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Original Research Paper

Role of SL8H super hybrid rice to achieve food security in Bangladesh: Interpretations of survey results

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This study examined the profitability of newly introduced super hybrid rice SL8H in the selected two villages in Sherpur District of Bangladesh. In total, 50 SL8H growers were selected randomly. Activity budgets and Cobb-Douglas model were used to achieve the objectives. Total cost for SL8H rice cultivation was Tk 62,681.00/ha and its total return was Tk 117,495.00/ha. Its net return was Tk 54,814.00/ha. The SL8H rice is not only profitable from farmers' viewpoints, but its yield (7026 kg/ha) is also much higher than those of other varieties of *Boro* rice. Human labour, seedlings, tillage operation, manure, fertilizer, insecticide and irrigation were considered as the important variables for SL8H rice production. Most included variables had significant impacts on this rice production. The scarcity of seeds, high prices of seeds and fertilizers, scarcity of human labour, low rice price, scarcity of credit and lack of training are the main problems for the farmers. More attentions should be given by the policy makers and extension agents to solve these problems and thus, per hectare yield of SL8H super hybrid rice can further be increased. This variety can be expanded in the *Boro* season, which in turn would help to achieve self-sufficiency in food grain and thus, food security of Bangladesh.

Key words: Activity budgets, profitability analysis and food security.

INTRODUCTION

Bangladesh is an agro-based developing country and has the vision of attained a medium developed country by the 2021. To achieve this vision, the main constraint is the food security and development of the country. The food security and development of the country is correlated which is mainly depend on increase agricultural production and improvement of many other dominant development factors. Food is the first and one of the basic needs of human being. About a decade ago before market liberalization, scientists were working to improve traditional *Boro* rice yields. This led to the development of modern varieties (MVs) of dry season irrigated *Boro* rice, which, in fact, are the highest yielding among Bangladesh's three seasonal rice varieties (Hossain 2009). Nevertheless, the gross domestic product (GDP) of the country goes up or down with the good or bad harvest of the rice. Agriculture and food policies of Bangladesh have, therefore, been production oriented and focus on increasing rice yields through increasing productivity of the land and adoption of maximum high yielding variety (HYV) of inbred, hybrid and super hybrid varieties of rice.

Food security of the country mainly depends on the cereal crops. Rice and wheat are consumed as cereal foods in Bangladesh. Food security of the country mainly depends on successful production of rice. About 30 million tonnes of cereal crop were produced in 2010/11. But this production could not ensure the country's food security. Rice contributes about 12.5 percent of the total crop production (BER 2008) and *Boro* rice contributed 54.2 percent of rice (BER 2010). It is often argued (Rahman, 2009) that there are significant potentials for raising agricultural output and profitability by improving production efficiency using existing resources. At present, horizontal expansion of area is not possible due to decrease of agricultural land by 1 percent every year (Chowdhury 2011). Only scope is vertical expansion. Among traditional *Aus*, *Aman* and *Boro* seasons, *Boro* production is safer, controllable, technology supported and more suited to environment. Horizontal expansion is not possible for *Boro* production. High yielding potential variety with the support of other factors is the

key of vertical expansion.

It may be noted that in 1996, China took research program to develop more HYVs of hybrid that is called super hybrid and successfully developed super hybrid varieties with around 20 - 30 percent yield advantage than the normal hybrid. In 2000, China planted in 240 thousand hectare of land under super hybrid and average yield obtained 9.6 ton/ha. Now, China already developed 2nd generation super hybrid with average yield of 12 tons/ha (Longping 2011). Outside China, the Philippines under technical assistant by Food and Agriculture Organization (FAO), International Rice Research Institute (IRRI) and China National Hybrid Rice Research and Development Center, a super hybrid variety called SL8H super hybrid rice had developed and planted in about 3000 ha of land in 2003 and obtained on an average yield of 8.5 tons/ha more than double the country's average rice yield (Chowdhury, 2011).

In Bangladesh, multilocational trials for SL8H-super hybrid rice have been conducted and found its higher yield potentiality than normal hybrids. The National Seed Board recommended SL8H-super hybrid variety for cultivation in *Boro* season. In 2009, Bangladesh imported parental seeds of SL8H from SL Agritech of Philippines in a partnership agreement. In 2010/11, Bangladesh Agricultural Development Corporation (BADC) distributed SL8H seeds throughout the potential *Boro* area of the country.

The SL8H super hybrid rice is a new high yield potential rice variety, superior to the present hybrid rice varieties; released for commercial cultivation in Bangladesh in the *Boro* season of 2010-11. Unfortunately, no study on economics of SL8H rice variety has yet been conducted in Bangladesh considering the socioeconomic conditions of the farmers in real world situation. The present study has, therefore, been designed to generate some valuable information to provide those to the concerned officials as well as farmers and also indicate the adjustment needed in the allocation of farm resources. An attempt has also been taken to provide more reliable information regarding the relative profitability of SL8H super hybrid rice production in the context of Bangladesh agro-economic conditions. The information revealed by the study may be helpful to the policy makers, extension personnel, seed producers and researchers for its future planning of expansion and rectification of the problems.

Some research studies (Hanifa 2009, Hossain and Chamala 1994, Jabbar and Jones 1997, and Julfiquar 1998) concerning the economic profitability, yield performance, adaptability and some economic aspects of modern HYV and hybrid rice production so far have done in Bangladesh. But studies on SL8H super hybrid rice are not available because SL8H super hybrid rice is released very recently to the farmers. The existing research has, therefore, been undertaken to make an in-depth study to fill in the knowledge gap in the field of rice production especially of SL8H-a super hybrid variety of rice. The specific objectives were:

to identify the socioeconomic characteristics of SL8H super hybrid rice farmers;

to assess the profitability of the SL8H super hybrid rice cultivation;

to estimate the contribution of key variables in producing SL8H super hybrid rice; and

to assess the major problems facing the farmers in cultivating SL8H super hybrid rice in the *Boro* season.

This paper is broadly divided into four sections. After this introduction, research methods followed in the study are presented in Section 2. The essences of the major findings of the study are given in Section 3. Finally, Section 4 was embodied with conclusion and some important policies considerations which arise from the study are also highlighted.

RESEARCH METHODS

Two villages namely: Baneshwardi and Talki villages of Nakla Upazila in Sherpur District of Bangladesh were selected purposively to achieve the set objectives. First of all, total numbers of SL8H rice farmers of these two villages were listed down and then 50 SL8H farmers were selected randomly. A structured questionnaire was designed in accordance with the set objectives of the study. Before making final, a draft questionnaire was pre-tested by interviewing a few farmers of the study area. Primary data for the *Boro* season of 2011 were collected by the first author herself. The formal data were collected during the late May to July 2011.

Descriptive statistics, activity budget (Dillon and Hardaker 1993) and Cobb-Douglas Production Function Model were employed to achieve the major objectives of the study. The profitability per hectare of SL8H super hybrid rice was assessed by using the following algebraic equation:

$$\pi = TR - TC, \quad \text{Or, } \pi = P_y.Y + P_b.B - (\Sigma P_{xi}.X_i + TFC)$$

Where:

TR = Total returns (Tk/ha);

TC = Total costs (Tk/ha);

π = Net return or profit from SL8H super hybrid rice production (Tk/ha);

P_y = Per unit price of paddy (Tk/kg);

Y = Total quantity of paddy (kg/ha);

P_b = Per unit price of by-product (i.e., straw);

B = Total quantity of straw;

P_{xi} = Per unit prices of the ith inputs used in rice production;

X_i = Quantity of the concerned ith inputs used for rice production;

i = 1, 2. 3. . . . 7.

TFC = Total fixed cost involved in per hectare rice production.

To estimate the contribution of key variables in the

Table 1: Age distribution of SL8H rice farmers

Age group (years)	Number of SL8H rice growers	Percentage of the total
20.01 - 30.00	9	18
30.01- 40.00	16	32
40.01 - 50.00	15	30
50.01- 60.00	6	12
Above 60.00 years	4	8
Total	50	100

Source: Adapted from Chowdhury (2011, p. 34).

Table 2: Literacy level of family members of the 50 respondents

Literacy level	Family member(Nos.)	Percentage of total
Illiterate (0)	21	10.65
Primary (I - V)	65	32.99
High school (VI - IX)	54	27.41
SSC	39	19.79
HSC	14	7.11
Graduate and above	4	2.03
Total	197	100

Source: Adapted from Chowdhury (2011, p. 34).

production processes of per hectare SL8H super hybrid rice, the following specification was made for the Cobb-Douglas production function model:

$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} u_i$

It can be written in linear form as follows:

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + Ui$.

Where,

Y = Return per hectare (Tk);
X_1 = Seedling cost (Tk/ha);
X_2 = Human labour cost (Tk/ha);
X_3 = Tillage cost by power tiller (Tk/ha);
X_4 = Manure cost (Tk/ha);
X_5 = Fertilizers cost (Tk/ha);
X_6 = Insecticide cost (Tk/ha);
X_7 = Irrigation cost (Tk/ha);
a = Constant or intercept term;
$b_1, b_2, \ldots b_7$ = Coefficients of the respective inputs to be estimated; and
Ui = Error term.

RESULTS AND DISCUSSION

The major findings of the study are presented in the following sub-sections chronologically:

Socioeconomic

An attempt was made in this section to identify some socioeconomic characteristics of the SL8H farmers. The socioeconomic background of the sample farmers particularly the family size and composition, literacy level, main occupation, land ownership patterns and its distribution are discussed in this sub-section.

In this study, the family member considered are wife, sons, unmarried daughter, father, mother, brother and other relatives, who live permanently in the family. Table 1 reveals that the majority farmers belonged to the age group between 30.01 to 50.00 years and the age group of above 60.00 years was the lowest for the SL8H rice growers.

On the basis of educational qualification, the educational status of the respondent farm family members has been categorized into six: Illiterate, Primary (I - V), High school (VI-IX), SSC (Secondary School Certificate), HSC (Higher Secondary Certificate), Graduate and above (Table 2).

It can be seen from the Table 2 that SL8H super hybrid rice respondent family members, 10.65 percent were illiterate, 32.99 percent had primary education, 27.41 percent had high school level, 19.79 percent had SSC, 7.11 percent had HSC and only 2.03 percent obtained graduation degree.

In the study area, agriculture, as expected, was the main occupation of 80.0 percent of total farm owners. In contrast, business and services were the main occupation of 16.0 and 5.6 percent of the farm owners, respectively (Table 3).

The farm size has been measured in this study using the following formula:

Farm size = Land owned + Rented in + Mortgaged in - Rented out - Mortgaged out.

The average farm size in the study area was found to be 0.78 hectare for SL8H rice growers (Table 4). It was

Table 3: Occupational status of the SL8H rice farmers

Main occupation	Number	Percentage of total
Agriculture	40	80.0
Business	8	16.0
Service	2	4.0
Total	50	100

Source: Adapted from Chowdhury (2011, p. 35).

Table 4: Distribution of land and average farm size of the selected SL8H rice farmers

Homestead (ha)	Others (ha)	Cultivated land (ha)			Farm size(ha)
		Owned	Rented in	Rented out	
0.10	0.07	0.81	0.097	0.11	0.78

Source: Adapted from Chowdhury (2011, p. 36).

Table 5: Distribution human labour for per hectare SL8H rice production

Farm operations	Human labour (Man-days/ha)		Total labour (Man-days/ha)	Per. of total human labour
	Family	Hired		
Land preparation	3.00	5.00	8.00	7.34
Transplanting	4.00	22.00	26.00	23.85
Weeding	7.00	19.00	26.00	23.85
Fertilizer application	3.00	2.00	5.00	4.59
Insecticide application	1.00	1.00	2.00	1.83
Irrigation application	2.00	3.00	5.00	4.59
Harvesting and carrying	5.00	22.00	27.00	24.77
Threshing, winnowing and drying	3.00	7.00	10.00	9.17
Total	28.00	81.00	109.00	100

Source: Adapted from Chowdhury (2011, p. 38).

reported that among the 50 respondent farmers, there were 38 small farmers, 11 medium farmers and only 1 large farmer in the study areas. The average farm size was 0.78 hectare which revealed that this research conducted mainly on an average on small size farmers. The dividing line between small, medium and large farms is 1 ha and that between medium and large farms is 2 ha (Miah, 1987).

Profitability of SL8H Super Hybrid Rice Production

Costs of SL8H rice production

The summary results of profitability analysis of SL8H super hybrid rice production are presented in this section. The cost items of SL8H super hybrid rice production included: cost of human labour; cost of tillage operations by power tiller, seedlings, manure, fertilizers viz. urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP), Gypsum and Zinc Sulphate, insecticides, irrigation and interest on operating capital, human labour cost was one of the major cost items SL8H super hybrid rice production. Human labour was used for land preparation, transplanting, weeding, applying fertilizers, insecticides, irrigation water, harvesting and carrying, threshing, winnowing and drying (Table 5). The cost of human labour for SL8H super hybrid rice was estimated to be Tk 26,429.00 (Figure 1).

Farm mechanization made tremendous progress as cent percent farmers used power tiller for tillage operation. Per hectare power tiller cost for land operation of SL8H super hybrid rice was Tk 6565.00. Cost of seedlings was Tk 6379.00 per hectare which was 10.18 percent of total cost. It was learned that 20.00 kg seed was required per hectare for SL8H rice and the price of seed was Tk 170.00 per kg. In the study areas, the farmers used cowdung from their own supply. Per hectare total costs for cowdung was estimated at Tk 5789.0 which was 9.23 percent of the total cost (Appendix Table 1).

Optimum dose of fertilizer is a major requirement for SL8H rice production. The sample farmers used five kinds of fertilizers, namely, Urea, TSP, MOP, Gypsum and Zinc Sulphate. It can be seen from Table 6 that SL8H rice growers used on an average 534.00 kg/ha fertilizers, where 246.37 kg/ha, 142.26 kg/ha, 86.45kg/ha, 55.58 kg/ha and 3.01 kg/ha were Urea, TSP, MOP, Gypsum and Zinc Sulphate, respectively. Total fertilizer cost for producing SL8H rice was Tk 8186.00/ha (Table 6) which was 13.05

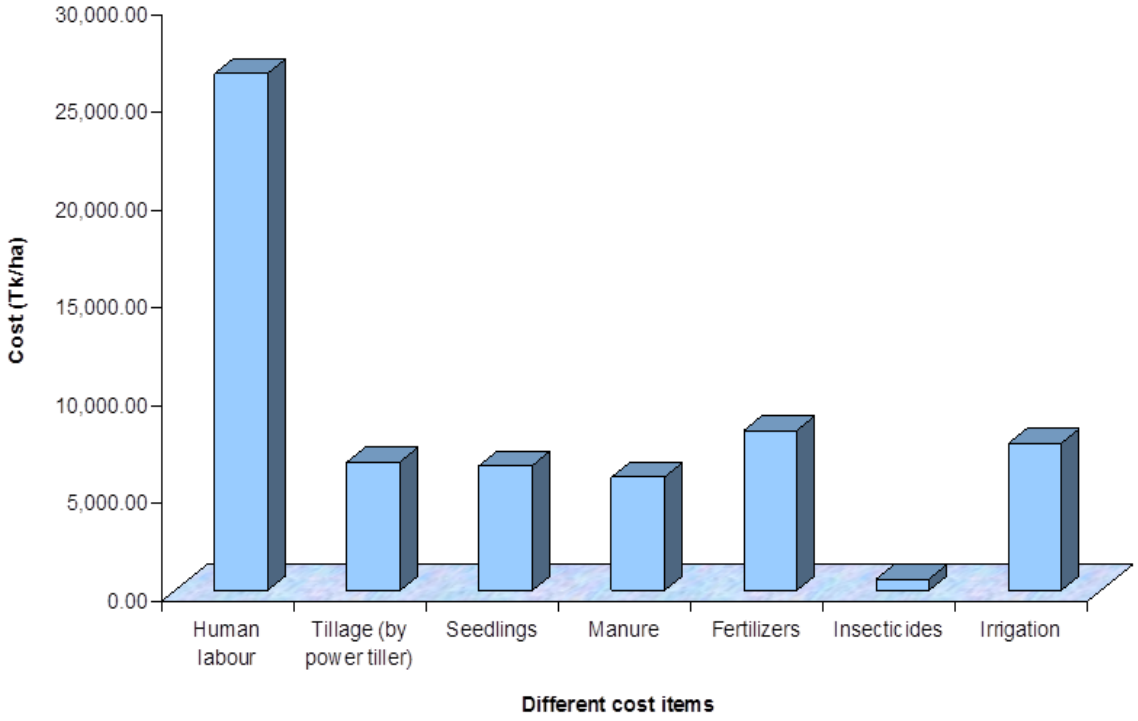

Figure 1 Cost Items of SL8H Super Hybrid Rice Production.

Table 6: Per hectare fertilizers used for SL8H rice production and their costs

Name of fertilizers	Quantity (kg/ha)	Cost (Tk/ha)
Urea	246.37	3040.00
TSP	142.26	3130.00
MOP	86.45	1330.87
Gypsum	55.58	339.87
Zinc sulphate	3.01	345.8
Total	534.00	8186.00

Source: Adapted from Chowdhury (2011, p. 42).

percent of total costs.

The SL8H rice growers used insecticides like Furadon, Dimecron, Basudin, Sumitheon, Ronster, etc. Unfortunately, none of them were sure about the name of pesticides they used for their rice plots. The insecticide cost was Tk 580.50/ha for SL8H which was 0.93 percent of total costs. All the sample farmers used irrigation water from shallow tube-wells (STWs) for producing SL8H rice. The average irrigation cost was Tk 7524.00/ha, which was 12.00 percent of the total gross costs (Appendix Table 1).

Interest on operating capital for growing SL8H rice was calculated for a period of 4 months (i.e., *Boro* rice production period). Interest on operating capital OC) was calculated using the following algebraic equation (Miah 1987):

Interest on OC = AIit

Where:

AI = (Total investment)/2

i = interest rate per year (i.e., 12%);

t = length of crop period in months (4 months).

Interest on OC altogether was Tk 1229.00 per hectare, which was 1.96 percent of the total cost in producing SL8H super hybrid rice (Appendix Table 1).

Returns from SL8H super hybrid rice production

Per hectare total returns were calculated by multiplying the total quantity of main product and by product with their respective farm-gate prices. Per hectare yield of SL8H rice was 7026.00 kg. The price of SL8H rice was Tk 16.00/kg. The values of main product of SL8H rice was Tk 112416.00/ha. Taking the value of by-product into account

Table 7: Per hectare costs and returns of producing SL8H rice

Particulars	Tk/ha
A. Total gross returns	117495.00
B. Total variable cost	61452.00
C. Total gross costs	62681.00
D. Gross margin (A – B)	56043.00
Net return or, Profit (A – C)	54814.00

Source: Adapted from Appendix Table 1.

Table 8: estimated values of coefficients and related statistics of Cobb-Douglas production function model for SL8H rice production.

Explanatory variables	Coefficients bi	standard error	t-value
Intercept	7.021	1.736	4.045
Seedling cost (X_1)	0.125	0.059	2.119*
Human labour cost (X_2)	0.081	0.153	0.529
Tillage cost (X_3)	0.108	0.052	2.076*
Manure cost (X_4)	-0.004	0.009	-0.444
Fertilizer cost (X_5)	0.182	0.083	2.192*
Insecticide cost (X_6)	0.285	0.126	2.261**
Irrigation cost (X_7)	0.008	0.019	0.421
F-value	6.025		
R^2	0.501		
R^{-2} (Adjusted)	0.418		
Returns to scale ($\sum$ bi)	0.785		

Source: Adapted from Chowdhury (2011, p. 55).
Note: *** = Significant at 1% level
** = Significant at 5% level
* = Significant at 10% level

the total gross returns became Tk 117495.00/ha.

Net Return for SL8H super hybrid rice production

The net return was calculated by deducting total gross costs from its total gross returns. The net return or profit was Tk 54814.00/ha (Table 7).

Undiscounted Benefit Cost Ratio (BCR)

The undiscounted BCR of SL8H rice was calculated as a ratio of total returns and total cost. The BCR of SL8H rice production was 1.87 implying that Tk 1.87 would be earned by spending Tk 1.00 in SL8H super hybrid rice production (Appendix Table 1). In other words, investment in this new SL8H super hybrid, like all other HYVs, rice is profitable from the viewpoints of individual farmers.

Interpretations of the Results of Cobb-Douglas Model

Estimated values of the relevant co-efficient and related statistic of Cobb-Douglas production function model used for SL8H rice production are presented in Table 8. The value of the co-efficient X_4 (Manure cost) was negative and insignificant this implies that keeping others factors constant, 1 percent increase in manure cost would decrease the gross return by 0.004 percent.

The value of co-efficient X_2 (Human labour cost) and X_7 (Irrigation cost) were found positive.The estimated values of X_1 (seedling cost), X_3 (tillage cost), X_5 (fertilizer cost), X_6 (Insecticide cost) were found positive and significant and hence, these variables can contribute to increase the SL8H rice production. Since the value of R^2 was 0.501, it implied that about 50.0 percent variation in gross return from SL8H rice has been explained by the explanatory variables included in the model.

The F-value of the equation derived for SL8H rice was 6.025 which was highly significant at 1 percent level implying that all the explanatory variables were important for explaining the variations in gross returns of SL8H rice.

The sum of the elasticity of SL8H super hybrid rice shows the returns to scale was found to be less than one which indicated that the SL8H super hybrid rice growers allocated their resources in the rational zone of production.

Table 9: Major Problems of the Producers of SL8H Super Hybrid Boro Rice

Problems faced by farmers	Number of respondents	Percentage %
Scarcity of quality seeds	33	66
High prices of seeds and fertilizers	32	64
Scarcity of human labour	23	46
Low price of output	23	46
Scarcity of institutional credit	13	26
Lack of training on hybrid rice production	11	22

Source: Adapted from Chowdhury (2011, p. 55).

Problems of SL8H Rice Production

Although SL8H rice production was found profitable, but the survey results presented in Table 9 clearly indicated that the farmers had to face some major problems in conducting SL8H rice production in Nakla Upazila. Scarcity of seeds was one of the crucial problems, since 66.0 percent farmers made a complaint against this problem. High prices of seeds, high price of fertilizers turned out as the second highest problems for the farmers as 64.0 percent were reported against this problem. Similarly, scarcity of human labour during the peak season, low price of paddy, scarcity of institutional credit, lack of training facilities etc., were the major problems for the farmers.

It was suggested that supply of sufficient quantity seeds of SL8H Super Hybrid *Boro* Rice at a reasonable price, ensured supply of quality fertilizers at a subsidized rate, training facilities for scientific ways for hybrid rice cultivation and availability of corruption free institutional credit to the door-steps of the interested farmers could be some positive steps for overall improvement as well as expanding SL8H rice production in rural Bangladesh.

Conclusion

The present study revealed that the SL8H rice production is profitable.

The study identified some problems faced by the farmers in producing SL8H super hybrid rice such as scarcity of quality rice seeds, high price of fertilizers, scarcity of human labour, low price of paddy, scarcity of institutional credit and lack of training facilities. Therefore, the study suggests that special attention should be given by the policy makers, researchers and extension agents to solve these problems of farmers and thus, SL8H super hybrid rice production can be increased substantially which in turn would help to achieve self-sufficiency in food grain production in Bangladesh. Since per hectare yield of SL8H rice is much higher than other modern and/or hybrid varieties of *Boro* rice, the country can ensure food security by expanding the cultivation of this variety throughout the country.

RECOMMENDATIONS

On the basis of the findings of the present study, the following recommendations are made for SL8H super hybrid rice production.

The financial return of SL8H super hybrid rice in the context of Bangladesh is quite attractive since its yield is relatively higher than other modern varieties of *Boro* rice. For its higher sustainable yield, more attentions should immediately be given by the concerned officials/researchers to solve the problems of the farmers outlined in this study. The cost of SL8H rice seed and cost of fertilizers should be kept within the farmer's purchasing power;

The shortage of financial capital, like other high yielding rice producers, was one of the severe problems faced by SL8H rice growers. Institutional credit facilities should be made available on easy terms and conditions so that the farmers can have enough credit for investing rice cultivation in time;

Since the farmers are not well educated, they don't have enough scientific knowledge regarding SL8H super hybrid rice cultivation. The concerned extension personnel may pay an immediate attention and can arrange training programme on SL8H super hybrid rice cultivation for the interested farmers. Thus, per hectare yield of rice can further be increased for the greater interest of the country.

The international network among scientists and/or field level officials of IRRI, BADC, DAE, BRRI, FAO and other agricultural research institutions should be strengthened so that the farmers can apply any new technology in their individual farms without any risk and hesitation.

Since the vast majority farmers of the study area did not maintain any written financial records of their day-to-days' farm transactions, the accuracy of data fully relied upon their memories and sincerity. Despite proper care was taken to collect accurate data, primary data collection was really a challenging task and the possibility of data errors, therefore, cannot fully be ruled out. Nevertheless, the present study has given the most important clues to the researchers, policy makers and farmers for making more effective decisions regarding future course of actions in the production of SL8H super hybrid rice during the *Boro* season. Nevertheless, this SL8H super hybrid rice can

contribute a lot to achieve self-sufficiency in food grain and thus, food security of the people of Bangladesh.

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Appendix

Table 1: Activity Budgets: Per Hectare Irrigated SL8H Rice Production

Items of costs/returns	Quantity of inputs/outputs	Costs/returns (Tk/ha)	Percentage of total
A. Gross Costs			
Human labour	109 Man-days	26,429.0	42.16
Tillage (by power tiller)	3 times	6565.0	10.47
Seedlings	-	6379.0	10.18
Manure	-	5789.0	09.23
Fertilizers	-	8185.0	13.05
Insecticides	-	580.5	0.93
Irrigation	-	7524.0	12.00
Interest on operating capital	-	1229.0	1.96
Total		62,681.0	100.0
B. Gross Returns			
Main product (Paddy)	7026.0 kg	112,416.0	96.00
By-product (Straw)	-	5079.0	4.00
Total		117,495.0	100.0
C. Net Rerun (B –A)		54,814.0	-
D. BCR (Undiscounted)		1.87	-

Source: Chowdhury (2011).