

**PROFITABILITY OF BARI RELEASED POTATO (*Solanum tuberosum* L.)
VARIETIES IN SOME SELECTED LOCATIONS OF BANGLADESH**

M.A. HAQUE¹, M. A. MONAYEM MIAH²
S. HOSSAIN³ AND M. M. RAHMAN⁴

Abstract

Potato is one of the important food crops in Bangladesh. Its demand is increasing day by day. The Tuber Crop Research Centre (TCRC) of BARI released 40 HYV potato varieties and disseminated them in the farmer's fields through different agencies. But most varieties were not adopted well by the farmers due to unknown reasons. Therefore, an attempt was made to assess the level of adoption and profitability of BARI released potato variety at farm level. Data were collected from 150 randomly selected potato farmers from Munshigonj, Bogra and Comilla districts during January-February 2010. The results indicated that 48% potato areas were covered by Diamant variety, 16% by Cardinal, 22% by Granola, and the rest 14% areas were covered by Binella, Asterix, Provento, Felsina, Multa and Hira. The cost of BARI released potato cultivation was Tk 2, 10,629 and Tk 1, 84,135 per hectare on full cost and variable cost basis. The major share of total cost was for seed (42%) followed by fertilizer (21%) and human labour (14%). The average yield of potato was 26 t/ha with gross margin of Tk 1, 51,003 per hectare. The net return of potato cultivation was Tk 1, 24,509 per hectare. The benefit cost ratios were 1.59 and 1.82 on full cost and variable cost basis. Human labour, land preparation, seed, and irrigation had positive and significant effect on potato production. Non-availability of HYV seed at proper time, lack of technical knowledge, high price of seed and fertilizer, infestation of insect and diseases, and lack of storage facilities were the major problems of potato production.

Keywords: Profitability, potato, cost of cultivation.

Introduction

Potato (*Solanum tuberosum* L.) is one of the important vegetables as well as cash crop in Bangladesh. Bangladesh ranks 11th in the world in terms of potato production in 2008 (Hossain and Miah, 2010). In fact, short cycle of potato frees the land for cultivating other crops. In 2008-2009, about 5166.7 thousands metric tons of potatoes have been produced from 395.6 thousands hectares (2.9% of total cultivated area) of land in Bangladesh (BBS, 2009). The area and production of potatoes are increasing day by day due to its higher demand and profitability. The annual growth rates of area, production and yield of potato

¹Principal Scientific Officer, ²Senior Scientific Officer, ³Chief Scientific Officer, Agricultural Economics Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, ⁴Director, Training and Communication, BARI, Gazipur, Bangladesh.

were estimated at 7.14%, 9.90% and 2.76% during 1989-1990 to 2008-2009, respectively (Miah *et al.*, 2011).

The Tuber Crop Research Centre of BARI released 40 HYV potato varieties which have good yield potential and tolerant to insect pests and diseases. These released varieties are disseminated in the farmer's fields through different agencies. Most of the varieties are not cultivated by the farmers because of various unknown reasons that need to be identified. Nevertheless, the economic profitability of BARI released potato varieties is not evaluated.

With this view in mind, the present study has been undertaken with the following objectives: (i) to know the level of adoption of BARI released potato varieties at farm level; (ii) to estimate the profitability of BARI released potato varieties; (iii) to evaluate the farmers attitude towards the cultivation of BARI released potato varieties; (iv) to identify the socio- economic constraints of BARI released potato varieties at farm level.

Materials and Method

Sampling technique: A multi-stage sampling technique was followed in this study to select study areas and sample farmers. In first stage of sampling, three potato growing districts namely Munshigonj, Comilla and Bogra were selected purposively. In the second stage, one Upazila was selected from each district for sample survey. The names of the Upazilas were Sadar under Munshigonj district, Shibgonj under Bogra district and Chandina under Comilla district. In the third stage, a complete list of potato growers were collected from each Upazila and finally a total of 150 potato farmers taking 50 farmers from each Upazila were selected by random sampling technique.

Method of data collection: Data for the present study were collected from sample potato farmers through face to face interview method using a pre-tested interview schedule. Field level data were collected by the researcher with the help of trained enumerators for the period of January-February, 2010.

Analytical techniques: Both fixed cost and variable cost were taken into account in calculating cost of potato cultivation. Land use cost was calculated on the basis of per year existing lease value of land. Irrespective of potato varieties, the profitability of potato production was examined on the basis of gross margin, net return and benefit cost analysis. The collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study. Tabular method using descriptive statistics was mostly used in the study. The following Cobb-Douglas production function model was used to estimate the contribution of factors to potato production.

$$Y = AX_1^{b_1} X_2^{b_2} \dots X_n^{b_n} e^{ui}$$

The production function was converted to logarithmic form so that it could be solved by least square method i.e.

$$\ln Y = a + b_1 \ln X_1 + \dots + b_n \ln X_n + U_i$$

The empirical production function was the following:

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

Where, Y = Yield (kg/ha); X₁ = Human Labor (Man-day/ha); X₂ = Land preparation cost (Tk/ha); X₃ = Seed (kg/ha); X₄ = Manure (kg/ha); X₅ = NPK fertiliser; X₆ = Insecticide cost (Tk/ha); X₇ = Irrigation cost (Tk/ha); A = Intercept; b₁, b₂ ---- b₇ = Coefficients of the respective variables to be estimated; and U_i = Error term.

Results and Discussion

Adoption of improved potato varieties

An attempt was made to assess the level of adoption in terms of area coverage of BARI released potato varieties at farm level. The farmers in the study areas adopted BARI released potato varieties such as diamant, cardinal, binella, asterisk, granola, provento, felsina, multa and hira. On an average 48%, 16% and 22% potato areas were covered by diamant, cardinal and granola variety and the rest 14% areas were covered by binella, asterix, provento, felsina, multa and hira. It was also observed that area covered by different varieties of potato varied from location to location mainly due to existing cropping patterns and soil types. The major cropping pattern in Munshigonj is Fallow-Potato-Fallow might be due to flood prone low land. Therefore, they cultivate more diamant variety due to its higher demand and yield compared to other varieties. On the other hand, the highly adopted cropping pattern in Bogra is T.aman-Potato-Boro. Therefore, Farmers in Bogra cultivate short duration potato variety granula (60-65 days) more than that of other varieties. About 88% potato areas in Munshigonj, 13% in Bogra and 42% in Comilla were covered by diamant variety, whereas 65% potato areas in Bogra were covered by granola. Detailed area coverage by BARI released potato varieties has been shown in Table 1.

Table 1. Adoption of BARI released potato varieties at farm level.

Variety	<i>(% of area covered)</i>			
	Munshigonj	Bogra	Comilla	All areas
Diamant	88	13	42	48
Cardinal	4	20	25	16
Binella	2	-	-	1
Asterix	2	-	-	1
Granola	-	65	-	22
Provento	2	2	-	1
Felsina	2	-	12	5
Multa	1	-	6	2
Hira	-	-	15	5
Total	100	100	100	100

Input use pattern

The human labour used for producing potato was found to be 211 man days per hectare of which 29% were family supplied. The rest 71% labours were used on hire basis. That means there are higher scopes of employment for hired labour in potato cultivation. The use of human labor was highest in Munshigonj (250 man-days/ha) followed by Comilla (208 man-days/ha) and Bogra (176 man-days/ha). The average cost of land preparation was Tk 5420 per hectare. The cost of land preparation was higher in Munshigonj compared to other study areas due to use higher labour and higher wage rate (Table 2). The average quantity of seed and manure used by the farmers were 2480 kg and 7584 kg per hectare respectively. The seed rate used by the farmers was 65% higher than the recommended seed rate of 1.5 t/ha (Satter *et al.*, 2005). They used chemical fertilizers like urea, TSP, MoP, zipsum, zink sulphate, and boron at the rate of 314 kg, 393 kg, 327 kg, 77 kg, 2 kg, and 1 kg per hectare. They used higher doses of urea, TSP and MoP than the recommended doses (220-250kg/ha, 120-150kg/ha and 220-250 kg/ha)(BARI, 2005) and also used lower doses of zipsum, zink sulphate and boron than the recommended doses (100-120 kg/ha, 8-10 kg/ha and 8-10 kg/ha)(BARC, 2005). Table 2 further reveals that Munshigonj farmers used higher amount of fertilizers compared to other study areas might be due to less confidence on the recommended doses of fertilizers. Earlier study on potato also found that Munshigonj farmers used higher dose of fertilizers (Haq *et al.*, 1995).

Table 2. Input use pattern of potato cultivation in different study areas.

Items	Munshigonj	Bogra	Comilla	All areas
Human labor (man-days/ha):	250	176	208	211
Family	72	54	60	62
Hired	178	122	148	149
Land preparation cost (Tk./ha):	8799	3644	3817	5420
Seed (kg/ha)	2793	2151	2496	2480
Manures (kg/ha)	-	13489	9264	7584
Fertilizers (kg/ha):				
Urea	380	346	216	314
TSP	500	283	396	393
MP	449	265	267	327
Zipsum	9	68	155	77
Zinc sulphate	-	7	-	2
Boric acid	-	4	-	1

Cost of cultivation

For calculating the cost of cultivation of potato, all variable costs like human labour, land preparation, seed, manures, fertilizers, insecticides, irrigation, and interest on operating capital were calculated per hectare basis. The fixed cost of potato cultivation included cost of land use and family labour. The cost of land use was calculated on the basis of lease value of land. The total cost included fixed cost and variable cost. The cost of potato cultivation was estimated to be Tk. 2,10,629 and Tk. 1,84,135 per hectare on total cost and variable cost basis, respectively. The major share in total cost was seed (42%), followed by chemical fertilizers (21%) and human labour (14%). The cost of potato cultivation in Munshigonj (Tk. 2,32,283/ha) was found highest followed by Bogra (Tk. 2,05,971/ha) and Comilla (1,93,636/ha) due to the higher cost of human labour, fertilizer and insecticides (Table 3).

Table 3. Cost of production of potato in different study areas.

(Figure in Tk./ha)

Items	Munshigonj	Bogra	Comilla	All areas
A. Variable Cost:	203807 (88)	179182 (87)	169115 (87)	184135 (88)
Land preparation cost	8799 (4)	3644 (2)	3816 (2)	5420 (3)
Hired labour	26732 (12)	18351 (10)	19097 (10)	21393 (10)
Seed	85569 (40)	96804 (46)	85458 (44)	89277 (42)
Organic manure	-	6443 (3)	4632 (2)	3692 (2)
Chemical fertilizers:	56518 (24)	35749 (17)	39631(20)	43966 (21)
Urea	4568	4150	2622	3780
TSP	28037	16060	21788	21962
MP	23798	14331	14443	17524
Zypsum	53	340	778	390
Zink	-	435	-	145
Boric acid	-	433	-	144
Insecticides	12488 (5)	10504 (5)	7450 (4)	10148 (5)
Irrigation	5863 (3)	3200 (2)	4926 (3)	4663 (2)
Interest on operating capital	7838 (3)	4487 (2)	4400 (3)	5575 (3)
B. Fixed cost:	28474 (12)	26789 (13)	24220 (13)	26494 (12)
Family labour	10849 (5)	8077 (4)	8477 (4)	9134 (4)
Land use	17625 (7)	18712 (9)	15743 (8)	17360 (8)
Total cost (A +B)	232281 (100)	205971 (100)	193335 (100)	210629 (100)

Figures within the parentheses indicates percentage of total cost

Profitability of potato cultivation

The yield of potato was 26 tons per hectare which was higher than the national average yield (15.43 t/ha) (BBS, 2009). The yield of potato was found to be the highest in Munshigonj (31 t/ha) followed by Comilla (25 t/ha) and Bogra (23 t/ha) due to better management and good soil condition (Table 4). The gross return and gross margin of potato cultivation were Tk 335138 and Tk.1,51,003 per hectare, respectively. Gross margin was found to be the highest in Munshigonj (Tk 1,91,345) followed by Comilla (Tk 15,1607) and Bogra (Tk 110355). The net return of potato cultivation was Tk 1,24,509 per hectare. It was the highest in Munshigonj (Tk 1,62,873) and the lowest in Bogra (Tk 83,566) due to higher gross return. The average benefit cost ratios were 1.59 and 1.82 on full cost and variable cost basis. It was also found that the highest BCR on variable cost received by the Munshigonj farmers followed by Comilla and Bogra farmers due to higher yield and price.

Table 4. Profitability of potato cultivation in different study areas.

Items	Munshigonj	Bogra	Comilla	All areas
1. Total variable cost (Tk./ha)	203809	179182	169115	184135
2. Total cost (Tk./ha)	232281	205971	193335	210629
3. Yield (kg/ha)	30735	23163	24520	26139
4. Price (Tk./kg)	12.85	12.51	13.00	12.79
5. Gross return (Tk./ha)	395154	289537	320722	335138
6. Gross margin (Tk./ha)	191345	110355	151607	151003
7. Net return (Tk./ha)	162873	83566	127387	124509
8. Benefit cost ratio				
Full cost basis	1.70	1.41	1.66	1.59
Variable cost basis	1.94	1.62	1.90	1.82

Factors affecting potato yield

In order to determine the contribution of inputs like human labour, land preparation, seed, manure, NPK fertilizers, insecticide and irrigation for potato production, Cobb-Douglas production function was used. The estimated values of co-efficients and related statistics of Cobb-Douglas production function have been presented in Table 5. All the co-efficients of human labour, land preparation, seed and NPK fertilizer are positive and significant at 1% level, indicated that 1% increase in the use of human labor, land preparation, seed and NPK fertilizer, keeping other factors remaining constant would increase the yield of potato by 0.225%, 0.076%, 0.313% and 0.386%, respectively. Manure and

insecticide application had positive impact on the yield of potato but the effects were not significant at desired level of significance. The co-efficient of irrigation was negative and significant at 10% level.

Table 5. Estimated coefficients and their related statistics of production function for potato.

Explanatory Variables	Co-efficient	t-values	P-values
Intercept	3.326***	5.7950	0.0000
Human labor (X_1)	0.225***	3.6977	0.0003
Land preparation (X_2)	0.076***	3.5843	0.0005
Seed (X_3)	0.313***	6.6129	0.0000
Manure (X_4)	0.026	1.1434	0.2548
NPK fertiliser (X_5)	0.386***	5.6004	0.0000
Insecticides (X_6)	0.021	1.1814	0.2394
Irrigation (X_7)	-0.082*	-1.8986	0.0597
R^2	0.80	-	
F value	79.74***	-	

Note: ***, and * indicate significant at 1% and 10% level respectively

The value of the coefficient of determination (R^2) was 0.80, which indicated that around 80% of the variation in yield was explained by the independent variables included in the model. The value of F was 79.74 which were significant at 1% level implying that the variation of yield mainly depends on the explanatory variables included in the model.

Farmers' attitude towards BARI released potato cultivation

Table 6 revealed that about 64% farmers were willing to increase the cultivation of BARI released potato varieties in the next year. Higher yield ranked top behind the reasons for increasing potato cultivation followed by short duration crop, profitability, and easy production technology. On the other hand, 36% farmers were not interested to increase the BARI released potato cultivation due to high price of potato seed during sowing period, storage problem, high infestation of insect and diseases, and lack of enough money for potato cultivation.

Problems of potato cultivation

The farmers in the study areas encountered different problems during potato cultivation. The problems were ranked based on their priority. A brief discussion on various problems has been made in the following sections.

Non-availability of quality seed: Potato yield largely depends on quality seed. Farmers in the study areas used potato seed from many sources like own source, BADC, market traders, etc. Market traders usually adulterate potato seed for making higher profit. BADC seed is almost scarce to the farmers. Nonetheless, own seed retained for their own use don't fulfill their requirements. Therefore, 70% of the respondent farmers mentioned non-availability of quality seed at planting time as a first ranked problem.

Table 6. Reasons for increasing BARI released potato varieties for the next year.

Type of Facility	% of farmers			
	Munshigonj	Bogra	Comilla	All areas
A. Willingness to increase				
1. Yes	35 (70)	30 (60)	32 (64)	32 (64)
2. No	15 (30)	20 (40)	18 (36)	18 (36)
B Reasons for increasing				
1. Profitable crop	20 (57)	15 (50)	22 (69)	19 (59)
2. Higher yield	25 (71)	20 (67)	23 (72)	23 (70)
3. Easy production technology	15 (43)	12 (40)	18(56)	15 (47)
4. Short duration crop	20 (57)	25 (78)	19 (59)	21 (66)
C. Reasons for not increasing				
1. High price of seed during sowing period	12 (80)	15 (75)	14 (78)	14 (78)
2. Ignorance about new HYV potato seed	10 (66)	15 (75)	12 (67)	12 (67)
3. Lack of enough money for potato cultivation	5 (33)	6 (30)	5 (28)	5 (28)
4. High infestation of insect and diseases	8 (53)	10 (50)	10 (56)	9 (50)
5. Storage problem	12 (80)	15 (75)	14 (77)	14 (78)

Lack of technical knowledge: Technical knowledge relating to crop cultivation is also crucial for getting higher yield. It optimize input use, saves production cost and increase yield of crops as well as farmers' income. Most respondent farmers in the study areas were suffering from lack of technical knowledge regarding potato cultivation since they used various inputs unwisely. This problem was highly reported by Bogra farmers compared to other areas. In all areas, this problem was reported by 54% of the farmers in the study areas.

Higher price of fertilizers: Fertilizers are important input for crop production. It increases soil fertility and crop yield. Due to its higher price many small and marginal farmers can not use proper dose of fertilizers and get lower yield. That's

why, half of the respondent farmers reported higher price of fertilizers to be a problem.

Insect and disease infestation: Late blight (LB) is one of the important potato diseases. The yield of potato is seriously hampered by this disease. Many respondent farmers (42%) faced this problem during potato cultivation.

Lack of storage facility: Potato is a semi perishable vegetable which needs storage for using it throughout the year. Most small and medium farmers have to sell most of their potatoes immediately after harvesting with lower price. Most of them have little access to the local cold storage because of their small volume. Therefore, lack of storage facility was reported to be a problem by 34% farmers in the study areas.

Table 7. Constraints to potato cultivation in different study areas (multiple responses).

Constraints	% responses			
	Munshigonj	Bogra	Comilla	All areas
<i>Observation (n)</i>	<i>N=50</i>	<i>N=50</i>	<i>N=50</i>	<i>N=150</i>
1.Non- availability of quality seed	70	74	64	70
2. Lack of technical knowledge	44	62	56	54
3. High price of fertilizer	50	52	48	50
4. Infestation of insects and diseases	44	44	42	42
5. Lack of storage facility	36	32	36	34

Conclusion and Recommendations

The study has been designed for assessing the farm level adoption and estimating the profitability of BARI released potato varieties in Bangladesh. The study shows that diamant is the highly adopted potato variety in the study areas followed by granola and cardinal. Besides, the cultivation of BARI released potato varieties at farm level is highly remunerative. Farmers' attitudes towards HYV potato production seem to be very positive because most of the farmers wanted to increase potato production in the next year. Although potato cultivation is a profitable venture, it faces various problems. The lack of quality seed is a major problem in higher adoption of HYV potatoes at farm level.

Based on study findings, the following recommendations are put forward for wider adoption of BARI released HYV potato at farm level:

- The quality of HYV seed should be made locally available to the farmers. Government should encourage private seed companies to come

forward for producing quality seed potatoes. Law enforcing authority should take appropriate action against seed adulteration.

- Motivational campaign through providing training, booklets and other supporting materials to farmers and extension personnel about the HYV potato should be continued.
- More intensive research should be undertaken by the BARI scientists to develop disease and insect-pest resistant potato varieties in the near future.
- Chemical fertilizers with low price should be made available at farm level.
- Storage facility should be developed for the actual farmers to conserve their interest. Therefore, the government should take appropriate steps so that the actual farmers can store their produces to cold storage. Besides, emphasis should also be given to increase the number of cold storage in the country.

References

- BBS (Bangladesh Bureau of Statistics). 2009. *Year book of Agricultural Statistics of Bangladesh*, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- BARC (Bangladesh Agricultural Research Council). 2005. *Fertilizer Recommendation Guide*, Published by the Bangladesh Agricultural Research Council, Farmgate, Dhaka-1215.
- BARI (Bangladesh Agricultural Research Institute). 2005. *Handbook of Agricultural Technology* 3rd edition, Gazipur.
- Hossain, M.A. and M.A.M. Miah. 2010. Post-harvest losses and technical efficiency of potato storage systems in Bangladesh. Technical Report submitted to FAO Bangladesh. Available at: <http://www.fao.org/inpho/content/condpend/text>
- Huq, A. S. M. A., M. S. Hussain and M. A. Rashid. 1995. Potato production in CDP demonstration area: yield gap analysis. Annual report 1995, Agricultural Economics Division, BARI, Gazipur.
- Miah, M. A. M., S. Hossain, T. M. B. Hossain, S. Rahman and *et al.* 2011. Assessment of potato farmers' perceptions on abiotic stresses and implications for potato improvement research in Bangladesh: a baseline survey. Research report submitted to International Potato Centre (CIP), Lima, Peru.
- Satter, M.A., M. M. Rahman, M. H. Rashid, M. S. Ali and M. S. Alam. 2005. *Krishi Projukti Hatboi* (Hand book on agro technology), 3rd Edition, BARI, Gazipur.