

ADOPTION AND PROFITABILITY OF BARI RELEASED POTATO VARIETIES IN NORTHERN REGION OF BANGLADESH

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Abstract

The study was conducted in three potato growing areas in northern districts of Bangladesh namely Rajshahi, Rangpur and Thakurgaon. Data were collected during 2016-17 to assess the level of adoption, profitability, farmers attitude towards the cultivation of BARI released potato varieties and to explore the constraints to potato cultivation. The study revealed that 59% potato areas were covered by BARI Alu-7 variety. The varieties BARI Alu-13, BARI Alu-25 and BARI Alu-8 covered 14%, 14% and 12% of the potato areas respectively. The adoption level of seed rate, gypsum and boron were found high which adoption score were 95, 72 and 71. The level adoption of urea, TSP and MoP were over used which adoption score were 103, 138 and 110. The adoption levels of cowdung and zinc sulphate were found medium which adoption score were 50 and 61. Only 37% farmers used potato seeds from their own source. Per hectare total cost of BARI released potato cultivation was Tk. 204003 and variable cost was Tk. 161033. The major share of cost was seed (31%) followed by fertilizer (13%) and land use (11%). Per hectare average yield of potato was 28 ton with gross return Tk. 249819 and gross margin Tk. 88786. The net return of potato cultivation was Tk. 45816 per hectare. The benefit cost ratio was 1.22. Infestation of insect and diseases, non-availability of quality seed, high price of seed and inadequate storage facilities were the major constraints to potato cultivation.

Keywords: Potato, Adoption, Profitability, Constraints.

Introduction

Potato (*Solanum tuberosum*) is a leading vegetable crop in the world and occupies top-most position after rice and wheat both in respect of production and consumption (Aktar *et al.*, 1998). It is the third largest food crop in Bangladesh and has recently occupied an important place in the list of major food and cash crops of Bangladesh (Ali and Haque, 2011). The crop ranks first among the vegetables in Bangladesh and its area and production are increasing day by day (BBS, 2016). The total potato area is 475709 ha and production is 9474000 M. tons in Bangladesh. The growth rate of area, production and yield were 6.4%, 9.5% and 3.1% respectively during the period from 1995 to 2016 (Table 1). Ensuring food security for all is one of the major challenges in Bangladesh today.

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So, to ensure adequate food supply, it is necessary to give thrust to increase food production using BARI released crop varieties and recommended production practices. Potato is a short duration and labour intensive crop. In fact, short cycle of potato frees the land for cultivating other crops. The Tuber Crop Research Centre of BARI released different HYV potato varieties which have good yield potential and tolerant to insect pests and diseases.

Table 1. Area, production and yield of potato in Bangladesh

Year	Acreage (ha)	Production (M. tons)	Yield (t/ha)
1995-96	132389	1492000	11.27
1996-97	134008	1508000	11.25
1997-98	136437	1553000	11.38
1998-99	244939	2762000	11.28
1999-00	243320	2933000	12.05
2000-01	248988	3216000	12.92
2001-02	237652	2994000	12.60
2002-03	245344	3386000	13.80
2003-04	270850	3908000	14.43
2004-05	326316	4856000	14.88
2005-06	301215	4161000	13.81
2006-07	345344	5167000	14.96
2007-08	402024	6648000	16.54
2008-09	395547	5268000	13.32
2009-10	434818	7930000	18.24
2010-11	460324	8326000	18.09
2011-12	430364	8205000	19.07
2012-13	444534	8603000	19.35
2013-14	462348	8950000	19.36
2014-15	471255	9254000	19.64
2015-16	475709	9474000	19.92
Mean	318401	50408000	14.89
Standard deviation	115151	2658452	3.01
Growth rate (%)	6.4	9.5	3.1

Most of the varieties are not cultivated by the farmers because of various unknown reasons that need to be identified. The adoption of recommended practices of potato production by the farmers could easily raise food production and net income of the users (Amin and Islam, 2009). Usually farmers follow different levels of production technologies depending upon their infrastructural facilities and socioeconomic conditions which ultimately resulted in variability in yields of potato (Elias *et al.*, 1992). Farmer's production performance depends on physical resources and technology available to them as well as existing farm

management conditions. Efficient use of inputs and technologies could help farmers to get higher production from a given amount of resources. A very few studies were conducted (Begum *et al.*, 2017 and Haque *et al.*, 2011) regarding the adoption of potato varieties in Bangladesh.

In view of the above discussion, the study attempted to achieve the following specific objectives: (i) to know the level of adoption of BARI released potato varieties at farm level; (ii) to know the agronomic practices of potatoes cultivation; (iii) to estimate the profitability of BARI released potato varieties; (iv) to evaluate the farmers attitude towards the cultivation of BARI released potato varieties and (v) to identify the socio- economic constraints of BARI released potato varieties adoption at farm level.

Methodology

Study area selection:

Sampling technique: Three districts, namely Rajshahi, Rangpur and Thakurgaon were purposively selected considering the major potato growing areas in northern region of Bangladesh. Again from each district three upazilas were selected considering the concentration of potato growers and easy access. From each upazila one block was also selected in consultation with the Upazila Agriculture Officer. A list of potato growers from the selected block were collected with the help of DAE personnel. Thus a total of 135 samples were randomly selected for the interview.

Method of data collection: Data were collected by the experienced field investigators with direct supervision of the researchers using a pre-tested interview schedule for the period of 2016-2017. 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. The profitability of potato production was examined on the basis of gross margin, net return and benefit cost analysis.

Analytical technique: Farm level collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study. In most cases, tabular method of analysis supported with appropriate statistical parameters such as average, ratio, percentages were used to present the results of the study. The adoptions of improved technologies were measured through three ways: variety adoption, acreage covered, and use of crop management technology (i.e. agronomic practices, time of operation, input use). For assessing the adoption of crop management technology, respondent farmers was grouped into three categories such as high adopter, medium adopter, and low adopter based on the mean index of the farmer with respect to each technology. A higher index was indicating a higher level of adoption, while a lower index was indicate a lower level of adoption of a technology. Adoption level were categorized for mean index >100 as over use; 70-100 as high, 50-69 as medium, and <50 as low.

Calculation of adoption index

Adoption index was calculated using the following formula (Gupta and Chowdhi, 2002):

$$\text{Adoption Index} = \frac{100}{\text{Recommended dose}} \times \text{Farmers dose}$$

Profitability analysis

Profitability of potato was analyzed to compare the return received by the farmers.

a. Measurement of cost and return from potato cultivation

Equations for cost analysis are as follows

$$\text{Variable Cost} = VC_i = \sum (X_i P_i)$$

$$TVC_i = VC_i + IOC_i$$

$$TC_i = TVC_i + TFC_i$$

Where, TC_i = Total cost (Tk/ha)

TVC_i = Total variable cost (Tk/ha)

TFC_i = Total fixed cost (Tk/ha)

VC_i = Variable cost (Tk/ha)

IOC_i = Interest of operating capital (Tk/ha)

X_i = Quantity of inputs (kg)

P_i = Price of inputs (Tk/kg)

i = Number of farmers (1.2.3.....n)

Equations for profitability analysis

$$\text{Gross return} = GR_i = Y_i P_i$$

$$\text{Net return} = GR_i - TC_i$$

$$\text{Gross margin} = GR_i - VC_i$$

Where,

GR_i = Gross return (Tk/ha)

P_i = Price (Tk/kg) received by i th farmer

Y_i = Quantity (kg/ha) produced

Results and Discussion

Adoption of potato varieties

Within the study areas, the sample farmers adopted BARI released potato varieties such as BARI Alu-7, BARI Alu-13, asterisk and BARI Alu-8. Within the sample farmers on an average, 59% area was covered by BARI Alu-7. Highest area coverage(92%) by BARI Alu-7 was found at Rajshahi followed by Rangpur and Thakurgaon. Area coverage of both BARI Alu-13 and BARI Alu-25 were 14% (Table 2). The farmers of Rangpur mostly cultivated BARI Alu-7 and BARI Alu-25 varieties as a result BARI Alu-8 variety adoption was low. The local variety potato were *Lalsheet*, *Sheet Bilatee*, *Lalpakri* etc. It was mentioned that farmers choice BARI Alu-7 variety due to high price, good test and high market demand. Farmer choose BARI Alu-13 for short duration, less disease infestation and low risk in cultivation. They cultivated BARI Alu-25 for high yield attractive colour and high demand in Rangpur. The farmers in the study areas also cultivated BARI Alu-8 variety for higher price and good test. It was observed that though BARI released more than 70 varieties, the farmers adopted only four varieties. Farmers of the study areas were not aware about the latest released varieties of potato.

Table 2. Adoption of area of BARI released potato varieties in northern region of Bangladesh

Variety	Adoption of area (%)			
	Rajshahi	Rangpur	Thakurgaon	All
BARI Alu-7	92	40	15	59
BARI Alu-13	-	15	37	14
BARI Alu-25	2	35	20	14
BARI Alu-8	5	9	25	12
Local*	1	1	3	1

* *Lalsheet*, *Sheet Bilatee*, *Lalpakri* etc.

On an average, 47% farmers adopted BARI Alu-7 variety followed by BARI Alu-13 (39%) BARI Alu-25 (31%) and BARI Alu-8 (30%) (Table 3). Among the locations BARI Alu-7 was popular at Rajshahi(73%), BARI Alu-25 at Rangpur and BARI Alu-13 at Thakurgaon.

Table 3. Farmers adopted different potato varieties in some selected areas of Bangladesh

Variety	% farmers responded			
	Rajshahi	Rangpur	Thakurgaon	All
BARI Alu-7	73	44	22	47
BARI Alu-13	-	40	78	39
BARI Alu-25	18	51	24	31
BARI Alu-8	31	13	44	30
Local	4	2	18	8

* *Lalsheet*, *Sheet Bilatee*, *Lalpakri* etc.

Technology used in potato production

The existing level of technology adoption in terms of agronomic practices, time of operation and input use are essential for achieving higher yield and return. The potato farmers in the study areas ploughed their lands with the help of power tiller and tractor.

Table 4. Adoption of crop management technologies in potato cultivation in the study areas

Technology	% Farmers responded and adoption score				Adoption level
	Rajshahi (n=45)	Rangpur (n=45)	Thakurgaon (n=45)	All (n=135)	
Ploughing:					
Recommended (4)	16(7)	55(25)	18 (8)	30 (40)	
Below recommendation > (4)	4(2)	8(18)	2(4)	12(9)	
Above recommendation <(4)	80(36)	27(12)	78(35)	61(83)	
<i>Adoption index</i>	<i>139</i>	<i>103</i>	<i>126</i>	<i>123</i>	<i>Over use</i>
Sowing date :					
Recommended (Nov.1-30)	78(35)	27(12)	93(42)	66(89)	
Below recommendation (Before Nov. 1)	-	-	-	-	
Above recommendation (After Nov.30)	22(10)	73(33)	7(3)	34(46)	
<i>Adoption index</i>	<i>89</i>	<i>101</i>	<i>71</i>	<i>87</i>	<i>High</i>

Note: Technology adoption was categorized for mean index >100 as overuse, 70-100 as high; 50-69 as medium and <50 as low.

Figures in the parentheses indicate number of farmer responded.

The number of ploughing varied from farm to farm and location to location. Four times ploughing is recommended for potato cultivation. Based on the mean index, land preparation secured the over ploughing level of adoption for cultivation. On an average, only 30% farmers ploughed their land 4 times. More than 4 times ploughing was done by 61% farmers. Sowing was started from the 1st week of November and continued up to the 3rd week of December. About 93% farmer of Thakurgaon and 78% farmers of Rajshahi district had plant their seed in optimum period (Table 4). Adoption level of ploughing and sowing date was found over use and high respectively. About 46% farmers followed recommended seed rate, whereas 43% farmer used above recommendation (Table 5). Only 8% farmers used recommended doses (Kamal *et al.*, 2012). of cowdung (1.5-2.0 t/ha) in their plots. About 48% of the farmers used more than recommended dose and 44% farmers used lower than recommended doses of cowdung.

Table 5. Adoption of recommended seed rate and fertilizer in potato cultivation in the study areas

Technology	% Farmers responded and adoption score				Adoption level
	Rajshahi (n=45)	Rangpur (n=45)	Thakurgaon (n=45)	All (n=135)	
Seed rate:					
Recommended (1.5-2.0 t/ha)	60(27)	40(18)	38(17)	46(62)	
Below Recommended	13(6)	13(6)	7(3)	11(15)	
Above Recommended	27(12)	47(21)	55(25)	43(58)	
<i>Adoption index</i>	91	92	102	95	High
Cowdung:					
Recommended (8-10 t/ha)	-	5(2)	15(6)	8(8)	
Below recommendation (<8t/ha)	67(8)	54(22)	27(11)	44(4)	
Above recommendation (>10 t/ha)	33(4)	41(17)	58(24)	48(45)	
<i>Adoption index</i>	15	61	73	50	Medium
Urea:					
Recommended (220-250 kg/ha)	7(3)	18(8)	20(9)	15(20)	
Below recommendation (<220 kg/ha)	22(10)	2(1)	7(3)	10(14)	
Above recommendation (>250 kg/ha)	71(32)	80(36)	73(33)	75(101)	
<i>Adoption index</i>	96	120	93	103	Over use
TSP:					
Recommended (120-150 kg/ha)	23(8)	19(4)	4(2)	14(14)	
Below recommendation (<120 kg/ha)	23(8)	-	2(1)	9(9)	
Above recommendation (>150 kg/ha)	54(19)	81(17)	94(42)	77(78)	
<i>Adoption index</i>	112	93	208	138	Over use
MoP:					
Recommended (220-250 kg/ha)	4(2)	18(8)	27(12)	16(22)	
Below recommendation (<220 kg/ha)	18(8)	-	24(11)	14(19)	
Above recommendation (>250 kg/ha)	78(35)	82(36)	49(22)	70(93)	
<i>Adoption index</i>	119	124	86	110	Over use
Gypsum:					
Recommended (100-120 kg/ha)	5(2)	12(5)	4(1)	8(8)	
Below Recommended (<100 kg/ha)	49(19)	29(12)	43(12)	40(43)	
Above Recommended (>120 kg/ha)	46(18)	59(24)	53(15)	62(57)	
<i>Adoption index</i>	69	87	61	72	High
Zinc:					
Recommended (8-10 kg/ha)	8(3)	56(23)	27(8)	32(34)	
Below recommendation (<8 kg/ha)	49(18)	12(5)	33(10)	30(33)	
Above recommendation (>10 t/ha)	43(16)	32(13)	40(12)	38(41)	
<i>Adoption index</i>	57	71	53	61	Medium
Boron:					
Recommended (8-10 kg/ha)	3(1)	40(17)	32(11)	25(29)	
Below recommendation (<8 kg/ha)	38(15)	20(8)	32(11)	30(34)	
Above recommendation (>10 kg/ha)	59(23)	40(17)	35(12)	45(52)	
<i>Adoption index</i>	67	83	63	71	High

Note: Technology adoption was categorized for mean index >100 as overuse, 70-100 as high; 50-69 as medium and <50 as low. Figures in the parentheses indicate number of farmer responded.

Table 6. Agronomic practices of potato cultivation in the study areas

Practices	Farmer responded (%)			All
	Rajshahi	Rangpur	Thakurgaon	All
Ploughing method :				
Power tiller	60	42	7	36
Tractor	40	58	93	64
Seed source :				
Own	34	40	38	37
Market	2	27	18	15
Neibours	42	15	3	20
BADC	2	7	13	8
Others*	20	11	28	20
Earthing up (No.) :				
One	49	73	22	48
Two	51	20	75	49
Three	-	7	3	3
Pesticides application (No.):				
2-4	7	7	33	16
5-8	78	45	65	62
9-12	15	48	2	22
Irrigation (No.):				
1-4	22	95	93	70
5-7	78	5	7	30

- Others means BRAC, Supreme seed, Ispahani, Research agro etc.

About 75% of the farmers used urea more than recommended dose. Fifteen percent farmers used recommended doses of urea (220-250 kg/ha) in their plots and only 10% farmers used lower than recommended dose. Adoption level of urea was found slightly over use in the study areas with an adoption score 103. Most of the farmers (77%) used TSP above the recommended rate (120-150 kg/ha). Only 14% farmers used recommended doses of TSP while 9% farmers used below recommended dose. Overall adoption score of TSP application was found 138%, which indicates over use of TSP in the study areas. About 70% of the farmers used MoP above recommended dose. About 16% farmers used recommended doses of MoP (220-250 kg/ha) in their plots and only 14% farmers used lower than recommendation. As a result adoption level of MoP application found to be slightly over use in the study areas with an adoption score 110. About 8% farmers used recommended doses of gypsum (100-120 kg/ha) in their plots and 40% farmers used lower than recommended dose. Most of the farmers (62%) used gypsum above than recommendation. Adoption level was found high in gypsum. About 32% and 25% farmers used recommended doses (8-10 kg/ha) of Zinc and Boron in their plots. Adoption level was found 61 and 71% which indicates medium and high level of adoption respectively.

Agronomic practices

Farmers in the study areas prepared their potato plots using power tiller and tractor. Sixty four percent farmers used tractor for land preparation which was higher in Thakurgaon (93%) followed by Rangpur (58%) and Rajshahi (40%). Rest of the farmers (34%) used power tiller (Table 6). About 37% farmers used their home supplied seed and rest of the farmers used seeds from different sources like local market, neighbouring farmers, BADC, BRAC and seed companies. Generally one earthing up (48%) which was more (73%) in Rangpur or two earthing up (49%) which was more (75%) in Thakurgaon, was practiced by the farmers in the study areas. Sixty two percent farmers applied insecticides 5-8 times, 22% applied 9-12 times and 16% applied 3-4 times. Most of the farmers (70%) irrigated their field 1-4 times.

Input use pattern

The human labour used for producing potato was found to be 176 man days per hectare of which 41% were family supplied (Table 7). The use of human labor was highest in Rangpur (183 man-days/ha) followed by Rajshahi (179 man-days/ha) and Thakurgaon (166 man-days/ha). The average quantity of seed used by the farmers were 1904 kg/ha which was similar to recommended doses (1.5-2.0 t/ha) (Kabir *et al.*, 2012). On average, farmers used 8075 kg/ha of cowdung which was similar to recommended doses (8-10 t/ha). The farmers of Thakurgaon used cowdung slightly higher than recommended doses and Rajshahi farmers used very less amount of cowdung. It may be due to availability of cowdung to the farmers in those areas. They used chemical fertilizers like urea (371 kg/ha), TSP (219 kg/ha), MoP (400 kg/ha), DAP (177 kg/ha) and gypsum (114 kg/ha). They used higher doses of urea, TSP and MoP and lower dose of gypsum than the recommended dose.

Table 7. Level of input used in HYV and local variety of potato cultivation in the study areas

Inputs	Rajshahi	Rangpur	Thakurgaon	All
Human labour:				
Own	67	77	74	73
Hired	112	106	92	103
Total	179	183	166	176
Seed (kg/ha)	1825	1851	2036	1904
Cow dung (kg/ha)	2194	9994	12039	8075
Urea (kg/ha)	331	443	339	371
TSP(kg/ha)	177	150	331	219
MoP (kg/ha)	413	453	333	400
DAP	340	174	16	177
Gypsum	98	148	98	114
Others	35	23	369	142

Source: Field Survey (2016-17)

Table 8. Per hectare cost of cultivation of potato in the study areas

Input costs	Taka per hectare			
	Rajshahi	Rangpur	Thakurgaon	All
A. Variable cost:				
Land preparation	15032	11678	14070	13927(7)
Hired human labour	29277	26876	25819	27327(13)
Seed	67760	54658	68625	63681(31)
Manures	1109	7367	8248	5575(3)
Fertilizers:				
Urea	5303	5744	5375	5825(3)
TSP	3883	3589	8187	5220(2)
MoP	6206	6765	4815	5929(3)
DAP	8616	4654	389	4553(2)
Gypsum	1393	1404	1113	1303(1)
Others	3846	2906	4195	3649(2)
Total	27247	25062	23776	25362(13)
Insecticides	16957	22527	11737	17074(8)
Irrigation	6961	3952	3345	4753(2)
Int. on opt. capital	3835	3549	3631	3672(2)
Total variable cost	168178	155669	159251	161033(79)
B. Fixed cost				
Family labour	19220	22021	21860	21033(10)
Land use cost	22249	21407	22155	21937(11)
Total fixed cost	41469	43428	44015	42970(21)
Total cost (A+B)	209647	199097	203266	204003(100)

Source: Field Survey (2016-17), Parentheses indicates the percentage of total cost

Cost of cultivation

The cost of potato cultivation was estimated to be Tk. 204003 and Tk. 161033 per hectare on total cost and variable cost basis, respectively. The major share in total cost was seed (31%), followed by chemical fertilizers (13%) and land use cost (11%). The cost of potato

cultivation in Rajshahi was found higher (Tk. 209647/ha) than Thakurgaon (Tk. 203266/ha) and Rangpur (199097/ha). due to the higher cost of human labour, land preparation and more use of DAP (Table 8).

Profitability of potato cultivation

The average yield of potato was 28 ton per hectare which was higher than the national average of 20.91 t/ha (BBS, 2015). Comparatively higher yield was recorded in Rajshahi (30 t/ha) followed by Rangpur (28 t/ha) and Thakurgaon (26 t/ha) (Table 9). Higher yield was obtained in Rajshahi due to better management.

The gross return and gross margin of potato cultivation were Tk. 249819/ha and Tk.88786/ha respectively. Gross margin was found to be highest in Rajshahi (Tk. 126759) followed by Rangpur (Tk. 74302) and Thakurgaon (Tk. 65298). The net return of potato cultivation was Tk. 45816 per hectare. The benefit cost ratio was 1.22. Average cost of production of potato was found 7.39 Tk/kg and it was highest in Thakurgaon (7.82 Tk/kg) and lowest in Rajshahi (6.99 Tk/kg).

Table 9. Profitability of Potato cultivations in the study areas

Items	Rajshahi	Rangpur	Thakurgaon	All
Yield (t/ha)	30	28	26	28
A. Total cost:				
Variable cost (Tk./ha)	168178	155669	159251	163886
Fixed cost (Tk./ha)	41469	43428	44015	42970
B. Gross return (Tk./ha)	294937	229971	224549	249819
C. Gross margin (Tk./ha)	126759	74302	65298	88786
D. Net return (Tk./ha)	85290	30874	21283	45816
E. Benefit cost ratio	1.41	1.16	1.10	1.22
F. Cost (Tk/kg)	6.99	7.11	7.82	7.39

Farmers' attitude towards BARI released potato varieties

Table 10 revealed that about 66% farmers willing to increase the cultivation of BARI released potato varieties in the next year. Higher yield (83%) ranked first behind the reasons for increasing potato cultivation followed by profitability (70%), easy production technology (57%) and short duration (47%). On the other hand, 34% farmers were not interested to increase cultivation of BARI released potato varieties due to high infestation of insect and diseases (87%), high price of seed (73%), lack of capital (51%) and inadequate storage facilities (48%).

Table 10. Reasons for increasing BARI released potato varieties for the next year

Type of Facility	Farmers responded (%)			
	Rajshahi	Rangpur	Thakurgaon	All
A. Willingness to increase				
1. Yes	73	62	58	66
2. No	27	48	62	34
B Reasons for increasing				
1. Higher yield	91	82	76	83
2. Profitable crop	78	62	71	70
3. Easy production technology	53	69	49	57
4. Short duration crop	44	53	42	47
C. Reasons for not increasing				
1. High infestation of insect and diseases	84	98	78	87
2. High price of seed	76	73	69	73
3. Lack of capital	51	56	47	51
4. Inadequate storage facilities	56	47	42	48

Constraints of potato cultivation

The farmers in the study areas encountered different constraints during potato cultivation. The constraints were ranked based on their priority (Table 11). A brief discussion on various problems has been made in the following sections.

Insect and diseases infestation: Late blight (LB) disease is the acute problem in potato cultivation. This was mentioned by 76% farmers. The yield of potato is seriously hampered by this disease. Although farmers have little knowledge about the harmful effects of disease incidence in potato. Generally farmers apply pesticide without recommendation in their field.

Non-availability of quality seed: Quality seed is the pre-requisite for higher yield of potato. Farmers in the study areas used potato seed from different sources like own source, BADC, market traders, etc. Market traders usually adulterate potato seed for receiving higher profit. Seed supplied by BADC is good but they supplied a small amount of seed, which do not meet the farmers' requirement and also the price of BADC seeds is very high. Nonetheless, own seed retained for their own use don't fulfill their requirements. Therefore, 70% respondent mentioned that non-availability of quality seed is a problem which hampered the potato yield.

Table 11. Constraints to potato cultivation in the study areas

Constraints	Farmer responded (%)			
	Rajshahi	Rangpur	Thakurgaon	All
Insect and disease	78	84	64	76
Non-availability of quality seed	76	64	71	70
High price of inputs	71	53	67	64
Impure fertilizer	56	53	62	57
Inadequate storage facilities	51	47	40	46
Lack of training/knowledge	29	22	33	28
Others*	27	16	20	21

*Others mean high price of insecticides, lack of capital, low price of product etc.

High price of input: Sixty four percent farmers opined that the cost of production of potato is high. Farmers have to spend a large amount of money in the form of seed, labour and fertilizer. Such a high cost prevents the farmers to expand the area under potato cultivation.

Impure fertilizer: About 57% farmers have identified the problem of adulteration and artificial scarcity of fertilizer. Farmers also informed that the dishonest traders try to create artificial scarcity through hoarding in the peak season for getting higher profit.

Lack of technical knowledge: Technical knowledge relating to crop cultivation is also crucial for getting higher yield. It optimize input use, save production cost and increase yield of crops as well as farmers' income. Respondent farmers (28%) in the study areas were suffering from lack of technical knowledge regarding potato cultivation since they used various inputs unwisely. Therefore, this problem was reported to be an important problem of potato cultivation.

Inadequate storage facility: Potato is a semi perishable vegetable which needs storage for using it throughout the year. The 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, inadequate storage facility (46%) reported to be a problem in the study areas.

Conclusions and Recommendations

The study shows that BARI Alu-7 is a highly adopted potato variety in the study areas followed by BARI Alu-13, BARI Alu-25 and BARI Alu-8. Adoption index in ploughing is over use and adoption level of sowing date is high. Adoption level of seed rate, gypsum and boron were found higher in the study areas. The adoption level of urea, TSP, MoP was over use and adoption levels of cowdung and zinc sulphate were found medium. Most of the farmers collected potato seeds from other sources. Mostly one and two times earthing up, 5-8 times insecticides application and 1-4 times irrigation was practiced by the farmers in the study areas. Yield of potato was found higher at Rajshahi followed by Rangpur and Thakurgaon. Gross return, gross margin and net return also found higher in Rajshahi than Rangpur and Thakurgaon. Farmers' attitudes towards BARI released potato varieties seem to be very positive because most of the farmers wanted to increase potato production in the next year. Although potato cultivation is profitable, it faces various constraints like unavailability of quality seed, high price of inputs, insect and diseases, inadequate storage facilities etc.

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

- BARI released potato seed should be made available to the farmers. So it should be need to encourage private seed companies to come forward for producing quality seed of potatoes.
- Motivational campaign through providing training, booklets and other supporting materials to farmers and extension personnel about the latest improved potato varieties should be continued.
- More intensive research should be undertaken by the breeders to develop disease and insect-pest resistant potato varieties in the near future.

- Farmers level low cost storage facilities should be developed. Therefore, emphasis should also be given to increase the number of cold storage in the potato growing areas of the country.

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