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Estimation of Gross and Net Technical Efficiencies of Wheat Production in Bangladesh under Two Alternative Functional Forms

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Abstract: In this study attempt has been made to formulate a model for environmental factors influences the gross and net technical efficiencies of wheat production function in Bangladesh. The environment has a direct influence on the production structure and model the technology by introducing some representative variables aside the production factors. Technical efficiencies measures by frontier model which is influences of environmental factors. The inefficiency effects are not identically distributed. A more appropriate approach involves the specification of a model in which both relations are estimated in a single stage.

Key words: Farmers, environment, productivity, efficiency of factors

INTRODUCTION

Wheat is the second most important cereal crop in Bangladesh. Average per capita per day calorie intake is 2240 kcal (estimated), of which a significant percent comes from wheat. About 5% of total cultivable lands are utilized for wheat production. Crop sector contribute about 14% to the country's GDP of which a remarkable portion is contribute by the wheat[1]. In 2001-2002 crop year Bangladesh produced 1903 thousand tons of wheat whereas in the same year imported 2424 thousand tons of wheat, which is 56% of total demand for wheat[1]. To meet domestic consumption of wheat. Bangladesh has to import increased amount of wheat every year, strikes our foreign currency as well as balance of trade. In the present economic condition, it is our striking need to increase total production of wheat to keep pace with the demand for wheat. Due to the continuous pressure on the demand for the wheat, the government of Bangladesh used to import wheat for neighboring countries. Sometimes we used to here that the imported wheat is not of good quality and some portion of it is not congenial for human consumption. The low quality of wheat jeopardizes human health. At the present context, we will have to increase wheat production several times more than the present volume of production. We will have to explore and use all avenues and growth promoting factors for sustainable growth of wheat. Production of wheat in general can be increased in different ways. Increasing cultivable area can increase first production of wheat. But increase in wheat production by increasing area is not possible since total cultivable area is decreasing day by day due to the increased used of land for non-agricultural purposes.

Second production may be increased from increased use of inputs. But farmers of Bangladesh face resource limitation. Improving the production technology without increased use of inputs can increase third wheat production. This improvement consists of improved package of inputs, such as improved water management, HYV seed, chemical fertilizer, agricultural credit integrated pest control and appropriate land tenure systems. But production technology of developing countries cannot be changed rapidly due to several factors ranging from institutional to economic and from physical to natural. Production of wheat cannot be advanced by adopting the technology for certain economic condition of Bangladesh.

Fourth, increasing the productivity of inputs by reallocating and combining them optimally without changing total quality of inputs and technology can also increase output. This technology is generally termed as efficient production technology, which is the main concern of this study. That is increasing the technical efficiency of wheat using existing can increase production. The possibilities of economic growth solely through the more efficient use of existing resources will obviously be exhausted when an efficient production technology is reached. In others words, the process of increasing wheat output only by improving efficiency can not continue indefinitely, since under perfect technically efficient conditions the frontier

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Table 1: Distribution of the two alternative production frontier model of wheat farmer in Dinajpur, Bangladesh

Age	Total production per year			Before 1973			1973-1982			1983-1992			1993-2003		
(year)	Obs	SPFM	TEMP	Obs	SPFM	TEMP	Obs	SPFM	TEMP	Obs	SPFM	TEMP	Obs	SPFM	TEMP
15-20	48	51.75	54.55	18	15.49	16.45	10	10.30	9.79	13	18.04	16.81	7	10.9	11.45
20-25	87	106.78	106.98	31	31.99	33.43	4	18.64	19.64	27	31.62	31.80	15	20.1	21.92
25-30	792	788.47	806.98	294	286.34	280.22	155	172.59	158.57	203	225.90	215.36	140	166.8	153.65
30-35	442	431.98	441.47	121	137.12	137.94	90	69.52	79.05	131	105.39	113.82	100	73.3	80.28
35-40	219	217.43	209.80	74	66.16	67.9	37	34.86	39.41	62	56.54	60.16	46	37.5	41.95
40-45	29	24.19	27.81	7	7.50	8.10	5	9.09	8.52	11	10.43	8.88	6	6.1	5.98
45-50	18	11.93	14.18	3	5.39	5.95	4	-	-	7	6.07	7.15	4	5.3	5.06
50-55	4	5.70	7.23	2	-	-	0	-	-	0	-	-	2	-	-
Total	1639	1639	1639	550	550	550	315	315	315	454	454	454	320	320	320
$\hat{\theta}$	-	-	0.2245	-	-	0.2364	-	-	0.2320	-	-	0.2126	-	-	0.2164
$\hat{\beta}_0$	-	6.9874	-	-	6.0231	-	-	5.5434	-	-	5.7546	-	-	5.4658	-
$\hat{\beta}_k$	-	-0.2534	-	-	-0.2407	-	-	-0.1668	-	-	-0.1670	-	-	0.1785	-
χ^2	-	0.1440	-	-	0.0129		-	-0.3722	-	-	-0.2379	-	-	0.2586	-
χ^2	-	8.44	9.98	-	3.527	5.24	-	9.12	4.82	-	11.33	5.45	-	18.79	10.53
df	-	4	6	-	3	4	-	2	4	-	3	5	-	3	5

SPFM: Stochastic Production Frontier Model, TEPM: Technical Efficiency Predictor Model

output level will be reached. Thus, other growth promoting strategies need to be considered when it is not possible to increase wheat output only through efficient utilization of existing resources. The use of modem technology in agriculture to raise wheat output per unit of input is one such strategy. A sound and realistic agricultural policy is the one of the most important instruments through which agricultural production can be increased.

The Dinajpur district was bounded on the south by Joypurhat zilla and north by Thakurgoan on the west Rangpur, Gaibanda, Kurigram district. The cluster survey sampling methodologyandy adapted for the selection of the sample. A total 2686 sample household from 10 clusters has been interviewed. A study of Dinajpur district survey can be seen in Table 1. We tried to fit the models mentioned earlier. The accuracy of the identification of the impact of different factors on the efficiency effects depends on factors including the functional form of the production.

Model specifIcation: In this study a Cobb-Douglas stochastic production frontier is specified with a composed error term, by Aigner, Lovel and Schmidt[2], which is given below:

$$\ln y_i = \beta_0 + \sum_{k=1}^{n} \beta_k \ln X_{ki} + v_i - u_i \qquad (1)$$

Where, y_i and X_{ki}, indicates the Output and inputs, respectively (i= 1,2, ..., N farms and k ......, n number of inputs); β_0 and the β_k are parameters to be estimated, v is a random error term and u is non-negative random variable assume to represent technical inefficiency in production. To estimate the parameters of this model using maximum likelihood one must select distributional forms for the two error terms (v and u). The most commonly made assumption are those the random error term, v is independently and identically distributed as N $(0, \sigma^2_v)$ and the non-negative inefficiency random variable, u, is distributed independently of the v and has a half normal. distribution. That is, it has a distribution equal to the upper half of the N $(0, \sigma^2_u)$ distribution. The intuition behind the error component specification is that any deviation from the frontier caught by the technical efficiency term, u is the result of factors under the firm's control, efforts of the producer. employees and factors such as defective damaged product[12]. However the frontier itself can vary randomly across firms due to the random error v. On this interpretation, the frontier is stochastic, with random disturbance v, being the result of favorable or unfavorable external events such as luck or climate. Moreover errors of observation and on measurement of production constitute another basis for the presence of v in the frontier model. Given the definition of the stochastic frontier production function in Eq. 1, we note that the realizations of the % are not observable. That is, following the estimation of the unknown parameters of the model defined in Eq. 1, the residuals of the model will be realizations of $\varepsilon_i = v_i - u_i$ not of u_i . Coelli *et al.*[3] observed that a best predictor for u_i is the conditional expectation of u_i given the value of $\varepsilon_i = v_i - u_i$. That is, one may defined the firm-specific technical efficiency predictor using:

$$Te_i = [\exp\{-E(u_i/\varepsilon_i)\}] \qquad (2)$$

The above model subsequently has an influence upon their technical efficiency level. In order to take into account this situation we consider two alternative approaches:

Case 1: Assume that environmental conditions or factors influence the shape of the production technology or assume to represent technical inefficiency in productionas mentioned above.

Case 2: Assume that environmental conditions or factors influence the shape of the production technology.

Case 3: Assume that environmental conditions or factors influence the firm's technical efficiency.

Case 4: In case 2 we consider that the environment has a direct influence on the production structure and model the technology by introducing by some representative variables aside the production factors. It is assume that in this case firm faces a different production frontier. In terms of Eq. 1 and assuming that M (firm-specific) factors representing the environment, Z_j enter in a simple long-linear way i8n the production frontier, we will have a modified production frontier:

$$\text{In}\, y_i = \beta_0 + \sum_{k=1}^{n} \beta_k \,\text{In}\, X_{ki} + \sum_{j=1}^{M} \theta_j \,\text{In}\, Z_{ji} + v_i - u_i \qquad (3)$$

where, the θ_j are parameters to be estimated. When Eq. 2 is used to define predictors of technical efficiency relative to the frontier model defined in Eq. 3 the technical efficiency measures obtained will be net of environmental influences. That is, this technical efficiency may be termed as net technical efficiency. One may also obtain measure of gross efficiency (i.e., inclusive of environmental influences) by re-evaluating the technical efficiency predictors with.

Case 5: In other studies[4,5] environmental factors are assumed to directly effect technical efficiency.

Then the underlying hypothesis is that all firms share the ame technology represented by the production frontier (1) and the environmental factors have an influences only one the distance that separate each firm from the best practice function. When Eq. 2 is used to defined predictors of technical efficiency relative to the frontier model in Eq. 1, the predicted technical efficiency is usually termed as gross technical efficiency.

Application: Both the estimation of stochastic frontier model production function and the prediction of the technical efficiency models are applied to the data of Bangladesh for different gross and net technical efficiencies of wheat production in which the first stage involves the specification and estimation of a stochastic frontier production function or management factors (Table 1).

The efficiency effects are not identically distributed. A more appropriate approach involves the specofication of a model in which both relations are estimated in a single stage.

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