Farmers' Education and Profit Efficiency in Sugarcane Production: A Stochastic Frontier Profit Function Approach

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In a globally competitive environment where everything is commercialized, agriculture is no exception. The role that education of the effective head of the farm household, education of the family of the farm household and their experience plays, in addition to the primary inputs, in improving the profit efficiency of the farm household has been empirically tested for the primary data collected from 200 sugarcane farm households in Orissa. The results of the joint estimation of parameters of profit function and the inefficiency components suggest that 93% differences in the efficiency scores are due to profit inefficiency, and profit inefficiency reduces significantly with higher education. The mean efficiency is 79% and more than 80% of the farmers achieve 70-99% profit efficiency. A grassroots level farming practice awareness program both by government and private agencies as well as the reorientation of the formal education curriculum toward farm-oriented curriculum are highly recommended.

Introduction

Agriculture is a way of life, which for centuries has shaped the thought, the outlook, the culture, and the economic life of the people of India. Agriculture, therefore, will continue to be the central to all strategies for planned socioeconomic development of the country. Rapid growth and diversification of agriculture is essential not only to achieve self-reliance at national level, but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in the poverty levels. After the pioneering work of T W Schultz in 1964, it was clear that to improve the lot of poor people in developing countries, the decisive factors are not space, energy and cropland, but the determining factor is improvement in human quality (Schultz, 1971). The fundamental and more concrete outcome of the recent research is that an integral part of the modernization of the economies of high and low-income countries is the decline in the economic importance of the farmland and a rise in that of human capital—skills and knowledge. As in the words of Margaret Mead, "The future of mankind is open ended. Mankind's future is not

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foreordained by space, energy, and cropland. It will be determined by the intelligent evolution of humanity". Schultz (1971) pointed out that one of the fundamental mistakes made by the economists is in understanding the human agents in agriculture, i.e., farm laborers and farm entrepreneurs, who both work and allocate resources in the production. Mellor (1976) argued that rural development can only be achieved to a larger extent in conjunction with large expansion of formal education due to the complementarity of education with new production inputs, such as High Yielding Varieties (HYV) of seeds, fertilizer, pesticides, etc.

Indian agriculture has been undergoing a rapid change particularly since mid-1960s, i.e., from the onset of Green Revolution. The traditional agriculture, which was a way of life for Indian farmers, is now becoming next best industrial activity. Traditional agriculture was mainly based on the experience transmitted from father to the son. However, with the developments taking place due to Five-Year Plans, and scientific and technological advancements and their diffusion in agriculture, traditional agriculture has changed into more dynamic, challenging and commercialized farming. The share of agriculture in Gross Domestic Product (GDP) has registered a steady decline from 36.4% in 1982-83 to 18.5% in 2006-07. Yet this sector continues to support more than half a billion people providing employment to 52% of the total workforce. The most important fact is that the overall growth rate of the economy is also largely determined by the performance of agriculture and its allied sectors.

Although, it is well-recognized and empirically proven that human capital is an important factor in increasing the level of productivity, dissemination of new technology, etc., very few attempts have been made to study the impact of various forms of human capital, such as formal schooling and information, on farm production in Indian agriculture (Tilak, 1993).

This paper is an empirical analysis of profit efficiency of the effective heads of the farm households in sugarcane production in the Jajpur District of Orissa. It combines the concept of technical and allocative efficiency in the profit relationship and any errors in the decision making are assumed to be translated into lower profits or lower revenue for the producer. The paper uses the Battesse and Coelli (1995) extended model, where the farm-specific profit efficiency and the linear factors of profit inefficiency can be estimated together. It aims toward better understanding of the farming practices of small-scale farmers of the study area with a view to predict the profit efficiency (a measure of farm's ability to achieve highest possible profit given the prices and the levels of fixed factors) using stochastic frontier normalized gross profit function. Secondly, the profit inefficiency is explained with special reference to non-farming factors, such as schooling of the farmer, education of the family, and experience of the farm household. Thirdly, this paper focuses on the economic importance of commercialized crop farming practice, such as sugarcane in Orissa, which lacks empirical investigation with respect to farm-specific efficiency. The paper is organized as follows: It discusses the contribution of education to production and reviews the related literature. The theoretical concept behind the stochastic frontier profit function and the empirical model used in the study are presented subsequently. Then, the results are presented with interpretation. Finally, the conclusion is offered.

Orissa, one of the states of India, lies by the side of the Bay of Bengal and is surrounded by states like Andhra Pradesh, Jharkhand and West Bengal. Situated in the tropical savanna that is subject to frequent cyclones, it has large rural population, which is mainly engaged in agricultural activities. Therefore, agricultural economy of the state is much dependent on the productivity of the land. Orissa has a total geographical area of 15,540 thousand hectares. The net shown area covered under different crops accounts for 59.90 thousand hectares, of which the gross irrigated land is 18.54 thousand hectares, and the gross cropped area is 82.75 thousand hectares. Some distinctive features of agriculture in Orissa, which have relevance to planning are: the pressure of population on land and the inadequacy of irrigation. About 40% of the geographical area of the state is used for agricultural purposes and the concentration is highest in the coastal districts of Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Puri, Khurda and Ganjam. The main crops include rice, oilseeds, jute, and sugarcane. Agriculture alone provides direct and indirect employment to around 65% of the total workforce of the state as per the 2001 Census. Although the contribution of agriculture to the state income has significantly declined, the percentage of the workforce engaged in agriculture has remained somewhat unchanged. Sugarcane is the second most important cash crop in Orissa in terms of area as well as production. It is grown in irrigated areas. Orissa stands eighth in sugarcane production in India. A considerable amount of cultivation occurs in Cuttack, Sambalpur, Balangir, Kalahandi, and Puri districts, with Cuttack district topping the list in cash crop production. In the overall strategy for agricultural development in the state, commercial crops like sugarcane, jute, mesta, cotton, soybean, groundnut, potato, chilly, onion, etc., are given more thrust. Farmers in the state opt for sugarcane cultivation because it is a high-value commercial crop. Steps are being taken to cover at least 1.5 lakh hectares under sugarcane, during the next five years. Sugarcane growers are provided with quality cane seeds, farm implements, and drip irrigation under two schemes, namely, Sugarcane Development Program under the state plan and the Sustainable Development of Sugarcane Based Cropping System under the centrally sponsored plan. It is programmed to increase the production of sugarcane to 2.36 lakh tons during 2003-04.

Sugarcane[1] is mostly cultivated in undivided districts of Puri, Cuttack, Ganjam, Koraput, Dhenkanal, Balangir, Kalahandi, and Sambalpur. The year-wise area, production and productivity are given in Table 1.

From 1970 onwards, there has been impressive growth in area under sugarcane cultivation. The super cyclone in Orissa in 1999 was the cause of decline in sugarcane production during that period. After that the area under cultivation again increased to 41 lakh hectares in 2006-07.

[1] The most popular varieties of sugarcanes are: CO-6907, CO-7508, CO-7704, CO-8014, CO-62175 and CO-7219.

Table 1: Area, Production and Productivity of Sugarcane in Orissa			
Year	Area (000 ha)	Production (000 MTs)	Yield (kg/ha)
1970-71	30	1,627	53,907
1980-81	49	3,060	62,449
1990-91	49	3,549	72,429
2000-01	31	2,103	66,951
2006-07	41	2,836	70,008
Source: Directorate of Agriculture and Food Production Orissa, 2006-07			

Contribution of Education to Production

Many of the ways in which education has significant and beneficial impact on farm productivity grow out of Human Capital Theory. Simply putting, the theory maintains that formal schooling will enhance the ability of the farmers to work with the production inputs at their disposal and to produce more output with fewer inputs. Education contributes to this result by increasing the cognitive abilities of the farmers. In microeconomic theory of perfect competition, allocative ability as a source of return to a factor is ruled out. With perfect and complete information, there is no room for the concept of superior alternative technology, since in equilibrium all alternatives are equally good at the margin. In other words, perfect information implies that the return to a factor is proportional to its marginal contribution to physical product. For education and some intangibles, it was not clear that the direct contribution to physical production accounts for the total revenue. There have been attempts to modify the competitive model to allow for 'entrepreneurial capacity', but the return to these factors is always considered as 'residual', which does not help in marginal analysis. As an alternative to computing marginal factor revenue as being proportional to marginal physical product in which all other things remain constant, is the implication of variations of an input (education) whose function, in part, is to vary the use of other inputs (Welch, 1970).

The productive value of education has its roots in two distinct phenomena. Increased education simply may permit a worker to accomplish more with resources at hand. This 'worker effect' is the marginal product of education as it is normally defined, i.e., the increased output per unit change in education, holding other factor quantities constant. On the other hand, increased education may enhance the worker's ability to acquire and decode information and cost and productive characteristics of other inputs. As such a change in education results in a change in other inputs, including perhaps the use of some new factors that otherwise would not have been used. The return to education is, therefore, considered to consist of two effects—'worker effect' and 'allocative effect'. In a pioneering study exploring the economic effects of education, Grilliches (1964) used production function analysis to highlight the contribution of education to agricultural productivity. However, following Welch (1970), the subsequent literature has not deemed it necessary to maintain the distinction between the innovative and allocative effects.

Choudhuri (1968) made the first clear-cut distinction between worker and allocative effects. Indeed, there have been many empirical tests of the effect of education on farm productivity. These generally have employed Cobb-Douglas production function. However, it has been shown that the engineering production function misses much of the impact of education on production.[2] All the three measures: worker effect, allocative effect, and input selection effect can be measured by estimating engineering, gross sales and value-added production function. A function with gross sales as the dependent variable will measure the allocative effect. A function with value added as the dependent variable and fixed inputs and education as the independent variables will estimate all the three effects (Pudasaini, 1983). But lack of information on the prices of inputs does not give a clear picture of the allocative effect. Another problem with traditional production function approach is that it may obscure the effects of education by mixing all farms in estimation. Hence a frontier analysis whether parametric or nonparametric will yield more valuable information regarding the effects of the levels of schooling on the level of efficiency of each farm household.

Literature Review

Several empirical studies have been done both in developed and developing countries, such as USA, Korea, China, Japan and India. Evidence from 13 low-income countries shows that farm productivity, on an average, increased by 8.7% as a result of the farmer completing four years of elementary education (Lockheed *et al.*, 1980). Birkhauser *et al.* (1991) reviewed 47 studies from 17 countries and found that 33 studies show significant and positive extension effect. Past studies in Indian context mainly focused on testing whether resources (fixed and variable) are allocated efficiently in line with the allocative hypothesis of Schultz (1964) using production function method (Hopper, 1965; Chennareddy, 1967; Sahota, 1968; Saini, 1968 and others), and later on applying stochastic and deterministic frontier production function (Aigner *et al.*, 1977) and profit function method (Kalirajan, 1981). However, only a few studies considered education as a factor of production and estimated its economic contribution using farm-level and district-level data (Chaudhuri, 1979; and Sidhu, 1986). Research toward identifying and understanding the role of education can be categorized into two parts. In the first part, technical efficiency is investigated between two groups of farmers either educated and uneducated or traditional and modern (Welch, 1970; Lockheed *et al.*, 1980; Moock, 1981; Pudasaini, 1983; Dhakal *et al.*, 1987; and Azhar, 1991). In another study, Phillip (1994) used meta analysis revised by Lockheed *et al.* (1980) The studies that analyzed allocative efficiency of production are Huffman (1977) and Ram (1980), while the studies that analyzed both technical and allocative efficiency are Welch (1970), Ram (1980), Pudasaini (1982 and 1983), Duraiswamy (1992 and 1994), and Mohapatra (1998).

The pioneering work of Farrell (1957) on the measurement of efficiency, in which he defined productive efficiency as the ability of a farm to produce a given level of output at

[2] Welch (1970) has shown that the engineering production function measures only the worker effect and neglects the allocative effect and input selection effect.

lowest cost, and the introduction of stochastic frontier models, independently by Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977), and later extended by Jondrow *et al.* (1982), led to a large number of empirical studies to analyze technical, allocative and economic efficiency of the farms with special reference to education, age, and experience of the farm households using cross-sectional data (Kalirajan, 1981 and 1991; Huang and Bagi, 1984; Ali and Byerlee, 1991; Squires and Tabor, 1991; Bravo-Ureta and Pinheiro, 1997; Ajibefun *et al.*, 2002; and Ogundari and Ojo, 2006).

Production efficiency is usually analyzed by its two components—technical and allocative efficiency. Recent developments combine both measures into one system, which enables more efficient estimates to be obtained by simultaneous estimation of the system. The popular approach to measure efficiency (technical efficiency) is the use of frontier production function. However, it has been argued that a production function approach to measure efficiency may not be appropriate when farmers face different prices and different factor endowments. This led to the application of stochastic profit function models to estimate farm-specific efficiency directly.

Since a production function approach, however, fails to capture inefficiencies associated with different factor endowments and different inputs and output prices across farms, under such conditions, the farms may exhibit 'different best practices' production function and operate at different optimal points. Secondly, the assumptions implied in estimating production function through Ordinary Least Square (OLS) method have been questioned and the use of OLS method is subject to criticisms, such as simultaneous equation bias, inconsistent estimates, etc. Further, Rudra (1973) criticized the methodology used in testing the allocative efficiency hypothesis.

Recent developments in the duality theory, namely, the profit function approach has helped to overcome some of the criticism (McFadden, 1970; and Yotopoulos and Lau, 1973 and 1979). Kalirajan (1981), Sidhu and Baanante (1981), and Kalirajan and Shand (1985), using this method examined the economic efficiency of Indian farmers. Most of the studies used the simultaneous function approach in which the input share functions derived from the profit function are used simultaneously and the parameters are estimated with the help of the Seemingly Unrelated Regression (SUR) method advocated by Zellner (1962).

The Concept of Profit Efficiency

As mentioned earlier, production efficiency is usually analyzed by its two components—technical and allocative efficiency. In a production context, technical efficiency relates to the degree to which a farmer produces the maximum feasible output from a given bundle of inputs (an output-oriented approach), or uses the minimum feasible level of inputs to produce a given level of inputs to produce a given level of output (an input-oriented approach). Allocative efficiency, on the other hand, relates to the degree to which a farmer utilizes inputs in optimal proportions, given the observed input prices. Recent developments combine both measures into one system, which enables more efficient estimates to be obtained by simultaneous estimation of system of equations (Ali and Flinn, 1989; and Wang *et al.*, 1996). The popular approach to measure efficiency, the technical efficiency component, is the use of frontier production (Battesse and Coelli, 1995). However, Yotopoulos and Lau (1973) and others argue that production function approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowments (Ali and Flinn, 1989). This led to the application of stochastic profit function models to estimate farm specific efficiency directly (e.g., Ali and Flinn, 1989; Ali *et al.*, 1994; and Wang *et al.*, 1996).

The profit function approach combines the concepts of technical and allocative efficiency in the profit relationship and any errors in the production decision are assumed to be translated into lower profits or revenue for the producer (Ali *et al.*, 1994). Profit efficiency, therefore, is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm, and profit inefficiency is defined as the loss of profit for not operating on the frontier (Ali and Flinn, 1989). Also, in a number of studies of efficiency measurement (Wang *et al.*, 1996), the predicted efficiency indices were regressed against a number of household characteristics, in an attempt to explain the observed differences in efficiency among farms using a two-stage procedure. Although this exercise has been recognized as a useful one, the two-stage estimation procedure utilized for this exercise has also been recognized as one which is inconsistent in its assumptions regarding the independence of the inefficiency effects in the two estimation stages.[3] Battasse and Coelli (1995) extended the stochastic production frontier model by suggesting that the inefficiency effects can be expressed as a linear function of explanatory variables reflecting farm-specific characteristics. The advantage of this model is that it allows the estimation of farm-specific efficiency scores and the factors explaining the efficiency differentials among farmers in single-stage estimation. Following Rehman (2002), this paper utilizes the Battasse and Coelli model by postulating a profit function, which is assumed to behave in a manner consistent with the stochastic frontier concept.

Methodology and Empirical Model Specification

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

Farm profit is measured in terms of Gross Margin (GM), which is equal to the difference between Total Revenue (TR) and the Total Variable Cost (TVC), i.e.,

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

[3] In this commonly used two-stage approach, the first stage involves the specification and estimation of the stochastic frontier function and the prediction of inefficiency effects, under the assumption that these inefficiency effects are identically distributed with one-sided error terms. The second stage involves the specification of regression model for the predicted inefficiency effects, which contradicts the assumption of an identically distributed one-sided error term in the stochastic frontier (Kumbhakar *et al.*, 1991; and Battesse and Coelli, 1995).

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price of super per kilogram, P_6 is the price of calcium per kilogram, P_7 is the average price of manure per quintal, P_8 is the price of a tractor hour, and P_9 is the price of irrigation per hour.

The inefficiency (U_i) is defined as:

$$U_i = \delta_0 + \delta_1 EF + \delta_2 EX + \delta_3 E + D_1 EDU + D_2 EDU + D_3 EDU \qquad ...(5)$$

where *EF*, *EX* and *E* represent the average family education of the farm household, experience of the effective farm household, and average education of the effective head of the farm household, respectively for the crop under consideration. These socioeconomic variables are included to estimate their possible influence on the profit efficiencies of the farmers in sugarcane production in the study area.

The variance of the random errors, σ_v^2 and that of the profit inefficiency σ_u^2 and the overall variance σ^2 are related; thus, $\sigma^2 = \sigma_v^2 + \sigma_u^2$, is the measure of total variation of profit from the frontier which can be attributed to profit inefficiency (Battesse and Corra, 1977). Battesse and Coelli (1995) provided the Log Likelihood Function (LLF) after replacing σ_v^2 and σ_u^2 by $\sigma^2 = \sigma_v^2 + \sigma_u^2$, and thus estimating gamma (γ) as $\sigma_u^2/(\sigma_v^2 + \sigma_u^2)$. The parameter γ represents the share of the 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 favor of OLS estimation.

The estimates of all the parameters of Equations (4) and (5) are jointly estimated using the program FRONTIER Version 4.1c developed by Coelli (1996). A three-step estimation method is used in obtaining the final MLE. The likelihood maximization procedure uses Davidson-Fletcher-Powel Quasi-Newton algorithm.

The profit function without inefficiency components is tested against the profit function with the inefficiency components as specified in Equation (4). The null hypothesis that there is no difference between these two models is rejected on the basis of the log likelihood ratio test. The two models are compared for the presence of profit inefficiency effects using generalized likelihood ratio test, which is defined by the test statistic chi-square (χ^2) as follows:

$$\chi^2 = -2\ln\{H_0/H_a\}$$

where the χ^2 has a mixed chi-square distribution with degree of freedom equal to the number of parameters excluded in the unrestricted model.

Results and Interpretation

The summary statistics of the variables and the maximum likelihood estimates of the parameters of the Cobb-Douglas frontier profit function as defined by Equations (4) and (5) are presented in this section. The results of detailed analysis of the sugarcane profit frontier for the study area are presented in Tables 2, 3 and 4, and the histogram of the frequency distribution of efficiency scores in given in Figure 1.

Table 2 presents the summary statistics of the gross margin, total output and price data of various important inputs of sugarcane cultivation. Since the average farm under the sugarcane cultivation is very small, the mean gross margin for sugarcane is ₹4,710 per farm household. Generally, sugarcane cultivation process takes time ranging from 12-18 months. During this time many tasks have to be performed, such as preparation of land, preparation of seed plants, irrigation, application of fertilizers, pesticides and manures, proper harvesting, and transportation of canes to the mills. These factors outweigh the expected monetary gains from sugarcane production. Therefore, the farmers always prefer to go for small area under sugarcane cultivation. The wide difference between the minimum and the maximum gross margin is attributed to the large difference in the minimum and the maximum area cultivated under sugarcane. Since different types of fertilizers are used, all the fertilizer prices are entered separately.

Table 3 presents the MLE results of the coefficients of the sugarcane profit frontier and the coefficients of the inefficiency functions. The profit frontier for the sugarcane function without inefficiency component was estimated and the LLF value was obtained as 59.64 and

Table 2: Summary Statistics of the Variables of the Stochastic Frontier Sugarcane Profit Function

(in ₹)

Variables	Minimum	Maximum	Mean	SD
Gross Margin	716	19,125	4,710	2,945.79
Area Under Crop*	1	5	1.915	0.91210
Average Labor Price per day	35	50	40	10.5
Average Bullock Price per day	60	75	70	10.23
Average Urea Price per kg	4	6	5	1.67
Average Potash Price per kg	3.5	4.5	4	1.5
Average Super Price per kg	3	5	3	2
Average Calcium Price per kg	4	6	3.5	2.3
Average Manure Price per kg	2	5	4	3.2
Average Tractor Hour Price	130	170	150	40.34
Average Irrigation Hour Price	60	80	70	15.57
Average Education of the Family#	2.514	8.270	10	4
Average Education of the Effective Head#	2.35	8.13	13	3
Experience#	2.521	8.21	3	13

Note: * The values are in acres of land; and # Figures are in number of years.

the result of LR test for one-sided error was 75.72. Hence, the null hypothesis that there are no significant differences between these two models is rejected, and the estimates of inefficiency error component model are presented in Table 3. The coefficients of land area, price of labor, price of nitrogen (urea), potash and calcium, price of tractor hour, and price of irrigation hour are statistically significant and have the expected sign. However, the price of super and manure are not statistically significant.

Among the inefficiency components the coefficients of family education, average education of the effective heads and the education dummies D_1 and D_2 are negative and statistically significant. It reveals the fact that farmer's education above primary and higher

Table 3: Maximum Likelihood Estimation of the Sugarcane Frontier Profit Function

Variables	Coefficient	Value of Coefficient	*t*-Value
Constant	β_0	9.00400	9.063**
Land Area	β_1	0.97580	17.65**
Labor Price	β_2	–2.88900	3.187**
Bullock Price	β_3	0.18420	2.108*
Urea Price	β_4	–0.07560	7.69**
Potash Price	β_5	–0.09750	9.8042**
Super Price	β_6	–0.09900	1.03
Calcium Price	β_7	–0.03990	4.0317**
Manure Price	β_8	0.59340	0.6010
Tractor Price	β_9	–0.25090	12.3808**
Irrigation Price	β_{10}	–0.20930	2.272*
Inefficiency			
Constant	δ_0	0.08890	1.568
EF	δ_1	–0.03570	13.86**
EX	δ_2	–0.00190	1.041
E	δ_3	–0.14610	2.9063*
College Education	D_1	–0.36400	4.643**
High School Education	D_2	–0.07200	12.169**
Primary Education	D_3	–0.53160	0.9663
	σ^2	0.54010	6.7307**
	γ	0.93510	3.237**
LLF		–59.64390	

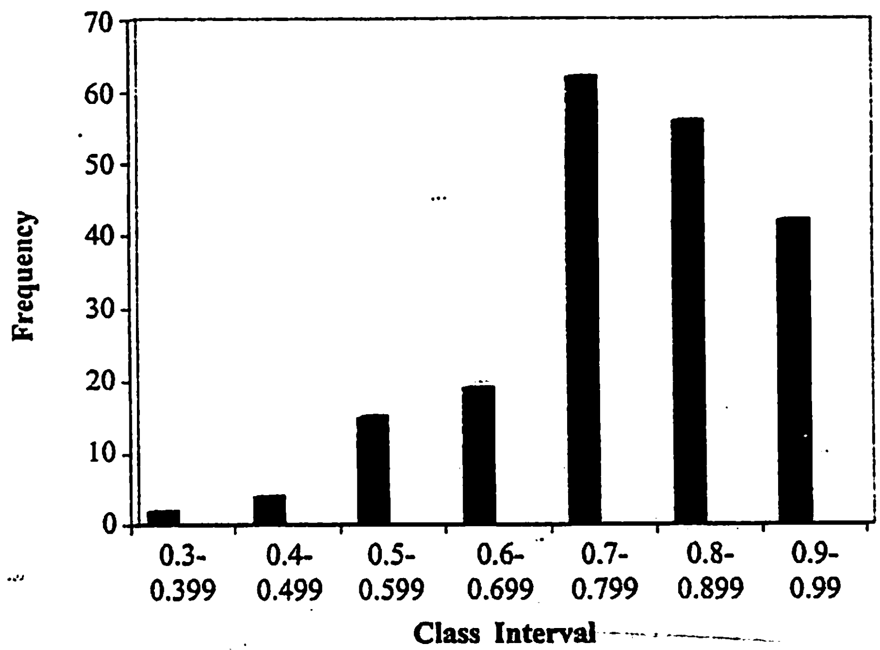
Note: * and ** indicate level of significance at 5% and 1% respectively.

Table 4: Frequency Distribution of Profit Efficiency of Sugarcane Farmers		
Class	Frequency	% of Total
0.3-0.399	2	1
0.4-0.499	4	2
0.5-0.599	15	7.5
0.6-0.699	19	9.5
0.7-0.799	62	31
0.8-0.899	56	28
0.9-0.99	42	21
Average	**0.79**	

primary levels has significant contribution in improving profit efficiency of the sugarcane farmers. 93% of the total differences in the inefficiency are due to profit inefficiency. As far as the efficiency scores for the sugarcane profit function is concerned, 80% of the total farmers achieve scores between 0.7 and 0.99, 9.5% have between 0.6 and 0.699, and 7.5% have between 0.5 and 0.599.

The histogram for profit efficiency of sugarcane farmers in Figure 1 shows that the numbers of the farmers achieving 70-79.9% profit efficiency is highest.

Figure 1: Histogram for Profit Efficiency of Sugarcane Farmers



Conclusion

T W Schultz's pioneering work on 'efficient but poor' hypothesis in 1964 and the consequent transformation of traditional agriculture, revealed the importance of the concept of human ability in the process of production, and it became the most fruitful area of research among the academicians worldwide. In realizing the fact that agricultural development is the key to the overall economic development of a country, like India, where agriculture is the livelihood and lifeline of majority of the population, and the quality of the human factor is very much significant, an empirical investigation of the impact of education of the farm people on production cost and profit of sugarcane crop has been made with the help of primary data collected from 200 farm households in Korei Block of Jajpur District of Orissa.

The stochastic frontier normalized profit function method was used to test the differences in profit efficiency of the effective heads of the farm households having different levels of schooling. This method takes into account the random error component and the error arising out of profit inefficiency. The profit inefficiency is assumed to be linearly related to the average education of the farm household, the average education of the effective head of the farm household, experience of the effective farm household, and education dummies (D_1, D_2 and D_3).

The MLE results of the coefficients of the sugarcane profit frontier and the coefficients of the inefficiency functions show that the coefficients of land area, price of labor, price of nitrogen (urea), potash and calcium, price of tractor hour, and price of irrigation hour are statistically significant and have the expected sign. However, the price of super and manure are not statistically significant.

Among the inefficiency components, the coefficients of average family education, average education of the effective head of the farm household and the education dummies, D_1 and D_2 are negative and statistically significant. It shows the fact that education above primary and higher primary levels has significant contribution in improving profit efficiency of the sugarcane farmers. 93% of the total differences in the inefficiency are due to profit inefficiency. Lastly, the null hypothesis that there is no difference between the profit efficiency model without inefficiency components and profit frontier with efficiency components is rejected. As far as the mean profit efficiency is concerned it is 79%, which implies that on an average 21% of inefficiency can be improved. From the study it can be concluded that in addition to the basic agricultural inputs, the education of the farmer, education of the family of the farm household and experience of the farm household do have significant role, as was emphasized by Schultz (1964). However, primary schooling has no significant contribution to reduce either technical, cost or profit inefficiency. Since most of the schools provide formal education with theoretical knowledge, the students after the completion of the course do not find any use of it in the practical field. The curriculum of the general courses is just to get certificates. Being agriculturally dominated, the school and college education must provide farming courses, which can equip the students with knowledge and better understanding of the techniques of cultivation and the ways of scientific cultivation with practical experience. This will not only protect the students from being unproductive and unemployed after the completion of their education, but the participation of more educated people in agriculture will also increase. As a result, the pressure of educated people on getting employment in the industry and service sectors will diminish and the influx of large section of the rural unemployed youth to the urban areas will reduce. Once the educated people start choosing agriculture as an occupation, it will get commercialized and there will be tremendous changes in the farming practice that the existing farmers have been adopting. Since majority of the people are dependent on agriculture and land is the most important asset to the rural people, the cropping pattern and intensity of the pattern will also change and ultimately the standard of living of the people will improve and the economic status of the state will experience an upward trend.

The National Policy on Agriculture seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen the rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro-business, create employment in rural areas, secure a fair standard of living for the farmers, agricultural workers and their families, discourage migration to urban areas, and face the challenges arising out of economic liberalization and globalization. To achieve all these objectives investment in farm people in terms of education is of utmost importance. The government should introduce farm management-oriented education at school and college levels. The course curriculum should contain lessons on crop management and methods of cultivation. The students should be asked to do project works on agricultural practices. Along with this, the government should take initiative in setting up special colleges for farm management in different blocks. In addition to these private organizations and NGOs must come forward in providing these facilities at grassroots level. Different types of agricultural exhibitions showing latest technology, different machines and pest management practices, must be arranged at school and college levels so that it will directly and indirectly help in higher growth in agricultural production. Since the governments at state and central levels are spending a lot of money on Sarva Siksha Abhiyan (Education for All), a strong and serious effort in providing farming education should be made at all levels, starting from village to city. The so-called Gram Sewaks (government extension agents) at each Panchayat level must be made accountable to the people of that area and must provide all information on farming practices at the schools in each village, so that the knowledge developed in the laboratory is delivered to the farmers. Hence, the educational system should be changed to farm-oriented and some top 'A' schools (Agricultural Schools) in line with top 'B' schools should be set up. Therefore, education in general, and farm-oriented education in particular, should be the main instrument for transforming the existing agrarian system. ○

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