Original research papers

Factors Influencing Economic Viability of Small Farmers of Rice Production in Bangladesh

Abstract

The focus of this study was to conduct research on small rice farmers and to identify the factors and their influence in viability of rice production in Bangladesh. The study was conducted using a longitudinal survey made under the VDSA project of ICRISAT. A total of 179,179,156 and 177 small rice farms were selected as a sample for the years of 2009, 2010, 2011 & 2012, respectively. Among 691 small farmers, 562 farmers were viable farmer and 129 farmers were non-viable farmers who were producing rice in the study area. The small farmers lived in the same socio-economic environment. The economic surplus of small farmer were11018.5tk. 12205tk., 6006tk. and 4461tk. in different years. To achieve the objective discriminant function analysis was used. For this analysis eight discriminant factors were selected i.e. family size, farm size, education, value productivity from crops, net income from dairy, off-farm income, total fixed investment and domestic expenditure. It is found that off-farm income was the most significant discriminat factor among the eight factors related to the discriminating of viable and non- viable of small farmers of rice production Besides value from crops, total fixed investment and domestic expenditure were the other significant factors found during all the years.

Key words: Factors, viability, small farmer and rice.

Introduction

Agriculture is the single largest producing sector of the economy of Bangladesh since it comprises about 16.77% of the country's GDP and employs around 45% of the total labor force (BBS,2013). Despite high pressure of population on land and other natural resources,

Bangladesh has made remarkable progress in food production over the last three and a half decades. Among all crops, rice is the driving force of Bangladesh agriculture. More than 200 million small farmers with an average of less than 1 hectare of land produce 90 percent of the total rice in the world (Tonini& Cabrera, 2011). Bangladesh being an agricultural country most of her food crops are produced from small farms. Small farmers still dominate the agricultural sector in Bangladesh and play a significant role in the country's economy. The small farmers (0.05-2.49 acre) account for nearly 84% of the total farm holdings in the country and out of 15.3 million total farm holdings, 12.7 millions small holdings (BBS, 2013). Therefore, small farmers still dominate the agricultural sector, specially the rice sector in Bangladesh. Available data indicate that, except in 1993-94 and 2005-2006, domestic rice production has never been adequate to meet the country's domestic demand. As such, rice imports have continued, although the volume varied from year to year depending on domestic production (Alam, 2012). However, recent trends are alarming as the average yield of modern varieties of rice has fallen from 3.8 ton/ha in 1968 to 2.9ton/ha in 2006 which raising serious concern in sustaining food-grain production. In this situation, production of rice should be sustained in Bangladesh. Specially, the risk of production by non-viable small rice farmers is high as they face the greatest challenge of integration and competitiveness in commercial agricultural markets, as well as budgetary or capital constraints. There are many factors affecting the rice production of small farmer. Therefore, it becomes very essential to know whether small farmers are economically viable in rice production or not.

A lot of study was conducted on rice in the past such as Singh and Kolar *(*2009) which examined the contribution of factors influencing economic viability of marginal and

small farmers in Punjab. Wander et.al. (2007) conducted a study to assess the economic feasibility of small scale organic production of rice, common bean and maize in Goias State, Brazil. Common bean is economically viable in leguminous mulching systems and green harvested maize was viable in all mulching systems. Nasrin (2013) evaluated the financial profitability of aromatic rice production and its impacts on farmers' livelihood in selected areas of Tangail district. He found total human labor, seed, fertilizer, power tiller and irrigation had significant impact and insecticides had insignificant impact on the per hectare output**.** Hyuha et. al. *(*2007) found that improvement in profit efficiency in rice production would require focused programs to increase access to education and extension services. Tama (2014) found total costs, gross return, gross margin and net return for aromatic rice were Tk. 64446.51, Tk. 114243.71, Tk. 59999.29 and Tk. 49797.20 per hectare. The aromatic rice production was profitable (BCR is 1.77). Nimoh et al. *(*2012) showed that farmers were in the second stages of production that land, fertilizer and seed were being underutilized and labor and chemicals were being highly over utilized. Kolawole (2006) examined the determinants of profit efficiency among the small scale paddy rice farmers in Nigeria. All the inputs have positive sign on the profitability of rice farming in Nigeria except the unit cost of fertilizer/kg. More than half of the farmers having profit efficiency of 0.61 and above with an average profit efficiency of 0.601 suggesting. Profit efficiency was positively influenced by (age, educational level, farming experiences and household size). Mustafi and Saiful (2004) found that production cost for MV Boro was much higher (Tk. 28249.0/ha) than MV Aus and MV T. Aman rice. The yield of MV Aus, MV T. Aman and MV Boro rice were 353kg/ha, 4310 kg/ha and 4962 kg/ha, respectively. Higher gross return (Tk. 35719.0/ha) was obtained from MV Boro rice production while the gross return from MV T. Aman was Tk. 35221.0/ha. But the higher net return (Tk. 13012.0/ha)

was obtained by the MV T.aman rice growers. Given the above literature, it is found that there was no study on factors responsible for viability of small rice farmers of Bangladesh. This study is an attempt to find out the factors and their influence on rice production. It helps to understand the viability of small farmers through profitability of rice production to create a more enabling economic environment for their development.

Methodology

The study was conducted using secondary sources of information and it has been drawn from a longitudinal survey made under the VDSA project of ICRISAT. Sample of this survey is nationally representative. A total of 179,179,156 and 177 small rice farms were selected as a sample through simple random sampling process for the year of 2009, 2010, 2011 & 2012, respectively. The study area were eleven districts of Bangladesh i.e. Chandpur, Comilla, Thakurgaon, Patuakhali, Bogra, Chuadanga, Mymensingh, Jhenaidah, Madaripur,Narsingdi and Kurigram. To achieve the objectives discriminant function analysis was used. SPSS software was used for this purpose.

Discriminant function analysis is a statistical technique used to differentiate between two or more classes, based on the common variables, and therefore was used in this study for analysis of data. The discriminant function helps in measuring the net effect of a variable by holding the other variables constant.

With the same socio-economic environment, the farmers who are thriving well and are able to earn enough income to meet their actual expenditure (farm expenditure+ cost of living determined by their prevailing consumption pattern and life styles) are known as viable farmers (Singh *et al.*, 2009).

The linear discriminant function of the form of Equation (1) was applied to find the relative importance of different variables in discriminating between these two groups of farms, viz. viable farms and non-viable farms.

$$Z = \Sigma L_i X_i \text{----------(1)}$$

Where,

Z= Total discriminant score for viable and non-viable farms of marginal and small farmers, respectively,

X_i = Variables selected to discriminate the two groups (i = 1, 2, ..., 8), like

X_1 = Education (years of schooling)

X_2 = Family size (no.) X_3 = Farm size (acres)

X_4 = Total fixed investment (Tk.) X_5 = Off-farm income in (Tk.)

X_6 = Domestic expenditure (Tk.)

X_7 = Value from crops production (Tk. /acre) X_8 = Value from dairy (Tk.)

L_i = Linear discriminant coefficients of the variables estimated from the data, (i=1, 2..., 8)

The method seeks to obtain coefficients (Li's) such that squared differences between the mean Z score for one group and mean Z score for other group is as large as possible in relation to the variation of the Z scores within the groups.

Mahalanobis D^2 (Radha and Chowdhry, 2005) statistics was used to measure the discriminating distance between the two groups,

$$D^2 = \Sigma L_i d_i \text{----------(2)}$$

Where,

L_i is the linear discriminant coefficient and

d_i is the mean difference of the two categories for the i^{th} variable (x_i).

The significance of D^2 was tested by applying the following variance ratio (F) test:

$$\frac{(n-1-p)\,(n_1 n_2)}{p\,(n-2)\,(n)} \cdot D^2 \sim F\,(p,\ n-p-1) \quad \text{----------(3)}$$

Where,

n_1= Number of farms in the viable farm group,

n_2= Number of farms in the non-viable farm group,

$n = n_1 + n_2$, and

p= Number of variables considered in the function. The critical mean discriminant score was obtained for each group by Equation (4):

$$Z = [\bar{Z_1} + \bar{Z_2}] / 2 \quad \text{----------(4)}$$

where,

$Z_1 = \Sigma L_i X_{1i}$ for viable farms

$Z_2 = \Sigma L_i X_{2i}$ for non-viable farms

For each individual, Z_i value was calculated by Equation (5):

$$Z_i = \Sigma L_i X_i \text{----------(5)}$$

If the individual Z_i value was more than Z, the individual belonged to the viable farm of the marginal and small farmers, otherwise to the non-viable category.

Results and Discussion

Socio economic condition of small farmer of rice production

From table 1, it is found that most of the small farmers (65.83%) belong to working age as they were involved in production of rice. Their average family size was 5.87. Though they are small farmer, in case of education, few of them (28.83%) were illiterate. The small rice farmers mostly

involved in farm activities (60.20%), they also worked in non-farm (39.80%). Half of the small farmers were married (53.33%).

Table 1: Socio economic condition of small farmer of rice production (Percentage)

Item		2009	2010	2011	2012	Average
Working age (15-64 years)		64.56	66.14	65.52	67.11	65.83
Family size (No.)		5.71	6.41	5.72	5.65	5.87
Education	Illiterate	29.25	29.48	27.16	27.83	28.43
	Literate	70.75	70.52	72.84	72.17	71.57
Occupation	Farm	56.63	61.11	61.69	61.38	60.20
	Non-farm	43.38	38.89	38.31	38.62	39.80
Marital status	Married	41.44	48.16	44.32	52.76	46.67
	Others	58.56	51.84	55.68	47.24	53.33

Source: Author's calculation, based on VDSA data.

Viability and non-viability in small farm

For this study holding the other variables constant the sample farmers were categorized into two groups i.e. viable and non-viable. The economic surplus was calculated by deducting the domestic expenditure from the total farm business which was negative for each year for small rice producing farmers. The farm income was the summation of crop and value of dairy of individual farm. Overall economic surplus was positive after deducting off-farm income for each year (Table 2).

Table 2: Economic surplus of rice producing small farmers in different years (Tk./farm/annum)

Particulars	2009	2010	2011	2012

Farm business income from crops	18345	19645	21300	15800
Farm business income from dairy	2133.5	2480	2335	2190
Total farm business income from crops and dairy	20478.5	22125	23635	17990
Domestic expenditure	52685	55965	60569	58769
Economic surplus from crops and dairy	-32206.5	-33840	-36934	-40779
Off-farm income	43225	46045	42940	45240
Overall economic surplus	11018.5	12205	6006	4461

172 Source: Author's calculation, based on VDSA data.

173 On the basis of economic surplus calculated in table 2, the group of small farmer i.e. viable and
174 non-viable farmer were calculated in table 3. From table 3 it is found that, total 691 number of
175 small farmer was selected. Among them, 562 farmers were viable farmer and 129 farmers were
176 non-viable farmers who were producing rice in the study area (Table 3).

177 Table 3: Number of viable and non- viable small farmers

Years	No. of viable farmers	No. of non- viable farmers	Total no. of farmers
2009	168 (93.85)	11(6.15)	179
2010	165 (92.18)	14(7.82)	179
2011	123 (78.85)	33 (21.15)	156
2012	106 (59.89)	71 (40.11)	177
Total	562(81.33)	129(18.66)	691

178 Note: Figures within the parentheses indicate percentage of the total respondents.

179 Source: Author's calculation based on VDSA data.

Factors Impact on Discrimination

The findings of discriminant function analysis on small farms of rice production from 2009 to 2012 have been presented in Table 4, 5, 6 and 7. It can be seen from the table 4 that value from crops production, off-farm income and total fixed investment were the factors, which differed significantly on viable and non-viable farms in 2009.Value from crops production was significantly higher on viable (21890 tk.) than non-viable (14800 tk.) farms. Off-farm income was found to be significantly higher on viable farms (55780 tk.) than non-viable ones (30670 tk.). Total fixed investment was found to be significantly higher on viable farms (51830 tk.) than

Table 4: Discriminant function on small farms of rice production in 2009

Items	Mean		Mean difference (di)	Discriminant coefficient (Li)	Discriminating distance (Li)(di)	Percent contribution to the total distance
	Viable	Non-viable				
X_1 - Education (years)	6.40	5.30	1.10	0.0187	0.021	0.79
X_2 - Family size (no.)	6.38	5.87	0.51	0.3869	0.197	7.56
X_3 - Farm size (acres)	2.11	1.67	0.44	-1.1380	-0.501	-19.18
X_4 - Total fixed investment (Tk.)	51830	35780	16050***	0.000056	0.899	34.44
X_5 - Off-farm income (Tk.)	55780	30670	25110***	0.000073	1.833	70.23
X_6 - Domestic expenditure (Tk.)	63700	41670	22030	-0.000009	-0.198	-7.60
X_7 - Value from crops production (tk.)	21890	14800	7090**	0.000080	0.567	21.73
X_8 - Value from dairy (Tk.)	3400	867	2533	-0.000079	-0.200	-7.67
D-square					2.62*** (11.73)	100.00

Notes: Figures within the parentheses indicate the F-ratio.

***, ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Source: Author's calculation, based on VDSA data.

Table 5: Discriminant function on small farms of rice production in 2010

Items	Mean		Mean difference (di)	Discriminant coefficient (Li)	Discriminating distance (Li)(di)	Percent contribution to the total distance
	Viable	Non-viable				
X_1 - Education (years)	6.10	5.10	1.00	0.02700	0.027	0.92
X_2 - Family size (no.)	6.73	5.80	0.93	-0.23600	-0.219	-7.44
X_3 - Farm size (acres)	2.05	1.58	0.47	-1.04100	-0.489	-16.59
X_4 - Total fixed investment (Tk.)	48530	37450	11080***	0.00008	0.886	30.05
X_5 - Off-farm income (Tk.)	57490	34600	22890***	0.00007	1.602	54.32
X_6 - Domestic expenditure (Tk.)	68300	43630	24670***	0.00004	0.987	33.45
X_7 - Value from crops production (tk.)	25490	13800	11690	0.00003	0.351	11.89
X_8 - Value from dairy (Tk.)	3690	1270	2420	-0.00008	-0.194	-6.56

D-square					2.95*** (3.85)	100.00

Notes: Figures within the parentheses indicate the F-ratio.
*** indicate significance at 1 per cent levels.
Source: Author's calculation, based on VDSA data.

Table 6: Discriminant function on small farms of rice production in 2011

Items	Mean		Mean difference (di)	Discriminant coefficient (Li)	Discriminating distance (Li)(di)	Percent contribution to the total distance
	Viable	Non-viable				
X_1 - Education (years)	6.80	4.70	2.10**	0.321000	0.674	24.51
X_2 - Family size (no.)	6.21	6.54	-0.33	-0.349200	0.115	4.19
X_3 - Farm size (acres)	1.90	1.46	0.44	-1.023000	-0.450	-16.37
X_4 - Total fixed investment (Tk.)	52850	39768	13082	0.000017	0.222	8.09
X_5 - Off-farm income (Tk.)	54800	31080	23720***	0.000043	1.01996	37.08
X_6 - Domestic expenditure (Tk.)	69400	51738	17662***	0.000052	0.918	33.40
X_7 - Value from crops production (tk.)	27900	14700	13200	0.000027	0.356	12.96
X_8 - Value from dairy (Tk.)	3490	1180	2310	-0.000042	-0.097	-3.53
D-square					2.046*** (4.73)	100.00

Notes: Figures within the parentheses indicate the F-ratio.
***, ** indicate significance at 1 per cent and 5 per cent levels, respectively.
Source: Author's calculation, based on VDSA data.

Table 7: Discriminant function on small farms of rice production in 2012

Items	Mean		Mean difference(di)	Discriminant coefficient (Li)	Discriminating distance (Li)(di)	Percent contribution to the total distance
	Viable	Non-viable				
X_1 - Education (years)	6.40	6.10	0.30	0.021	0.006	0.35
X_2 - Family size (no.)	6.54	6.15	0.39	-0.327	-0.128	-7.01

X_3 - Farm size (acres)	2.11	1.87	0.24	-1.002	-0.240	-13.21
X_4 - Total fixed investment (Tk.)	52315	41238	11077***	0.00005	0.576	31.65
X_5 - Off-farm income (Tk.)	53690	36790	16900**	0.00002	0.338	18.57
X_6 - Domestic expenditure (Tk.)	67859	49679	18180***	0.00004	0.764	41.95
X_7 - Value from crops production (tk.)	19800	11800	8000***	0.00008	0.640	35.16
X_8 - Value from dairy (Tk.)	3290	1090	2200	-0.00006	-0.134	-7.37
D-square					1.822*** (3.89)	100.00

Notes: Figures within the parentheses indicate the F-ratio.

***, ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Source: Author's calculation, based on VDSA data.

non viable farm (35780 tk.)These factors contributed 21.73%, 70.23% and 34.44 %, respectively towards the total distance between the two populations, i.e. viable and non-viable small farmer of rice production.

In 2010, from the table 5, it is found that off-farm income, total fixed investment and domestic expenditure were the factors, which differed significantly on viable and non-viable small farm . Off-farm income was found to be significantly higher on viable farms (57490 tk.) than non-viable ones (34600 tk.). Total fixed investment was found to be significantly higher on viable farms (48530 tk.) than non-viable ones (37450 tk.).Domestic expenditure was significantly higher on viable (68300 tk.) than non-viable (43630 tk.) farms .These factors contributed 54%, 30% and 33 %, respectively towards the total distance between the two populations, i.e. viable and non-viable small farmer of rice production.

In 2011, from the table 6, it is found that education, off-farm income and domestic expenditure were the factors, which differed significantly on viable and non-viable small farm. Education was found to be significantly higher on viable farms (6.80 years) than non-viable ones (4.70 years). Off-farm income was found to be significantly higher on viable farms (54800 tk.) than non-viable ones (31080 tk.). Domestic expenditure was significantly higher on viable (69400 tk.) than non-viable (51738 tk.) farms. These factors contributed 24.51%, 37.08% and 33.40%, respectively towards the total distance between the two populations, i.e. viable and non-viable small farmer of rice production.

In the year 2012, table 7 shows that value productivity from crops, off-farm income, total fixed investment and domestic expenditure were the factors, which differed significantly on viable and non-viable small farm. Value productivity from crops was found to be significantly higher on viable farms (19800 tk.) than non-viable ones (11800tk.). Off-farm income was found to be

significantly higher on viable farms (53690 tk.) than non-viable ones (36790 tk.). Total fixed investment was significantly higher on viable (52315 tk.) than non-viable (41238 tk.) farms. Domestic expenditure was significantly higher on viable (69400 tk.) than non-viable (49679 tk.) farms. These factors contributed 35.16%, 18.57%, 31.65% and 41.95 %, respectively towards the total distance between the two populations, i.e. viable and non-viable small farmer of rice production.

Among the eight factors related to the discriminating of viable and non- viable of small farmers of rice production, it is found that off-farm income was the common significant discriminat factor during the time (2009 to 2012). The reason was that small farmers were in high farm income risk due to low investment and low production which can be reduced by off farm income. Thus, the small farmers can sustain their livelihood only if they get adequate income from non-farm sector. Besides value from crops, total fixed investment and domestic expenditure were the other significant factors found during all the years.

Conclusion

There was less difference in the same socio economic conditions of small farmers in terms of age, education, family size and occupation. Income from dairy and crops for small rice farmers was always negative. But the economic surplus after deducting off-farm income was positive. Number of non-viable small rice farmers was less. The factors responsible for the discrimination of viable and non-viable small farmer were family size, farm size, education, value productivity from crops, net income from dairy, off-farm income, total fixed investment and domestic expenditure . In the study, off-farm income was identified most important factor in the discrimination following value from crops, total fixed investment and domestic expenditure.

Reference

APCAS, 2010. Asia and Pacific Commission on Agricultural Statistics, Twenty Third Session, Siem Reap, Cambodia, 26-30 April 2010.

BBS, 2003. Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Hyhua, T.S., Bashaasha, B., Nkonyai, E., Kraybill, D., 2007. Analysis on Profit Efficiency in Rice Production in Eastern and Northern Uganda. African Crop Science Journal, 4, 243 – 253.

Kolawole, O. (2006). Determinants of profit efficiency among small scale rice farmers in Nigeria: A profit function approach. *Research Journal of Applied Sciences*, *1*(1), 116-122.

Mustafi and Saiful LM 2004.Cost and Returns Modern Rice Cultivation in Bangladesh.Agricultural Economics Division, Bangladesh Rice Research Institute, Gazipur, Bangladesh.

Nasrin J. 2013. Financial Profitability of Aromatic Rice Production and Its Impacts on Farmers' Livelihood in Selected Areas of Tangail District.MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Nimoh F, Tham-Agyekum EK and Nyarko PK 2012: Resource Use Efficiency in Rice Production: the Case Kpong Irrigation Project in the Dangme West District of Ghana, *International Journal of Agriculture and Forestry,* 2(1), 35-40.

Radha, Y. and Chowdhry, K. R. (2005) Comparative economics of seed production vis-a-vis commercial production of cotton in Andhra Pradesh.*Indian Journal of Agricultural Economics,* **60**: 94-102.

Singh, J., Kolar, J. S., 2009: Agricultural economy of the Punjab at the cross roads. *International Journal of Punjab Studies,* **8**: 239-50.

Tama, Z.A.R., 2014: Financial And Economic Profitability on Prospects of Exporting Aromatic Rice From Bangladesh, MS Thesis, Bangladesh Agricultural University, Mymensingh.

Tonini, A., Cabrera, E., 2011: "Globalizing rice research for a changing world (Technical Bulletin No. 15). Los Banos: International Rice Research Institute. Alam, M.S., 2012. Technology and productivity in rice sector. Article published on Daily Star 09 February, 2012.

Wander, A. E., Didonet, A. D., Moreira, J. A. A., Moreira, F. P., Lanna, A. C., Barrigossi, J. A. F. & Ricardo, T. R. (2007). Economic viability of small scale organic production of rice,

common bean and maize in Goias State, Brazil. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *108*(1), 51-58.