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Price Response of Marketable Surplus in a Developing
Economy: A Theoretical Framework

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PRICE RESPONSE OF MARKETABLE SURPLUS IN A DEVELOPING
ECONOMY: A THEORETICAL FRAMEWORK

by

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Introduction: The role of the agricultural marketable surplus in the

process of economic development is well emphasized. However, the knowledge

about the price response of the marketable surplus is rather poor.

For the last few decades, economists have been intrigued by the

probable sign of the price elasticity of the marketable surplus for

subsistence crops[1].   Only recently, some of the economists have

shown inclination that the marketable surplus response to price

positively.   The beliefs on the positive price response are based on

indirect estimates from the theoretically derived expression on the

price elasticity of marketable surplus   (η_s).

Among the theoretical attempts made at deriving the η_s,

attempts by Raj Krishna $\underline{/}10\underline{/}$ and Behrman $\underline{/}$ 1 $\underline{/}$ are the basic

ones. Both the attempts, though useful in throwing light on the

problems involved, suffer from certain drawbacks - hence the greater

need for developing a more comprehensive theoretical framework through

which one could predict the nature of the price response of

1/ The main obstacle in verifying the sign of the price elasticity
of marketable surplus is the lack of time series data.

marketable surplus.[2/]

At the empirical level, most studies use cross-sectional data and try to identify the important factors that affect the marketable (or marketed) surplus of various food crops $\underline{/}$ 1, 3, 4, 8, 9, 11, 12, 14, 15 $\underline{/}$. The information gathered from the empirical studies is of great value in policy making. In some cases, however, the empirical results are vague and inconsistent in that they verify conflicting hypotheses. In order to give a meaningful interpretation to the empirical results and to obtain maximum benefit from the research effort, theoretical frameworks are badly needed.

It is the purpose of this paper to set up a theoretical model which will help us to identify some of the important factors influencing the marketable surplus of agricultural commodities, and will enable us to draw conclusions about the nature of the price response of marketable surplus (i.e., the sign of η_s).

2/ Raj Krishna $\underline{/}$ 10 $\underline{/}$ was the first to develop a theoretical model on the price elasticity of the marketable surplus of a subsistence crop. He started with the identity:
$M = Q - C$, ... (1) where, Q, C, and M are the quantity of wheat produced, consumed, and marketed, respectively. Since (1) is an identity, Krishna proceeded by differentiating both sides with respect to P : $\frac{dM}{dP} = \frac{dQ}{dP} - \frac{dc}{dP}$ .... (2)
where, P = relative price of wheat. Examination of (2) shows that in order to estimate $\frac{dQ}{dP}$, price of wheat should be relative to production substitutes, whereas to estimate $\frac{dc}{dP}$, one needs price of wheat relative to the consumption substitutes. But Krishna does not distinguish between the two relative prices and hence the derivation of (2) is erroneous.
        Behrman $\underline{/}$ 1 $\underline{/}$ corrected the basic Krishna model for the ambiguity in the prices involved. We think, however, that both models $\underline{/}$ 10, 1 $\underline{/}$ suffer from the following drawbacks : i) although the models are supposed to be consistent with utility maximization on the part of the farmers, no formal and explicit model of utility maximization exists, ii) both models ignore the survival constraint which arises from the fact that farmers, in order to be alive, need some minimum food consumption, iii) both models treat the farmer as producer-consumer type economic unit, but fail to explain the reasons for it and to draw the full implications

II. THE THEORETICAL MODEL

II.1.   In this section, a utility maximization model will be developed for a farmer who is both a potential producer and an actual consumer of a subsistence crop. The model is primarily developed in the context of an under-developed area like East Pakistan, though it can be extended to other areas very easily by relaxing some of its assumptions.

II.2.   In the context of East Pakistan, the following assumptions are made for a single farming unit:

Assumption: (i)   Fixed cultivable land to be allocated between the

                  two competing crops: rice and jute.

Assumption: (ii) The farmer's income is derived from the cultivation

                  of rice/jute.

Assumption:(iii) Income is spent on two consumption goods: food

                  (i.e., rice) and a nonfood good.

Assumption: (iv) Constant Y_J/Y_r for the same farm.

        where,

                  Y_J = normal yield of jute per unit of land (i.e., acre).

                  Y_r = normal yield of rice per unit of land (i.e., acre).

Assumption: (v)   Heterogeneous land in the farm sector as a whole

                  (i.e., variation in Y_J/Y_r over the various farm units).

Assumption:(vi)   Farmer's utility function is of the form:

$$U(F,H) = \theta \log (F_H + F_M - F_S) + (1 - \theta) \log H$$

        where,

                  F_H = food produced at the farm for consumption.

                  F_M = food purchased from the market for consumption.

                  F_S = minimum food required for farmer's household in
                         order to survive.

___

of such a role, iv) both models analyse price response of the
marketable surplus in the absence of other factors that might
complicate matter in the course of time.

$$F = F_H + F_M - F_S.$$

N = nonfood consumption good. This might be a single good like cloth, salt, kerosene oil, or a combination of all nonfood goods in the form of a composite commodity.

θ = weight assigned to the utility derived from food.

There is a built-in survival constrain in the utility function:

$$F_H + F_M \geq F_S.$$

In case $(F_H + F_M) < F_S$, there is no farmer and hence no utility function.

Farmer's Income: His income is derived from the cultivation of rice and jute: $P_{F2}^*(A_F Y_F - F_H) + P_J^* (A - A_F)Y_J$

where:

P_{F2}^* = expected sale (or harvest) price of rice per unit of weight (i.e., maund)

P_J^* = expected sale (or harvest) price of jute per unit of weight (i.e., maund)

A = total land available for allocation

A_F = land allocated to produce food (i.e., rice) crop.

The constraint of fixed cultivable land is incorporated in the income-generating expression. The assumption of fixed land is always true at a point of time when land allocation decisions are being made.

Farmer's Expenditure: The farmer's expenditures consist of purchasing food and nonfood goods for consumption:

$$P_{F1}^* F_M + P_N N$$

where:

P_{F1}^* = expected purchase price of food (i.e., rice)

P_N = purchase price (index) of nonfood consumption goods.

The farmer is assumed to be rational in the sense that his production and consumption decisions are dictated by the maximization of a well-ordered function; i.e., utility function, subject to the various constraints: fixed land (A) and the survival of the family ($F_H + F_M \geq F_S$), which are incorporated in the budget constraint and the utility function, respectively.

We introduce another constraint $A_F Y_F \geq F_H$ implying that home consumption of rice cannot be larger than rice production; i.e., marketable surplus of rice must be nonnegative.

Since the problem is to maximize utility subject to the constraints: $F_H + F_M \geq F_S$, fixed land ($\overline{A}$) and $A_F Y_F \geq F_H$, we set up the Langrangian $(\mathcal{L})$ and proceed to solve it. [3]

$$
\mathcal{L} = \Big[\theta \log (F_H + F_M - F_S) + (1 - \theta) \log N \Big] + \lambda \Big[P_{F2}^*(A_F Y_F - F_H)
$$
$$
+ P_J^*(A - A_F)Y_J - (P_{F1}^* F_M + P_N) \Big]
$$
$$
+ \mu \Big[A_F Y_F - F_H \Big].
$$

Differentiating $\mathcal{L}$ with respect to N, F_M, F_H, and A_F, we get:

$$
\frac{\partial \mathcal{L}}{\partial N} = \frac{1 - \theta}{N} - \lambda P_N = 0 \tag{1}
$$

$$
\frac{\partial \mathcal{L}}{\partial F_M} = \frac{\theta}{F_M + F_H - F_S} - \lambda P_{F1}^* \begin{pmatrix} = 0 \\ \leq 0 \end{pmatrix} \text{ if } \begin{pmatrix} F_M > 0 \\ F_M = 0 \end{pmatrix} \tag{2}
$$

$$
\frac{\partial \mathcal{L}}{\partial F_H} = \frac{\theta}{F_M + F_H - F_S} - \lambda P_{F2}^* - \mu \begin{pmatrix} = 0 \\ \leq 0 \end{pmatrix} \text{ if } \begin{pmatrix} F_H > 0 \\ F_H = 0 \end{pmatrix} \tag{3}
$$

$$
\frac{\partial \mathcal{L}}{\partial A_F} = \lambda \Big[P_{F2}^* Y_F - P_J^* Y_J \Big] + \mu Y_F \begin{pmatrix} \leq \\ = \\ \geq \end{pmatrix} 0 \text{ for } \begin{pmatrix} A_F = 0 \\ 0 < A_F < A \\ A_F = A \end{pmatrix} \tag{4}
$$

Distinguishing three possible cases, we derive the consumption demand functions for food (rice) and nonfood goods.

II.2. (i)   Case I: Complete Jute Specialization: This means that n land is allocated to produce the food crop and all the consumption dem for food is met through purchases from the market:

$$A_F = 0 \Rightarrow F_H = 0 \Rightarrow F_H \geq F_S$$

Thus, taking $A_F = 0$, $F_H = 0$, and $F_H > 0$, we can rewrite:

(2):
$$\frac{\theta}{F_H - F_S} = \lambda P_{F1}^*$$
(2-a)

(3):
$$\frac{\theta}{F_H - F_S} \leq \lambda P_{F2}^* + \mu$$
(3-a)

(2-a) and (3-a) $\Rightarrow \mu \geq (P_{F1}^* - P_{F2}^*)\lambda > 0$

or $\lambda(P_{F1}^* Y_F - P_{F2}^* Y_F) \leq \mu Y_F > 0$ (5)

(4): $(\lambda P_{F2}^* Y_F - \lambda P_J^* Y_J) + \mu Y_F \leq 0$ (4-a)

By adding (4-a) and (5):

$$0 \geq \lambda \left[P_{F1}^* Y_F - P_J^* Y_J \right]$$

or $P_J^* Y_J \geq P_{F1}^* Y_F > P_{F2}^* Y_F$ (as $P_{F1}^* > P_{F2}^*$) (4-b)

(4-b) is necessary for this case, but thus far has not been shown to be sufficient.

The next step is to derive the consumption demand function for the food purchased from the market (F_H). Dividing (2-a) by (1):

$$\frac{\theta}{1 - \theta} \cdot \frac{H}{F_H - F_S} = \frac{P_{F1}^*}{P_H}$$
(6)

Budget constraint becomes:

$$P_J^* A Y_J = P_{F1}^* F_H + P_H H$$

Putting the values of $P_{F1}^{*}F_{H}$ and $P_{H}N$ from (6) into the budget constraint:

$$P_{H}N = P_{J}^{*}AY_{J} - \left\{ \frac{\theta}{1-\theta} P_{H}N + P_{F1}^{*}F_{S} \right\}$$

or $\qquad P_{H}N = (1-\theta) \left[P_{J}^{*}AY_{J} - P_{F1}^{*}F_{S} \right]$

$$P_{F1}^{*}F_{H} = P_{F1}^{*}F_{S} + \frac{\theta}{1-\theta} P_{H}N$$

$$= \theta P_{J}^{*}AY_{J} + (1-\theta) P_{F1}^{*}F_{S} \qquad (7)$$

Demands:

$$N = (1-\theta)\left[\frac{P_{J}^{*}}{P_{N}} AY_{J} - \frac{P_{F1}^{*}}{P_{N}} F_{S} \right]$$

$$F_{H} = \theta \frac{P_{J}^{*}}{P_{F1}^{*}} AY_{J} + (1-\theta) F_{S} \qquad \left.\begin{array}{c} \\ \\ \end{array}\right\} \qquad (8)$$

$$F_{H} = 0$$

Note: Subsistence requires $P_{J}^{*}AY_{J} \geq P_{F1}^{*}F_{S}$.

II.2 (ii) Case II. Complete Rice Specialization: In the case of complete rice specialization, $A_{r} = A, \Rightarrow F_{H} = 0, F_{H} > 0$; since $P_{F1}^{*} > P_{F2}^{*}$, $\mu \geq 0$.

In view of the fact that $F_{H} = 0, F_{H} > 0$, and $\mu > 0$, we can re-write:

(2): $\qquad \dfrac{\theta}{F_{H} - F_{S}} \leqslant \lambda P_{F1}^{*} \qquad (2\text{-b})$

(3) $\qquad \dfrac{\theta}{F_{H} - F_{S}} = \lambda P_{F2}^{*} \qquad (3\text{-b})$

(3-b) divided by (1)

$$\frac{P_{F2}^{*}}{P_{N}} = \frac{\theta}{1-\theta} \quad \frac{N}{F_{H} - F_{S}} \qquad (9)$$

From (4):

$$\frac{\partial \mathcal{L}}{\partial A_F} \;\geq\; 0 \;:\; \lambda\left[P^{*}_{F2}Y_F - P^{*}_J Y_J\right] \geq 0 \;\Rightarrow\; P^{*}_{F2}Y_F - P^{*}_J Y_J \tag{4-c}$$

$P^{*}_{F2}Y_F \geq P^{*}_J Y_J$ provides two possibilities (a) $P^{*}_{F2}Y_F > P^{*}_J Y_J$,

which would mean complete rice specialization, and (b) $P^{*}_{F2}Y_F = P^{*}_J Y_J$,
implying complete rice specialization or that rice is grown to meet
the farm consumption demand for food (F_H) and the remaining land is
devoted to the cultivation of jute (i.e., Case II or Case III).

Confining to the complete rice specialization case for which
the necessary condition is $P^{*}_{F2}Y_F > P^{*}_J Y_J$, we derive the demand
functions.

Budget constraint becomes:

$$P_H H \;=\; P^{*}_{F2}\,(AY_F - F_H)$$

Substituting into (9):

$$\frac{1-\theta}{\theta}\; P^{*}_{F2}\,(F_H - F_S) \;=\; P^{*}_{F2}\,(AY_F - F_H)$$

or $\dfrac{1}{\theta}\, P^{*}_{F2} F_H = P^{*}_{F2} AY_F \;+\; \dfrac{1-\theta}{\theta}\, P^{*}_{F2} F_S$

or $F_H \;=\; \theta\, AY_F \;+\; (1-\theta)\, F_S$

Demands:

$$\left.\begin{aligned}
F_H &= F_S + \theta\,(AY_F - F_S)\\[4pt]
H &= \frac{P^{*}_{F2}}{P_H}\,(1-\theta)\left[AY_F - F_S\right]\\[4pt]
F_K &= 0
\end{aligned}\right\} \tag{11}$$

Equation (11) means that the consumption demand for food is
equal to F_S (minimum food needed for survival) plus a proportion

(depending on θ) of the rice left over deducting F_S from the total rice production $(= AY_F - F_S)$.

II.2, (iii) Case III. Food Production to Meet the Family Consumption Demand for Food, and Jute Production on the Remaining Land: The So-Called Practice of Subsistence Farming: This involves production of both jute and rice and implies that $F_H > 0$, $F_M = 0$. We can rewrite:

(2):
$$\frac{\partial \mathcal{L}}{\partial F_M} \leq 0 : \quad \frac{\theta}{F_H - F_S} \leq \lambda P_{F1}^*$$
(2-c)

(3)
$$\frac{\partial \mathcal{L}}{\partial F_H} = 0: \quad \frac{\theta}{F_H - F_S} = \lambda P_{F2}^* + \mu$$
(3-c)

The budget constraint becomes:
$$P_H H + P_{F1}^* F_H = P_J^* (A - A_F) Y_J + P_{F2}^* A_F Y_F$$
(12)

If $P_J^* Y_J \leq P_{F2}^* Y_F$, income is maximized at $A_F = A$ (Case II). If $P_J^* Y_J > P_{F2}^* Y_F$, income is maximized subject to $A_F Y_F \geq F_H$ at
$$A_F Y_F = F_H$$
(Case III).

From (4):
$$\mu = \lambda P_J^* \frac{Y_J}{Y_F} - \lambda P_{F2}^*$$
(4-d)

From (4-d) and (3-c) :
$$\frac{\theta}{F_H - F_S} = \lambda P_J^* \frac{Y_J}{Y_F}$$
(3-d)

(3-d) divided by (1) :

$$\frac{\theta}{1 - \theta} \quad \frac{H}{F_H - F_S} = \frac{P_J^* \ Y_J/Y_F}{P_H} \quad , \text{ and}$$

From the budget constraint:

$$P_H H = P_J^* A Y_J - P_J^* \frac{Y_J}{Y_F} F_H$$

$$\therefore \quad \frac{1 - \theta}{\theta} \frac{P_J^* Y_J}{Y_F} (F_H - F_S) = - \frac{P_J^* Y_J}{Y_F} F_H + P_J^* A Y_J$$

$$\frac{1}{\theta} \frac{F_H}{Y_F} = A + \frac{1 - \theta}{\theta} \frac{F_S}{Y_F} \quad \text{or} \quad F_H = \theta A Y_F + (1 - \theta) F_S$$

(13)

Demands:

$$F_H = F_S + \theta (A Y_F - F_S),$$

$$N = (1 - \theta) \frac{P_J^*}{P_N} \left[A Y_J - \frac{Y_J}{Y_F} F_S \right], \quad \text{and}$$

$$F_M = 0$$

(14)

Note: Subsistence requires $A Y_J > \dfrac{Y_J F_S}{Y_F}$ or $A Y_F > F_S$.

Consumption demand function for food is the same in Case II and Case III, although production decisions are different, i.e., complete rice specialization in Case II, and partial rice specialization limited to the extent of family consumption demand for food (F_H) in Case III.

It is to be emphasized that Case III emerges in place of Case I or Case II, as a result of the fact that the expected purchase price of rice (P_{F1}^*) is higher than the expected sale price of rice (P_{F2}^*). Hence, $P_{F1}^* > P_{F2}^*$ is a sufficient condition for Case III (subsistence farming) to exist.[4]

4/ Risk and uncertainty about prices and crop yields could be additional factors responsible for the practice of subsistence farming. In our model the introduction of risk and uncertainty will increase the size of Category III (i.e., (β). See /_6: 96-97_/.

II.2.(iv)   Concluding Remarks on the Various Production Possibilities

In the case of a single farm unit for which the Y_J and Y_F are given, three production possibilities exist, depending on the prices and yields involved: $P_{F1}^* Y_F$, $P_{F2}^* Y_F$, and $P_J^* Y_J$. The possibilities are:

If,

1. $P_J^* Y_J > P_{F1} Y_F$ jute specialization (Case I)

2. $P_J^* Y_J < P_{F2}^* Y_F$ rice specialization (Case II)

3. $P_{F2}^* Y_F < P_J^* Y_J < P_{F1}^* Y_F$ rice production to meet F_H and jute cultivation on the remaining land (Case III)

4. $P_J^* Y_J = P_{F1}^* Y_F$ either (Case I) or (Case III)

5. $P_J^* Y_J = P_{F2}^* Y_F$ either (Case II) or (Case III)

Possibility 5 becomes a clear-cut Case III when we introduce risk.

Even if possibilities 4 and 5 retain their dual character, our model remains fully workable at the aggregate level since we lump Case I with Case III, and Case II with Case III; whereas Case I and II are mutually exclusive.

In the above section we have worked out the relevant consumption demand functions for all the three production possibilities. It should be noted that, given the relevant prices and crop yields, only one of the above-mentioned possibilities will prevail in the case of a single farm unit.

II.3.(i)   Marketable Surplus Function: Cross-sectional Level:

Contrary to jute, the marketed surplus functions for rice are of great interest since a substantial part of the rice produced is consumed by the farmers themselves.

In the framework of our model, marketable surplus of rice can only originate from farm units in Category II if the rice production exceeds the consumption demand for food at the farm. Thus for the i th farm unit in Category II, the marketable surplus can be derived as:

Production for the i th farm (Category II) $= A_i Y_{Fi}$ -----(15)

From Equation (11):

Rice consumption for the i th farm (Category II):

$$= F_{Si} + \theta (A_i Y_{Fi} - F_{Si}) \qquad ---- (16)$$

Marketable surplus of rice for the i th farm unit $(S_i) =$

$$A_i Y_{Fi} - \left[F_{Si} + \theta (A_i Y_{Fi} - F_{Si}) \right] \qquad ------ (17)$$

Equation (17) shows that over the various farm units, S will vary positively with the output and inversely with the dependent family size. In case S is in relative terms (e.g., S as a percentage of total rice production) then the variation in S will be positively related to Y_F (or some proxy variable to indicate differences in productivity), and negatively with family size [5]. Of course, if farm units are scattered over space and sell their produce in a common market, then any variable indicating the cost of transportation, etc., will also be important in explaining variation in S over farms.

It should be noted that in setting up the model, the complications arising from the land tenure (or crop sharing) practices are ignored. Our model is that of a farmer who owns the land being cultivated. An additional variable indicating the crop sharing arrangements (i.e., rent paid) will be necessary when the farm unit in question is not owned by the cultivator.

5/ Requibuzzaman's empirical study on East and West Pakistan /¯15_/ found results consistent with the implication of our model at the cross-sectional level.

II.3.(ii) Aggregation at the Farm Sector Level

When a large number of farm units within a farm sector
are considered we are bound to find variation in the crop yield of jute
(Y_J) relative to the crop yield of rice (Y_F) per unit of land. This
is inevitable as land is not homogeneous in productivity due to diffe-
rences in soil and weather conditions and other factors that influence
the crop yields. Some farm units will have higher productivity for rice
cultivation, and others for jute cultivation.

Thus, given the level of P_J^* and P_{F1}^* (and P_{F2}^*), all the three
production possibilities mentioned under II.2.(iv) can be found for the
farm sector as a whole, though they were mutually exclusive in the case
of a single farm unit due to the constant Y_J/Y_F.

For aggregation all the farm units are classified into the above
three possible cases. By assigning weights on the basis of land contain-
ed in each category relative to the total land in the farm sector, we will
sum up the jute and rice acreage separately. The weights for each pro-
duction mix category are:

γ = proportion of total farm land under Category I (Case I):
complete jute specialization. It includes farm units for which

$$P_J^* Y_J \geq P_{F1}^* Y_F$$

α = proportion of total farm land under Category II (Case II):
complete rice specialization. It includes all farm units for which

$$P_J^* Y_J \leq P_{F2}^* Y_F$$

β = proportion of total farm land under Category III (Case III):
partial rice specialization to the extent of $F_H \geq F_S$ and jute cultivation

on the leftover land. It consists of farm units for which

$$P^*_{F2}Y_F \leq P^*_J Y_J < P^*_{F1}Y_F$$

Since γ, α and β are expressed in land in each category as a proportion of the total farm land (A), $\gamma + \alpha + \beta = 1$.

Before proceeding further, we redefine the following notations, and make an additional assumption:

Y_{JII} = normal yield of jute per acre in Category II.

Y_{FII} = normal yield of rice per acre in Category II.

F_S = minimum food required for farmer's household in order to survive in the farm sector as a whole.

P = farm population.

Assumption (vii): The population in the farm sector is evenly distributed over the area under cultivation. Thus, weights γ, α and β also reflect the relative distribution of population in Category I, II, and III, respectively.

This assumption is made for simplification only. Its removal does not upset the model or the results obtained from it.

II.3.(iii) Marketable Surplus Function At the Aggregate Level:

Since Category II is the only source of marketable surplus for rice, we can derive the marketable surplus function as follows, provided the relevant prices (P^*_{F1}, P^*_{F2}, P^*_J) and relative crop yields (Y_{FII}/Y_{JII}) remain constant:

Rice area in Category II   = αA

Rice production in Category II = $\alpha A Y_{FII}$

Rice Consumption in Category II $= \alpha \left[F_S + \theta (AY_{FII} - F_S) \right]$

Rice marketable surplus $= \alpha AY_{FII} - \alpha \left[F_S + \theta (AY_{FII} - F_S) \right]$

$$\dots\dots(18)$$

Equation (18) shows that the aggregate marketable surplus (S) is determined by the relative size of Category II (i.e., α), rice productivity (Y_{FII}) and the minimum food required to sustain the dependent farm population in Category II. Equation (18) holds only at a given point of time when the relative size of Category II is constant

II.3.(iv) Price Response of the Marketable Surplus in the Course of Time.

In the course of time, however, the relative size of Category II cannot remain constant when the relevant prices and crop yields show variation.

From the conditions laid out earlier for the various production possibilities, and assuming linear relationship:

$$\alpha = g_0 + g_1' \frac{P^*_{F2}}{P^*_{J}} \quad \text{or} \quad \alpha = g_0 + g_1 \frac{P^*_{F1}}{P^*_{J}}$$

(assuming that P^*_{F1} bears a constant relationship with P^*_{F2} in the course of time)

By putting the values of α, Equation (18) becomes:

$$S = \left[(g_0 + g_1 \frac{P^*_{F1}}{P^*_{J}}) \bar{A} Y_{FII} \right] - \left\{ (g_0 + g_1 \frac{P^*_{F1}}{P^*_{J}}) \left[F_S + \theta (\bar{A} Y_{FII} - F_S) \right] \right\} \quad \dots\dots\dots\dots\dots\dots(19)$$

In the course of time, the dependent farm population will be growing (i.e., $\frac{\dot{P}}{P} > 0$). In case the population is growing faster than rice productivity ($\frac{\dot{P}}{P} > \frac{\dot{Y}_{FII}}{Y_{FII}}$) when total land is fixed, and

$\frac{\dot{P}}{P} > (1 + \frac{\dot{A}}{A}) \frac{\dot{Y}_{FII}}{Y_{FII}}$ when land is growing also, the minimum subsistence food requirements (F_S) will tend to grow also.

Assuming that under the influence of $\frac{\dot{P}}{P} > \frac{\dot{Y}_{FII}}{Y_{FII}}$ or $\frac{\dot{P}}{P} >$

$(1 + \frac{\dot{A}}{A}) \frac{\dot{Y}_{FII}}{Y_{FII}}$, F_S takes the following functional form in time [6].

$$F_S = d_o + d_1 \, T \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(20)$$

Putting the values of F_S into (19):

$$S = \left[(g_o + g_1 \frac{P^*_{F1}}{P^*_J}) \bar{A} \, Y_{FII} - \left\{ (g_o + g_1 \frac{P^*_{F1}}{P^*_J}) \left[d_o + d_1 \, T \right. \right.$$

$$+ \, \theta \, \bar{A} Y_{FII} - \theta d_o - d_1 \theta \, T$$

$$\text{or} = \left[(g_o + g_1 \frac{P^*_{F1}}{P^*_J}) \bar{A} \, Y_{FII} \right] - \left[(g_o + g_1 \frac{P^*_{F1}}{P^*_J}) \right.$$

$$\left. (C_o + C_1 \, T + \theta \, \bar{A} \, Y_{FII}) \right]$$

where, $\left. \begin{array}{l} C_o = d_o - \theta \, d_o \\ C_1 = d_1 - \theta \, d_1 \end{array} \right\}$ and $\theta < 1$.

$$\text{or} = g_o \, \bar{A} \, Y_{FII} + g_1 \frac{P^*_{F1}}{P^*_J} \bar{A} \, Y_{FII} - g_o C_o - g_o C_1 \, T - g_o \, \theta \, \bar{A} \, Y_{FII}$$

$$- \frac{P^*_{F1}}{P^*_J} (C_o g_1) - \frac{P^*_{F1}}{P^*_J} \, T \, (g_1 C_1) - \frac{P^*_{F1}}{P^*_J} (g_1 \, \theta \, \bar{A} \, Y_{FII})$$

$$\text{or} \quad S = b_o + b_1 \frac{P^*_{F1}}{P^*_J} - b_2 \, T \frac{P^*_{F1}}{P^*_J} - b \, T \quad \dots\dots\dots(21)$$

6/ This is only a suggested functional form. We do not mean to exclude other forms.

where, $b_o = g_o \bar{A} Y_{FII} - g_o C_o - g_o \theta \bar{A} Y_{FII}$

$b_1 = g_1 \bar{A} Y_{FII} - C_o g_1 - g_1 \theta \bar{A} Y_{FII}$

$b_2 = g_1 C_1$

$b_3 = g_o C_1$

An examination of Equation (21) shows interesting results. In order to answer the question whether the marketable surplus of rice responds to price or not, we have to examine the probable sign of

$b_1 = g_1 \bar{A} Y_{FII} - C_o g_1 - g_1 \theta \bar{A} Y_{FII} = g_1 (1-\theta) \bar{A} Y_{FII} - g_1 (1-\theta) d_o,$

as $C_o = d_o - \theta d_o$.

Since within the framework of our model, the relative size of Category II responds positively to the relative price of rice i.e., P^*_{F1}/P^*_J, g_1 is positive. g_1 being positive and $\theta < 1$ (due to the existence of non-food substitutes, one can say that $g_1 (1 - \theta) \bar{A} Y_{FII} >$ $g_1 (1 - \theta) d_o$ since $\bar{A} Y_{FII} (= $ total rice output in category II) is larger than some constant (d_o) quantity of food required to meet the minimum subsistence requirements. $\bar{A} Y_{FII}$ has to be larger than d_o by the mere fact that Category II is a category in which marketable surplus exists. Thus by virtue of the fact that

$\bar{A} Y_{FII} > d_o \Rightarrow g_1 (1 - \theta) \bar{A} Y_{FII} > g_1 (1 - \theta) d_o \Rightarrow$

$b_1 > o,$ since $g_1 > o,$ $\theta < 1$ and

$b_1 = g_1 (1 - \theta) \bar{A} Y_{FII} - g_1 (1 - \theta) d_o,$ we put forward the following hypothesis:

Hypothesis No.1. If marketable surplus of a subsistence crop ever exists, it will respond positively to price[7].

An examination of Equation (21) will show that the price response of marketable surplus declines as a result of the population pressure (i.e., $\dfrac{\overset{\cdot}{P}}{P} > (1 + \dfrac{\overset{\cdot}{A}}{A}) \overset{\cdot}{Y}_{FII}$). The adverse effect of the population pressure on the price response of S is unambiguous since the co-efficient $b_2 = g_1 c_1$ is positive, as $g_1 > o$ and $c_1 > o$.

Hypothesis No.2: The price response of the marketable surplus of a subsistence crop declines in the course of time as a result of the growing population pressure (i.e., $\dfrac{\overset{\cdot}{P}}{P} > (1 + \dfrac{\overset{\cdot}{A}}{A}) \overset{\cdot}{Y}_{FII}$).

Hypothesis No.2. is very useful in pointing out the limitations of price policy in the agricultural sector which is growing but not as fast as to off set the population pressure. The hypothesis is also useful in understanding some of the riddles relating to the behaviour of the marketable surplus of agricultural commodities. For example, in the Twentieth Conference of the Indian Society of Agricultural Economics it was noted that:

'The views of the contributors on this point are disconcerting. Quite a few of them contended that the marketable surplus is not increasing in proportion to the rise in food production. Others have expressed the view that there is an absolute decline in it. As against the known current level of marketable surplus of 20 - 25 million tons, one of the contributors indicates that it will be 17 million tons in 1961. The market arrivals indicate a lower marketable surplus than that which obtained in the pre-war years' /¯7: 115_7.

7/ It should be noted that the price referred to is not absolute price. The concept of price used is a more complex one due to/existence of production and market alternatives.

The causes of the probable decline in the agricultural marketable surplus can be traced within the framework of our model. They could be the growing population pressure and/or the adverse movements in the agricultural prices.

II.4. Non-farm Supply Function of Subsistence Crop.

Whereas Category II is the source of marketable surplus, farm units in Category I purchase food. Taking the sales and purchases made by both the categories into account, we can derive a supply function of rice for the non-farm sector[8].

Marketable surplus (Category II):

$$= \alpha \, \Delta Y_{FII} - \gamma \left[F_S + \theta \, (\Delta Y_{FII} - F_S) \right] \qquad \text{(Equation 18)}$$

Food demand by Category I

$$= \gamma \, \theta (\Delta Y_{\cdot I}) \, \frac{P_J^*}{P_{F1}^*} + \gamma (1 - \theta) \, F_S \qquad \text{(From Equation 8)}$$

Supply function for the non-farm sector $= S_{n.f.} =$

$$\alpha \, \Delta \dot{Y}_{FII} - \alpha \left[F_S + \theta \, (\Delta Y_{FII} - F_S) \right] - \left[\gamma \, (\theta \, \Delta Y_{JI}) \, \frac{P_J^*}{P_{FI}^*} \right.$$

$$\left. + \gamma (1 - \theta) \, F_S \right] \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(22)$$

Putting the values for α and F_S into Equation (22) and giving the following form:

$$\gamma = b_o - b_1 \, \frac{P_{FI}^*}{P_J^*} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(23)^{[9]}$$

8/ Non-farm sector includes the urban-industrial sector and those who reside and draw income in the rural areas but do not cultivate land and depend on those who are engaged in farming.

9/ The rationale underlying this suggested functional form is explained under section II.2.(iv)

$$S_{n.f.} = \left[(g_o + g_1 \frac{P^*_{FI}}{P^*_J}) \bar{A}Y_{FII} \right] - \left[(g_o + g_1 \frac{P^*_{FI}}{P^*_J}) (d_o + d_1 T + \theta \bar{A}Y_{FII} \right.$$

$$\left. - \theta d_o - d_1 \theta T) \right] - \left[(b_o + b_1 \frac{P^*_{FI}}{P^*_J}) \theta \dot{A}Y_{JI} \frac{P^*_J}{P^*_{FI}} + \right.$$

$$\left. (b_o + b_1 \frac{P^*_{FI}}{P^*_J}) (d_o + d_1 T - \theta d_o - \theta d_1 T) \right]$$

$$or \quad = (1 - \theta)(g_o \bar{A}Y_{FII} - g_o d_o - b_o d_o) - b_1 \theta \bar{A}Y_{JI} +$$

$$\frac{P^*_{FI}}{P^*_J} \left[(1 - \theta)(g_1 \bar{A}Y_{FII} - g_1 d_o - b_1 d_o) \right] - \frac{P^*_{FI}}{P^*_J} T$$

$$\left[(1 - \theta)(g_1 d_1 + b_1 d_1) \right] - \frac{P^*_J}{P^*_{FI}} (b_o \theta \bar{A}Y_{JI}) -$$

$$T \left[(1 - \theta)(g_o d_1 + b_o d_1) \right]$$

$$or \quad S_{n.f.} = \pi_o + \pi_1 \frac{P^*_{FI}}{P^*_J} - \pi_2 T \frac{P^*_{FI}}{P^*_J} - \pi_3 T - \pi_4 \frac{P^*_J}{P^*_{FI}}$$

$$\dots\dots(24)$$

where,

$$\pi_o = (1 - \theta)(g_o \bar{A}Y_{FII} - g_o d_o - b_o d_o) - b_1 \theta \bar{A}Y_{JI}$$

$$\pi_1 = (1 - \theta)(g_1 \bar{A}Y_{FII} - g_1 d_o - b_1 d_o)$$

$$\pi_2 = (1 - \theta)(g_1 d_1 + b_1 d_1)$$

$$\pi_3 = (1 - \theta)(g_o d_1 + b_o d_1)$$

$$\pi_4 = b_o \theta \bar{A}Y_{JI}$$

An examination of Equation (24) shows that the supply/subsistence

crop responds positively to $\dfrac{P^*_{FI}}{P^*_J}$ when $g_1 \bar{A} Y_{FII} > (g_o d_o + b_o d_o)$

and this price response definitely declines due to the population pressure

through π_2 and π_3. The results are similar to those noted in

Equation (21).

III. Policy Implications:

As emphasized else where [6: chapter 7] , price incentives

can play a great role in mobilizing marketable surplus since the price

response of marketable surplus is positive. We should hasten to add

that although a positive price policy is a useful instrument for

mobilizing marketable surplus, its effectiveness declines in time for

an agricultural sector where population pressure is growing (i.e.,

$\dfrac{\dot{P}}{P} > (1 + \dfrac{\dot{A}}{A}) \dot{Y}_F$.

In the short-run, the usefulness of price policies can hardly

be emphasized due to the factor that any direct interference to mobilize

marketable surplus will not only cause disincentives for farmers but

also will be extremely costly and cumbersome to be enforced.

However, due to the increasing limitations on the price policies,

it is essential that other policies should be adopted to reduce the

population pressure in the farm sector. This will involve raising the

area under crops as well as raising crop yields to such an extent

that $\dfrac{\dot{P}}{P} > (1 + \dfrac{\dot{A}}{A}) \dfrac{\dot{Y}_F}{Y_F}$. In countries like India and Pakistan,

considerable attention has been given to increase the cultivable land

resources. We think that concerted efforts should be made to raise

crop yields on a continuing basis. This will be the only sure way to

increase the agricultural marketable surplus and ease its response to

price.

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