MARKETED SURPLUS OF PADDY AT THE FARM LEVEL IN BANGLADESH: AN ANALYSIS BY CAUSAL VARIABLES OF PRODUCTION AND CONSUMPTION

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ABSTRACT

Two basic factors-paddy production and rice consumption-determining marketed surplus of paddy were analysed in terms of their causal variables using data collected from three categories of farmers randomly selected from different parts of Bangladesh. The causal variables considered were paddy area and yield as determinants of paddy production; farm size and intensity of paddy cultivation as determinants of paddy area; resource endowment, tenurial status and HYV technology as determinants of paddy yield; family size measured in adult male equivalent unit as determinant of rice consumption. Land being limited in the country, yield expansion measures are particularly suggested for increasing production and marketed surplus of paddy. Family planning measures are also expected to contribute to the increase in marketed surplus.

1. INTRODUCTION

Bangladesh is trying desperately to augment paddy production in the face of rapid population growth. But increased production to be meaningful must be accompanied by an increase in marketed surplus which ensures food supply to the non-agricultural sector and relieves pressure on hard earned foreign exchange reserves. Since a variety of factors seem to affect directly or indirectly the volume of production and consumption and thereby the volume of marketed surplus, the identification on these factors may have important policy implications regarding the marketed surplus of paddy at the farm levels.

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Inspite of its considerable significance in the economy, marketed surplus of paddy has received only limited attention of researchers in Bangladesh. Raquibuzzaman (1966) observed that production and family size were the principal determinants of marketed surplus of paddy. Rahman (1980) also found that per capita production had significant positive effect on marketed surplus ; while Murshed and Rahman (1987) showed that size of family as a unit of consumption had significant negative impact on marketed surplus of paddy. However, these studies failed to identify the causal variables of production which might exert considerable impact on marketed surplus. Unless these causal factors are identified and their relative impact on marketed surplus is ascertained, any attempt at increasing marketed surplus of paddy is likely to be ineffective.

In a recent study, QuaSem (1987) analysed marketed surplus of paddy in terms of per capita production, price, cultivated land, income and institutional loan and found that per capita production, price, cultivated land and income exerted significant positive impact on marketed surplus of paddy ; while the impact of institutional loan was insignificant. He treated cultivated land, income and institutional loan as independent variables rather than as causal variables of paddy production.

In the present study, an attempt has therefore been made to regress a number of causal variables of production and consumption on marketed surplus of paddy. More specifically, the objectives of this study are : (i) to estimate the volume of marketed surplus of paddy in relation to size of holding and (ii) to identify the factors influencing paddy production and consumption and determine their relative impact on the marketed surplus.

The next section provides data sources and presents methodological framework. Section III summarizes findings of the study. Policy implications are given in the concluding section.

II. SOURCES OF DATA AND METHODOLOGICAL FRAMEWORK

Sources of Data

The data have been collected from different parts of the country to make the study broad based and more representative. Data on which this study is based was collected from eight districts of the country, viz., Dinajpur and Pabna in Rajshahi division, Jessore and Satkhira in Khulna division, Mymensingh and Narsingdi in Dhaka division, Sunamganj and Chittagong in Chittagong division. For analytical purposes, farmer-sellers of paddy were classified into 3 strata according to their farm sizes : small (0.20 to 0.99 hectare), medium (1.00 to 2.00 hectares) and large (above 2.00 hectares). A total of 240 farmer-sellers of paddy, viz., 30 from each district and 80 from each stratum were randomly selected for interview [1]. The data covered 1986-87 crop year.

A questionnaire was carefully designed to elicit relevant information from the respondents as comprehensively as possible. Eight undergraduate students of agricultural

economics at Bangladesh Agricultural University and belonging to the eight selected districts were chosen for data collection through face to face interview. The investigators were sent to their respective survey areas after a brief session of training and directives regarding data collection. The data thus collected were carefully scrutinized and a number of filled-in questionnaires were altogether rejected on the ground of inconsistent answers. As a result, the total number of samples stood at 222 and the sample sizes of small, medium and large farms became 80, 70 and 72 respectively.

Methodological Framework

Marketed surplus of paddy has been defined as the gross quantity of produce actually sold by the farmers. Following the leasing practices in the study areas, paddy production has been considered to include full production from own land plus half production from rented-out and rented-in land plus full production from mortgaged-in land. The paddy area and farm size have also been estimated on the basis of such tenurial arrangements. Rice consumption (paddy equivalent) includes the quantity of rice actually consumed by the family members, permanent and casual labourers and guests.

One-way analysis of variance has been conducted in order to examine the significance of the differences between the average marketed surplus of paddy in selected farm types. The same analysis has also been done for paddy production and rice consumption.

In a largely peasant economy like Bangladesh, marketed surplus depends on two basic factors : production and consumption[2]. Obviously, the greater the volume of production, the greater would be the surplus, other things remaining the same. Similarly, the greater the proportion that is consumed out of a given volume of production, the lesser would be the surplus. Since a variety of factors seem to affect directly or indirectly the volume of production and consumption, they may be considered as causal variables influencing marketed surplus of paddy. In order to identify these variables, we have assumed the following identity equation as well as functional relationships (which, by no means, are exhaustive) as given :

$$P = A \times Y$$
$$A = f (S, I)$$
$$Y = f (M, L, T)$$
$$C = f (F)$$

where,

P = Paddy production in metric tons annually,

A = paddy area in hectares.

Y = paddy yield per hectare in metric tons,

S = farm size in hectares,

I = intensity of paddy cultivation in percentage,

i. e., $\dfrac{A}{S}$ X 100

M = resource endowment measured by on-farm and off-farm annual family income in '000 Taka,

L = tenurial status of the farmers measured by owned and cultivated paddy area in hectares,

C = family consumption of rice (paddy equivalent) in metric tons annually,

F = family size measured in adult male equivalent unit according to the conversion rate : adult male = 1, adult female = 0.8 and child = 0.6,

F = functional relationship.

Like other studies (Hussein and Rajbanshi 1985 ; Quasem 1987), we have developed single equation models to examine the impact of the causal factors which affect the marketed surplus indirectly[3]. But what makes our study different is that we first identified these variables on the basis of the above functions and then incorporated them to develop the following three alternative single equation models :

$$\log MS_t = a_{jt} + b_{ijt} \log A + b_{ijt} \log Y$$
$$- b_{ijt} \log F \quad \dots \quad \dots \quad \dots \quad \text{Model I}$$

$$\log MS_t = a_{jt} + b_{ijt} \log S + b_{ijt} \log I$$
$$+ b_{ijt} \log Y - b_{ijt} \log F \dots \quad \dots \quad \text{Model II}$$

$$\log MS_t = a_{jt} + b_{ijt} \log A + b_{ijt} \log M + b_{ijt} \log L$$
$$+ b_{ijt} \log T - b_{ijt} \log F \dots \quad \dots \quad \text{Model III}$$

where,

MS_t = marketed surplus of paddy in metric tons for t-th farm type ; $t = 1, 2$ and 3.

a_{jt} = constant term (intercept value) of the equation in j-th model for t-th farm type ; $j = 1, 2$ and 3.

b_{ijt} = regression coefficient of the i-th variable in j-th model for t-th farm type representing elasticity of marketed surplus with respect to i-th variable ; $i = 1, \dots\dots, 8$.

Utilizing the stepwise method[4], nine least squares regression equations were fitted to the above models.

III. RESULTS AND DISCUSSION

Production, Consumption and Marketed Surplus of Paddy.

The estimated average annual production, consumption and marketed surplus of paddy of the selected farm types are presented in Table 1. An analysis of the data reveals the following features:

(a) The average productions of paddy for small, medium and large farms were 2.43, 4.60 and 11.03 metric tons respectively, while the marketed surplus were about 26, 28 and 36 percent of production for the respective farm types.

TABLE 1. ANNUAL AVERAGE PRODUCTION, CONSUMPTION AND MARKETED SURPLUS OF PADDY PER FARM ACCORDING TO FARM TYPES AND THEIR ONE-WAY ANALYSIS OF VARIANCE

Farm type	Production	Consumption	Marketed surplus
	Metric tons		
Small farm	2.43	2.14	0.64
Medium farm	4.60	3.06	1.29
Large farm	11.03	4.51	3.93
	F-ratio		
Between farms	100.13**	86.04**	53.15**
	Scheffe's range test		
Between Small & medium	S	S	NS
Between Small & large	S	S	S
Between Medium & large	S	S	S

**Highly significant.
S = Significant atleast at 5 percent level.
NS = Not significant at 5 percent level.

(b) Production, consumption and marketed surplus increased with an increase in the size of holding. However, as expected, with given increase in production, the rate of increase in consumption was considerably lower than that in marketed surplus.

(c) In the case of small farms, the balance was negative, viz., marketed surplus and family consumption together exceeded production. This indicates the prevalence of distress sale[5] among farmers belonging to the small size group.

(d) The F-test establishes the fact that the difference in production, consumption and marketed surplus between the farm types were highly significant.

(e) The Scheffe's test shows that the production and consumption of small farms were significantly different from those of medium and large farms and also the production, consumption and marketed surplus of medium farms were significantly different from those of large farms. The test also reveals that the marketed surpluses of small and medium farms were not statistically significant. Interestingly, the Scheffe's test reinforces our finding of the prevalence of distress sale for small farms, which tended to increase their marketed surplus.

FACTORS AFFECTING MARKETED SURPLUS OF PADDY FOR SMALL, MEDIUM AND LARGE FARMS

Regression estimates of the three models using alternative sets of explanatory variables are presented in Tables 2 through 4. With the exception of two equations, all the estimated equations showed satisfactory adjusted R^2 in so far as they exceeded 0.50. Since an explanatory variable was substituted by its causal variables, the adjusted R^2, as expected, did not vary significantly. This implies that any of the three models using alternative sets of explanatory variables could serve the purpose. All the explanatory variables when appearing in an equation showed expected signs for their coefficients. Judged by F-values, all the estimated equations yielded an excellent fit. The regression estimates of the three categories of farms with alternative sets of explanatory variables under three different models are analysed below.

Model I : In this model the marketed surplus of paddy has been regressed on three variables—paddy area, paddy yield and family size. The paddy area and yield turned out to be highly significant and their effects on marketed surplus were positive for all the three categories of farms. Table 2 shows that the magnitude of area coefficient (1.22887) was much lower than that of yield coefficient (1.97292) for small farms, while they were almost equal for medium and large farms. This indicates that the response of marketed surplus of paddy to a given percentage change in paddy yield was greater than that of paddy area for small farms, while a given percentage increase in either paddy area or paddy yield tended to increase marketed surplus of paddy by about equal percentage for each of medium and large farms.

TABLE 2. EFFECTS OF SELECTED FACTORS USED IN MODEL I ON MARKETED SURPLUS OF PADDY FOR SMALL, MEDIUM AND LARGE FARMS IN BANGLADESH.

Selected factors & related statistics	Small farm	Meidum farm	Large farm
Regr. coefficient			
Paddy area	1.22887** (0.19194)	1.96142** (0.30417)	1.84152** (0.19716)
Paddy yield	1.97292** (0.29963)	2.14774** (0.25956)	1.56479** (0.29858)
Family size	N.E.	—0.79488** (0.29581)	—0.84609** (0.22745)
Constant term	—1.13705	—0.78814	—0.50101
Adjusted R²	0.5198	0.5598	0.6253
F-value	43.75**	30.24**	40.49**
D.F.	2, 77	3, 66	3, 68

Figures in parenthesis indicate standard error of regression coefficient.

**Significant at 0·01 leve l.

N.E. = Not entered in the model due to non-fulfilment of criteria.
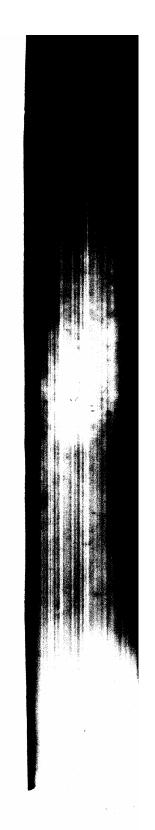
TABLE 3. EFFECTS OF SELECTED FACTORS USED IN MODEL II ON MARKETED SURPLUS OF PADDY FOR SMALL, MEDIUM AND LARGE FARMS IN BANGLADESH

Selected factors & related statistics	Small farm	Medium farm	Large farm
Regr. coefficient			
Farm size	1.24922**	1.91849**	1.74968**
	(0.22120)	(0.54472)	(0.21131)
Intensity of paddy	1.16957**	1.97017**	2.12813**
cultivation	(0.36886)	(0.31991)	(0.31169)
Paddy yield	1.97702**	2.14962**	1.45793**
	(0.30231)	(0.26227)	(0.31106)
Family size	N.E.	-0.78614**	-0.77149**
		(0.31182)	(0.23536)
Constant term	-3.46440	-4.73117	-4.75824
Adjusted R^2	0.5137	0.5530	0.6275
F-value	28.81**	22.34**	30.90**
D.F.	3, 76	4, 65	4, 67

Figures in parenthesis indicate standard error of regression coefficient.

**Significant at 0·01 level.

N.E.—Not entered in the model due to non-fulfilment of criteria.

**TABLE 4. EFFECTS OF SELECTED FACTORS USED IN MODEL III ON
        MARKETED SURPLUS OF PADDY FOR SMALL, MEDIUM AND
        LARGE FARMS IN BANGLADESH**

Selected factors & related statistics	Small farm	Medium farm	Large farm
Regr. coefficient			
Paddy area	1.83720** (0.32000)	N.E.	1.35896** (0.26900)
Resource endowment	N.E.	N.E.	N.E.
Tenurial status	N.E.	0.84203** (0.32453)	N.E.
HYV technology	N.E.	0.62553** (0.18446)	0.47432** (0.12119)
Family size	N.E.	N.E.	-0.64385** (0.25400)
Constant term	-0.27028	-0.07270	0.21189
Adjusted R^2	0.4100	0.3052	0.5750
F-value	32.96**	13.52**	28.51**
D.F.	1, 45	2, 55	3, 58

Figures in parenthesis indicate standard error of regression coefficient.

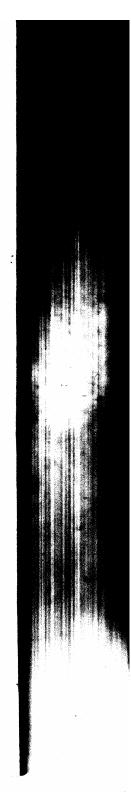**Significant at 0.01 level.

N.E. Not entered in the model due to non-fulfilment of criteria.

2—

As expected, family size as a causal variable of rice consumption exerted negative and significant effect on marketed surplus of paddy for medium and large farms. But it failed to get a berth in the equation for small farms due to its insignificant negative effect on the marketed surplus. The insignificant negative coefficient of family size was not considered as surprising since it has a particular relevance to the earlier finding of distress sale for small farms. The distress sale and family size are likely to be positively related and therefore the insignificant coefficient of family was not unlikely.

Model II :   Among the two primary factors affecting paddy production, this model retained paddy yield and used farm size and intensity of paddy cultivation in place of paddy area.   These two causal variables of paddy area turned out to be highly significant and their regression coefficients bore expected signs for all the three categories of farms. To be more specific, a 10 percent increase in farm size, other things remaining constant, would result in about 12 percent increase in marketed surplus of paddy for small farms, 19 percent increase for medium farms and 17 percent increase for large farms. Similarly, a 10 percent increase in intensity of paddy cultivation, other things remaining constant, led to about 12, 20 and 21 percent increase in the marketed surplus for small, medium and large farms respectively. It is interesting to note that this model reaffirmed the coefficient of paddy yield in model I in so far as the magnitude, direction and level of significance were concerned. The coefficients of family size also corroborated our previous findings, i.e., the negative impact of family size on the marketed surplus was significant for medium and large farms, while its impact on the marketed surplus for small farms was insignificant. A 10 percent increase in the family size, ceteris paribus, resulted in about 8 percent decrease in marketed surplus of paddy each for medium and large farms (Tables 2 and 3).

Model III :   Finally, this model retained paddy area and family size and considered resource endowment, tenurial status and HYV technology in lieu of paddy yield as factors affecting marketed surplus of paddy. The incorporation of the explanatory variables of paddy yield gave the following results :

(a)   In case of small farms, none of the explanatory variables of paddy yield turned out to be significant (Table 4). It seems that their significance was not reflected in the corresponding equation owing to the presence of another significant variable, paddy area, which was observed to be strongly correlated with resource endowment (0.809) and tenurial status (0.754).

(b)   The tenurial status and HYV technology were found to be the most significant positive determinants of marketed surplus of paddy for farmers belonging to the medium size group. A 10 percent increase in the cultivation of owned land, ceteris paribus, resulted in about 8 percent increase in the marketed surplus. Similarly, a 10 percent increase in the cultivation of high yielding varieties, all other things remaining constant, would lead to about 6 percent increase in the marketed surplus. Since the tenurial status, a

significant variable, was found to be strongly correlated with paddy area (0.806), the latter turned out to be an insignificant variable. Moreover, the significance of negative impact of family size got reduced to 10 percent level and therefore, contrary to our earlier findings, it failed to enter into the corresponding equation.

(c) In case of large farms, the HYV technology was observed to have a positive and significant impact on marketed surplus of paddy. A 10 percent increase in the cultivation of high yielding varieties, keeping all other things constant, resulted in about 5 percent increase in the marketed surplus. The tenurial status seems to be an important factor affecting marketed surplus, but it could not show its significance due to the presence of another significant but strongly correlated (0.855) variable, paddy area.

IV. POLICY IMPLICATIONS

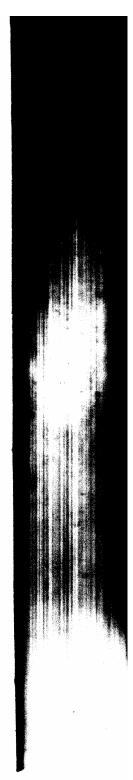The findings of the study indicate the following important policy implications :

(a) Production, consumption and marketed surplus of paddy in Bangladesh were found to be positively related with the size of land holdings. However, in the case of small farms, marketed surplus and family consumption together exceeded production signifying prevalence of distress sale among farmers belonging to the small size group. This calls for special policy measures for them in order to increase their sustaining power and thereby reduce their obligatory sales. The factors causing distress sales among the small farmers should however be analysed thoroughly before making any policy recommendation.

(b) Marketed surplus can be increased by increasing paddy production of all categories of farms in Bangladesh. This can be achieved either through expansion of paddy area or through paddy yield.

(c) Although the causal variables of paddy area, i.e., farm size and intensity of paddy cultivation seem to have significant positive impact on marketed surplus, the change of farm size is difficult due to socio-economic and institutional limitations. Emphasis should therefore be given on increasing intensity of paddy cultivation through effective technology like irrigation and hybrid seed with short maturation period.

(d) Land being extremely limited in Bangladesh, emphasis should also be given on yield expansion measures. Since the present analysis of the explanatory variables of paddy yield got vitiated on account of multicollinearity, further research is suggested for the future. Inspite of the problem of multicollinearity, the present study however indicates that the relative significance of each of the causal variables of paddy yield varied considerably among the different farm size groups. This suggests that the limitations and prospects of each of the causal variables of yield in the case of different farm size groups

ought to be taken into consideration while preparing policy prescriptions for yield expansion in the country.

(e) Since family size was found to be inversely related with marketed surplus, particularly in case of medium and large farms, family planning measures are likely to contribute significantly to the increase of marketed surplus of paddy in the country.

NOTES :

(i) Since the equal number of samples (80) does not reflect the actual ratios between the different categories of farms (small, medium and large) in Bangladesh, the average estimates and regression statistics of "all farms" are not shown and analysed in this study to avoid possible biased results.

(2) In a commercial agriculture price should be treated as one of the basic determinants of marketed surplus since it pays an important role in farmers' marketing decisions. But in a subsistence agriculture like Bangladesh, farmers usually sell their produce to meet some specific cash requirements irrespective of prices and therefore price may not be considered as a primary factor affecting marketed surplus. This is substantiated by a number of Indian studies in which price as a determinant of marketed surplus has often been found to provide uncertain and contradictory results (Narain 1961 ; Krishna 1962 ; Krishnan 1965 ; Harriss 1982). Moreover, the price data in this study have been collected without monitoring and therefore, it has also been felt that the use of annual average paddy price as a variable determining marketed surplus of paddy would not serve any meaningful purpose, even for the large farms.

(3) In such cases the use of a structural model or simultaneous equations is preferable from methodological point of view. But we have deliberately refrained from doing so in order to avoid the complications that go with it.

(4) Among the various methods available in the SPSS PC$^+$ programme, the step wise method of entry and removal of independent variables which is really a combination of forward and backward procedures has been used in this study for estimating regression equations. The criteria for entry are : (a) the minimum value (3.84) of the F-statistics that a variable must achieve in order to enter ; (b) the probability associated with F-statistics called **probability of F to enter,** with a value of 0.05 ; (c) passing both tolerance and minimum tolerance (0.01) tests by the variable before entering the equation. The criteria for removal of a vriable are ; (a) the minimum F-value (2.71) that a variable must have to be able to remain in an equation ; and (b) the maximum probability (0.01) of F-to-remain a variable could have (Norusis 1986).

(5) Distress or obligatory sale usually signifies lack of real marketable surplus and curtailment of consumption and other requirements from own production.

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