

Measuring the Costs of Production Based on Sizes of Farm Operation: A Study on Rice Farmers in Jessore District of Bangladesh

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Abstract: The quantity of rice production has increased regardless of the land operation size in recent years, but small and medium farmers still have a serious problem especially regarding the increasing cost involved in the production. As rice is the main crop, the condition of production, cost incurred in different inputs, purchasing nature of inputs and the source of production elements influence the cost of production, which directly effects rural subsistence. The study included three categories of rice farmers: small (30), medium (23) and large (11) in the district of Jessore in the south-western part of Bangladesh. The objectives of this study were to measure the differences in the cost of production of *boro* rice farmers on the basis of land held to determine further steps for their well being. The study found that although there were no significant differences in the quantity of inputs used for all categories of farmers, the unit cost of some inputs significantly varied between small – large and medium – large, thus affecting the cost of production. The reasons for the raised cost of production were that most of the small and medium farmers purchased inputs on credit, spending comparatively more than cash and they paid higher interest on borrowed money.

Key words: Rice, farmer, size of farm operation, cost of production, Bangladesh

INTRODUCTION

A small parcel of land not only acts as a constraint to profitable investment, but also deprives farmers of access to production inputs, formal credit and other institutional services required for improved agricultural practices. As a result, farmers are often forced to continue traditional agricultural practices, which lead to low productivity^[1,2]. Hayami^[3] states, ‘Small farmers are unable to use modern variety efficiently since financial constraints make it difficult for them to purchase cash inputs such as fertilizers and chemicals.’ In Bangladesh, land ownership serves as a surrogate for a large number of factors, as it is a major source of wealth and influences crop production^[4]. The ownership of agricultural land remains as one of the most difficult problems in the rural sector in Bangladesh. In most villages, few families have enough land to live comfortably, while a large number of families have either no land, or not enough land to support their families^[5]. In general, pecuniary economies are said to exist when larger farms pay lower prices for their inputs due to lower transaction costs and/or stronger bargaining power, thus lowering

their average production cost. And for similar reasons, large farms may receive higher prices for their outputs^[6]. Large farmers mainly deploy their own money and have easier access to the credit market for cultivation than those of small and medium farmers.

Since independence in 1971, the government has introduced a revised agricultural policy in varying degrees. As a result, the quantity of production increased regardless of the sizes of land operation. But farmers still have a serious problem, especially regarding the increasing cost involved in production^[7]. Seeds, fertilizers, irrigation and labor are the four major inputs that are essential in producing any crop and contribute significantly to the total cost of production. As rice is the main crop, the conditions of production cost incurred in different inputs, the purchasing nature of inputs and sources of production elements influence the cost of production, which has a direct effect on rural subsistence. For example, lower cost of production ensures higher returns thus influencing total income. Jahan and Jaim^[8] reports that the rural economy of Bangladesh mostly depends on the farmers’ profitability i.e., costs incurred and return earned from rice production.

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The farmers who have different socio-economic conditions use almost the same type of inputs in the Jessore district of Bangladesh. The quantity of inputs did not vary widely, but the unit price was widely differed. As a result, it affected the total cost of production. The variation of the unit price exists in the total costs among the farmers has been found as a cause of purchasing nature of inputs either by cash or by credit. Due to having the limited resources, most of the small and medium farmers used credit-purchasing inputs by spending comparatively higher price than cash. Another influencing factor on the total cost is the sources of funds for cultivation. Due to lack of institutional loans, most of the small and medium farmers borrowed money from informal sources for mitigating expenses, paying a high rate of interest. Rice dominates the cropping pattern in most parts of the country and is grown in three different seasons *aus*^a, *aman*^b and *boro*^c. After the green revolution, High Yielding Variety (HYV) *boro* rice has gained importance, because of its higher yields. The production system dominated by a single crop (i.e. rice) is not scientific from an economic point of view. It is, therefore, necessary to increase the cultivation and production of other crops. However, considering the increasing demand for food grains and with a view to ensuring food security, the reduction in the cost of production of rice should get priority. The specific objective of this study is to measure the differences in the costs of production of HYV *boro* rice (HYV *boro* paddy) among farmers' on the basis of the size of land operation (small, medium and large) in the surveyed area by considering the nature of inputs purchased, inputs quantity and production elements used.

STUDY AREA AND METHODOLOGY

Study area: The study was based on interviews during February to March 2005 for the production in the year of 2003/04 in Jhikargacha Upazila^d in the district of Jessore in Bangladesh of HYV *boro* rice (HYV *boro* paddy) cultivation, which started in December 2003/January 2004 and ended in April/May 2004. The study site was 276 kilometers south west of Dhaka and 15 kilometers west of the Jessore district headquarters. The study selected 64 farmers (small: 30, medium: 23 and large: 11) randomly from two villages, namely Barbakpur and Bodhkhana. The area was selected for study for two major reasons. First, the area bears the common characteristics of the Jessore district comprising different types of farmers producing rice as main crop. Second, so far no attempt has been made to

Table 1: General characteristics of the households

Parameters	Farmer*		
	Small	Medium	Large
Member: ≤ 4	13	13	–
Member: 5 – 7	70	39	27
Member: ≥ 8	17	48	73
<i>Education level of the farmer</i>			
Illiterate	20	9	–
Primary education	53	35	45
Secondary education	23	48	36
Higher secondary and above	3	9	18
<i>Family labor</i>			
Person: ≤ 2	70	70	45
Person: ≥ 3	30	30	55

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer. Five small farm families were found in the surveyed villages having a labor force of minimum 2 and maximum 3, but these families did not use family labor for cultivation. They used exclusively hired labor. Eight and five medium and large farm families were found in the surveyed villages having a labor force minimum 2 and maximum 4 respectively, but these families also did not use family labor for cultivation. They used only hired labor. A person who was adult and had the physical ability to work was considered as labor, except students. Women in the surveyed families were not engaging field level farming work. After harvesting the rice, in some cases, they were engaging in threshing, preservation and processing of the agricultural product.

evaluate whether there exists any difference in the costs of production on the basis of sizes of the farm operation of the various farmers. Both the villages have almost the same characteristics in terms of rice production as well as the operation pattern of their paddy fields. There were three types of farm holdings in the surveyed area; small, medium and large. According to the definition of the Bangladesh Bureau of Statistics^[9], the concept of small, medium and large-scale of farm holdings have been defined as follows: A small-scale farm consists of an area of 0.02 to 1.01 hectares of land with a minimum of 0.02 hectares as cultivated land; medium-scale defined as an operated area of 1.02 to 3.03 hectares of land; and large-scale as an operated area of 3.04 hectares and above. A brief profile of the study area is shown in Appendix 1.

Methodology: The calculation of the cost of production, i.e., the cost of seeds, fertilizer, pesticide, labor, irrigation, interest on borrowed money and land rental, were calculated using the measurement provided by the Bangladesh Bureau of Statistics^[5]. Although depreciation on the fixed assets and maintenance costs are essential for the calculation of the cost of production, they were not mentioned in the BBS calculation. However, in the present study, depreciation and maintenance expenses were considered as per the practical situation in the surveyed area. The price of home made seeds, home made organic fertilizer, family

Table 2: The pattern of Land operation in the surveyed villages

Parameters	Farmer*			Land (Hectare)**		
	Small	Medium	Large	Small	Medium	Large
Total cultivated land	100	100	100	0.73 (0.22)	1.49 (0.44)	3.50 (0.51)
Own land	100	100	100	0.56 (0.31)	1.39 (0.52)	3.50 (0.51)
Tenant land	47	26	–	0.36 (0.14)	0.38 (0.13)	–
Cultivated land other than <i>boro</i>	60	87	100	0.24 (0.15)	0.77 (0.36)	2.17 (0.56)
Cultivated land for <i>boro</i>	100	100	100	0.59 (0.23)	0.82 (0.23)	1.32 (0.36)
Only own land for <i>boro</i>	53	74	100	0.58 (0.24)	0.75 (0.22)	1.32 (0.36)
Only tenant land for <i>boro</i>	20	–	–	0.40 (0.16)	–	–
Own + tenant land for <i>boro</i>	27	26	–	0.73 (0.17)	1.01 (0.16)	–

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. Mix cropping system was found in the area. *Figure indicates the percentage of farmer; **figure in parenthesis indicates the standard deviation. The mean rental value of land for four months for one hectare of small, medium and large was Tk. 6,924, 6,736 and 7,055, respectively. Rental value of land was not affected by the mode of the payment of money (whether by cash or credit) to the landowner. The variation of rental value of land was affected by the land quality, demand and inter-personal relationship between tenant cultivator and landowner. US \$ 1 = Tk. 62.25.

labor, land irrigated by own device and own land used for cultivation have been evaluated as per the local rate and considered in the calculation of the cost of production included with other expenses. To investigate the significant difference of the inputs used and their unit prices, one-way ANOVA: post hoc multiple comparisons by Tukey HSD method^[10] was adopted. To measure the cost of production of 100 kg of rice, mean value is used in each parameter.

RESULTS AND DISCUSSION

General characteristics: In the study, the general characteristics of the farmers include the family size, education level and family labor. Table 1 reveals that most of the small farmers (70%) in the surveyed villages have 5 – 7 family members while 48% of medium and 73% of large farmers respectively have family members 8 or above. Among the 30 small farmers, 53% of them have primary education while 48 and 36% of medium and large farmers respectively have secondary education. 70% of each small and medium farmer and 45% of large farmers have family labor 2 or less. Only males were engaged in farming activities and no group farming/farmers' associations were found in farming activities. Individual farming activities among all categories of farmers for purchasing inputs, accumulation of production elements and cultivation practice were the principal characteristic in the area.

Pattern of land Operation: Rapid population growth and a tradition of bequeathing land to all heirs have led to the fragmentation of holdings in Bangladesh. As noted by Srinath, *et al.*^[11], 'It is well recognized that fragmented holdings have been a major constraint in the

Table 3: Net agricultural income of the study villages

Parameters	Income (Tk.)**		
	Small	Medium	Large
Agricultural income	14467 (11866)	21831 (13559)	57819 (14467)
Agricultural income other than rice	11557 (7923)	15320 (7204)	25130 (9180)
Income of rice	2909 (7227)	6510 (8627)	32689 (10528)
Income of <i>boro</i> rice	–1497 (7215)	1748 (8927)	20985 (9834)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. ** Figure in parenthesis indicated the standard deviation. Agricultural income contained the income of a fiscal year from July/2003 to June/2004. Income of rice contained three types of rice: *Aus*, *Aman* and *Boro* around the year.

implementation of improved farming practices by small-scale farmers.' As shown in Table 2, three types of rice farmers were found in the surveyed villages: own land cultivators, tenant cultivators and owner-cum-tenant cultivators^e. According to Table 2, the total cultivated land of small, medium and large farmers are 0.73, 1.49 and 3.50 hectares respectively, while own land is 0.56, 1.39 and 3.50 hectares. The study revealed that 53, 74 and 100% of small, medium and large farmers respectively, used their own land for *boro* cultivation, while on the other hand 20% of small farmers^f used only tenant land for cultivation. No medium and large farmers used exclusively tenant land in the surveyed villages. Small and medium farmers who used both their own and tenant land were 27 and 26%, respectively.

Income level: The farmers in the surveyed villages are involved in a broad range of activities to survive their families. Different members in the same households are

engaged in different activities across seasons. The annual agricultural income of the households has been classified into 17 categories according to the sources of income: income from rice, wheat, jute, potato, papaya, vegetables, fruits, pulse, spices, forest, fisheries, livestock, poultry, wage labor, rent for agricultural assets, irrigation (water selling) and other. According to Table 3, the agricultural income of small, medium and large farmers was Tk. 14,467, 21,831 and 57,819, respectively. The respective agricultural income other than rice was Tk. 11,557, 15,320 and 25,130. The income from rice of small, medium and large farmers was Tk. 2,909, 6,510 and 32,689, while the income of only *boro* rice was Tk. (-1,497), 1,748 and 20,985, respectively. The negative return of small farmers from *boro* rice was caused of not only an increasing amount of production cost but also due to selling the raw product immediately after harvesting at a lower price.

Sources of inputs: A gradual liberalization of markets for modern inputs in agriculture was carried out between 1978 and 1990, under pressure from foreign donors and with the realization that various direct interventions were fiscally unsustainable and unproductive in the long term^[12]. These reforms greatly reduced the role of the Bangladesh Agricultural Development Corporation (BADC) in the marketing and distribution of fertilizer, irrigation equipment, power tillers, pesticides and seeds. Agricultural inputs such as seeds, fertilizers and pesticides are now available in both the primary and secondary market in Bangladesh, at different prices. Privatization of input supplies, reduction of subsidies and other related factors have raised the cost of production^[13]. However, Mandal^[14] says that, 'Fertilizer consumption increased significantly with improved accessibility by farmers after the liberalization and there have been painful instances of artificial supply shortages and consequent price hikes at times.' Husain^[13] notes that access to high quality and adequate production inputs like credit, seeds, fertilizer and irrigation facilities are inadequate in Bangladesh agriculture.

It was a commonly known fact that the traditional seed markets in Bangladesh involve farmers' producing seeds for their own use and for sale as well. Appendix 2 shows, for the production of rice, farmers used both home made and purchased seeds. The study found that a large number of small and medium farmers used only purchased seeds. Appendix 2 also shows that 27 and 22% of small and medium farmers used only credit-purchased seeds, while none of the large farmers used credit to purchase seeds.

Table 4: Quantity of inputs used for one hectare (one-way ANOVA based on land)

Parameters	Qty. of inputs**		
	Small	Medium	Large
Seeds (Kg)	54(5)	54 (5)	57 (5)
Fertilizer (Kg.)			
Urea	368 (44)	371 (44)	353 (57)
TSP	104 (7)	101 (10)	106 (12)
MP	49 (5)	52 (7)	49 (7)
Sulphur	27 (2)	30 (2)	27 (5)
Gypsum	143 (17)	148 (17)	143 (22)
Organic fertilizer [▲]	3632 (806)	4047 (724)	4490 (1006)
Pesticide (Kg.)	12 (2)	15 (2)	12 (2)
Labor (Man day)	205 (30)	217 (27)	217 (20)
Irrigation hour	287 (35)	294 (44)	284 (32)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11, but for[▲]: Small – 9, Medium – 6 and Large – 3. No significant difference found in the quantity of inputs used. **Figure in parenthesis indicates the standard deviation.

Table 5: Unit price as per table 4 (one-way ANOVA based on land)

Parameters	Unit price (Tk.)**		
	Small	Medium	Large
Seeds (Kg)	20 ^a (3)	20 ^a (3)	16 ^b (*)
Fertilizer (Kg.):			
Urea	7 ^a (1)	7 ^a (1)	6 ^b (*)
TSP	19 ^a (1)	19 ^a (1)	16 ^b (*)
MP	16 ^a (1)	16 ^a (2)	14 ^b (*)
Sulphur	15 ^a (1)	14 ^a (1)	13 ^b (*)
Gypsum	4 ^a (1)	4 ^a (1)	3 ^b (*)
Organic fertilizer [▲]	0.17 (*)	0.17 (*)	0.19 (*)
Pesticide (Kg.)	67 ^a (6)	67 ^a (5)	61 ^b (2)
Labor (Man day)	53 (4)	52 (2)	52 (3)
Irrigation hour	46 ^a (6)	44 ^a (6)	39 ^b (2)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. Same letter indicates no significant difference but different letters indicate significant difference at the 0.05 level. **Figure in parenthesis indicates the standard deviation. *Standard deviation is less than one.

A large portion of large farmers used their own cash to purchase seeds. The quantity of seed purchased by credit was highest for small farmers, followed by medium.

The survey also learnt that the farmers used five kinds of chemical fertilizers (Urea, TSP, MP, Sulphur and Gypsum) and one type of organic fertilizer (Appendix 3). The highest number of farmers using credit purchasing for chemical fertilizers were small farmers, followed by the medium farmers. No large farmer in the surveyed area was found to be using exclusively credit purchased fertilizer for cultivation. As shown in the Appendix, all farmers used chemical fertilizer, but only 30, 26 and 27% of small, medium and large farmers respectively, used home made organic fertilizer.

Furthermore, the survey found that 37, 35 and 100% of small, medium and large farmers respectively, used only cash purchased pesticides (Appendix 4). It is also interesting to note that both small and medium farmers purchased pesticides by cash and/or credit, while large farmers were not purchasing such input on credit.

Appendix 5 shows that two types of labor were used for production i.e. family and hired labor. Most of the small farmers used family labor, followed by the medium and large farmers.

For the production of rice, farmers used both their own device and purchased water for irrigation. In the surveyed areas, only Shallow Tube Wells (STW) were found for irrigation. All large farmers in the surveyed area had their own irrigation device. However, the small farmers had the least number of STW followed by the medium farmers (Appendix 6).

Quantity of inputs and unit price: The amount of seed was estimated at 54 kg per hectare for each small and medium farmer and 57 kg per hectare for large farmers (Table 4). There was no significant difference found in the amount of seed used in respect to the farmers' categories. Table 5 shows the unit price of seed for each small and medium farmer was Tk. 20 and for large farmers was Tk. 16 per kg. The price variation must be stated as being caused by the purchasing nature, whether by cash or by credit. It is a natural phenomenon that the credit-purchasing price of the same goods is higher than the cash-purchasing price for rural farmers. The unit price for seeds was found to be significantly different between small – large and medium – large farmers. The significant difference obviously was as a result of credit purchasing by most of the small and medium farmers. Therefore, money spent for seed was comparatively higher for small and medium farmers than for large farmers (Appendix 7).

According to Table 4, there was no significant difference in quantity of fertilizers used by the three categories of farmers, but the unit price paid for Urea, TSP, MP, Sulphur and Gypsum was observed to be significantly different between small – large and medium – large farmers (Table 5). The significant difference obviously was as a result of credit purchasing by most of the small and medium farmers (Appendix 7).

The quantity of pesticides used by the small, medium and large farmers were estimated to be 12, 15 and 12 kg per hectare, respectively and their unit prices were Tk. 67 for each small and medium farmer and Tk. 61 a for large farmer.

Table 6: Cost of production of rice, Tk./100 Kg

Parameters	Tk.**		
	Small	Medium	Large
Seeds	20 (4)	20 (4)	16 (1)
Fertilizer:			
Urea	48 (10)	49 (10)	39 (7)
TSP	35 (5)	34 (7)	31 (7)
MP	14 (2)	15 (3)	12 (2)
Sulphur	7 (1)	7 (2)	7 (1)
Gypsum	10 (2)	11 (3)	8 (1)
Organic fertilizer	12 (4)	13 (3)	15 (3)
Pesticide	16 (4)	17 (4)	14 (3)
Labor	192 (31)	203 (37)	207 (28)
Irrigation	233 (53)	236 (64)	198 (27)
Interest on borrowed fund [▶]	51 (16)	47 (12)	–
Land rental	123 (19)	122 (20)	128 (18)
Depreciation	6 (4)	8 (5)	14 (7)
Maintenance and other	16 (6)	18 (6)	16 (6)
Cost of production	771 (108)	775 (134)	693 (69)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11 but for [▶]: Small – 27, Medium – 15 and Large – 0. In case of depreciation, Small – 24, Medium – 23, Large – 11. Depreciation on machinery, building and other fixed assets was calculated on the basis of straight-line method. During the cultivation of rice, the amount of money needed to meet expenses for maintenance such as draining, ridging, allaying, inputs carrying, labor for irrigation, labor for fertilizing and labor for pesticing, etc. were treated as maintenance cost. **Figure in parenthesis indicates the standard deviation.

There were no significant differences found in the quantity of pesticides used, but the money spent was found to be significantly different between small – large and medium – large farmers (Table 4 and 5). The significant variation among the prices was also recognized as a consequence of credit purchasing of pesticides by small and medium farmers (Appendix 7).

For the production of rice, as shown in Table 4, 205 man-day for small and 217 man-day per hectare for each medium and large farmer was used and their unit prices were Tk. 53 for small and Tk. 52 for each medium and large farmer (Table 5). According to Table 4 and 5, no significant differences were found either in the man-day or in the unit price.

The irrigation hours used per hectare by small, medium and large farmers were accounted at 287, 294 and 284 (Table 4) and their respective unit prices were Tk. 46, 44 and 39 (Table 5). As seen in Table 4, no significant difference was found in the irrigation hours among the farmers, but Table 5 shows, the money spent for this purpose was found to significantly different between small – large and medium – large farmers. The higher price for small and medium farmers compared to large farmers was due to the purchase of irrigation water by credit (Appendix 7).

Sources of finance: The sources of rural finance are directly related to cost of production in Bangladesh. When farmers use their own money for production, the cost of production is reduced on the one hand and farmers have better prices for outputs by selling them in the future market on the other. But in the case of borrowed money, it must be paid off within a certain period and/or mutual agreement, which sometimes not only raises the cost of production but also reduces the price of outputs because of selling immediately after harvesting. Rural financial markets contain formal institutions (Commercial and specialized bank and credit cooperatives of NGOs) and a range of informal financial intermediaries, for example, local moneylenders, traders in agricultural inputs and output markets, shopkeepers, landlords, friends, relatives, etc.^[15]. At present, rural financial markets in Bangladesh are fragmented and inadequate for agricultural producers^[12]. There are very limited savings services available in rural areas and the wealthy farmers have relatively better access to cheap credit. The importance of the banking sectors in declining rural financing may be exemplified by a fall in loans disbursed from 24% in 1990 to 18% in 1997^[13]. It is estimated that in 2001- 2002 fiscal year, the total amount of loan disbursed by the four NGOs (Grameen Bank, BRAC, PROSHIKA and ASA) stood at 1.7 times higher than the total agricultural/rural credit disbursed by all the nationalized commercial banks, specialized agricultural banks and other government development organizations^[16]. NGOs are mainly concerned with the poor, who are either landless or have marginal land ownership, but are unable to fulfill their basic needs for living. The credit programs of these NGOs are conducted mainly for non-farm activities and to some extent for agriculture, with the objective of crops diversification, especially vegetables and cash crops, but not for rice cultivation. Both the banking institutions and the NGOs pass over the small and medium farmers, who contribute significantly to rice production.

The study found that farmers used both their own money and borrowed money for cultivation. In the case of borrowed money, farmers collected it from informal sources. According to the survey, 10, 35 and 82% of small, medium and large farmers respectively, used only their own money; while on the other hand, 43 and 4% of small and medium farmers used exclusively borrowed money; 47, 61 and 18% of small, medium and large farmers used both their own and borrowed money. Of the surveyed large farmers, none were found to be dependent on exclusively borrowed money.

Appendix 8 shows that 27 (90%), 15 (65%) and 2 (18%) small, medium and large farmers used borrowed money Tk. 8,097, 7,326 and 12,729, respectively. The interest paid by small and medium farmers was Tk. 2,387 and 1,300 where the annual rate of interest was 44 and 45%, respectively. Although two large farmers used borrowed money alongside their own money but they did not pay any interest. These farmers collected the money from their friends and relatives; therefore, they did not have to pay the interest on borrowed money.

Cost of production: In calculating the cost of production, seeds, fertilizers, pesticide, labor, irrigation, interest on borrowed fund, land rental, depreciation and maintenance costs were considered. As shown in Table 6, for producing 100 kg of HYV *boro* rice (HYV *boro* paddy), the cost was Tk. 771, 775 and 693 for small, medium and large farmers, respectively. The differences in the cost of production between small – medium, small – large and medium – large are Tk. (– 4), 78 and 82, respectively. Having almost the similar characteristics in the production elements between small and medium farmers, the differences of the costs of production are not wide. But the wide differences of the costs of production between small – large and medium – large is because of credit purchased inputs, at higher prices than cash prices, by small and medium farmers. Another reason for the higher cost of production for small and medium farmers is the higher interest rate on borrowed money.

CONCLUSION

The study revealed that the quantity of agricultural inputs used in respect to sizes of farm operation showed no significant difference, but the unit price of seed, chemical fertilizers, pesticides and irrigation differed significantly among the farmers, influencing the cost of production. Small and medium farmers have inadequate production facilities in terms of the source of money. These types of farmers either have no assets to mortgage or have very little and therefore, banks are generally unwilling to give them credit^[13,15,17,18]. Small farmers face higher interest rates on working capital due to capital market imperfections^[6]. Conversely, large farmers have easy access to the credit market for obtaining agricultural inputs at any time. Moreover, they can borrow money without any interest from their relatives and friends, which contributes to lowering their production cost. These farmers purchase larger quantities of inputs at a time, so the rate is cheaper than for small and medium farmers. Price of inputs also

depends upon the supply and demand situation, purchasing nature, payment nature, frequency of purchasing and interpersonal relationship. The cost variations explained here consider only the payment nature of purchased inputs, whether they were by cash or by credit and the sources of funds for cultivation. The study found that most of the small and medium farmers purchased their inputs on credit and borrowed money from informal sources with high rates of interest, uplifting their cost of production. The present study found that the differences of the costs of production for 100 kilogram of rice between small – large and medium – large farmers were Tk. 78 and 82, respectively.

Although all small and medium farmers in the study villages know that the credit purchasing of inputs and borrowing money from informal sources raise the cost of production, they could not limit these types of practices due to the economic constraints in deploying their own money. Poor socio-economic conditions, fragmented land structure, individual farming traditions and variety of cultivation of products are hindering these small and medium farmers from making united efforts towards building an association through which they can raise funds by themselves and eventually which they can use on their own to mitigate the financial obstacles for cultivation. In the above-mentioned circumstances, it is necessary to provide institutional credit to these farmers in some subsidized way. Raising the cost of production adversely affects the income of the farmers. Reducing different types of costs involved in production can enhance the farmers' income.

Notes

^a Premonsoon direct-seeded and transplanted rice crop generally planted in March-May and harvested in June-August. In many places, *aus* is cultivated before *aman* and is thus an alternative to *aman* in deep flood areas. Classifications of *aus*: Local broadcast *aus*, local transplanted *aus*, HYV *aus* and *pajam aus*.

^b Generally planted before or during the monsoon season and is either broadcast or transplanted. Broadcast *aman* is direct-seeded, normally in March and transplanted *aman* is generally planted in June-August and harvested in November-January. Classifications of *aman*: Local broadcast *aman*, local transplanted *aman*, HYV transplanted *aman* and HYV broadcast *aman*.

^c Classifications of *boro*: Local *boro*, HYV *boro* and *pajam boro*.

^d There are eight Upazilas in the Jessore district, Jhikargacha is one of them. The Jessore district is

situated between 22°48' and 23°22' North latitudes and between 88°51' and 89°34' East longitudes. It is bounded on the North by the Jhenaidah district, on the East by Magura and Narail districts, on the West by India and on the South by Khulna and Satkhira districts. It has an area of 2567 square kilometers including a riverine area which constitutes 1.74% of the total area of the country.

^e Owner-cum-tenant cultivators are those who may or may not lease out their own land to others, but take some land from others on a share-cropping basis or on other terms^[19].

^f These types of small farmers were using their own land for the cultivation of vegetables and all other crops except rice. For rice cultivation, they used tenant land.

Appendix 1: Profile of the study area (Jhikargacha Upazila of Jessore district)

Items	Farmer			
	Small	Medium	Large	Total
Number of holdings	25625	6270	834	32729
Percentage	78.29	19.16	2.55	67.13
Percentage of district total	11.81	12.00	14.07	11.89
Tenureship				
Owner holdings	15646	4535	683	21164
Percentage	73.93	21.43	3.23	61.99
Percentage of all holdings	61.06	72.33	81.89	64.66
Owner- cum-tenant holding	9104	1721	150	10975
Percentage	82.95	15.68	1.37	98.73
Percentage of all holdings	35.53	27.45	17.99	33.53
Tenant holdings	575	14	1	590
Percentage	97.46	2.37	0.17	16.87
Percentage of all holdings	2.24	0.22	0.12	1.80
Agri. Labour households	9166	398	45	9609
Percentage	95.39	4.14	0.47	57.70
Percentage of all holdings	35.77	6.35	5.40	29.36
Operated area	9562	10056	3745	23362
Percentage	40.93	43.04	16.03	97.86
Percentage of district total	11.80	12.09	14.35	12.28
Area per holding	0.37	1.60	4.49	0.71
Net cultivated area	8000	8865	3302	20167
Percentage	39.67	43.96	16.37	99.95
Percentage of district total	11.60	11.86	14.01	12.06
Area per holding	0.31	1.41	3.96	0.62
Gross cropped area	13913	14898	5229	34040
Percentage	40.87	43.76	15.36	100.00
Percentage of district total	12.49	12.82	14.85	12.95
Intensity of cropping	193.5	182.6	173.1	185.3
Irrigation				
Holding reporting	19150	5281	745	25176
Percentage of farm holdings	74.73	84.23	89.33	76.92
Irrigated area	5702	6293	2397	14392
Percentage of cultivated area	71.27	70.99	72.58	71.36
Use of fertilizer				
Holding reporting	21498	5957	812	28267
Percentage of farm holdings	83.89	95.01	97.36	86.37
Fertilized area	6582	7372	2694	16648
Percentage of cultivated area	82.28	83.15	81.59	82.55
Cropped area				
HYV <i>Aus</i>	1047	1027	357	2431
HYV <i>Aman</i>	2924	3174	1048	7146
HYV <i>Boro</i>	3008	2972	1044	7025

Source: Census of Agriculture – 1996, Zila Series: Jessore, 2002. Area is measured in hectare. The intensity of cropping is expressed in percentage value.

Appendix 2: Sources of seeds

Parameters	Farmer*			Qty. of seeds (Kg./hectare)**		
	Small	Medium	Large	Small	Medium	Large
Seeds						
Home made only	10	13	18	47 (☼)	52 (7)	52 (2)
Home made+ purchased	37	26	45	57 (5)	54 (5)	59 (2)
Purchased only	53	61	36	57 (5)	54 (5)	57 (5)
Cash purchased only	13	17	73	54 (7)	52 (5)	49 (10)
Credit purchased only	27	22	–	57 (5)	54 (5)	–
Cash + credit purchased	33	35	9	47 (10)	47 (12)	32 (◊)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation. ☼All three farmers used the same quantity (47 kg/hectare) of seeds. Therefore, no standard deviation was found. ◊Only one large farmer used both cash and credit purchased seeds (32 kg/hectare) here. When farmers used only purchased seed and when some of them used home made and purchased seed simultaneously, in both cases, the purchased seed used cash and credit money.

Appendix 3: Purchasing nature of fertilizers

Parameters	Farmer*			Qty. of fertilizers (Kg./hectare)**		
	Small	Medium	Large	Small	Medium	Large
Urea						
Cash purchased only	3	22	82	383 (■)	339 (49)	348 (62)
Credit purchased only	53	30	–	381 (44)	378 (35)	–
Cash + Credit	43	48	18	353 (47)	383 (42)	378 (12)
TSP:						
Cash purchased only	7	30	91	96 (2)	96 (10)	106 (12)
Credit purchased only	53	48	–	104 (7)	104 (10)	–
Cash + Credit	40	22	9	106 (5)	104 (12)	82 (◊)
MP:						
Cash purchased only	27	39	100	49 (5)	49 (7)	49 (7)
Credit purchased only	43	35	–	52 (2)	54 (7)	–
Cash + Credit	30	26	–	49 (5)	54 (5)	–
Sulphur:						
Cash purchased only	27	39	82	30 (2)	27 (2)	30 (5)
Credit purchased only	43	39	–	27 (2)	30 (2)	–
Cash + Credit	30	22	18	27 (2)	30 (2)	27 (2)
Gypsum:						
Cash purchased only	30	30	91	136 (17)	141 (20)	143 (22)
Credit purchased only	37	43	–	143 (20)	148 (15)	–
Cash + Credit	33	26	9	148 (17)	148 (17)	148 (◊)
Organic fertilizer:						
Home made only	30	26	27	3632 (806)	4047 (724)	4490 (1006)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation. ■ Only one small farmer used cash purchased seeds (383 kg./hectare). ◊Only one large farmer used both cash and credit money for purchasing TSP (82 kg./hectare) and Gypsum (148 kg./hectare).

Appendix 4: Purchasing nature of pesticides

Parameters	Farmer*			Qty. of pesticides (Kg./hectare)**		
	Small	Medium	Large	Small	Medium	Large
Pesticides						
Cash purchased only	37	35	100	12 (2)	15 (2)	12 (2)
Credit purchased only	43	39	–	15 (2)	15 (2)	–
Cash + credit	20	26	–	15 (2)	15 (2)	–

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation.

Appendix 5: Nature of labor

Parameters	Farmer*			Man days/hectare**		
	Small	Medium	Large	Small	Medium	Large
Labor						
Family labor only	40	9	–	195 (32)	210 (69)	–
Hired labor only	17	35	45	200 (44)	210 (25)	213 (25)
Family + hired labor	43	57	55	215 (17)	222 (22)	222 (20)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation.

Appendix 6: Nature of irrigation

Parameters	Farmer*			Hours/hectare**		
	Small	Medium	Large	Small	Medium	Large
Irrigation						
Own machine only	7	30	100	267 (10)	277 (42)	284 (32)
Own machine + purchased	13	22	–	277 (35)	319 (27)	–
Purchased only	80	48	–	289 (35)	294 (52)	–
Cash purchased only	20	26	–	203(94)	213 (84)	–
Credit purchased only	20	9	–	279 (27)	242 (10)	–
Cash + credit purchased	53	35	–	282 (69)	272 (96)	–

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation. When farmers used only purchased water and when some of them used own machinery and purchased water for irrigation simultaneously, in both cases, the purchased water used cash and credit money.

Appendix 7: Unit price of inputs

Parameters	Farmer*			Unit price (Tk.)**		
	Small	Medium	Large	Small	Medium	Large
Seeds						
Cash rate	57	57	82	18 (1)	17 (1)	16 (♥)
Credit rate	70	65	9	24 (2)	24 (2)	17 (♠)
Home made seeds rate	47	39	64	17 (1)	18 (1)	16 (♥)
Fertilizers:						
Urea:						
Cash rate	47	70	100	7 (♥)	7 (♥)	6 (♥)
Credit rate	97	78	18	8 (♥)	8 (♥)	6 (♥)
TSP:						
Cash rate	47	52	100	17 (♥)	17 (♥)	16 (♥)
Credit rate	93	70	9	20 (1)	19 (1)	16 (♠)
MP:						
Cash rate	57	65	100	14 (♥)	14 (♥)	14 (♥)
Credit rate	73	61	–	17 (1)	17 (1)	–
Sulphur:						
Cash rate	57	61	100	13 (♥)	13 (♥)	13 (♥)
Credit rate	73	61	18	16 (1)	15 (1)	13 (□)
Gypsum:						
Cash rate	63	57	100	3 (♥)	3 (♥)	3 (♥)
Credit rate	70	70	9	5 (♥)	5 (♥)	3 (♠)
Organic fertilizer:						
Home made fertilizer rate	30	26	27	0.17 (♥)	0.17 (♥)	0.19(♥)
Pesticides:						
Cash rate	57	61	100	61 (2)	61 (2)	61 (2)
Credit rate	63	65	–	72 (3)	72 (3)	–
Labor (Man day):						
Family labor rate	83	65	55	53 (4)	51 (3)	51 (2)
Hired labor rate	63	91	100	52 (3)	52 (3)	52 (3)
Irrigation hour:						
Cash rate	73	61	–	40 (1)	40 (♥)	–
Credit rate	73	43	–	50 (6)	55 (4)	–
Own machine irrigation rate	20	52	100	42 (2)	41 (2)	39 (2)

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. *Figure indicates the percentage of farmer, **figure in parenthesis indicates the standard deviation. ♥Standard deviation is less than one. ♠Only one farmer engaged. □Two farmers paid the same amount of money, therefore, no standard deviation was found. In case of seed, fertilizers and pesticides, unit prices express the price of one kilogram. In the case of labor and irrigation hours, unit prices express the rate of one-man day and one hour, respectively.

Appendix 8: Borrowed money and interest paid			
Parameters	Tk.**		
	Small	Medium	Large
Total borrowed money	8097 (1602)	7326 (2383)	12729 (7179)
Borrowed money/hectare	16066 (6439)	9130 (3741)	9437(4433)
Interest paid for 4 month/hectare	2387 (1248)	1300 (479)	–
Annual interest rate (%)	44 (11)	45 (11)	–

Source: Field survey, 2005

Total farmer: Small – 30, Medium – 23 and Large – 11. In case of borrowed money, Small – 27, Medium – 15 and Large – 2. **Figure in parenthesis indicates the standard deviation. Interest rates for small and medium farmers were minimum 30 and maximum 60 percent. The period of cultivation of *boro* rice was almost four months, therefore, paid interest rate was calculated on the basis of that period.

REFERENCES

- Devendra, C. and D. Thomas, 2002. Smallholder farming systems in Asia. *Agri. Syst.*, 71: 17-25.
- Golam, R. and B.T. Gopal, 2004. Sustainability of ecological and conventional agricultural systems in Bangladesh: As assessment based on environmental, economic and social perspectives. *Agri. Syst.*, 79: 327-351.
- Hayami, Y., 2001. *Development Economics from the Poverty to the Wealth of Nations*. 2nd Edn., Oxford University Press Inc., New York, pp: 197.
- Rahman, S., 2000. Women's employment in Bangladesh agriculture: composition, determinants and scope. *J. R. Stud.*, 16: 497-507.
- Rahman, S.M. and J. Takeda, 2004. Measuring the cost of production of rice in Bangladesh with special reference to irrigation water. *Bull. Fac. of Agri, Saga Univ., Japan*, 89: 55-70.
- Chavas, J.P. 2001. Structural Change in Agricultural Production: Economics, Technology and Policy, *Hand Book of Agricultural Economics*, Vol. 1A, Elsevier Science B.V, 1000 AE Amsterdam (eds B.L. Gardner, and , G.C. Rausser) pp. 264-282. The Netherlands.
- Azad, M.A.S. and B.A.A. Mustafi, 2004. Economics of modern rice cultivation in different rice growing environments in Bangladesh. *The Agri.*, 2: 126-132.
- Jahan, H. and W.M.H. Jaim, 2002. Dimensions of structural changes in cost and return of HYV *boro* paddy over time in Bangladesh and determinants of the changes. *B. J. Agri. Econ.*, 15: 35-62.
- Bangladesh Bureau of Statistics (BBS), 2005. *Statistical Pocketbook Bangladesh 2003*, Ministry of Planning, Government of the People's Republic of Bangladesh, pp: 212-215.
- Pallant, J., 2001. *SPSS Survival Manual, A Step by Step Guide to Data Analysis Using SPSS for Windows (Version 10)*, Open University, Philadelphia, USA, pp: 186-200.
- Srinath, K., M. Sridha, P.N.R. Kartha and A.N. Mohanan, 2000. Group farming for sustainable aquaculture. *Oce. & Coas. Mgt.*, 43: 557-571.
- World Bank (WB), 2002a. *Bangladesh Agriculture in the 21st Century*. The World Bank Bangladesh Office, Dhaka, pp: 3-83.
- Husain, A.M.M., 1999. Agricultural development in Bangladesh and the role and effectiveness of NGOs: The case of BRAC. *F. Econ.*, 11: 27-42.
- Mandal, M.A.S., 1999. NGO and private sector participation: How far does it go to help transformation of Bangladesh Agriculture? *F. Econ.*, 11: 5-26.
- World Bank (WB), 2002b. *Poverty in Bangladesh: Building on Progress*, Report No. 24299-BD, Poverty Reduction and Economic Management Sector Unit, South Asia Region, pp: 21-32.
- Bangladesh Bank (BB), 2002. *Annual Report 2001-2003 (Bengali Edn)*. Ministry of Finance, Government of the People's Republic of Bangladesh, pp: 38-41.
- Edison, D., 1997. *Food, Nutrition and Hunger in Bangladesh*. Ashgate publishing Ltd, Gower House, Hants GU11 3HR, England, pp: 26-30.
- Anderson, J.R. 2003. Risk in rural development: Challenges for managers and policy makers. *Agri. Syst.*, 75: 161-197.
- Bangladesh Bureau of Statistics (BBS), 2002. *Census of Agriculture – 1996, Zila Series, Jessore*. Ministry of Planning, Government of the People's Republic of Bangladesh, pp: 5-368.