.5}$ 1,311=3.84). Then the profit maximizing and CRTS conditions, were imposed as restrictions as seen in the last column of Table 1

The output supply function which is derived from C-D profit function (equation 29) is in the form:

$$\ln Qs = \ln \alpha_0 + \alpha_1 \ln(w/p) + \alpha_f \ln(w_f/p) + \beta_a \ln A + \beta_k \ln K + \ln(1-\alpha_1-\alpha_f) \quad ...32$$

The output supply and input demand elasticities were computed under CRTS and profit maximising conditions. The set of elasticities[5] computed is shown in Table 2

From Table 2 we can conclude that;

(i) an increase in paddy price will serve to increase paddy output supply, and increase labour and fertilizer use. The most important effect for farm households is that paddy price increases will lead to an increase in profit from rice. If the paddy price rises by 1%, the farm profit will increase by 0.5%.

(ii) increasing wages or fertilizer price will decrease output supply and input demand. Labour demand with respect to wages is highly elastic (1.352), as is the fertilizer demand with respect to fertilizer price (1.11).

(iii) Fixed input level, especially land, has a positive effect on output, as well as on labour demand. If land

5 see Appendix:1

area cultivated is increased by 1%, demand for labour, fertilizer and output supply will increase by 0.9%.

III. Demand Systems

Neo-classical economics postulates that an individual or household will maximize utility subject to a budget constraint. Using this postulate, the demand function for a commodity can be derived.

Suppose an individual faces the following utility function for a set of commodities (q):

$$U=U(q_1,q_2,\ldots,q_n) \qquad \ldots 33$$

subject to a budget constraint (E):

$$E=p_1q_1+p_2q_2+\ldots+p_nq_n \quad (\text{for } i=1,2\ldots,n) \qquad \ldots 34$$

where p_i is price of the i^{th} commodity.

Using a Lagrangian function, we can derive a utility maximizing equation for each commodity (q_i). Then the Marshallian demand function for the i^{th} commodity and marginal utility of money (τ) can be derived as:

$$q_i=q_i(p_i,p_j,E) \quad \text{for } i\neq j=1,2,\ldots,n \qquad \ldots 35$$

$$\tau=q_i(p_i,p_j,E)$$

Substitution of demand functions 35 into the direct utility function 33 or applying the duality concept between prices and quantities in demand theory, we obtain indirect utility function:

$$U=U(p_i,E) \quad \text{for } i=1,2,\ldots,n \qquad \ldots 36$$

Lau, Lin and Yotopoulos (1978) proposed the indirect utility function as transcendental logarithmic function in terms of variables normalized with expenditure (E) as:

$$\text{Ln } U^{*}= \alpha_0 + \Sigma\alpha_i \ln p^{*}_i + ½\Sigma\Sigma\beta_{ij} \ln p^{*}_i \ln p^{*}_j \qquad \ldots 37$$

where $p^*_i = p_i/E$ and the function satisfies property symmetry ($\beta_{ij}=\beta_{ji}$); Engle aggregation ($\Sigma\alpha_i=-1$) and homogeneity ($\beta_{ij}=0$).

The commodity expenditure function can be derived using Roy's indentity:

$$p^*_i q_i = -\delta \ln U^* / \delta \ln p^*_i \qquad ...38$$

Equation 38 becomes the LLES (Log Linear Expenditure System) that is:

$$- p^*_i q_i = \alpha_i + \Sigma\beta_{ij} \ln p_i \qquad ...39$$

Commodity Demand

The LLES functional form (including household characteristics: a_1, a_2, a_3) of three commodities; (leisure(R), paddy (C) and non-farm goods, M) are:

$$-Rw^* = \alpha_1 + \beta_{11}\ln w^* + \beta_{12}\ln p^* + \beta_{13}\ln q^* + e_{11} \ln a_1 + e_{12} \ln a_2 + e_{13} \ln a_3 \qquad ...40$$

$$-Cp^* = \alpha_2 + \beta_{12}\ln w^* + \beta_{22}\ln p^* + \beta_{23}\ln q^* + e_{21} \ln a_1 + e_{22} \ln a_2 + e_{23} \ln a_3 \qquad ...41$$

$$-Mq^* = \alpha_3 + \beta_{13}\ln w^* + \beta_{23}\ln p^* + \beta_{33}\ln q^* + e_{31} \ln a_1 + e_{32} \ln a_2 + e_{33} \ln a_3 \qquad ...42$$

which restrictions are:

$$\beta_{11} + \beta_{12} + \beta_{13} = 0; \qquad ...42a$$

$$\beta_{12} + \beta_{22} + \beta_{23} = 0; \qquad ...42b$$

$$\beta_{13} + \beta_{23} + \beta_{33} = 0; \qquad ...42c$$

$$\alpha_1 + \alpha_2 + \alpha_3 = -1; \qquad ...42d$$

$$e_{11} + e_{21} + e_{31} = 0; \qquad ...42e$$

$$e_{12} + e_{22} + e_{32} = 0; \qquad ...42f$$

$$e_{13} + e_{23} + e_{33} = 0 \qquad ...42g$$

where: $w^*=w/E$, $p^*=p/E$, and $q^*=q/E$, and

E: is total expenditure
p: is price of paddy
q: is price of all market goods.
Given the heterogenity of market goods, it was set up in terms of value of non-farm goods (that is qM)
a_1: is number of working family members
a_2: is non-working family (dependents)
a_3: is age of household head.

Using restrictions (equations 42a to 42c), one can construct two LLES equations (we choose equations 41 and 42) to be estimated purposes, yields:

$$-Cp^* = \alpha_2 + \beta_{22}(\ln p^* - \ln w^*) + \beta_{23}(\ln q^* - \ln w^*) + e_{21} \ln a_1 + e_{22} \ln a_2 + e_{23} \ln a_3 \quad \ldots 43$$

$$-Mq^* = \alpha_3 + \beta_{23}(\ln p^* - \ln w^*) + \beta_{33}(\ln q^* - \ln w^*) + e_{31} \ln a_1 + e_{32} \ln a_2 + e_{33} \ln a_3 \quad \ldots 44$$

Two equations can be estimated jointly imposing β_{23} in equation 43 equal to β_{23} in equation 44. If $\beta_{23}=\beta_{23}$, it is consistent with utility maximization. The LLES function (w^*R) is evaluated at the mean of the independent variables: $\ln W = \ln a_{ij} = 0$ $(i,j=1,2,3)$. This property is required by the quasi-convexity of the utility function (Lau, Lin and Yotopoulos, 1978). Only two out of three LLES were estimated[6] (equation 43 and 44), whilst equation 40 is derived using the restriction imposed for the LLES (equation 42a to 42g).

By rearranging the LLES functions the demand functions for the commodities are derived. The

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6 This method was discussed by Theil (1975: 185). Three of expenditure equations are stochastically independent.

commodity's demand functions are written as:

$$R=E/w_1\ [-\alpha_1-\beta_{11}\ln w^*-\beta_{12}\ln p^*-\beta_{13}\ln q^*-e_{11}\ln a_1$$
$$-e_{12}\ln a_2-e_{13}\ln a_3] \qquad \ldots 45$$
$$C=E/p\ [-\alpha_2-\beta_{12}\ln w^*-\beta_{22}\ln p^*-\beta_{23}\ln q^*-e_{21}\ln a_1$$
$$-e_{22}\ln a_2-e_{23}\ln a_3] \qquad \ldots 46$$
$$M=E/q\ [-\alpha_3-\beta_{13}\ln w^*-\beta_{23}\ln p^*-\beta_{33}\ln q^*-e_{31}\ln a_1$$
$$-e_{32}\ln a_2-e_{33}\ln a_3] \qquad \ldots 47$$

The labour supply is estimated indirectly through the demand function for leisure (R). It is assumed that the total time available for work (4 months period under consideration) for a household is $D=120a_1$ (total time multiplied by number of working family members). Therefore the labour supply function (S) is given by

$$S = 120\ a_1 - R$$
$$= 120\ a_1+(E/w)\ [\alpha_1+\beta_{11}\ln w^*+\beta_{12}\ln p^*+\beta_{13}\ln q^*$$
$$+e_{11}\ln a_1+e_{12}\ln a_2+e_{13}\ln a_3] \quad ..\ 48$$

(R is given in equation 45).

Marketable Surplus (MS) is obtained by subtracting own rice consumption (C) (equation 46) from output supply (Qs) (equation 32) written in log term, the marketable surplus is:

$$\ln MS=\ln[\{\alpha_0\ (w/p)^{\alpha l}\ (w_f/p)^{\alpha f}\ A^{\beta a}\ K^{\beta k}\ (1-\alpha_1-\alpha_f)\}\ +$$
$$E/p(\alpha_2+\beta_{12}\ln(w/E)+\beta_{22}\ln(p/E)+\beta_{23}\ln(q/E)$$
$$+e_{21}\ln a_1+e_{22}\ln a_2+e_{23}\ln a_3) \qquad \ldots 49$$

Estimates of the LLES

The LLES was estimated using SURE. The functions were estimated using data from 169 households as were the production side estimates. The first estimation showed that dependent (a_2) and age of head of household

(a_3) in equation 43 was not significant at the 10% significance level nor was variable a_2 in equations 44. Equations 43 and 44 were re-estimated after dropping those variables which were not significant. The final estimates of the LLES (equation 43 and 44, and equation 40 is derived from them) are shown in Table 3.

The estimated elasticities of consumption, total household labour supply, marketable surplus and expenditures[7] are reported in Table 4. These elasticity calculation were based on the assumption that the expenditure (E) is fixed or that profit is not allowed to vary. This is one of the weaknesses of applying traditional consumption theory to analyse the behaviour of a houshold that is both a productive and consumptive unit.

The estimated effects of changes in the value of the independent variables are:

(i) an increase in wage will increase the demand for leisure. The elasticity of labour supply with respect to wages was found to have a negative sign. This LLES model may not fit the data properly or it may be, as Barnum and Squire (1979:66) said that labour supply, derived indirectly from the leisure demand, is sensitive to total time available (in our case 120 days per season was assumed)[8]. This indicates a need to test other consumption demand models in future work

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7 For the formulae used to determine elasticities for commodities (R, C, and M); household labour supply; and marketable surplus; see Appendix: 2.

(ii) an increase in wages has a negative effect on the consumption of own-paddy and market goods. This implies that both commodities are substitutes for leisure.
(iii) an increase in number of working family members has a positive effect on the consumption of commodity leisure but a negative effect on rice consumption and market goods. The number of family workers has positive effect on labour supply and marketable surplus as well.
(iv) the expenditure elasticity with respect to each commodity is one. Increasing expenditure will decrease the labour supply, is well as marketable surplus. If expenditure increases by 1%, the marketable surplus will decrease by 1.2%.
(v) The marketable surplus of rice will increase if there are increases the number family workers. The marketable surplus will be reduced when wages are increased. Rice price has a positive effect on marketable surplus, it is higly elastics (2.091).

The discussion above assumes that expenditure does not vary. In reality, consumption may vary due to changes in profit which makes up part of household income. The profit in agricultural production may change with changes in technology, and when output and input prices are changed. This will be discussed in more detail

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8 The arbitrariness is mainly due to specification of the average length of workdays. The LLES model computes only total time available for working family members, it doesn't include leisure come from dependents. It means that time consumed by dependent doesn't constribute to family welfare (Barnum and Squire, 1979:65).

in Section IV where household production theory is discussed.

IV. Interaction Between Production and Consumption

As discussed earlier, commodity demand functions (equation 45, 46, and 47) and the labour supply function (equation 48) can be written in the following forms:

$$i=i(w,p,w_f,a_1,a_2,a_3,E) \quad \text{for } i=R,C, \text{ and } M, \qquad ...50$$

and

$$S= S(w,p,w_f,a_1,a_2,a_3,E) \qquad ...51$$

Similarly the marketable surplus function (equation 49) can be written as:

$$MS= MS(p,w,w_f,a_1,a_2,a_3,A,K,E) \qquad ...52$$

The full income concept comes from summing: farm profit (equation 15), imputed labour income (total time available[9] for the period under consideration multiplied by the number of workers in the family and the wage rate in agriculture) and other income (O) such as drawing on saving, remittances etc. Then the expenditure equation (E) may be rewritten as

$$E= \Pi(p,w,w_f,A,K) + wa_1D + O \qquad ...53$$

Changes in output price or input prices will influence farm profit. This will affect E, which then changes household consumption, labour supply and marketable surplus.

If there was a change in wages (w), what would be the effect on consumption?. Evaluating this using the

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9 Calculated as 120 days for one period DS 1983.

composite function rule yields:

$$di/dw = \delta i/\delta w + \delta i/\delta E\ (\delta\Pi/\delta w + a_1 D) \qquad \ldots 54$$

for i=R, C, and M

Equation 54 then can be written in log form as

$$d\ln i/d\ln w = \delta\ln i/\delta\ln w + (\delta\ln i/\delta\ln E)\ (\delta\ln\Pi/\delta\ln w)(\Pi/E)$$
$$+ (\delta\ln i/\delta\ln E)\ a_1 Dw^* \qquad \ldots 55$$

where $w^*=w/E$ for i=R, C, and M

Equation 55 can also be written in terms of elasticities

$$\eta_{iw} = \varepsilon + (\delta\ln i/\delta\ln E)\ (\delta\ln\Pi/\delta\ln w)(\Pi/E) \qquad \ldots 56$$

for i=R, C, and M

where:

$\eta_{iw}=d\ln i/d\ln w$, and $\varepsilon = \delta\ln i/\delta\ln w+(\delta\ln i/\delta\ln E)(a_1 Dw^*)$

For η allows the profit to vary, while ε is traditional elasticity.

Using traditional elasticity, ε, the total effect of changing a commodity price can be divided into two effects (as shown by Slutsky's equation) income effect and substitution effect. The substitution effect is always negative, while the income effect may be positive or negative. For a normal commodity the effect is positive, while it is a negative for inferior goods.

In the household model, the total effect η comes not only from the two effects already mentioned for ε, (income and substitution), but also from the profit effect as follows:

$(\delta\ln i/\delta\ln E)(\delta\ln\Pi/\delta\ln w)(\Pi/E)$ for i=R, C, and M

Intergration of consumption and production behaviour into the model, there are three important items to be explained as shown by equation 56: (i) sign and magnitute of consumption elasticity with respect to E or (δlni/δlnE), for i=R,C, and M; (ii) sign and magnitute of profit elasticity with respect to wages (w) or ($\delta ln\Pi/\delta lnw$); and (iii) proportion of profit to total expenditure or (Π/E).

Commodity demand elasticity with respect to output price (p), wages(w), number of working family members(a_1) and num r of dependents (a_2) can be calculated. Similarly for labour supply, marketable surplus and expenditure elasticities with respect to output price, wages and household characteristics can be calculated using the formulae in Appendix 3. The elasticities in Table 5 were obtained from formulae given in Appendix 3 using coefficient given in Tables 2 and 4.

V. Concluding Remarks

Estimation of the impacts of a change in the values of exogeneous variables such as output price and wage from agricultural household theory is more accurate compared to either consumption or production prediction alone (Barnum and Squire, 1977:90). Most elasticities determined for the agricultural household model (Table 5) are higher than those when the household is treated as being solely a consumtive unit (Table 4). The elasticities with respect to the price of a market good in Tables 5 and 4 are equal because the price of a market good (q) does not influence farm profit.

If the other elasticities in Tables 4 and 5 are compared it is clear that they are not only different in magnitude but also, some coefficients have different signs. This is due to the former, farm profit is held constant, while in the latter, the profit is allowed to vary (i.g changing in inputs or output prices). Marketable surplus elasticities with respect to the number of family workers is positive in table 4 but becomes negative in the household model. It is found also that commodity demand elasticities for C and for M with respect to wages are negative in table 4 but in the household model they are positive.

Increased wages raise demand for all commodities, including leisure. This means that leisure is a normal good, and family labour supply has a negative slope. Family labour supply elasticity is clearly negative (-0.36). This result should be taken with caution. As mentioned earlier the supply function is derived indirectly from leisure demand in the LLES model and is very sensitive to the total time assumed to be available to the household. Therefore other demand models such LES or AIDS need to be considered in future research.

If the paddy price increases, the farm profit is increased, so that expenditure on market goods also increases, but paddy consumption is reduced. It appears that a household would respond to a rise in paddy prices by increasing the amount of paddy to be sold to the market. Marketable surplus elasticity with respect to paddy price is elastic (1.08). The marketable surplus elasticity estimated from the household model is lower than that estimated assuming traditional consumption theory as seen in Table 4. If the paddy price increases by 1%, the paddy marketable surplus increases by 1.1%.

Further Research

Extension of the model reported in this paper will be developed later to account for labour segregation and multiple own-farm enterprises. A more fully developed model will then be used to examine the effect of fertilizer and crop-pricing policies, agricultural technology and non-farm employment opportunities on the labour allocation and associated income levels of different household classes (farm size, land tenure etc). These findings will provide a basis for measuring the income and equity impacts on rural households of impending changes to the agricultural sector of Indonesia.

Table 1 Estimate of Normalized C-D Profit Function for Paddy Farmers in CRB West Java (DS 1983).

Independent Variables	Parameter	SURE (Zellner's Method): Un-Restricted	Restricted: Profit Max.	Restricted: CRTS and Profit Max.
				$\beta_a+\beta_k=1$
			$\alpha^1=\alpha^2$	$\alpha^1=\alpha^2$
			$\alpha^1=\alpha^2$	$\alpha^1=\alpha^2$
Intercept	($\ln \alpha_0$)	6.241 (6.757)	6.369 (8.137)	6.367 (8.142)
$\ln w^*$ (Wages)	(α^1_1)	-0.246 (-1.346)	-0.351 (-1.999)	-0.352 (-2.006)
$\ln w_f^*$ (Fertilizer price)	(α^1_f)	-0.219 (-0.519)	-0.126 (-4.376)	-0.126 (-4.383)
ln A (Area)	(β_a)	0.893 (7.959)	0.888 (8.487)	0.884 (10.885)
ln K (Capital)	(β_k)	0.111 (1.280)	0.117 (1.432)	0.116 (1.431)
Factor Share:				
Labour	(α^2_1)	-0.263 (-2.834)	-0.351 (-1.999)	-0.352 (-2.006)
Fertilizer	(α^2_f)	-0.320 (-3.804)	-0.126 (-4.376)	-0.126 (-4.383)

note:
i) dependent variable is $\mathrm{Ln}\Pi^*$
ii) t-values are in brackets
iii) supper script: α^1 and α^2 refer to profit function and factor share equations, respectively.

Table 2 Output supply, labour demand, fertilizer demand and profit elasticities

Exogeneous Variable	Output Supply (Qs)	Labour (L)	Fertilizer (F)	Profit (Π)
Paddy Price (p)	0.478	1.478	1.478	0.522
Wages (w)	-0.352	-1.352	-0.352	-0.352
Fertilizer Price (w_f)	-0.126	-0.126	-1.126	-0.126
Area (A)	0.884	0.884	0.884	0.884
Capital (K)	0.116	0.116	0.116	0.116

Table 3 Estimated of LLES
for CRB households (DS 1983)

Variable	Expenditure Share		
	Own Consumption $(-p^* C)$	Market Good $(-q^* M)$	Leisure $(-w^* R)^{a)}$
1. Constant $\alpha_1, \alpha_2, \alpha_3$	-0.3482 (-2.366)	-0.5283 (-2.986)	-0.1235
2. Wages (w) $\beta_{11}, \beta_{12}, \beta_{13}$	0.0864	0.1756	-0.2620
3. Paddy price (p) $\beta_{12}, \beta_{22}, \beta_{23}$	-0.0607 (-1.607)	-0.0257 (-1.382)	0.0864
4. Market good price (q) $\beta_{13}, \beta_{23}, \beta_{33}$	-0.0257 (-1.382)	-0.1499 (-9.037)	0.1756
5. Family Worker (a_1) e_{11}, e_{21}, e_{31}	0.1534 (4.429)	0.1170 (4.404)	-0.2704
6. Dependent (a_2) e_{12}, e_{22}, e_{32}	0	0	0
7. Head of house hold Age (a_3) e_{13}, e_{23}, e_{33}	0	-0.0647	0.0647 (-1.854)

a) derived using restrictions equations (equations 42a-42g).
b) figures in the brackets are t-value

Table 4 : Elasticity of Commodity Demand, Labour Supply and Marketable Surplus with repect to exogenous variables (E held constant)

Exogenous Variable	Commodities: Leisure (R)	Commodities: Rice (C)	Commodities: Market Good (M)	Labour Supply (S)	Marketable Surplus (MS)
Wages (w)	1.1215	-0.2481	-0.3324	-0.2832	-0.7876
Price of Rice (p)	-1.6336	-0.8287	0.0486	0.1580	2.0910
Price of Market Good (q)	-1.4219	0.0738	-0.7163	0.3211	-1.0913
Worker (a_1)	2.1835	-0.4486	-0.2215	0.7314	0.9451
Dependent (a_2)	0	0	0	0	0
Age of household head (a_3)	-0.9219	0	0.1225	0.1183	0
Expenditure (E)	1	1	1	-0.2258	-1.2374

Evaluated at sample arithmetic means ($120 a_1 w^* = 0.6704$).
One season (Dry Season) is assumed to be 120 days long.

Table 5 : Elasticity of Commodity Demand, Labour Supply and Marketable Surplus with repect to selected exogeneous variables (E and Profit allowed to vary)

Exogeneous Variable	Commodities: Leisure (R)	Commodities: Rice (C)	Commodities: Market Good (M)	Labour Supply (S)	Marketable Surplus (MS)	Expenditure (E)
Wages (w)	1.6379	0.2683	0.1840	-0.3698	-1.4266	0.5164
Price of Rice (p)	-0.4713	-0.5974	0.2769	0.2096	1.080	0.2283
Price of Market Good (q)	-1.4219	0.0738	-0.7163	0.3211	-0.0913	-
Fertilizer price (w_f)	-0.0551	-0.0551	-0.0551	0.0124	0.0682	-0.0551
Worker (a_1)	2.8599	0.2298	0.4489	0.5800	-0.2845	0.6704

From formulae in Appendix 3, using coefficients in Table 2 and 4. Evaluated at arithmetic means of samples: $a_1 Dw = 0.6704$; $\Pi/E = 0.4374$

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Appendix: 1 Elasticity Formulae for Input Demand Output Supply and Profit

1. Elasticity Formulae (see Table 2):

1.1 Input Demand wrt w_i, w_j, K and p;

$$\delta \ln x_i/\delta \ln w_i = [\delta \ln x_i/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln w_i]-1$$
$$=(\alpha_i)-1 \qquad \ldots 1$$

$$\delta \ln x_i/\delta \ln w_j = [\delta \ln x_i/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln w_j]$$
$$= \alpha_j \quad \text{for } i\#j=1,2,\ldots n \qquad \ldots 2$$

$$\delta \ln x_i/\delta \ln K_k = [\delta \ln x_i/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln K_k]$$
$$= \beta_k \qquad \ldots 3$$

$$\delta \ln x_i/\delta \ln p = [\delta \ln x_i/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln p] + \delta \ln(w/p)/\delta \ln p$$
$$= -\alpha_i + 1 \qquad \ldots 4$$

(where $\delta \ln x_i/\delta \ln \Pi^* = 1$) for k= A,K and i= 1,f

1.2 Output Supply wrt p, w_i, and K;

$$\delta \ln Q^*_s/\delta \ln p = [\delta \ln Q^*_s/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln p]$$
$$= -\Sigma \alpha_i \qquad \ldots 5$$

$$\delta \ln Q^*_s/\delta \ln w_i = [\delta \ln Q^*_s/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln w_i]$$
$$= \alpha_i \qquad \ldots 6$$

$$\delta \ln Q^*_s/\delta \ln K_k = [\delta \ln Q^*_s/\delta \ln \Pi^*][\delta \ln \Pi^*/\delta \ln K_k]$$
$$= \beta_k \qquad \ldots 7$$

(where $\delta \ln Q^*_s/\delta \ln \Pi^* = 1$) for k= A,K and i= 1,f

1.3 Profit wrt p, w_i, and K

$$\delta \ln\Pi / \ln\delta p = 1 + \Sigma\, \alpha_i \qquad \ldots 8$$

$$\delta \ln\Pi / \ln\delta w_i = \alpha_i \qquad \ldots 9$$

$$\delta \ln\Pi / \ln\delta K_k = \beta_k \qquad \ldots 10$$

for k= A,K and
i= 1,f

Appendix: 2 Elasticity Formulae for Commodities Demand, Labour Supply and Marketable Surplus

2.Elasticity Formulae (from LLES, see Table 4):

2.1 Demand for Leisure wrt w,p,q, a_1, a_2, a_3 and E;

$\delta lnR/\delta lnw = \varepsilon_{rw} = -1+(-\beta_{11}/w*R) = -1+(-\beta_{11}/-\alpha_1)$ ...11

$\delta lnR/\delta lnp = \varepsilon_{rp} = -\beta_{12}/w*R = -\beta_{12}/-\alpha_1$ ...12

$\delta lnR/\delta lnq = \varepsilon_{rq} = -\beta_{13}/w*R = -\beta_{13}/-\alpha_1$ ...13

$\delta lnR/\delta lna_1 = \varepsilon_{ra11} = -e_{11}/w*R = -e_{11}/-\alpha_1$ ...14

$\delta lnR/\delta lna_2 = \varepsilon_{ra12} = -e_{12}/w*R = -e_{12}/-\alpha_1$ ...15

$\delta lnR/\delta lna_3 = \varepsilon_{ra13} = -e_{13}/w*R = -e_{13}/-\alpha_1$ ...16

$\delta lnR/\delta lnE = \varepsilon_{re} = 1$ ...17

2.2 Demand for Commodity C wrt w,p,q, a_1, a_2, a_3 and E;

$\delta lnC/\delta lnw = \varepsilon_{cw} = -\beta_{12}/-\alpha_2$ ...18

$\delta lnC/\delta lnp = \varepsilon_{cp} = -1+(-\beta_{22}/-\alpha_2)$ ...19

$\delta lnC/\delta lnq = \varepsilon_{cq} = -\beta_{23}/-\alpha_2$ ...20

$\delta lnC/\delta lna_1 = \varepsilon_{ca21} = -e_{21}/-\alpha_2$ ...21

$\delta lnC/\delta lna_2 = \varepsilon_{ca22} = -e_{22}/-\alpha_2$ ...22

$\delta lnC/\delta lna_3 = \varepsilon_{ca23} = -e_{23}/-\alpha_2$ ...23

$\delta lnC/\delta lnE = \varepsilon_{ce} = 1$ ...24

2.3 Demand for Commodity M wrt w,p,q, a_1, a_2, a_3 and E;

$\delta \ln M/\delta \ln w_1 = \varepsilon_{mw} = -\beta_{13}/-\alpha_3$ ...25

$\delta \ln M/\delta \ln p = \varepsilon_{mp} = -\beta_{23}/-\alpha_3$ ...26

$\delta \ln M/\delta \ln q = \varepsilon_{mq} = -1+(-\beta_{33}/-\alpha_3)$ ...27

$\delta \ln M/\delta \ln a_1 = \varepsilon_{ma31} = -e_{31}/-\alpha_3$ ...28

$\delta \ln M/\delta \ln a_2 = \varepsilon_{ma32} = -e_{32}/-\alpha_3$ ...29

$\delta \ln M/\delta \ln a_3 = \varepsilon_{ma33} = -e_{33}/-\alpha_3$ ...30

$\delta \ln M/\delta \ln E = \varepsilon_{me} = 1$ ...31

2.4 Labour Supply (S) wrt w,p,q, a_1, a_2, a_3 and E;

$\delta \ln S/\delta \ln w = \varepsilon_{sw} = [\beta_{11}/(120a_1 - R)w^*] + [R/(120a_1 - R)$

$= (\beta_{11} - \alpha_1)/(120a_1 w^* + \alpha_1)$ ...32

$\delta \ln S/\delta \ln p = \varepsilon_{sp} = (\beta_{12})/(120a_1 w^* + \alpha_1)$ ...33

$\delta \ln S/\delta \ln q = \varepsilon_{sq} = (\beta_{13})/(120a_1 w^* + \alpha_1)$ ...34

$\delta \ln S/\delta \ln a_1 = \varepsilon_{sa1} = [120a_1 w^* + e_{11}]/[120a_1 - R)w^*]$

$= [(120a_1 w^* + e_{11})/(120a_1 w^* + \alpha_1)]$ ...35

$\delta \ln S/\delta \ln a_2 = \varepsilon_{sa2} = e_{12}/(120a_1 - R)w^*$

$= e_{12}/(120a_1 w^* + \alpha_1)$ ...36

$\delta \ln S/\delta \ln a_3 = \varepsilon_{sa3} = e_{13}/(120a_1 - R)w^*$

$= e_{13}/(120a_1 w^* + \alpha_1)$ ...37

$\delta \ln S/\delta \ln E = \varepsilon_{se} = -R/S = -w^* R/(120a_1 - R)w^*$

$= \alpha_1/(120a_1 w^* + \alpha_1)$ ...38

2.5 Marketable Surplus (MS) wrt w_1, a_1, a_2, a_3, E and p;

$$dlnMS/dlnp = [[(-\alpha_1-\alpha_f)p^*Q]+\beta_{22}-\alpha_2]/(p^*Q+\alpha_2) \quad ...39$$

$$dlnMS/dlnw = [\alpha_1(p^*Q)+\beta_{12}])/(p^*Q+\alpha_2) \quad ...40$$

$$dlnMS/dlnq = \beta_{23})/(p^*Q+\alpha_2) \quad ...41$$

$$dlnMS/dlnw_f = \alpha_f(p^*Q)+\beta_{21})/(p^*Q+\alpha_2) \quad ...42$$

$$dlnMS/dlna_1 = e_{21}/(p^*Q+\alpha_2) \quad ...43$$

$$dlnMS/dlna_2 = e_{22}/(p^*Q+\alpha_2) \quad ...44$$

$$dlnMS/dlna_3 = e_{23}/(p^*Q+\alpha_2) \quad ...45$$

$$dlnMS/dlnE = \alpha_2/(p^*Q + \alpha_2) \quad ...46$$

Appendix: 3

Elasticity Formulae for Commodity Demand, Labour Supply Marketable Surplus and Expenditure (allowed expenditure and profit to vary)

Exogenous Variables / Wages (w)	Paddy (p) price	Fertilizer price (w_f)	Market Good price (q)	Workers (a_1)
1. Commodity Demand:				
1.1 Leisure (R): $\delta lnR/\delta lnw + (\delta lnR/\delta lnE)(\delta ln\Pi/\delta lnw)(\Pi/E) + (\delta lnR/\delta lnE)(a_1 Dw^*)$	$(\delta lnR/\delta lnp) + (\delta lnR/\delta lnE)(\delta ln\Pi/\delta lnp)(\Pi/E)$	$(\delta lnR/\delta lnE)(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	$(\delta lnR/\delta lnq)$	$\delta lnR/\delta lna_1 + \delta lnR/\delta lnE (a_1 Dw^*)$
1.2 Rice (C): $\delta lnC/\delta lnw + (\delta lnC/\delta lnE)(\delta ln\Pi/\delta lnw)(\Pi/E) + (\delta lnC/\delta lnE)(a_1 Dw^*)$	$(\delta lnC/\delta lnp) + (\delta lnC/\delta lnE)(\delta ln\Pi/\delta lnp)(\Pi/E)$	$(\delta lnC/\delta lnE)(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	$(\delta lnC/\delta lnq)$	$\delta lnC/\delta lna_1 + \delta lnC/\delta lnE (a_1 Dw^*)$
1.3 Market Good (M): $\delta lnM/\delta lnw + (\delta lnM/\delta lnE)(\delta ln\Pi/\delta lnw)(\Pi/E) + (\delta lnM/\delta lnE)(a_1 Dw^*)$	$(\delta lnM/\delta lnp) + (\delta lnM/\delta lnE)(\delta ln\Pi/\delta lnp)(\Pi/E)$	$(\delta lnM/\delta lnE)(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	$(\delta lnM/\delta lnq)$	$\delta lnM/\delta lna_1 + \delta lnM/\delta lnE (a_1 Dw^*)$
2. Labour Supply (S): $\delta lnS/\delta lnw) + (\delta lnS/\delta lnE)(\delta ln\Pi/\delta lnw)(\Pi/E) + (\delta lnS/\delta lnE)(a_1 Dw^*)$	$(\delta lnS/\delta lnp) + (\delta lnS/\delta lnE)(\delta ln\Pi/\delta lnp)(\Pi/E)$	$(\delta lnS/\delta lnE)(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	$(\delta lnS/\delta lnq)$	$\delta lnS/\delta lna_1 + \delta lnS/\delta lnE (a_1 Dw^*)$
3. Marketable-Surplus (MS): $\delta lnMS/\delta lnw + (\delta lnMS/\delta lnE)(\delta ln\Pi/\delta lnw)(\Pi/E) + (\delta lnMS/\delta lnE)(a_1 Dw^*)$	$(\delta lnMS/\delta lnp + (\delta lnMS/\delta lnE)(ln\Pi/\delta lnp)(\Pi/E)$	$(\delta lnMS/\delta lnE)(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	$(\delta lnMS/\delta lnq)$	$lnMS/\delta lna_1 + \delta lnMS/\delta lnE (a_1 Dw^*)$
4. Expenditure (E): $(\delta ln\Pi/\delta lnw)(\Pi/E) + (a_1 Dw^*)$	$\delta ln\Pi/\delta lnp (\Pi/E)$	$(\delta ln\Pi/\delta lnw_f)(\Pi/E)$	-	$a_1 Dw^*$