# Efficiency Analysis of Paddy Seed Producers in Lamjung District, Nepal

P. KC* and T. Bhandari
Institute of Agriculture and Animal Science, Tribhuwan University, Nepal
*pravatkc1617@gmail.com

**Abstract-** Albeit study on efficiency of the Paddy seed producer is very crucial in determining the factor productivity, no past literatures support the status of producers in the study area. To analyze the technical, allocative and economic efficiency of paddy seed producers along with their variable relationships, this study was conducted with 50 randomly selected respondents in Sundar Bazaar Municipality, Rainas Municipality and Dordhi rural municipality of Lamjung district in December, 2017 with using interview schedule. Descriptive and statistical tools were used along with Data Envelopment Analysis technique for analyzing efficiencies. Result showed that average 0.15 ha of land was used for seed production with the average seed yield of 855 kg. Mean technical, allocative and economic efficiency scores of the respondents were in the order of 0.65,0.56 and 0.36 respectively under constant return to scale. Single input single output relationship was established to obtain scale efficiency of 0.76 of the study. 14% farms were technically efficient. Only 1 farm was efficient economically and allocatively. Yield result showed that 78% households had increasing returns to scale, 10% had decreasing return to scale and 12% had constant return to scale. Income level of household head found to have the significant impact in the technical efficiency. Seed producers should make the proper co-ordination with model farmers. Target for minimizing the input use and cost of production along with increasing the output should be set.

**Keywords**: allocative, crs, dea, economic, technical



## 1. INTRODUCTION

Rice is the most important cereal crop of Nepal. considering its roles in food security and people's livelihoods. It contributes 51% of the national cereal production, and 20% of the agriculture gross domestic product (GDP). The productivity of 3.15 t/ha in Nepal [1]. About two- third of the rice is grown in the Terai region (72%), one fourth i.e. 24 % in the hilly region and 4 % of the rice is cultivated in the mountain region. But this production is not sufficient to all the people residing in the district as rice is the staple and mostly consumable cereals in Nepal. Lamjung is suitable for the both upland and lowland rice and hill maize seed production. For the production of the seed, foundation seed is required.

So, the demand of foundation seed in Lamjung is fulfilled from the District agriculture Development office (DADO) and the seed producer farmers affiliated to District Seed self-sufficiency Program (DISSPRO) and to the community-based seed production (CBSP) for the purpose of the seed multiplication to produce the certified and improved seed. The demand of the foundation paddy seed in Lamjung was 1250 Kg in 2015 which was 0.54% of the total national demand of 23.5 metric ton [2]. Farmers in the Lamjung form the seed producer group/co-operatives so as to produce the quality seed of the rice as preferred by the consumers of the Lamjung, Tanahun and Gorkha. The extension program of the seed production in neighboring district, Lamjung faces the problem of competition in the paddy seed distribution [3]. But most of the seed is demanded inside the district and supplied inside the district. Resource efficiency is the capacity of the resources to produce high level of output with the given level of inputs. Improving the efficiency of resources means increasing both the production and productive efficiency of the paddy seed production. Technical efficiency is the ability of a firm to produce a maximal output from a given set of inputs or it is the ability of a firm to produce a given level of output with the minimum quantity of inputs and with the available technology [4]. Allocative efficiency is

- *P. K.C. is graduate in bachleor degree program in Agriculture in Tribhuwa University, Nepal, PH-9846593037. E-mail: pravatkc1617@gmail.com*
- *T. Bhandari is Asst. Professor in Tribhuwan University, Nepal, PH-9851151741. E-mail: agecon.iaas2069@gmail.com*

the ability of a firm to use the inputs in optimal proportions, given the market prices of inputs and outputs [5]. Economic efficiency is the multiplicative product of technical and allocative efficiency [6]. Measuring technical efficiency is one commonly used method for understanding how farmers could maximize the benefits accruing from use of current resources and technology. The introduction of new technology has been used as a standard for distinguishing between a modern system and a traditional system and for improving the efficiency of the production system [7].

## Objectives:

The main objective of this study is to estimate and analyze the efficiency of paddy seed producers in Lamjung district, Nepal whereas specific objectives are as follows:

1. To estimate the technical efficiency of paddy seed producers in Lamjung;
2. To estimate the allocative efficiency of paddy seed producers;
3. To determine the economic efficiency in seed production;
4. To examine the relations of socio-economic and efficiency variables on paddy yield.

## 2. MATERIALS AND METHODS

Field survey was conducted from October 2017 to December 2017 and interview schedule was conducted for 50 seed producers (Saghanbali agriculture group-12, Majhuwa women seed producers group-12, sundar seed co-operative-08 and Harrabot seed producer group-18), were selected randomly through pre-tested questionnaire in Sundar bazaar municipality Rainas municipality and Dordhi rural municipality of Lamjung district.

For the analysis data were coded and tabulated on the Microsoft Excel and simple statistical as well as descriptive tools were used. Furthermore, computer software DEAP version 2.1 was used for the efficiency analysis. Similarly, Chi-square test (Cross tabulation) was conducted to study the relationship between socio-economic variables and efficiencies. Categorical variables viz; education level of household head, income level of household head and technical and economical efficiencies were cross tabbed. Furthermore,the significance level at 5% and 1% was tested between the two categorical variables.

In this study, Data envelopment analysis (DEA) technique was used to estimate the technical and economic efficiency. It is a linear programming model which uses a data regarding inputs to outputs to construct the best practice frontier over the data points.

### Estimation of Technical efficiency (TE)

In this study, input oriented DEA model under the assumption of constant return to scale was used for the estimation of technical efficiency of paddy seed producers. Output variable used for the estimating the technical efficiency was total yield of the rice seed (Y). In this study five inputs are considered namely, Land used for seed production (ha.), Seed amount, qty. of NPK used (Kg.), quantity of FYM used (doko) and $X_5$ = number of labours

Min $\Theta, \lambda$

Subject to:

$-y_i + Y\lambda \geq 0$

$\Theta_{xi} - X\lambda \geq 0$

$N1' \lambda = 1$

$\lambda \geq 0$

where, Y = output matrix for N number of HH

$\Theta$ = input technical efficiency scale having value $0 \leq \Theta \leq 1$

$X_i$ = input vectors

$y_i$ = yield from individual farm

$\lambda$ = vector defining linear combination of farm

N= total number of farms

$X_{1i}$ = Land used for seed production (ha.),

$X_{2i}$ = Seed amount,

$X_{3i}$ = qty. of NPK used (Kg.),

$X_{4i}$ = quantity of FYM used (doko)

$X_{5i}$ = number of labours

### Estimation of Economic efficiency

Economic efficiency is the ratio of minimum cost to the observed cost. Following Coelli et al. (1998), a cost minimization DEA model used to estimate minimum cost was specified as:

ISSN 2229-5518

Min $\lambda$, $X_i^E$, $x_i$, $w_i$

$-y_i + Y\lambda \geq 0$

$X_i^E - X\lambda \geq 0$

$\lambda \geq 0$

where, Y = output matrix for N number of farms

$X_i$ = input vectors

$y_i$ = yield from individual farm

$\lambda$ = vector defining linear combination of farm

$X_i^E$ = minimum input for the output

$W_i$ = price of i number of input

$W_{1i}$ = amount for land rent (Rs.)

$W_{2i}$ = cost of seed (Rs.)

$W_{3i}$ = cost of NPK(Rs.)

$W_{4i}$ = Cost of FYM (Rs.)

$W_{5i}$ = amount for labour (Rs.)

**Estimation of allocative efficiency**

Allocative efficiency is the ratio of economic efficiency and technical efficiency.

$$\text{Allocative efficiency} = \frac{\text{Economic efficiency}}{\text{Technical efficiency}}$$

### Estimation of scale efficiency

Scale efficiency can be obtained for each farm operating with the both assumption of the constant return to scale(CRS) and variable return to scale (VRS) DEA and decomposing the TE scores. When the farm differs in the CRS TE scores and VRS TE score, it indicates the farm has scale inefficiency. For the calculation of scale efficiency one input-one output case is generally practicable. Input oriented CRS model is widely used. When not all the farms are operating at optimal scale, results the measures of TE that are confounded by scale efficiency.

$$SE = \frac{TECrs}{TE\ Vrs} \ [8]$$

Chi- square test was conducted to check the hypothesis that whether or not socio-economic variables have relations on technical efficiency.

## 3. Results and Discussion

Technical, allocative and economic efficiency of sample farms for paddy seed producers is presented in Table 1. It is evident from the results that the mean technical efficiency of the sample farms is 0.652, with minimum level of 0.188 and maximum level of 1. The mean allocative efficiency of the sample farms is estimated at 0.564, with a low of 0.087 and a high of 1. The mean economic efficiency of the sample farms is 0.362, ranging between 0.087 and 1.0.

Frequency and percentage distribution of the sample farm is shown in the table 1 with the technical, allocative and economic efficiency.

**Table 1: Deciles range of frequency distribution of Technical, allocative and economic efficiencies**

| Efficiency | Technical efficiency | | Allocative efficiency | | Economic efficiency | |
|---|---|---|---|---|---|---|
| Level | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
| 0.01-0.1 | | 0 | 1 | 2 | 2 | 4 |
| 0.11-0.2 | 2 | 4 | 0 | 0 | 3 | 6 |
| 0.21-0.3 | 0 | 0 | 3 | 6 | 13 | 26 |
| 0.31-0.4 | 5 | 10 | 7 | 14 | 14 | 28 |
| 0.41-0.5 | 4 | 8 | 7 | 14 | 11 | 22 |
| 0.51-0.6 | 12 | 24 | 11 | 22 | 4 | 8 |
| 0.61-0.7 | 8 | 16 | 14 | 26 | 1 | 2 |
| 0.71-0.8 | 6 | 12 | 5 | 10 | 0 | 0 |
| 0.81-0.9 | 6 | 12 | 2 | 4 | 1 | 2 |
| 0.91-1 | 7 | 14 | 1 | 2 | 1 | 2 |
| Total | 50 | 100 | 50 | 100 | 50 | 100 |
| Mean | | **0.65** | | **0.56** | | **0.36** |
| Minimum | | 0.188 | | 0.087 | | 0.087 |
| Maximum | | 1 | | 1 | | 1 |

(Source: Own analysis, 2017)

### 3.1 Estimation of technical efficiency (TE)

The mean technical efficiency of the sampled farms in the study area was 0.65 i.e. about 65% at constant return to scale. This can be interpreted as if the farmers under the study to operate at full efficiency level, they could lessen their input utilization on an average by 35% and still produce the same level of output. It can also be interpreted as with using the advance technology the output level of the farm can be increased by 35 % under constant return to scale.

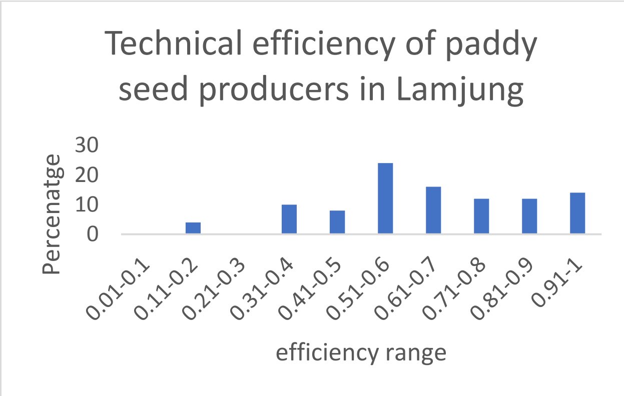



Fig: percentage of technical efficiency

From the above bar diagram, it is clear that 24% farms lied between 0.51 to 0.6. 14% were found technically efficient. This might be due to the efficient use of the inputs with in the small fragments of land. Variation in the technical efficiency get differs from farm to farm, it might be due to the managerial ability and use of the existing technology in farm level. The range of the technical efficiency in this result ranged from 0.188 to 1. This finding is also supported by the findings of Kyi and Oppen [9] that the range of technical efficiency of Nepalese rice farmers is 12 % to 100%. Similarly, Previous study on rice had 59 % TE [10], 50 % TE [11].

### 3.2 Estimation of the allocative efficiency (AE)

The mean allocative efficiency of the sampled farm was 0.56 at constant return to scale with the low efficiency of 0.087 to 1. It is clear that the minimum AE of the sampled household ranged from 0.087 as minimum value to 1 as maximum value. The maximum numbers of farm were operating at the allocative efficiency of value ranging from 0.61 to 0.7, 28 % of the farm were operating between this range. Similarly, only 2% of the farm were found to be allocatively efficient. This might be due to the efficient allocation of the inputs with correct input mix. Furthermore, allocative efficiency is used to determine the resource, which is underutilized or over utilized. The mean allocative score 0.56 can be interpreted as the paddy seed growers in Lamjung apply the wrong input mix at given input price, that an average cost is about 44% higher than the cost minimization level.

The result is supported by the findings of Bravo-Ureta [10], reported that the farm level average allocative efficiency ranged from 43% to 89% in developing countries. Similarly, Similarly, Ahmad et al. [12] found that the mean allocative efficiency score of 0.581 for large rice farmers, 0.598 for small rice farmers and 0.634 for medium rice farmers of Bihar, India.

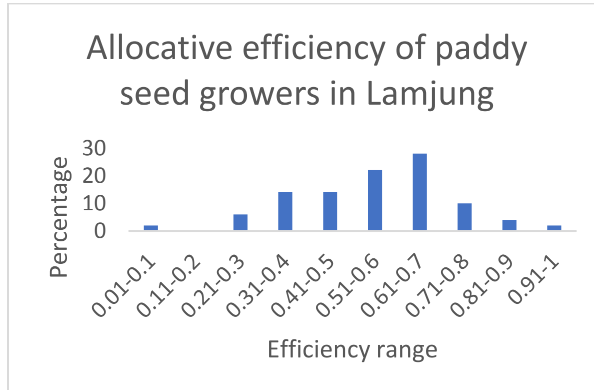


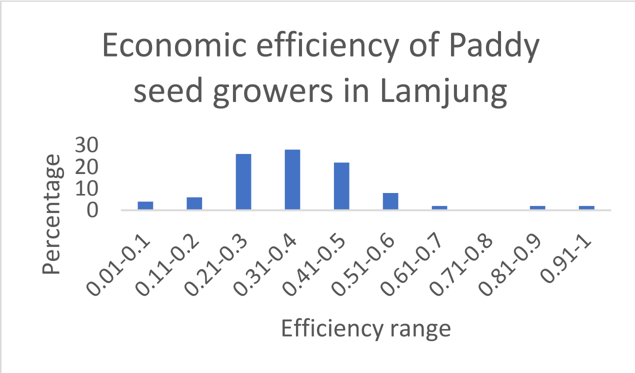

Fig: percentage of allocative efficiency

### 3.3 Estimation of Economic efficiency (EE)

Since EE is also called as cost efficiency, the mean economic efficiency (EE) of the sampled farms was found to be 0.362, i.e.36 %, ranging 0.087 to 1. Figure shows that maximum farms were operating at the economic efficiency between 0.31 to 0.4. While 2% at optimum efficiency. It might be due to the proper management of the cost of production in the use of the input and maximum output made the farm efficient. 26% of the farms were operating between 0.21-0.3. As we know that, the economic efficiency is the ratio of the minimum cost to the observed cost. This result can be interpreted as 36.2 % of the observed cost is the minimum cost, so as to produce the given level of output as produce by the observed cost. About 64% of the total cost of production was over-utilized. Over-all cost of production of paddy seed could be reduced by average of about 64% to achieve same level of output.

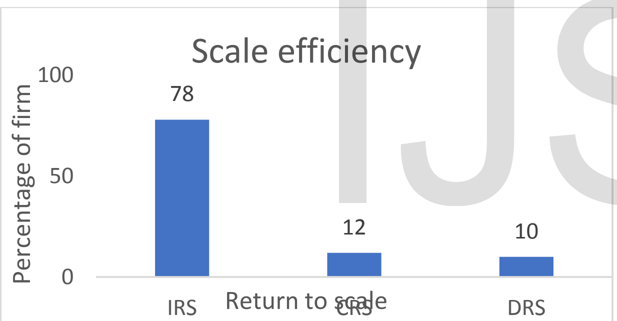
The result is in line with the findings of Bravo-Ureta and Pinheiro [10] which reported the average range of the economic efficiency ranges from 13% to 69% for developing countries. Similarly, Ahmad et al. [12] found that the mean economic efficiency score of 0.448 for large rice farmers, 0.398 for small rice farmers and 0.44 for medium rice farmers in Bihar, India.

ISSN 2229-5518




### 3.4 Estimation of the scale efficiency (SE)

The study revealed that the mean technical efficiency assuming the constant return of scale was found to be 0.276 and mean technical efficiency assuming variable return to scale was found to be 0.373 yielding the mean scale efficiency as 0.764. Similarly, of the total farm 39 (78%) farms in terms of the land used as single input, experienced the increasing return to scale and 6 (12%) farms experienced the constant returns to scale and 5 (10%) farms experienced to the decreasing return to scale. (N=50).






This finding is also can be supported by Islam and Backman [13] revealed 73% farms experienced increasing return to scale, 11% experienced CRS and 16% experienced decreasing return to scale among the rice farmers of Bangladesh.

### Determinants of technical efficiency (TE)

**Table 2: Relationship between income level of household head and technical efficiency**

| Range of TE | Income level of HHH | | | Total |
|---|---|---|---|---|
| | <0.3 million | 0. 3 million to 0.6 million | ≥ 0.6 million | |
| <0.33 | 1 (11) | 1 (3) | 0 | 2 (4) |
| 0.33-0.66 | 3 (33) | 16 (47) | 3 (43) | 22 (44) |
| >0.66 | 5 (56) | 17 (50) | 4 (57) | 26 (52) |
| Total | 9 | 34 | 7 | 50 |

Source: Own analysis, 2018

Figure in parentheses represent percentage

Chi-square = 0.011* (Significant at 5% level of significance)

The high-income level of the household head had positive and significant impact to the technical efficiency. This might be the case because off-farm work may raise the income available for farm investment in the inputs used for production. The result is in line with the Haji et al. [14], argued that income level absorbs under-employed labour resources. Especially, it may improve the experience and human capital of the farm operator and bring additional income that could be used for farm activities. Solis et al [15] also found the same type of result as like of the Haji et al. [14]

**Table 3: Relationship between the technical efficiency and education level**

| Range of TE | Education level of household head | | | Total |
|---|---|---|---|---|
| | <Primary | Class 5 to SLC | >SLC | |
| <0.33 | 3 (8) | 0 | 0 | 3 (6) |
| 0.33-0.66 | 19 (53) | 4 (50) | 1 (17) | 24 (48) |
| >0.66 | 14 (39) | 4 (50) | 5 (83) | 23 (46) |
| Total | 36 (72) | 8 (16) | 6 (12) | 50 |

Source: Own analysis, 2018

Chi-square = 0.307 (Ns); Significance level at 5%

The efficiency score was ranged with the interval of 0.33. Table 7 shows that 8% household head whose technical efficiency smaller than 0.33 had the education of primary level. Similarly, 53% household head had the education of the primary level operating at efficiency between 0.33 to 0.66, nearer to the mean technical efficiency score and the 39% household head had the education up to only primary level, found to have the efficiency score above 0.66. Among the 8-household head whose education level was from class 5 to SLC level, 50% respondents had the efficiency level ranging from 0.33 to 0.66 and 50% had the efficiency level more than 0.66. Similarly, 6 respondents whose level of education was above the SLC and 83% had the efficiency level greater than 0.66 and only one had the efficiency level between 0.33 to 0.66. About 46 % of the household head had the technical efficiency score greater than 0.66 and 48% had the technical efficiency score nearer to the mean technical score. It could be said that education had impact on the efficiency level as seen in the respondents with education level above SLC, 83% firm are operating at higher range of efficiency. But, the education became non-significant to the technical efficiency in this study.

In Lamjung, most farms were characterized by small land size, abundant agricultural labour and low technology. In this case, levels of education might have a different impact on technical efficiency. The above result is supported by the Rio and Shively [16] argued that efficiency falls with higher levels of education on small farms because education increases opportunities for off-farm work and thereby reduces on-farm management intensity. Similar result was obtained by the Rahman and Rahman [17] and Coelli [18] failed to identify the significant impact of education on technical efficiency of rice farmers in Bangladesh.

## 4. Conclusion and Recommendations

Above results supported the researcher to conclude inefficient farming of majority of the farms. Meaning that few farmers used proper allocation of the inputs, tools or machineries. Study also found complexity in the management of the farm produces, because of the decreasing return to scale. There is substantial room to improve the efficiency level of the respondents. Since most farmers were characterized by small landholdings, low technology and low income, household income is found to have the significant impact on the technical efficiency of the paddy seed producers.

As depicted by the results, policy should be made from the local government side to make people involved in the off-farm income generation activities, as the efficiency increases with increasing the income level of household. The farmer should be made aware about the efficiency level of production from the municipal level. Seed producers should make the proper co-ordination with model farmers. Training at the local level should be given for the production of the seed with the consideration of the costs and benefits. As the IRRI targeted area, IRRI-STRASA is suggested to focus on the quality seed production and marketing. Local technicians are suggested to provide the information regarding the optimal use of the nutrients, farm tools and implements and other inputs in the unit area of land for increasing the input use efficiency. In order to correct the problems in the seed marketing, Sundar bazaar Municipality is suggested to make the policies on the seed multiplication and seed marketing. Target should be set up with in the farmers' group for minimizing the input use and cost of production along with increasing the output.

## 5. ACKNOWLEDGEMENT

I would like to express deep gratitude to my major advisor Mr. Thaneshwar Bhandari for his consistent guidance, encouragement and invaluable support throughout the progress of my study. I like to express my gratitude to Research Assistant of IRRI-STRASA, Bishnu Ghimire, the research would not be possible without his help. I would like to thank the respondents who were taken under the research for their information.

## 6 REFERENCES

[1] MoAD. 2017. Statistical Information on Nepalese Agriculture. Ministry of Agricultural Development, Singh Durbar, Kathmandu, Nepal.207p

[2] SQCC, 2015. Seed balance sheet paddy seed demand 2072. Seed quality control center (SQCC). Hariharbhawan, Lalitpur

[3] Poudel, M.R. 2013. Study of Sundar seed co-operative and its role in rice seed production in Lamjung, Nepal.

[4] Bakhsh, K. 2007. An analysis of technical efficiency and profitability of growing potato, carrot, radish and bitter gourd: A case study of Pakistani Punjab. Department of Farm Management, University of Agriculture, Faisalabad, Pakistan.

[5] Farrell, M.J. (*1957*) The Measurement of Productive Efficiency. Journal of the Royal Statistical Society, 120, 253-290.

[6] Coelli, T., D.S.P. Rao and G.E. Battese. 1998. An introduction to efficiency and productivity analysis. Kluwer Academic Publishers, Boston.

[7] Schultz, T.W.1964.Transforming Traditional Agriculture. New Haven CT: Yale University Press, 1964, xiv Pp 212

[8] Coelli, T.J. 1996. A guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer)Program. CEPA Working Paper 96/08, Department of Econometrics, University of New England, Armidale.

[9] Kyi, T. and M. V. Oppen, "Stochastic Frontier Production Function and Technical Efficiency Estimation: A Case Study on Irrigated Rice in Myanmar".

[10] Bravo-Ureta, B. E., & Pinheiro, A. E. (1993). Efficiency analysis of developing country agriculture: A review of the frontier function literature. Agriculture and resource economics review, 22(1): 88-101

[11] Kalirajan, K., and J.C. Flinn. 1983 "The measurement of farm specific technical efficiency." Pakistan Journal of Applied Economics 11:167–80.

[12] Ahmad, N., D. Sinha, and K.M. Singh, 2017. Estimating production efficiency in rice cultivation of Bihar: An Economic Approach. Retrived Available at SSRN: https://ssrn.com/abstract=3052070 or http://dx.doi.org/10.2139/ssrn.3052070

[13] Zahidul Islam, K.M., S. Backman, and J. Sumelius. Technical, Economic, and Allocative Efficiency of Microfinance Borrowers and Non-borrowers: Evidence from Peasant Farming in Bangladesh. European Journal of Soil Science 18(2011):361–77.

[14] Haji, J, 2006, "Production Efficiency of Small Holder's Vegetable Dominated Mixed Farming System in Eastern Ethiopia: A Non-parametric Approach" Journal of African Economies, Vol.16, No. 1, pp.1-27.

[15] Solis, D., Bravo-Ureta, B.E. and Quiroga, R.E., 2009 Technical Efficiency among Peasant Farmers Participating in Natural Resource Management Programs in Central America. Journal of Agricultural Economics, Vol. 60, No. 1, pp. 202-219.

[16] Rios, A. and G.E. Shively, 2005. "Farm size and nonparametric efficiency measurements for coffee farms in Vietnam" Paper for presentation at the American Agricultural Economics Association Annual Meeting, 24-27 July, 2005, Rhode Island.

[17] Rahman, S. and Rahman, M. 2008. Impact of Land Fragmentation and Resource Ownership on Productivity and Efficiency: The Case of Rice Producers in Bangladesh" *Land Use Policy*, Vol. 26, No. 1, pp.95-103.

[18] Coelli, T.J., Rahman, S. and Thirtle, C., 2002, "Technical, Allocative, Cost and Scale Efficiencies in Bangladesh Rice Cultivation: A Non-parametric Approach" *Journal of Agricultural Economics*, Vol. 53, No. 3, pp. 607-626.