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Research Note

CONTRIBUTION OF FACTORS TO SUGARCANE PRODUCTIVITY DIFFERENTIAL BETWEEN LARGE AND SMALL FARMS IN AN AREA OF BANGLADESH

Humayun Kabir

ABSTRACT

The present study attempts to determine the neutral technology, non-neutral technology and input use contribution differences between large and small sugarcane farms. Decomposition technique was used to achieve the study objectives. The contributions of neutral and non-neutral technologies were in favour of large farms. The input use contribution difference of large farms appeared to do better than small farms in sugarcane production. The study revealed that the highest input use contributing factor differences obtained by fertilizer followed by labour, pesticides with seed, and capital between large and small farms. The large sugarcane farms were more productive than small farms.

I. INTRODUCTION

Introduction of newly recommended sugarcane production technologies can play a vital role in increasing cane yield and sugar content significantly. The new technologies, including high yielding varieties of sugarcane have been developed to raise per hectare yield. The use of various technological input in the mill-zone areas has increased the yield by 25-30% r, during the last five years (Shajahan 1980).

Several studies were undertaken in India and Bangladesh to show the socio-economic i ffects of seed, fertilizer and water technology. The debate on farm size and productivity in Inwa and Bangladesh was initiated by Sen 1962, Khusro 190.4, Rao 1967, Hamunantha Rao 1968, Rudra 1968, Sainai 1969, Mahabub 1973, 1977, Asaduzzaman and Islam 1976, Rah 1988 and others, but the controversy has remained largely inconclusive. Majority of the above economic analysts observed an inverse relationship between farm size and output per hectare in the farm management studies. The explanations given for increased productivity on small farms include (i) intensive use of family labour on small farms, (ii) qualitative differences in land and labour inputs and (iii) cropping pattern, crop intensity and technological differences.

Mandal 1980 observed that productivity per acre increased upto certain level (about 4.00 acres) then decreased as the farms (2.00-3.99 acres) were found relatively more productive than large and small farms.

The author is a Senior Scientific Officer, Sugarcane Research and Training Institute, lshurdi. Pabna. The author is indebted to the anonymous referees for their very useful suggestions in revising the note into the present structure. However, responsibilities for any remaining errors lie with the author.

Khan 1979 and Mahmood 1981 of Pakistan suggested that where the large farmers switched to labour-saving technology, the inverse size productivity relation was replaced by a positive relation. Rathore 1984, an Indian economist, made a different approach in the controversy of farm size and productivity by using decomposition analysis. He estimated the productivity differential between small and large farms and then decomposed these difference into contributing factors which were grouped into three categories: (i) neutral technological differences, (ii) non-neutral technological differences and (iii) input use contribution. He found that small farms had higher level of output than large farms in Himachal Pradesh. Neutral technology was in favour of large farms and non-neutral technology was in favour of small farms. In case of input use difference contribution, small farms appeared to do better than large farms. Abedin and Bose 1988 also undertook a study on T. Aman rice at Thakurgaon. They estimated that neutral technology was in favour of small and medium farms as compared to large farms. Non-neutral technology was in favour of small farms as compared with medium and large farms. In the input use component, medium and large farms were better placed than small farms.

In the present study, an attempt has been made to look at the controversy of farm size and productivity using decomposition analysis. The decomposition technique allows one to have a more systematic look at the factors and their contribution to the productivity differentials between large and small farms. Technological differences are reflected in the scale parameters (neutral technology) and the production elasticities (non-neutral technology) of the production functions. The results of the study will have important implications for (i) land reform policies, (ii) allocation of public resources to help farmers increase efficiency and (iii) development of technology. This study has two sequential objectives:

(i) to estimate the productivity differential between large and small farms, and then
(ii) to decompose the productivity difference into contributing factors which are grouped into three categories
   a) neutral technological differences
   b) non-neutral technological differences, and
   c) input use contribution.

II. METHODOLOGY

The study was based on data collected from three purposively selected cane growing villages namely Puritan Ishurdi and Zukadaha villages of Lalpur Thana in the district of Natore and Ilshamari village of Ishurdi Thana in the district of Pabna. The availability of all categories of farmers and modern sugarcane culture were the main two reasons for selecting this area. Moreover, the above three villages are the project villages of the Bangladesh Sugarcane Research Institute where long established institutional framework and motivation has been going on regarding adoption of recommended technology such as improved variety, healthy seeds, early plantation, high land, medium high land use, fertilizer dose, row spacing,

trench planting, weeding and mulching (three times or more), earthing up, seed treatment, soil treatment, pest control and disease control.

In the selected villages, 54 farmers were selected randomly based on sugarcane farm size categories. The selection of sample farm was preceded by a preliminary survey in the area. Data were collected plot-wise from 97 sugarcane plots by interviews from the selected cane growers by the investigators staring from Jan. 1, 1988 to March 31, 1989. The sugarcane farms of small (0.0-0.6070 ha) and large (0.6071 ha and above) were classified.

The differences in technologies of production between large and small farms can be studied by analysing the parameters of production function of large and small farms.

Cobb-Douglas production function was chosen to estimate the productivity of large and small farms because it gave better fit to the data and found statistically more reliable. Let the function be specified as:

$$Y = A \prod_{i=1}^{m} X_i^{b_i} e^{u} \quad \ldots\ldots\ldots\ldots (1)$$

where Y represents per hectare quantity of output, X_i,s(i=1, 2, ...m) are the factors of inputs, A is the scale parameter (intercept), b_i's are the production elasticities and u is the disturbance term.

Subscripts L and S respectively for large and small farms were applied to the variables and parameters of the above production function. The difference between natural logarithms of productivity for large and small farms respectively (equation 1) may be written as:

$$LnY_L - LnY_S = (LnA_L - LnA_S) + \sum_{i=1}^{m} (b_{Li} LnX_{Li} - b_{Si} LnX_{Si}) \quad \ldots\ldots\ldots\ldots (2)$$

By adding and subtracting
$b_{Li} LnX_{Si}$ in (2)
By arranging the term for large and small farms.

$$LnY_L - LnY_S = (LnA_L - LnA_S) + \sum_{i=1}^{m} (b_{Li} - b_{Si}) LnX_{Si} + \sum_{i=1}^{m} (b_{Li} (LnX_{Li} - LnX_{Si}) \ldots\ldots\ldots (3)$$

The three components of the right hand side of equation (3) represent the productivity differences between large and small farms respectively due to differences in the neutral technology, non-neutral technology and the level of input use.

The variables of large and small farms are defined on per hectare basis and are given below.

Y = the output of sugarcane in kg.,
X_1 = consumption of nutrients (N + P205, + K2O) in kg.,
X_2 = man-hours equivalent of labour (family + hired),
X_3 = consumption of pesticides and seeds in Tk.,
X_4 = consumption of organic manure in kg.,

X_5 = bullock pair hours,
X_6 = gross value of assets,
X_7 = planting time in weeks,
U = disturbance term.

Production function was estimated by the method of ordinary least squares. Before fitting the production function, correlation matrices were examined to detect the multicollinearity problem. Using the parameters of Table 1 in equations 3, the contribution of factors to productivity differences between large and small farms were estimated.

• In the estimated models of large and small farms, seven independent variables (fertilizer, pesticides and seed combined, organic manure, human labour, bullock labour, capital and planting time) were specified.

Statistical significance of the individual regression coefficient was tested using t-statistics while that of regression equation by F-statistics. The significance of difference in the resource productivities of large and small farms was tested by Chow's F-statistic.

III. RESULTS AND DISCUSSION

The estimated parameters of the production function for large farms, small farms and pooled for all farms together are shown in Table 1. F-values of each of the estimated regression functions of the above equations were found to be statistically significant. The Chow test on the equality of parameters of the two separate functions revealed that the parameters of the production functions for large and small farms differ from each other. The overall difference in per hectare quantity of output between large and small farms is 41.31 percent (Table 2). This implies that overall productivity in large farms is higher by 41.31 percent (Table 2). This indicates a positive relationship between farm size and productivity, particularly in sugarcane production using modern technology e.g., seed, fertilizer and pesticides. The study also reveals that modern sugarcane production technologies have positive effects in obtaining higher yields by the farmers.

Neutral Technological Differences

The neutral technological difference between large and small famrs is 13.56 percent. This implies that the neutral technology is in favour of large farms as compared to small farms (Table 2).

Non-neutral Technological Differences

The total contribution of all non-neutral technological difference between large and small farms is 6.45 percent which shows that large farms have advantage over small farms. The contributions of different input coefficients to the non-neutral technological differences are estimated which reveals that the large sugarcane farms have an advantage in utilizing purchased inputs viz., fertilizer (145.36%) and organic manure (17.50%) (Table 2). This implies that development of these inputs (fertilizer and organic manure) will favour large farms relative to

small farms. This supports the hypothesis that large farms have more capital and better access to credit, they are placed in a favorable position to get the purchased inputs. If both neutral and non-neutral components are added, an approximate measure of the contribution of technologies to per hectare basis of output difference between large and small farms is obtained.

This turns out to be 20.01 percent to large farms (Table 2). This implies that the present technology is in favour of large farms in the existing marketing system. If small farms use the same mean level of inputs as large farms, the output per hectare will be 20.01 percent more than that of large farms (Table 2).

Input Use Contribution

The third component is the contribution of mean level inputs difference on large and small farms to the per hectare total output difference. The t-test was applied to test the difference between the mean level of inputs used between large and small farms (Table 3). Fertilizer, pesticides with seeds, labour and capital was found to be significantly different between large and small farms. Table 2 shows that this component contributes 21.63 percent to the total difference between large and small farms. The use of each input in large and small farms shows that fertilizer contributes (11.41%) which is the highest, labour is the second highest (8.12%) and the contributions of the rest of the inputs/technologies are planting time (1.32%), pesticides and seeds (combined) 0.73%) and capital (0.22%) (Table 2).

Therefore, the study reveals that large farms have technological advantage which employ modern technology like fertilizer, pesticide, good seeds and capital. Since these are purchased inputs, large farms can afford to purchase them. Hence, the improved sugarcane production technologies are in favour of large farms.

IV. CONCLUSIONS

The study does not suggest any inverse relationship between sugarcane farm size and productivity per hectare. It is observed that the neutral and non-neutral technologies are in favour of large farms. The input use contribution differences of large farms appeared to do better than that of small farms in sugarcane production in the selected villages with the present modern technologies. Fertilizer, pesticides and good seeds which constitute the modern technology and require cash/credit are better used by large farms.

Finally, it can be said that the total difference of per hectare output is positive for large farms mainly due to input use contribution. The study suggests that so far as the modern sugarcane production technology is concerned, it can contribute sufficiently to improve sugarcane production in the country if adequate credit facilities, input supply at the right time and proper marketing facilities are provided to the farmers. It can also be said that small farms may be more productive than large farms if adequate access to the modern inputs are improved.

It may be mentioned here that the findings of this study are limited to a particular area and crop. Before making any generalisation of the findings, this sort of study should be conducted in other areas so as to compare the results.

Table 1. Estimated Parameters of Production Functions.

Variable	Large	Small	Pooled
Fertilizer	0.3315	0.0839	0.2896
	(2.80)*	(0.65)	(3.41)**
Labour	0.7450	0.8389	0.7640
	(4.83)**	(3.85)**	(5.60)**
Pesticide & seed	-0.2444	-0.1858	-0.2981
	(-0.88)	(-0.49)	(-1.21)
Manure	-0.0030	-0.0277	-0.1572
	(-0.18)	(-1.68)	(-1.29)
Bullock power	0.1933	0.2815	0.2371
	(-0.84)	(0.68)	(1.06)
Capital	-0.0053	0.0162	0.0018
	(-0.18)	(0.44)	(0.08)
Planting time	0.2282	0.2556	0.2379
	(1.52)	(1.82)	(2.30)*
Intercepts	5.6742	5.5386	6.0436
R^2	0.68	0.51	0.59
Number of plots	50	47	97
F-value	12.83**	5.90**	18.11**
Chow's F-value		3.59**	
Degrees of freedom		7.89	

Figures in parentheses are t-values
**, *significant at 1 and 5% probability level respectively.

Table 2. Decomposition of total Difference in Quantity of Output between Large and Small farms, at Panba and Natore Areas 1989.

Items	Contribution in difference Large and small
Sources of difference	
1. Neutral technological difference	13.56
2. Non-neutral technological difference	
(i) Fertilizer	145.36
(ii) Labour	-53.16
(iii) Pesticide and seed	-50.01
(iv) Organic manure	-17.50
(v) Bullock power	-29.19
(vi) Capital	-17.75
(vii) Planting	6.30
Total	6.45
3. Input use contribution in difference	
(i) Fertilizer	11.41
(ii) Labour	8.12
(iii) Pesticide & seed	0.73
(iv) Organic manure	-0.10
(v) Block labour	-0.40
(vi) Capital	0.22
(v) Planting	1.32
Total	21.30
Total difference in output due to all sources	41.31

Table 3. Geometric Mean level of Inputs and Output.

Variable	Large	Small	Pooled
Fertilizer	500.2**	354.6	419.9
Labour	320.9**	287.7	304.3
Pesticide & seed	4885.4*	5034.2	4954.2
Organic manure	1665.7	1210.3	1422.3
Bullock power	25.9	26.3	26.1
Capital	2457.7**	3699.7	2995.9
Planting time	10.6	10.0	10.3
Output	63,449.5**	41,904.2	51,896.2

** Difference in the mean level of input use between large and small farms significant at 1% probability level.

* Significant at 5% probability level.

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