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Determinants of Profit Effciency among Small Scale Rice Farmers in Nigeria: A Profit Function Approach

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Abstract: This study employs a stochastic frontier approach to examine profit efficiency of small scale rice farmers in Nigeria using farm-level survey data collected from 200 farmers in the study area. Data were analysed using descriptive statistics and standard profit function. The result shows that about 60% of potential profit is gain due to production efficiency while the remaining can be attributed to both technical and allocative inefficiencies in the study area.Also, the result further revealed that age, educational level, farming experience and household size positively affected profit efficiency .These variables are thus important in policy formulation by government.

Key words: Stochastic frontier, profit efficiency, small-scale, farmers, Nigeria. Jel Classification: C8, C21, Q12

INTRODUCTION

Nigerian economy is mainly an agrarian economy one with over 70% of the country's 120 million people engage in agriculture and agricultural related activities[1]. Based on this, development of the country's agricultural sector is synonymous to achieving economic development. However, the sectorial contribution of agriculture to Nigeria's Gross Domestic Product (GDP) is an indication that more still need to be done to resuscitate the sector. The sectoral contribution of agriculture to GDP was put at 41.3% in 2002[2]. The poor growth recorded in this sector is a reflection of food crisis currently experienced in the country in which the rate of population growth rate exceeds the rate of food production. Food growth rate has been put at 2.5% and population growth at 3.5% leaving a food deficit at 1% currently experienced in the country[2].

Rice is the staple food of more than 60% of the world's population[3]. According to[4], rice has becomes a staple food of considerable strategic importance in many rapidly growing African cities where its consumption among urban poor households has increased substantially. In Nigeria rice has become a major staple food in most homes today and unfortunately the domestic production of this grain has not met the demand leading to food shortages. The food problem in Nigeria has been exacerbated by the low level of productivity of resources used in recent time. Existing low level of productivity in food grain production reflect low level of technical, allocative and economic efficiencies. Therefore, increasing agricultural growth is an indication of appreciable growth in agricultural production process that is linked to farm profit. Hence, farm productivity and efficiency is no longer debatable but a necessity in view of imminent food deficit experienced in the country judged by the over reliance on food importation in recent time[2]. The imposition of ban on the importation of rice and other food stuff that can be produced locally in the country is an indication that rice growers in the country must leave up to the expectation of meeting the local demand. To achieve this objective, effort must be taken to examine the productive efficiency of the rice farmers in the country using profit efficiency that is based on perfect competitive market.

Computing profit efficiency therefore, constitutes a more important source of information for policy makers than the partial vision offered by analysing cost efficiency[5]. The estimation of a frontier profit function capture firm level production specialization, thus allowing the higher revenues reserved by the firms that produce differentiated or higher quality output to compensate for the higher cost incurred.

However, considerable efforts have been directed at examining productive efficiency of farmers that is exclusively focused on technical efficiency of the farmers in Nigeria[6-8]. Little attention has been given to measuring profit efficiency of farmers even when the prices of output and Input are known in an attempt to examine the allocative efficiency of the farmers. The physical productivity considerations (Technical efficiency) are important improvement in production efficiency, but profit efficiency will lead to greater benefits to agricultural producer in the country.

The objective of this and is to derive a statistical measure of profit efficiency of small scale Up land Rice farmers in Nigeria using a stochastic profit frontier approach. This and, therefore, uses a frontier analysis which is a means to measure the relative performance of the farmer by objectively providing a numerical efficiency value and ranking them accordingly. It shows how close farmers are to the "best-practiced" frontier and such analysis proves to be significant in providing information that is useful in either of the following:

- In assessing the effects of social-economic variable such as age, education, credit, on the efficiency that may be valuable to the policy maker;
- In dealing with academic research studies of efficiency of farm and its comparison to other efficiency approach; or
- In improving the performance of a farm by distinguishing the "best-practises" and worst-practices associated with the respective efficiency level.

MATERIALS AND METHODS

This study was based on the farm level data on small-scale rice (upland) farmers in Ekiti State, Nigeria. Ekiti State has a tropical climate with its characteristic high temperature all year round. The state enjoys tropical climate with two distinct seasons. These are the raining (April to October) and dry (November to March) seasons.

Agriculture (crop farming) forms the base of the overall development thrust of the state, with about 75% of the population being agrarian. They grow crops, which include maize, cowpea, rice, cassava, plantain, yam, pepper, tomatoes and different green vegetables. They also grow cash crops which include cocoa, kola and palm produce. Farmers in the state are predominantly small scale who still depends on traditional method of farming. Apart from farming, they also engage in trading and other activities such as tailoring, shoe making, barbing etc.

The data mainly from primary sources were collected from 200 rice farmers selected from 4 LGAs which were purposely selected as first stage (Erinmon, Gbonyin, Efon and Ikere) using multistage sampling techniques. The second stage involved a simple random selection of 50 farmers from each of the four LGAs, thus making 200 respondents. Data were collected with the use of structured questionnaire administered in the sampled farms to collect data relating to yield, a unit cost of labour per man day (the total labour expenditure per farm include the imputed cost of family labour at the wage rate paid to permanent hired labour), land area under cultivation (ha), inputs prices such as price per kg of fertilizer, price per kg of seeds, average price of agro-chemical per kg and average price of farm implements/tools. Data were also collected on the socio-economic variables such as age, educational level (year of schooling), farming experience and household size.

The data collected (on quantity of rice harvested and output price) were used to compute farm total revenue as PxQ, where P is the price of the output and Q is the quantity produced while the farm level profit (Π) was computed as difference between the total revenue and total variable cost expended on producing the rice i.e., [Gross Margin in (Π) = TQ-WX].

Theoretical framework: The stochastic frontier model was simultaneously proposed by[9] and[10] who drew their works upon the[11] seminar study on efficiency measurement in which he defined productive efficiency as the ability of a firm to produce a given level of output at lowest cost.

Broadly, three quantitative approaches are developed for measuring productive efficiency: Parametric (deterministic and stochastic), non-parametric based on Data Envelopment Analysis (DEA) and productivity indices based on growth accounting and index theory principles[12]. Stochastic Frontier Analysis (SFA) and the DEA are the most commonly used methods. Both methods estimate the efficiency frontier and calculate the firms' technical, cost and profit efficiency relative to it. The frontier shows the best performance observed among the firms and it is considered as the efficient frontier. The SFA approach inquires that a functional firm be specified for the frontier production function while DEA approach uses linear programming to construct a piece-wise frontier that envelops the observations of all firms. An advantage of the DEA method is that multiple inputs and output can be considered simultaneously and inputs and outputs can be quantified using different units of measurement.

However, a strong point of SFA in comparison to DEA is that it takes into account measurement errors and other noise in the data. This point is very important for studies of farm level data in developing economy like Nigeria as data generally include measurement errors.

The SFA, which is also referred to as the econometric frontier approach, specifies the relationship between output and input levels and decomposes the error term into two components: (a) a random error and (b) an inefficiency component. The random error which is assumed to follow a symmetric distribution is the traditional normal error term with zero mean and a constant variance while the inefficiency term is assumed to follow an asymmetric distribution and may be expressed as a half-normal, truncated normal, exponential or two-parameter gamma distribution. Furthermore, this approach distinguishes a functional form for the cost, profit, or production relationship among inputs, outputs and non-factors. Profit efficiency is broader concept since it takes into account the effects of the choice of vector of production on both costs and revenues. Two profit functions can be distinguished, depending on either or not market force is taken into account; the standard profit function and the alternative profit functions.

The standard profit function assumes that markets for outputs and inputs are perfectly competitive. Given the input (W) and output price vectors (P), the firm maximizes profits by adjusting the amount of inputs and output. Thus, the profit function can be expressed implicitly as $\Pi = f(P, W; V, U)$ and in logarithms terms:

$$\ln(\Pi+\theta) = \ln f(P, W) + (V-U)$$

Where θ is a constant added to the profit of each firm in order to attain positive values, enabling them to be treated logarithmically. The exogenous nature of prices in this concept of profit efficiency assumes that there is no market power on the firms'/farmers side. If instead of taking price as given, the firms/farmers assume the possibility of imperfect competition, given only the output vector and not that of price.Thus, alternative profit function is defined as:

$\Pi a = \Pi a(Y, W, V, U)$ in which the quantity of output (Y) produce replaces the price of output (P) in the standard profit function.

Economic application of stochastic profit frontier model for production efficiency analysis include:[13] and[14] applied the technique in a study of efficiency of rice farmers in the Northern Ghana and Cote d'Ivoire, respectively[15] applied the technique to U.S. Banking Institute and[16] applied the technique to European banks.

The stochastic profit frontier model specifications: Profit efficiency in this study is defined as profit gain from operating on the profit frontier, taking into consideration farm-specific prices and factors. And, considering a farm that maximizes profit subject to perfectly competitive input and output markets and a singular output technology that is quasi-concave in the (n x 1) vector of variable inputs and the (m x 1) vector of fixed factors, Z. The actual normalized profit function which is assumed to be well behaved can be derived as follows:

Farm profit is measured in term of Gross Margin (GM) which equals the difference between the Total Revenue (TR) and Total Variable Cost (TVC).That is:

$$GM(\Pi) = \Sigma(TR-TVC) = \Sigma(PQ-WX_i)$$

To normalize the profit function, gross margin (Π) is divided on the both side of the equation above by P which is the market price of the output (rice).That is:

$$\frac{\Pi(p,z)}{P} = \frac{\Sigma(PQ-WX_i)}{P} = Q - \frac{WXi}{P} = f(X_i, Z) - \Sigma p_i X_i$$

Where: TR represents total revenue,TVC represents total variable cost, P represents price of output (Q),X represents the quantity of optimized input used,Z represents price of fixed inputs used, $p_i = W/P$ which represents normalized price of input X_i while $f(X_i,Z)$ represents production function.

The Cobb-Douglas profit function in implicit form which specifies production efficiency of the farmers is expressed as follows:

$\Pi_i = f(p_i,z)\exp(V_i - U_i)$ $i = 1, 2,\ldots\ldots n$.Where, Π,p_i and z as defined above. The V_is are assumed to be independent and identically distributed random errors, having normal $N(0, \sigma^2_v)$ distribution, independent of the U_is. The U_is are profit inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution $N(\mu,\sigma^2_u)$

The profit efficiency is expressed as the ratio of predicted actual profit to the predicted maximum profit for a best-practiced rice farmer and this is represented as follows:

$$\text{Profit Efficiency } (E\Pi) = \Pi \frac{\exp[\Pi(p,z)]\exp(\ln V)\exp(-\ln U)-\theta}{\Pi_{max}\exp[\Pi(p,z)]\exp(\ln V)-\theta}$$

Firms specific profit efficiency is again the mean of the conditional distribution of Ui given by Eï and is defined as: $E\pi = E[\exp(-U_i)/E_i]$

Eï takes the value between 0 and 1. If $U_i=0$ i.e. on the frontier, obtaining potential maximum profit given the price it faces and the level of fixed factors. If $U_i > 0$, the firm/farm is inefficient and losses profit as a result of inefficiency.

However, for this study,[16] model was used to specify the stochastic frontier function with behaviour inefficiency components and to estimate all parameters together in one-step maximum likelihood estimation. The explicit Cobb-Douglas functional form for the rice farmers in the study area is therefore specified as follows:

$$\ln\Pi = \ln\beta_0 + \beta_1\ln Z_{1i} + \beta_2\ln P_{1i} + \beta_3\ln P_{2i} + \beta_4\ln P_{3i} + \beta_5\ln P_{4i} + \beta_5\ln Z_{2i} + (V_i - U_i)$$

Where: Π_i represents normalized profit computed as total revenue less variable cost divided by farm specific rice price;Z_1 represents Farm size (ha);P_1 represents average price per man day of labour ;P_2 represents average price per kg of fertilizer ;P_3 represents average price per kg of seed ;P_4 represents price per kg of agro chemical;Z_2 represents average price of farm tools

The inefficiency model (U_i) is defined by:

$$U_i = \partial_0 + \partial_1 M_1 i + \partial_2 M_{2i} + \partial_3 M_{3i} + \partial_4 M_{4i}$$

Where M_1, M_2, M_3 and M_4 represent age, educational level, farming experience and household size. These socio-economic variables are included in the model to indicate their possible influence on the profit efficiencies of the rice farmers (determinant of profit efficiency). The variance of the random errors, σ_v^2 and that of the profit inefficiency effect σ_u^2 and overall variance of the model σ^2 are related thus: $\sigma^2 = \sigma_v^2 + \sigma_u^2$, measure the total variation of profit from the frontier which can be attributed to profit inefficiency[17,18] provided log likelihood function after replacing σ_v^2 and σ_u^2 with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and thus estimating gamma (γ) as: $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$ .The parameter γ represents the share of inefficiency in the overall residual variance with values in interval 0 and 1. A value of 1 suggests the existence of a deterministic frontier, whereas a value of 0 can be seen as evidence in the favour of OLS estimation.

The estimate for all parameters of the stochastic frontier profit function and the inefficiency model are simultaneously obtained using the program frontier version 4.1c[16]. A three-step estimation method is used in obtaining the final maximum likelihood estimation. The likelihood maximization procedure uses Davidson Fletcher Powel Quassi Newton algorithm.

And for this study, two different models were estimated in the final MLE. Model 1 is the traditional response function OLS in which the efficiency effects are not present (U_i=0). It is a special form of the stochastic frontier production function model in which the total variation of output due to technical inefficiency is zero that is γ=0. Model 2 is the general model where there is no restriction and thus γ = 0.The two models were compared for the presence of profit inefficiency effects using the generalized likelihood ratio test which is defined by the test stochastic. Chi-square (x^2) thus defined by: x^2= -2In $\{H_o/H_a\}$.Where x^2 has a mixed Chi-square distribution with the degree of freedom equal to the number of parameters excluded in the unrestricted model. Ho is the null hypothesis that $\gamma = 0$. It is given as a value of the likelihood function for the frontier model and H_a is the alternative hypothesis that $\gamma = 0$ for the general frontier model.

RESULTS AND DISCUSSION

The result from the data analysis shows that the mean yield of 1,159.8 kg per ha of paddy rice was recorded over the sampled area with a standard deviation of 1260.14 kg ha^{-1}. The variability as measured by standard deviation revealed that majority of the farmers' recorded average yield of paddy rice close to the average yield recorded in the sample area. Also an average of N 55 per kg of paddy rice was recorded in the sampled area as price of output.

Table 1 gives the summary statistics of variables for the estimation of the stochastic profit frontier model. The mean gross of N 124, 172.53 and a standard deviation of N 108,460.64. The larger variability indicate that farmers cultivate different hectare of farmland with the majority of the rice farmers having average profit very close to that recorded in the sampled area.

The maximum likelihood estimates of the parameters of the stochastic profit frontier model are presented in Table 2. The estimated coefficients of the parameters of the normalized profit function based on the assumption of competitive market are positive except the cost of fertilizer as expected. The positive coefficient of price per man day of labour is against expected sign. This may be due to the fact that rice production is labour intensive as most operation are done manually which resulted into increase in the cost of labour since service of hired labour are frequently used by the farmers in an attempt to meet their production.

The study also revealed that there was presence of profit inefficiency effects among paddy rice farmers in the study area as confirmed by a test of hypothesis for the presence of inefficiency effects using the generalized likelihood ratio test and significance of the gamma (γ) estimate.

The generalized likelihood ratio test which is defined by the Chi-square (x^2) distribution shows that the computed Chi-square is 31.8 while the critical value of the Chi-square at 5% level of significant with 6 degree of freedom x^2 (5%, 6) equal to 12.60. Thus the null hypothesis was strongly rejected, leading to the preference of model 2 for the adequate representation of the data. Furthermore, the estimated gamma parameter (γ) of model 2 of 0.983 in Table 2 was highly significant at 5% level of significance. This implies that one-sided random inefficiency component strongly dominates the measurements error and other random disturbance indicating that about 98% of the variation in actual profit from maximum profit (profit frontier) between farms mainly arose from differences in farmers' practices rather than random variability.

Table 1: Summary statistics of variables for the estimation of stochastic frontier model

Variables	Minimum	Maximum	Mean	Std.Deviation
Gross margin	22,478.34	215,010.81	124,172.53	108,460.64
Farm size(ha)	0.37	3.80	0.901	0.74
A unit cost of labour per man day	62.42	250.3	120.92	71.27
Ave.price of fertilizer per kg	34.46	98.65	62.15	76.18
Ave.price of seed per kg	45.93	167.97	81.18	44.67
Ave.price of agro- chemical per kg	67.00	290.03	159.82	242.81
Ave.price of farm tools	413.11	1210.94	866.48	535.96
Age (Yrs)	27	66	48.27	34.27
Educational level(Yrs)	6	14	12.41	9.65
Farming experience(Yrs)	3	24	17.93	11.44
Household size(Yrs)	4	13	9.93	7.74

Table 2: Maximum Likelihood Estimates of the stochastic profit frontier function

Variables	Parameters	Model 1	Model 2
General Model			
Constant	β_0	9. 700*(8.086)	10.089*(9.968)
Farm size (ha)	β_1	0.622*(2.145)	0.486*(5.759)
Ave.Price per man days of labour	β_2	0.079*(5.419)	0.148*(3.834)
Ave.price of fertilizer per kg	β_3	0.062 (-0.337)	-0.245 (-1.394)
Ave.price of seed per kg	β_4	0.170*(11.658)	0.135*(14.069)
Ave.price of agro- chemical per kg	β_5	0.918 (0.179)	0.691*(10.222)
Ave.price of farm tools	β_6	0.029*(3.322)	0.018*(2.239)
Inefficiency Model			
Constant	∂_0	0	2.611*(3.158)
Age (Yrs)	∂_1	0	-0.012(-1.225)
Educational level(Yrs)	∂_2	0	-0.164(-1.549)
Farming experience(Yrs)	∂_3	0	-0.052*(-2.843)
Household size(Yrs)	∂_4	0	-2.746(-1.247)
Variance			
Sigma square	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	0.852	0.706*(9.683)
Gamma	$\gamma = \sigma_u^2 / \sigma_u^2 + \sigma_v^2$	0	0.983*(2.694)
log likelihood	llf	-264.164	-248.277

Figures in parentheses are t-ratio * Estimate is significant at 5% level

Table 3: Deciles frequency Distribution of Profit Efficiencies of Rice farmers

Efficiencies	Frequency	Relative frequency (5)
0.11-0.20	1	0.5
0.21-0.30	11	5.5
0.31-0.40	31	15.5
0.41-0.50	32	16.0
0.51-0.60	33	16.5
0.61-0.70	12	6.0
0.71-0.80	20	10.0
0.81-0.90	32	16.0
0.91-1.00	28	14.0
Total	200	100
Minimum	0.201	
Maximum	0.932	
Mean	0.601	
Std.Deviation	0.228	

The deciles frequency distribution of efficiencies of the rice farmers in the sampled area is presented in Table 3. The Table revealed that average measure of profit efficiency of 60.1% was recorded in the area. This suggest that an average of about 60% of potential maximum profit is gained due to production efficiency while the remaining short fall of discrepancy between observed profit and the frontier profit can be attributed to both technical and allocatively inefficiencies as had earlier confirmed by the likelihood ratio test. The table further shows that about 63% of the farmers had profit efficiency from 0.61 and above, indicating that on the relative term more than half of the farm under assumption of the perfect competition market used for the analysis were fairly efficient in allocating their cost structure in course of rice production.

The parameters estimates for determinants of profit efficiency were reported in the lower part of Table 2. However, the analysis of inefficiency models shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer. And based on this, all the variables in the inefficiency model have negative coefficients ,meaning that as these variable (age, educational level, farming experience and household size) increases the profit inefficiency of the farmer decreases with farming experience (significant at 5% level of significance). The negative coefficient of age is in contradiction to the work of[3] while the negative coefficient of educational level was in conformity with[13,19-21].

CONCLUSION

The study examined the determinants of profit efficiency among the small scale paddy rice farmers in

Nigeria, using stochastic Cobb-Douglas profit frontier model. The estimated parameters of the Cobb-Douglas profit frontier indicate that all the inputs have positive sign on the profitability of rice farming in Nigeria except the unit cost of fertilizer/kg. The negative sign of price of fertilizer/kg may be due to wrong application leading to excessive application of such fertilizer by the farmers, thus leading to extra cost incurred on the part of the farmers. Deciles profit efficiency distributions as shown that rice farmers were fairly efficient in their resources allocation, judged by the fact that more than half of the farmers having profit efficiency of 0.61 and above with an average profit efficiency of 0.601 suggesting that considerable amount of profit is gained due to the relative level efficiency of observed in the sample area.

The results also showed their profit efficiency where positively influenced by (age, educational level, farming experiences and household size).These findings have important policy implications in improving production efficiency among farmers in Nigeria. Nevertheless government should make it a priority to encourage both young and old to go into rice farming in attempt to bridge the gap between the old and the young.

The investments in rural education through effective extension delivery program in the current political and economic environment in Nigeria will provide farmers with skills essential to increasing efficiency.

In conclusion the result of this study has clearly shown that employing the stochastic profit frontier allows a detailed analysis of the determinant of specific farm efficiency. Further work is, however, required to capture the effects of farm extension, accessibility to credit and soil conditions when examining determinants of profit efficiencies.

REFERENCES

1. Central Bank of Nigeria CBN, 1996. Statistical Bulletin, 7: 64-1421.
2. Central Bank of Nigeria CBN, 2003. Central Bank of Nigeria Annual Report and Statement of Account for the year ended 31st.
3. Richard, W.N. and T. Stubbs, 1978. Plants, Agriculture and Human Society. Menlo Park, California. W.A. Benjamin Incorporation.
4. West African Rice Development Association WARDA, 1993. Rice Trends in Sub-Saharan Africa (A synthesis of statistical gains in Nigeria) IITA Research Briefs, pp: 9-487.
5. Maudos, J., J.M. Pastor, F. Perez and J. Quesada, 2002. Cost and profit efficiency in european Banks. J. Intl. Financial Markets, Institutions and Money, 12: 33-58.
6. Ajibefun, I.A, G.E. Battese and A.G. Daramola, 2002. Determinants of technical efficiency in small holder food crops farming: Application of Stochastic frontier production function". Quartely J. Intl. Agric., 41: 225-240.
7. Ojo, S.O., 2004. Improving labour productivity and technical efficiency in food crop production: A panacea for poverty Reduction in Nigeria. Food, Agric. and Environment, 2: 227-231.
8. Ogundari, K. and S.O. Ojo, 2005. The Determinants of Technical Efficiency in mixed Crop Food Production in Nigeria: A Stochastic Parametric Approach. Proceedings of the 1st Annual Conference on Developments in Agriculture and Biological Science, 21st April, 2005. School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Nigeria, pp: 159-164.
9. Aigner, D.J., C.A.K. Lovell and P. Schmidt, 1992. Formulation and estimation of stochastic frontier production models. J. Econo., 6: 21-32.
10. Meeusen, W. and J. van den Broeck, 1977. Efficiency estimation from Cobb-Douglas production functions with composed error', Intl. Econo. Review, pp: 435-444.
11. Farrell, J.M., 1957. The Measurement of productive efficiency" J. Royal Stats 506 Part III pp: 253-290.
12. Coelli, T.J., D.S. Prasada Rao, G.E. Battese, 1998. An Introduction to Efficiency and Productivity Analysis Kluwer Academic Publishers,Boston/Dordrecht.
13. Abdulail, A. and W.E. Huffman, 1988. An examination of profit Inefficiency of rice farmers in Northern Ghana: Working paper in Dept. of Econo., Iowa State University, Ames, U.S.A.
14. Adesina, A.A. and K.K. Djato, 1996. Farm size, relative efficiency and agrarian policy in cote d'Ivoire; Profit Function Analysis of Rice Farmers. Agric. Econo., 14: 101-119.
15. Berger, A.N. and L.J. Mester, 1997. Inside the black box; What explains differences in the efficiencies of financial Institutions. J. Banking Finance, 21: 895-947.
16. Coelli, T.J., 1996. A guide to Frontier Version 4.1c. A computer program for stochastic frontier production and cost function Estimation, mimeo, Department of Econometrics University of New England, Armidale, Australia.

17. Battese, G.E. and G.S. Corra, 1977. Estimation of a production function model with applied to the pastoral zone of Eastern Australia. Austarilian J. Agric. Econo, 21: 169-179.
18. Battese, G.E. and T.J. Coelli, 1995. A Model for technical inefficiency effect in stochastic frontier production for panel data; Empirical Econo, 20: 325-345.
19. Kumbhakar, S.C. and A. Bhattacharyyas, 1992. Price distribution and resource-use Inefficiency in Indian agriculture: A Restricted Profit Function Approach. Review of Economic and statistics, 74: 231-39.
20. Ali, M. and J.C. Flin, 1989. Profit efficiency among basmatic rice producers in Pakistan Punjab. Am. J. Agric. Econo., 71: 303-10.
21. Huffman, W.E., 1974. Decision making: The role of education. Am. J. Agric. Econo., 56: 85-97.