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Profit Efficiency Among *Jhum* Practicing Tribal People of Mizoram State

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ABSTRACT

The present study was undertaken in Mizoram state to study the profit efficiency in *jhum* farming on sample households using a Translog stochastic profit frontier and inefficiency model. The primary data were collected from 120 sample dairy farmers in the three districts of Mizoram, viz., Aizawl, Kolasib and Champhai during 2014-15 using structured interview schedule. The results showed that profit efficiencies of the sample farmers varied widely between 31 and 78 per cent with a mean of 55 per cent suggesting that an estimated 45 per cent of the profit was lost due to a combination of both technical and allocative inefficiencies. The study further observed that farming experience, size of the farm and non-farm income influenced profit efficiency positively while profit efficiency decreased with age. The results found a considerable capacity to improve profitability of *jhum* farmers in the state. The study recommends that the inputs should be made available to farmers at competitive prices and the quantity of labour use should be decreased because the current level is incompetitive. Training should also be provided to farmers to enable them to adopt the best *jhum* farming practices.

Keywords: Shifting cultivation, Tribals.

JEL: Q1, Q15

INTRODUCTION

Shifting cultivation or slash and burn agriculture (locally called as *jhum*) is the main form of agriculture in the hills of North Eastern Region (NER) of India. The people involved in this practice are known as '*Jhumiyas*' (Choudhury, 2004). The area under shifting cultivation in the entire NER is around 19.91 lakh ha which occupies 5.51 per cent of the total geographical area. This accounts for nearly 83.73 per cent of the total area under shifting cultivation in India (Patel *et al*., 2013; Mandal, 2011). Like other states of the region, Mizoram is also known for its shifting cultivation and it affects 8.98 per cent of the total geographical area of the State. *Jhum* cultivation is practiced in 40089 ha of land which accounts about 38.64 per cent of net sown area (Government of Mizoram, 2013). The *jhum* cycle in most areas, which used to be 10-15 years earlier is now reducing to 2-3 years only mainly due to

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population explosion and increased demand for cultivable land (Tripathi and Barik, 2003). This leads to severe soil loss due to erosion, deforestation causing serious environmental degradation and ecological imbalance (Satapathy and Bujarbaruah, 2006). *Jhumiyas* earn meager income from shifting cultivation. Over the last decade, the crop productivity has declined to 50 per cent even after using fertilisers and pesticides to some extent due to land and forest degradation (Mantel *et al*., 2006). Yields are almost equal to input values and farmers are facing food shortage of 2 to 6 months every year (Rezaul Karim and Mansor, 2011). Even though this type of cultivation has adverse negative impact on the farmers as well as the land, it is also necessary to study the profitability as majority of the farmers in NER still depend on this type of cultivation.

The objective of this study is to estimate the profit efficiency of *jhum* farmers in Mizoram. As this type of study has not been conducted in Mizoram, the present study analyses the profit efficiency among sampled *jhum* farmers and identifies farm-specific characteristics that explain variation in efficiency. The measurement of efficiency remains an important area of research both in developing and developed countries. The measurement of efficiency goes a long way to determine the profitability of an enterprise and agricultural growth is linked to profit (Abdulai and Huffman, 2000). An understanding of these relationships could provide the policy makers with information to design programmes that can contribute to measures needed to expand the food production potential of a country (Rahman, 2002) and better measures to enhance agricultural efficiency can be implemented. The measurement of efficiency has received considerable attention in economic literature.

ANALYTICAL FRAMEWORK

Profit efficiency is defined as the capability of a farm to achieve the highest possible profit, given the prices and levels of fixed factors of that farm (Ali and Flinn, 1989). The most popular approach to measure efficiency is the use of stochastic frontier production function (Rahman, 2003). Ali and Flinn (1989) argued that a frontier production function approach may not be appropriate while estimating efficiency when in reality farmers face different prices and have different factor endowments. As a result, they have different best-practice production functions and, thus, different optimal operating points (Rahman, 2003). This led to the application of stochastic profit function models to estimate farm-specific efficiency directly and simultaneously (Kumbhakar and Bhattacharyyas, 1992, Rahman, 2003; Ali and Flinn, 1989). The stochastic profit function specified for farmer in a given season is defined as:

$$\pi_i = f(P_{ij,} Z_{ik}).\exp(\xi_i) \qquad \text{....(1)}$$

where,

π_i = Normalised profit of the i-th farm defined as gross revenue less variable cost, divided by farm specific output price

P_{ij} = The price of j-th variable input faced by the i-th farm divided by output price
Z_{ik} = The level of the k-th fixed factor on the i-th farm
ξ_i = Error term
i = 1, ….., n, is the number of farms in the sample

The error term ξ_i is assumed to behave in a manner consistent with the frontier concept (Ali and Flinn, 1989), i.e.,

$$\xi i = v_i - u_i \quad \text{….(2)}$$

where v_is are assumed to be independently and identically distributed $N(0,\sigma_v^2)$ two sided random errors, independent of the u_is; and the u_is are non-negative random variables, associated with inefficiency in production, which are assumed to be independently distributed as truncations at zero of the normal distribution with mean, $\mu_i = \delta_0 + \sum_d \delta_d W_{di}$ and variance $\sigma_U^2(|N(\mu, \sigma_U^2)|)$, where W_{di} is the d-th explanatory variable associated with inefficiencies on farm i and δ_0 and δ_d are the unknown parameters.

The profit efficiency of farm *i* in the context of the stochastic frontier profit function is defined as

$$EFF_i = E[\exp(-u_i)|\xi_i] = E[\exp(-\delta_0 - \sum_{d=1}^{D} \delta_d W_{di})\,|\xi_i] \quad \text{....(3)}$$

where, E is the expectation operator. This is achieved by obtaining the expressions for the conditional expectation u_i upon the observed value of ξ_i. The method of maximum likelihood is used to estimate the unknown parameters, with the stochastic frontier and the inefficiency effects functions estimated simultaneously. The likelihood function is expressed in term of the variance parameters, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$ (Battesse and Coelli, 1995).

DATA AND METHODOLOGY

Source of Data

The study was conducted in Mizoram State. Out of the eight districts in Mizoram, the three districts, viz., Aizawl, Kolasib and Champhai were selected as these districts have higher *jhum* and net sown area than other districts of the state. From each of the three districts, two blocks and from each block two villages and from each village, the sample farmers were randomly selected make a total respondents of 120 households. The primary data was collected in structured schedule through personal interview method on various aspects of crop enterprise from selected households for two seasons, i.e., rainy season (June-August) and dry season (March-May) during the year 2014-15. The crops considered under the study were paddy, maize, colocasia, chow-chow and pumpkin as these are the major crops grown in the study area.

Empirical Model

The general form of the translog profit frontier, dropping the i-th subscript for the farm, is defined as:

$$\ln\pi = +\sum_{j=1}^{3}\alpha_j \ln P_j + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3}\tau_{jk} \ln P_j \ln P_k + \sum_{j=1}^{3}\sum_{l=1}^{3}{}_{jl} \ln P_j \ln Z_l + \sum_{l=1}^{m}\beta_l \ln Z_l + \frac{1}{2}\sum_{l=1}^{2}\sum_{t=1}^{2}\varphi_{lt} \ln Z_l \ln Z_t + v - u \quad ....(4)$$

where,

π' = Restricted profit i.e.,t otal revenue less total cost of variable inputs normalised by price of output (P_y)
P'_j = Price of the j-th input (P_j) normalised by the output price (P_y)
P_1 = Normalised seed price
P_2 = Normalised manures and fertiliser price
P_3 = Normalised labour wage
Z_l = Quantity of fixed inputs, *l*
Z_1 = Size of land holding
Z_2 = Farm capital used
v = Two sided random error
u = One sided half-normal error

The inefficiency model (u_i) is defined by:

$$u_i = \delta_0 + \delta_{1i}W_{1i} + \delta_{2i}W_{2i} + \delta_{3i}W_{3i} + \delta_{4i}W_{4i} + \delta_{5i}W_{5i} + \delta_{6i}W_{6i}$$

where,
W_1 = Level of education
W_2 = Farming experience
W_3 = Age
W_4 = Household size
W_5 = Size of land holding
W_6 = Non-farm income

The maximum likelihood estimates of the parameters of the stochastic frontier profit function and the inefficiency model was simultaneously obtained using FRONTIER 4.1 (Coelli, 1996).

RESULTS AND DISCUSSION

The average statistics of the sample *jhum* farmers are presented in Table 1. On an average, a farmer gets an annual profit of Rs. 803 per farm and the crop output was sold at Rs. 129/kg in the study area. A typical *jhum* farmer in the state was 51 years old, with 6 years of education, 15 years of farming experience and an average household size of 7 persons. The average farmer cultivated 0.47 ha of land and earned income of Rs. 9721 from non-farm enterprises.

TABLE 1. SUMMARY STATISTICS OF DESCRIPTIVE VARIABLES

Parameters (1)	Minimum (2)	Maximum (3)	Mean (4)	Standard deviation (5)
Profit (Rs.)	157.16	2501.63	802.98	471.02
Output price (Rs.)	28.33	219.99	128.77	56.90
Seed price (Rs.)	7.14	333.33	90.72	70.28
Manures and fertiliser price (Rs.)	12.32	292.80	62.78	45.23
Labour (Rs./day)	38.42	793.15	353.98	205.45
Land holding (ha)	0.2	1.2	0.47	0.26
Farm capital (Rs.)	22.90	1626.94	390.43	314.76
Education of the farmer (years)	1	12	5.87	3.24
Farming experience (years)	1	45	14.75	9.97
Age of the farmer (years)	29	78	51.02	12.19
Household size (nos.)	3	12	6.88	1.82
Non-farm income (Rs.)	0	30000	9721	7644

Maximum Likelihood Values (MLE) Values for Stochastic Function Profit Frontier

The coefficients of the input variables in the Translog production function provided in Table 2 are the elasticities of profit with respect to different inputs. A perusal of the Table 2 revealed that the profit elasticity with respect to manures and fertiliser price was 1.053, which was statistically significant at 5 per cent level. This suggested that with one per cent increase in expenditure on manures and fertiliser used, the profit obtained by the farm would increase by 1.053 per cent. Thus, it can be concluded that there was further scope for investment in manures and fertiliser in order to increase the profit obtained from *jhum* farming. The elasticities of labour was estimated to be negative and significant at 10 per cent level with a magnitude of 0.847 suggesting that if the value of this input was increased by one per cent, the profit obtained by a farm would decrease by 0.847. The coefficient for seed was found to be negative and non-significant indicating that such expense did not have any significant impact on the profit obtained from *jhum* farming. The coefficient fixed input like land holding size was also found to be positively significant at 5 per cent level. The findings of Rahman (2003), who provided a direct measure of profit efficiency of the rice farmers in Bangladesh showed that the elasticity of fertiliser was statistically significant while the estimate of wage rate and seed price were negatively significant. Ohajianya *et al*. (2010) also reported that elasticity of seed was positively significant while that of labour and fertilisers were found to be negatively significant among the maize farmers in Imo State of Nigeria.

TABLE 2. MAXIMUM LIKELIHOOD ESTIMATES OF PROFIT FRONTIER FUNCTIONS

Variables (1)	Parameters (2)	Coefficients (3)	t-ratio (4)
Profit function			
Constant	α_0	8.752	3.187***
$\ln P_1$	α_1	-0.697	-1.712
$\ln P_2$	α_2	1.053	1.986**
$\ln P_3$	α_3	-0.847	-1.708*
$\ln Z_1$	β_{Z1}	0.651	1.994**
$\ln Z_2$	β_{Z2}	-0.704	-1.065
½ $\ln P_1 \times P_1$	τ_{11}	0.023	0.276
½ $\ln P_2 \times P_2$	τ_{22}	-0.091	-0.612
½ $\ln P_3 \times P_3$	τ_{33}	0.360	1.880*
$\ln P_1 \times \ln P_2$	τ_{12}	0.107	1.850*
$\ln P_1 \times \ln P_3$	τ_{13}	-0.093	-1.273
$\ln P_2 \times \ln P_3$	τ_{23}	-0.015	-0.133
$\ln P_1 \times \ln Z_1$	$\square_{1Z1}$	-0.018	-0.241
$\ln P_1 \times \ln Z_2$	$\square_{1Z2}$	0.115	1.863*
$\ln P_2 \times \ln Z_1$	$\square_{2Z1}$	0.036	0.289
$\ln P_2 \times \ln Z_2$	$\square_{2Z2}$	-0.140	-2.469**
$\ln P_3 \times \ln Z_1$	$\square_{3Z1}$	0.151	1.351
$\ln P_3 \times \ln Z_2$	$\square_{3Z2}$	-0.062	-0.520
½ $\ln Z_1 \times Z_1$	φ_{Z1Z1}	-0.491	-1.802*
½ $\ln Z_2 \times Z_2$	φ_{Z2Z2}	0.196	1.681
$\ln Z_1 \times \ln Z_2$	φ_{Z1Z2}	-0.139	-1.996**
Variance parameters			
$\sigma^2 = \sigma_v^2 + \sigma_u^2$	σ^2	0.111	7.239***
$\gamma = \sigma_u^2/\sigma^2$	γ	0.285	6.678***
Log likelihood		-36.841	
LR test of the one sided error		26.003	

***,** and* Significant at $p < 0.01$ level, $p < 0.50$ level and $p < 0.10$ level, respectively.

The lower section of Table 2 reports the results of testing the hypothesis that the efficiency effects jointly estimated with the profit frontier function are not simply random errors. The key parameter is $\gamma = \sigma_u^2/\sigma^2$, which is bounded between zero and one, where if $\gamma = 0$, inefficiency is not present, and if $\gamma = 1$, there is no random noise. The estimated value of γ is close to 1 and is significantly different from zero, thereby, establishing the fact that inefficiencies exists among the *jhum* farms in Mizoram. The diagnostics statistics showed that the estimated sigma-squared (σ^2) is significant at 1 per cent level. This indicated a good fit and correctness of the specified distributional assumptions of the composite error term. This signifies that subjecting the data to Ordinary Least Square (OLS) could not give an adequate estimate. In addition, the estimated gamma (γ) of 0.69 which is the ratio of the variance of farm specific profit efficiency to the total variance of the profit was significant at the 1 per cent level of significance as indicted in Table 2, signifying that 69 per cent of the variation in actual profit from maximum profit (profit frontier) among *jhum* farms was due mainly to differences in farmers' practices.

Determinants of Profit Inefficiency

The parameter estimates for the determinants of profit inefficiency are presented in Table 3. Farming involves a lot of risks and uncertainties, hence, to be competent enough to handle all the vagaries of farming, a farmer must have stayed on the farm for quite some time. The result from the analysis reveals that farming experience had negative impact on profit inefficiency. This result is expected, because experience is gained through learning by doing which enables farmers to correct past mistakes and adopt better practices in the farm. This is in line with that of Rahman (2003) who concluded that farmers in his study area with more than three years of experience in growing modern rice varieties earn significantly higher profit, incur less profit/loss and operate at significantly higher level of profit efficiency. The results of the analysis of inefficiency model also show that age had positive coefficient. The young farmers have more years to obtain the benefits from making costly change and thus have higher adoption rates for profitable technologies than the older farm operators. This result is in contrast with the findings of Tijjani and Usman (2015) who suggested that as a farmer gets older, the more allocative efficient they become, because they might have accumulated experiences and opportunities to correct the observed errors in the past. The coefficients of land holding size and non-farm income were negative and significant at 5 and 10 per cent level, respectively. This implies that farmers having bigger land and higher non-farm income are more profit efficient in *jhum* farming.

TABLE 3. DETERMINANTS OF PROFIT INEFFICIENCY

Variable (1)	Coefficient (2)	t- ratio (3)
Intercept term	0.533	2.254**
Level of education	-0.022	-1.455
Farming experience	-0.045	-2.042**
Age	0.058	1.998**
Household size	0.020	0.945
Size of land holding	-0.613	-2.141**
Non-farm income	-0.083	-1.741*

***,** and* Significant at $p < 0.01$ level, $p < 0.50$ level and $p < 0.10$ level, respectively.

Table 4 represents the distribution of profit efficiency of *jhum* farmers. The profit efficiency ranged between 0.31 and 0.78 for the worst and best farmer respectively and with mean efficiency of 0.55. This implies that the average *jhum* farmer in the study area could increase profit by 45 per cent by improving his/her technical and allocative efficiencies. This suggests that there is a wide chance for the *jhum* farmers to increase their farm incomes and consequently reduce their poverty level. It can be observed that even the best efficient farmer was not optimal in resource allocation and, therefore, need improvement to attain frontier profit. The improvement can be achieved if inefficiency determinants are minimised.

TABLE 4. FREQUENCY DISTRIBUTION OF PROFIT EFFICIENCY OF *JHUM* FARMERS

Efficiency estimate (per cent) (1)	Frequency (2)	Per cent (3)	Cumulative per cent (4)
0.31-0.40	16	13.33	13.33
0.41-0.50	40	33.33	46.67
0.51-0.60	29	24.17	70.83
0.61-0.70	18	15.00	85.83
0.71-0.80	17	14.17	100.00
Minimum	0.31		
Maximum	0.78		
Mean	0.55		

The estimated efficiency and inefficiency indexes of the sample farms for different studies and different countries may vary based on the database collection, referred period of survey time, farm structure etc. Thus, comparison between those estimates obtained in different analyses must be interpreted cautiously. Ali et al. (1994) obtained mean profit inefficiency index about 0.28 for China and A. Abdulai and W. Huffman (2000) used Translog profit frontier function and obtained inefficiency index about 0.27 for northern Ghana; E.W. Chirwa (2007) used Cobb-Douglas frontier production function and obtained technical efficiency index of 46.23 per cent implying that inefficiency among farms is about nearly 55 per cent in southern Malawi for the study of maize.

CONCLUSION

The study has used stochastic profit frontier function to analyse the efficiency of sampled *jhum* farmers in Mizoram. Using detailed survey data obtained from 120 farms, the study showed that *jhum* farmers in the study area are not operating at full profit efficiency level, but opportunities exist for improvement of profit efficiency by the farmers. Small farm holdings, inadequate application of manures and fertiliser, etc. lead to misallocation of the resources employed by *jhum* farmers. Therefore, credit should be extended to *jhum* farmers to enable them to purchase farm inputs and increase farm holdings. The farm labour can also be encouraged to take up other non-farm businesses in order to improve the financial condition of the farmers. Extension attention to the *jhumiyas* should be intensified so as to extend improved practices and technical advice to the farmers.

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