Study on Profitability Using Modern Inputs against Traditional for Potato Production at Different Agro-Ecological Zones of Bangladesh

M. M. Haque[1], N. Tabassum[2*], N. A. M. E. Kabir[3], S. Akter[4] and M. Saha[5]

[1]Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202
[2]Department of Agribusiness and Marketing, Bangladesh Agricultural University, Mymensingh-2202
[3]Petrochem (Bangladesh) Limited, Dhaka
[4]Bangladesh Bank, Motijheel, Dhaka-1000, Bangladesh
[5]Scientific Officer, Bangladesh Institute of Nuclear Agriculture (BINA) Substation, Rangpur
[*]Corresponding author: naziabau@yahoo.com

Abstract

The study on Economics Faculty in using modern inputs against traditional inputs and practices for potato production were conducted in the different agro-ecological zones and agro-climatic locations of Bangladesh during 2011-2012. The aim of the study was how to enrich the knowledge of farmers and traders by the use of modern inputs (fertilizers, green pesticides and micronutrients) for potato production and management technologies. A total number of 150 farmers were randomly selected from Rangpur, Thakurgaon, and Comilla regions under agro-ecological zones of Tista Meander Floodplain, Old Himalayan Piedmont Plain and Middle Meghna River Floodplain respectively. Cobb-Douglas production function was used to measure the effect of various factors on potato production. The factors of production considered in this study were land preparation, labor cost, seed, fertilizer, pesticides, irrigation and land use cost. The cost was comparatively low in modern practices than higher in traditional practices as it was mainly due to adoption of recommended technology, appropriate dose and time in case of modern inputs and practices whereas non-recommended technology, higher dose of inputs adopted in traditional practices. The out-put in-terms of per unit yield was found 26 t ha^{-1} in modern practices but 24 t ha^{-1} in traditional practices. The net profit was significantly higher in modern practices than traditional practices; the net profit in modern practices was found at Rangpur Tk 98,079, Thakurgaon Tk 72, 741 and Comilla Tk 46, 950. It transpires from the study that the farmers would be economically benefitted if they use modern inputs; adopt technologies and practices in terms of using quality seed of improved varieties at recommended dose and time of use of fertilizers and pesticides, timely application of irrigation and appropriate crop management including weeding and other practices.

Key words: Cost of cultivation, Profitability, Resource use efficiency

Introduction

Potato is one of the staple foods in Bangladesh. Bangladesh achieves the 4th position in Asia and 14th in the world potato production. The area under potato is around 3.77 to 4.54 lac ha in Bangladesh. The total production of potato was 52.77 to 100.00 lac tons and the yield was 14.01-22.03 t ha^{-1} (BBS and FAO 2006-07 to 2010-11). From 1960 to 2013 over 46 modern Potato varieties have been released and notified in Bangladesh. The major improved varieties introduced, released and notified in Bangladesh are from the Netherlands, very few from CIP (Peru), India and other countries. The potato varieties introduced from the Netherlands are highly popular in Bangladesh in terms of yield, table potato and industrial processing potatoes. Potato is playing a major role in the rural economy of Bangladesh. Farmers can earn very high financial and economic return through production potato as seed, table potato, industrial processing and exportable potato. There is enormous potentiality to increase per unit yield of potato through adoption of modern technologies and practices along with use of quality seed potato of improved varieties. With a view to adopting advanced technologies and modern practices the utmost needs is to up-scale the technical knowledge of farmers and motivate them through training and technological supports. One of the major constraints of potato sector is the Lack of knowledge of farmers on appropriate use of inputs: Majority of potato farmers of the northern districts of Bangladesh has very little knowledge regarding appropriate use of input materials and disease management practices (Uddin *et al*., 2010). In case of potato cultivation, farmers of the northern part of Bangladesh lack proper knowledge of using input materials and seed quality management. Use of over dose or under dose of pesticides, micronutrients and chemical fertilizers and other inputs is very common to potato farmers that lead to production loss, increase cost of production and environmental pollution. Little knowledge of appropriate irrigation and harvesting technique by farmers causes wastage and post harvest loss of potato during and after harvesting. It has also been observed that farmers' level of knowledge regarding disease management, time of planting, clean cultivation, deposition of residues on their field which might be the primary source of pathogen, spray schedule and procedure, selection of pesticides (both systemic and contact), fertilizer application, soil test, sorting, grading and storage is not enough. As a result, 5% potato on an average is getting wasted each year before the harvest. On this regards, the above facts are directing towards the demand for this intervention improving competitiveness of potato farmers by increasing productivity through adopting proper usage of quality inputs so that these farmers can reduce their production cost and effectively manage potato diseases which ultimately will result in higher profit for farmers. This study was conducted to identify the present gaps in farmers knowledge and practices and suggest how to up-scale their knowledge and capabilities as well as capacities for potato production. Keeping with all these facts in mind, the present study has been undertaken with the following objectives: (i) to improve the knowledge of the farmers and traders on

appropriate input management and cultivation technique. (ii) to promote green pesticide and micronutrients along with other necessary input materials to potato farmers.

Materials and Methods

The study areas were selected at Rangpur, Thakurghaon, Comilla under the agro-ecological zones of Tista Meander Floodplain, Old Himalayan Piedmont Plain and Middle Meghna River Floodplain respectively. Data were collected from primary and secondary sources. Primary data were collected from face to face interview method using a pre-tested interview schedule by the researchers with the help of trained enumerators for the period of January - February, 2012. Secondary data were from government and non government organizations, such as Soil Resources Development Institute (SRDI), Bangladesh Bureau of Statistics (BBS), Food and Agriculture Organization (FAO), Department of Agricultural Extension (DAE) etc. Primarily 150 farmers from 9 districts (Panchaghar, Dinajpur, Thakurgaon, Nilphamari, Gaibandha, Rangpur, Lalmonirhut, Chandpur, Comilla) of Bangladesh were randomly selected and they were trained with modern technologies. At last data were collected from 50 selected farmers and compiled finally according to the greater regions. Rangpur region comprises 20 farmers from Nilphamari, Gaibandha, Lalmonirhut and Rangpur districts, Thakurgaon region comprises 15 farmers from Panchaghar, Dinajpur and Thakurgaon districts and Comilla region comprises 15 farmers from Chandpur and Comilla districts. For this study the Following input pattern was maintained timely: Different varieties of potato were cultivated like Diamont, Cardinal and Granola. Potato varieties were sown on 15 November, 2011 and harvested on 15 February, 2012 in each region. The spacing of potato was 60 cm x 25 cm for whole tuber and 50 cm x15 cm for cut tuber and Seed rate was1.5 t ha^{-1}. (Satter *et al.*, 2005). Chemical fertilizers like Urea, TSP, MoP, Gypsum, Zingsul (zinc sulphate), Petroboron (Boric acid), Petromag (Magnesium Sulphate) and Joiboshakti (Bone Meal) were applied at the rate of 350 kg, 220 kg, 270 kg, 120 kg, 7 kg, 6 kg, 50kg and 50kg per hectare (BARI, 2005). Irrigation was applied in two times; after 35 DAP and 65 DAP.

Analytical techniques

Both fixed cost and variable cost were taken to calculate the total 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 this study. The following Cobb-Douglas production function model was used to estimate the contribution of factors of potato production.

$Y = AX_1^{b1}X_2^{b2}$ ---------- $Xn^{bn}e^{ui}$

The production function was converted to logarithmic form so that it could be solved by least square method i.e. $\ln Y = a + b_1\ln X_1 + \ldots\ldots\ldots\ldots + b_n\ln X_n + U_i$

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); X_1 = Human Labor (Man-day/ha); X_2 = Land preparation cost (Tk/ha); X_3 = Seed (kg/ha); X_4 = Manure (kg/ha); X_5 = NPK fertilizer; X_6 = Insecticide cost (Tk/ha); X_7 = Irrigation cost (Tk/ha); a =Intercept; b_1, b_2 ---- b_7 = Coefficients of the respective variables to be estimated; and U_i = Error term.

Results and Discussion

Cost of cultivation

The total cost included fixed cost and variable cost. For calculating the total cost of cultivation of potato, all variable costs like human labor, 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 labor. The cost of land use was calculated on the basis of lease value of land. The use of human labor was highest in Comilla Region (100 man-days/ha), followed by Rangpur Region (85 man days/ ha) and Thakurghaon Region (80 man-days/ha). The average cost of land preparation was Tk 4300 per hectare for modern practice and Tk 4000 per hectare for traditional practice. The cost of land preparation was highest in Comilla region compared to other study areas due to use of higher labor and higher wage rate. The average seed use cost was higher in traditional practice (80,000Tk) than modern practice (60,000Tk). The major share of total cost was for seed (43.1%) followed by human labor i.e. hired and family (19.93%), fertilizer (16.23%) and pesticides (5.26%) through use of appropriate technology used. Another local practices used in farmers the major share of total cost was for seed (46.46%) followed by fertilizer (21.66%), human labor (10%) and pesticides (9.9%). The cost of potato cultivation in Comilla region (Tk. 148735/ha) was found highest followed by Rangpur region (Tk. 137250/ha) and Thakurghaon region (Tk.132180/ha) due to the higher cost of human labor, fertilizer and insecticides (Table 1). 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.

Profitability of potato cultivation

The yield of potato was 28 tons per hectare which was higher than the national average yield, 15.43 t ha^{-1} (BBS, 2009). The yield of potato was found to be the highest in Rangpur region (28 t ha^{-1}) followed by Thakurghaon region (25.6 t ha^{-1}) and Comilla region (24.5 t ha^{-1}) (Table 2) due to better management and good soil condition. The gross return and gross margin of proper input used in potato cultivation were Tk. 2,

11,978 and Tk.1,39,388 per hectare, respectively (Table 2). On the other hand, the gross return and gross margin of the farmers of local practices were Tk 1,98,068 and Tk.1,72,358 per hectare, respectively (Table 2). Gross margin was found to be the highest in Rangpur followed by Thakurghaon and Comilla. The net return of potato cultivation was Tk. 72590 per hectare. It was the highest in Rangpur (Tk. 98079) and the lowest was in Comilla (Tk. 46950) (Table 4.) as the higher gross return. The average benefit cost ratios were 1.67 in Rangpur, 1.55 in Thakurgaon and 1.32 in Comilla on total cost and variable cost basis (Table 2). It was also found that the highest BCR on variable cost were received by the Rangpur farmers followed by Thakurghaon and Comilla farmers due to higher yield and selling price of potato.

Table 1. Fixed cost and Variable cost of potato cultivation in different study areas

Items	Modern Practices			Traditional Practices		
	Rangpur	Thakurgaon	Comilla	Rangpur	Thakurgaon	Comilla
A. Variable cost	**118,930**	**110,680**	**128,680**	**149,120**	**156,120**	**158,960**
Land preparation	4,000	4,500	4,500	4,000	4,000	4,000
Hired labor	21,250	12,000	30,000	12,000	14,000	12,000
Seed	60,000	60,000	60,000	80,000	80,000	80,000
Organic Manure	3,000	3,500	3,500	3,000	3,500	4,000
Chemical fertilizer						
Urea	5,250	5,250	5,250	7,500	7,500	8,000
TSP	3,520	3,520	3,520	10,560	10,560	14,080
MoP	4,320	4,320	4,320	12,960	12,960	17,280
Gypsum	480	480	480	100	100	100
Zinc sulphate	980	980	980	0	0	0
Boric acid	1,020	1,020	1,020	0	0	0
MgSO4	1,250	1,250	1,250	0	0	0
Joiboshakti	2,470	2,470	2,470	0	0	0
Pesticides	7,340	7,340	7,340	15,500	20,000	15,500
Irrigation	4,050	4,050	4,050	3,500	3,500	4,000
B. Fixed cost	**18,320**	**21,500**	**20,055**	**18,320**	**14,500**	**20,055**
Family labor	3,500	10,000	4,000	3,500	3,000	4,000
Land used	14,820	11,500	16,055	14,820	11,500	16,055
(A+B)	**137,250**	**132,180**	**148,735**	**167,440**	**170,620**	**179,015**

Modern practice

The calculated regression coefficient of human labor cost was -0.417 indicating the negative effect of money spent on human labor. An increase of one percent of money spent on human labor, keeping other factors constant, would result in a decrease of gross return by -0.417 percent. The estimated coefficient of seed cost was -0.256, which was negative and highly significant at one percent level. It implies that 1 percent increase in seed cost, keeping other factors constant, would decrease gross return by -0.256 percent. The value of estimated coefficient of fertilizer cost was -0.197, which was negative and highly significant at one percent level. It implies that 1 percent increase in seed cost, would decrease gross return by -0.256 percent. The estimated coefficient of pesticides cost was -0.292, which was negative and significant at one percent level. It implies that 1 percent increase in seed cost, would decrease gross return by -0.292 percent, keeping other factors constant. (Table-3).

Traditional practices

The calculated regression coefficient of human labor cost was 0.131 indicating the negative effect of money spent on human labor. An increase of one percent of money spent on human labor, keeping other factors constant, would result in a increase of gross return by 0.131.The estimated coefficient of seed cost was -0.106, which was negative and significant at ten percent level. It implies that 1 percent increase in seed cost, would decrease gross return by -0.256 percent. The value of estimated coefficient of fertilizer cost was -0.058, which was positive and not significant at one percent level. It implies that 1 percent increase in seed cost, keeping other factors constant, would decrease gross return by -0.256 percent. The estimated coefficient of pesticides cost was -0.292, which was negative and significant at one percent level. It implies that 1 percent increase in seed cost, keeping other factors constant, would decrease gross return by -0.292 percent (Table-3).

Efficiency of resource allocation

For efficiency allocation of resources one should use more of the resources so long as the value of the added product is greater than the cost of the added amount of the resources in producing it.

Table 2. Profitability of potato cultivation in different study areas

Items	Modern Practices			Traditional practices		
	Rangpur	Thakurghaon	Comilla	Rangpu	Thakurghaon	Comilla
1. Total Variable Cost (Tk ha^{-1})	118,930	110,680	128,680	149,120	156,120	158,960
2. Total cost (Tk ha^{-1})	137,250	132,180	148,735	167,440	170,620	179,015
3. Yield (Tk ha^{-1})	28.8	25.6	24.5	23.4	25.0	23.6
4. Price (Tk kg^{-1})	8.00	8.00	8.00	8.00	8.00	8.00
5. Gross return (Tk ha^{-1})	230,329	204,921	195,685	187,490	199,716	188,610
6. Gross margin (Tk ha^{-1})	111,399	94,241	67,005	38,370	43,596	29,650
7. Net return (Tk ha^{-1})	93,079	72,741	46,950	20,050	29,096	9,595
8. Benefit cost ratio	1.67	1.55	1.32	0.89	1.17	1.05

Table 3 . Estimated production functions of different practices of potato

Exlanatory Variables	Modern Practices		Traditional Practices	
	Co-efficient	t-Values	Co-efficient	t-Values
Land Preparation (X_1)	1.618	-.005	10.852	1.751
Labor (X_2)	-0.417***	.005	0.131*	-2.049
Seed (X_3)	-0.256***	-5.806	-0.106*	0.785
Fertilizer (X_4)	-0.197*	-5.779	0.058	1.069
Pesticides (X_5)	-0.292	-1.803	0.035	1.609
Irrigation (X_6)	-0.021	-1.439	0.068	1.157
Land Used (X_7)	0.198***	-.372	0.055	-3.929
R^2	0.89			
Adjusted R^2	0.79		.546	
F	18.775***		-.139***	
Sample size	150		150	

note: figures in parentheses are t-values

*significant at 10 percent level, **significant at 5 percent level, ***significant at 1 percent level

The resources are considered to efficiently use when the ratio of Marginal Value Product to Marginal Factor Cost approaches one, or MVP and MFC are equal for each input. The optimum use of a particular input would be ascertained by the condition of equality of MVP and MFC.

Modern practices

The ratio of MVP and MFC of fertilizer, pesticides and land used of potato production were positive and greater than 1, which indicates that more profit could be obtained by increasing the uses of these inputs. The ratio of MVP and MFC of labor, seed and irrigation were negative implying the level of profit would

decrease by increasing the use of both the inputs (Table-4).

Traditional practices

The ratio of MVP and MFC of irrigation and land preparation of potato production were positive and greater than 1, which indicates that more profit could be obtained by increasing the uses of these inputs. The ratio of MVP and MFC of seed, fertilizer and pesticides were positive but less than 1, which indicates the excessive use of the resource, hence the use of the inputs should be reduced for deriving optimum return from them. Moreover the ratio of MVP and MFC of labor and land used were negative implying the level of profit would decrease by increasing the use of both the inputs (Table-4).

Table 4. Ratio of Marginal Value products (MVP_S) and Marginal Factor costs (MFCs) of different inputs included in production function

Explanatory Variables	Modern Practices			Traditional Practices		
	GM	MFC	MVPs	GM	MFC	MVPs
Land Preparation (X_1)	4206.16			3984.03	1	6.35
Labor (X_2)	23606.35	1	-3.86	16151.72	1	-1.27
Seed (X_3)	60000.00	1	-0.93	79966.48	1	0.14
Fertilizer (X_4)	22533.18	1	1.91	34155.46	1	0.20
Pesticides (X_5)	7347.42	1	8.69	17274.73	1	0.76
Irrigation (X_6)	4032.32	1	-1.14	3501.61	1	3.03
Land Used (X_7)	13256.44	1	3.27	13200.48	1	-2.03

GM-Geometric Mean, *Significant at 10 percent level, **Significant at 5 percent level, ***Significant at 1 percent level

Conclusions

The study has been designed for assessing profitability of appropriate input use over traditional practices in potato cultivation and promoting green pesticide and micronutrients along with other necessary input materials to potato farmers in different agro ecological zones of Bangladesh. The study found that net profit per hectare in Rangpur region was (TK. 98,079), Thakurghaon region was (Tk. 72,741) and in Comilla region was (Tk. 46,950) and the average benefit cost ratios were 1.67, 1.55 and 1.32 on total cost and variable cost basis. The net profit was found to be the highest in Rangpur region followed by Thakurghaon region and Comilla region due to better management and good soil condition. Through the several trainings and meetings farmers got technical knowledge regarding appropriate usages of agricultural inputs like Pesticides, Fungicides, and Fertilizer & Micronutrients for potato cultivation which will minimize production cost in potato cultivation and promote the tendencies of appropriate input uses instead of local practices.

References

Mukul, A. Z. A.; Rayhan, S. J.; and Hassan, M. M. Farmer's Profitability of Potato Cultivation at Rangpur District: The Socio-economic Context of Bangladesh. *International journal of Economics, Finance and Management Science.* 1: 1-22.

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.

BBS (Bangladesh Bureau of Statistics). 2011. *Year book of Agricultural Statistics of Bangladesh*, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

FAO and CIP. 1995. Potatoes in the 1990s: Situation and prospects of the world potato economy. FAO, Rome (Italy), 39p.

Hossain, M. A. and Miah, M. A. M. 2010. Post-harvest losses and technical efficiency of potato storage systems in Bangladesh. Technical Report submitted to FAO Bangladesh.

Uddin, M. A.; Yasmin, S.; Rahman, M. L.; Hossain, S. M. B. and Choudhury, R. U. 2010. Challenges Of Potato Cultivation In Bangladesh And Developing Digital Databases Of Potato. *Bangladesh J. Agril. Res.* 35(3): 453-463,

Haque, M. A.; Monayem Miah, M. A.; Hossain, S. and Rahman, M. M. 2012. Profitability of bari released potato *(solanum tuberosum* l.) Varieties in some selected locations of bangladesh. *Bangladesh J. Agril. Res.* 37(1): 149-158.

Satter, M. A.; Rahman, M. M.; Rashid, M. H.; Ali, M. S. and Alam, M. S. 2005. *Krishi Projukti Hatboi* (Hand book on agro technology), 3rd Edition, BARI, Gazipur.

Ignacimuthu, S. and Jayaraj, S. 2005. Green Pesticides for Insect Pest Management. ISBN: 978-81-7319-686-7, 336p.