

IMPACT OF POTATO VAR. BARI ALU-25 ADOPTION ON THE GROWERS' LIVELIHOOD**

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Abstract

BARI Alu-25 is one of the popular potato varieties released by BARI. The main objective of the study was to assess the impact of potato var. BARI Alu-25 adoption on the growers' livelihood. The study was conducted in Sirajdikhan and Tongibari upazilas under Munshiganj district and Pirgacha and Mithapukur upazilas under Rangpur district during December, 2020 to November, 2021. Eighty BARI Alu-25 growers were selected. Descriptive statistics and paired t-test were used for data analyses. The BARI Alu-25 growers' access to livelihood capitals increased by 42.0-90.8 percent. Their access to human capital was increased by 80.2 percent, access to social capital by 90.8 percent, access to natural capital by 42.0 percent, access to physical capital by 48.1 percent, and access to financial capital by 48.4 percent as adoption results of BARI Alu-25 cultivation. They experienced improvement in access to information, knowledge, employment generation, prestige, attitude, cooperation, and management. Increases or improvement were also noticed in their forestry/trees, leased cultivable land, electricity use, furniture, electronic communication devices, housing condition, annual agricultural income, and cash in hand after BARI Alu-25 cultivation. Potato var. BARI Alu-25 cultivation had a potential influence on the respondents' increase in participation in income generating activities.

Keywords: Potato, BARI Alu-25, Adoption, Impact on livelihood, Human capital, Social capital, Natural capital, Physical capital, and Financial capital.

Introduction

Bangladesh Agricultural Research Institute (BARI) generates technologies for food and nutrition, health security, and employment generations for farmers and general public. Since its inception, BARI released 104 potato varieties (Akhond *et al.*, 2025), out of which BARI Alu-25 (Asterix) becomes a promising and the most popular variety among farmers in Bangladesh. Asterix potato variety was developed as a hybrid variety of 'Cardinal' and 'VSP Ve 70-9' in Netherlands. It was later released by Bangladesh Agricultural Research Institute as BARI Alu-25

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in 2005 by introduction (Azad *et al.*, 2020). Its yield is high (25-30 MT/ha) and it is suitable for processing. Haque *et al.* (2012) reported that 14.0 percent potato areas were covered by Binella, Asterix, Provento, Felsina, Multa and Hira in Munshiganj, Bogura and Comilla districts. Cardinal, Diamant, Granola and Asterix were the major HYV/modern varieties cultivated in Rangpur and Bogura districts (Begum *et al.*, 2014, 2015). However, no research had been found so far regarding the impact of the popular potato var. BARI Alu-25 on growers' livelihoods, especially in the context of Bangladesh. Therefore, it was essential to explore the impact of BARI Alu-25 adoption on growers' livelihoods.

Materials and Methods

The study was conducted in Sirajdikhan and Tongibari upazilas under Munshiganj district and Pirgacha and Mithapukur upazilas under Rangpur district, which were purposively selected based on the abundance of cultivation of BARI Alu-25 (DAE, 2019; DAE, 2020a; DAE, 2020b; DAE, 2020c). The population of the study was the growers who cultivated BARI Alu-25 for at least three years. The sampling population under the study was 800 growers (330 and 100 in Sirajdikhan and Tongibari upazila, respectively, under Munshiganj district, and 220 and 150 in Pirgacha and Mithapukur upazila, respectively, under Rangpur district). According to Al-Zahrani *et al.* (2019), 80 growers (10.0% of the population) were selected as sample of the study. Data were collected during December, 2020 to November, 2021. Fifteen selected characteristics of the respondents, viz., age, level of education, family size, farm size, annual income, training experience, extension contact, farming experience, access to credit, off-farm activities, availability of irrigation water, organizational membership, cosmopolitaness, innovativeness, and knowledge on potato cultivation were the independent variables of the study. These variables of the study were measured by assigning scores and weights as follows: Age was measured in terms of years, level of education was measured in terms of years of schooling, family size was measured by counting the total number of family members of the respondent comprising the head of the household, his wife, children, parents, and other dependents who jointly lived and ate together, farm size was measured in terms of hectares, annual income was measured in terms of thousand Tk., training experience was measured by assigning score for each day of training participation, extension contact was measured by putting weights according to the degree of contact, farming experience was measured in terms of years, access to credit, off-farm activities, and availability of irrigation water were measured in ordinal scale where if the respondents had access to credit, it was coded as one (1), and if he/she had no access to credit, it was coded as zero (0). Similarly, if the respondents had off-farm activities, it was coded as one (1), and if he/she had no off-farm activities, it was coded as zero (0). In case of availability of irrigation water, if the respondents had available irrigation water, it was coded as one (1), and if he/she did not have available irrigation water, it was coded as zero (0). Organizational

membership, cosmopolitaness, innovativeness and knowledge on potato cultivation were measured in scores. Data were coded, compiled, tabulated and analyzed according to the objectives of the study using SPSS v20. Descriptive statistical measures like number and percentage distribution, range, mean, standard deviation etc. were used. The impact of BARI Alu-25 adoption on growers' livelihood was measured in terms of five capitals namely human capital, social capital, natural capital, physical capital and financial capital known as assets pentagon (DFID, 2000). An individual owns five different types of assets to build his/her livelihood consisting of natural, social, human, physical and financial assets (Ibrahim *et al.*, 2018). The impact was measured by the changes in assets position of the growers before and after the adoption of BARI Alu-25 and the changes in assets position were measured in nominal scale where increase/improvement was denoted as (2), decrease was denoted as (1) and no change was denoted as (0). Descriptive statistics were used to express the percent of the respondents experiencing increase/improvement, decrease and no change in the assets position (Rahman *et al.*, 2019). The changes in participation in income generating activities were measured in terms of participation in different income generating activities scores before and after the adoption of BARI Alu-25. Each respondent was asked to mention the frequency of his/her extent of participation in different income generating activities. His/her participation in different income generating activities score was obtained by adding the weights for his/her responses to all the income generating activities listed in the instrument. It was measured by assigning scores based on participation categories as follows: '3', '2', '1' and '0' were assigned for 'regularly', 'occasionally', 'rarely' and 'not at all' respectively. The basis of categorization of participation in income generating activities was mean $\pm$ SD. The comparison between the participation in income generating activities scores before and after the adoption of BARI Alu-25 was assessed by paired t-test.

Results and Discussion

Results presented in Table 1 show that age of the BARI Alu-25 growers ranged from 24 - 78 years. About half (46.3%) of them were old aged, who had abundant experience of potato cultivation. As the study areas are famous for potato cultivation, each grower whether young or old, was found to be eager for BARI Alu-25 cultivation. There was no illiterate potato grower in the study areas except 17.5%, who could sign only. More than four-fifths (82.5%) of the respondents had school education ranging from primary to higher secondary level. The highest percentage (42.5%) of them belonged to secondary education level. Their academic level helped them to be innovative, cosmopolite, and social assets. However, the small sized (2-4) and medium sized (5-6) family were supposed to be more helpful for impact of BARI Alu-25 adoption. The majority of them (45.0%) had small sized family. It was found that 75% of BARI Alu-25 growers had medium and large farm. There were no landless farmers. Their average annual income was Tk. 649.4 thousand, which

was much higher than the national average (Tk. 137.8 thousand) (BBS, 2021), and most of the growers (81.2%) belonged to the medium to low annual income category. So, they had no severe financial problems to fulfil input, irrigation, and plant protection demands. Training is an essential variable of the present study. It helps potato growers to learn about variety selection, seed rate, land preparation, fertilizer application, pest and disease control, intercultural operation etc. The large majority (73.8%) of the respondents received agricultural training, which offered an opportunity for the BARI Alu-25 growers in the study area. Two-fifths (40.0%) of the respondents had high training experience. Extension contact is the core variable for any field research. Extension contact is an out of school education system through which extension teaching methods are organized by DAE for the farmers. The teaching methods are individual contact, group contact and mass contact. In the present study all the potato growers had good extension contact, the score of which ranged from 11-56. Four-fifths of the respondents (80%) had medium to high extension contact that increased farmers' social and financial assets. Farming experience encourages farmers to adopt concerned technology like BARI Alu-25. All the farmers had farming experience ranging from 4-65 years. More than four-fifths of the respondents (82.5%) had medium to high farming experience. So, the respondents successfully cultivated BARI Alu-25 and could earn financial assets. Most of the respondents (86.3%) had access to credit. More than half (55.0%) of them had no off-farm activities. All the respondents (100.0%) had availability of irrigation water. Majority of the BARI Alu-25 growers were members of different social organizations. More than three-fifths of them (63.8%) had medium to high organizational membership.

Table 1. Characteristic profile of the respondents

Sl#	Characteristics (Measurement unit)	Possible and observed range	Respondents (n= 80)		Mean
			Categories	%	
01.	Age (Year)	Unknown (24-78)	Young (up to 35)	26.2	47.5
			Middle aged (36-50)	27.5	
			Old (above 50)	46.3	
02.	Level of education (Years of schooling)	Unknown (0.5-18)	Illiterate (0)	0.0	7.8
			Can sign only (0.5)	17.5	
			Primary (1-5)	20.0	
			Secondary (6-10)	42.5	
			Higher secondary (>10)	20.0	
03.	Family size (Number)	Unknown (2-16)	Small family (up to 4)	45.0	5.3
			Medium family (5-6)	32.5	
			Large family (above 6)	22.5	

Sl#	Characteristics (Measurement unit)	Possible and observed range	Respondents (n= 80)		Mean
			Categories	%	
04.	Farm size (Hectare)	Unknown (0.2-13.5)	Marginal (up to 0.2)	1.3	2.4
			Small (0.21-1.00)	23.7	
			Medium (1.01-3.00)	51.3	
			Large (above 3.00)	23.7	
05.	Annual income (‘000’Tk.)	Unknown (10-3900)	Low (up to 291)	38.7	649.4
			Medium (292-1008)	42.5	
			High (above 1008)	18.8	
06.	Training experience (Number of days)	Unknown (0-330)	No training (0)	26.2	39.8
			Low (1-5)	26.3	
			Medium (6-10)	7.5	
			High (above 10)	40.0	
07.	Extension contact (Score)	0 to 80 (11-56)	Low (up to 21)	20.0	31.7
			Medium (22-42)	63.8	
			High (above 42)	16.2	
08.	Farming experience (Years)	Unknown (4-65)	Low (up to 13)	17.5	26.6
			Medium (14-40)	66.3	
			High (above 40)	16.2	
09.	Access to credit	-	No	13.8	-
			Yes	86.3	
10.	Off farm activities	-	No	55.0	-
			Yes	45.0	
11.	Availability of irrigation water	-	No	0.0	-
			Yes	100.0	
12.	Organizational membership (Score)	Unknown (0-216)	Low (up to 11)	36.2	37.7
			Medium (12-64)	48.8	
			High (above 64)	15.0	
13.	Cosmopoliteness (Score)	0 to 15 (3-15)	Low (up to 8)	18.7	10.9
			Medium (9-14)	71.3	
			High (above 14)	10.0	
14.	Innovativeness (Score)	0 to 21 (0-15)	Low (up to 3)	43.7	5.4
			Medium (4-7)	27.5	
			High (above 7)	28.8	
15.	Knowledge on potato cultivation (Score)	0 to 30 (14-28)	Low (up to 19)	18.7	22.4
			Moderate (20-26)	75.0	
			High (above 26)	6.3	

During their organizational activities they shared BARI Alu-25 cultivation knowledge, attitude and activities through which they earned social and personal prestige. Organizational membership and cosmopolitaness both have traditional bondage. Therefore, data presented in the table 1 show that like organizational membership more than four-fifths of the respondents (81.3%) had medium to high cosmopolitaness. But in case of innovativeness, about three-fourths (72.5%) of the respondents had low to high innovativeness. Comparing the scores of organizational membership and cosmopolitaness, innovativeness was supposed to be lower. However, in case of knowledge on potato cultivation more than four-fifths of the respondents (81.3%) had moderate to high knowledge on potato cultivation. It could be assumed that BARI Alu-25 growers received praise worthy training and had good farming experience.

Impact of BARI Alu-25 on growers' livelihood

Findings related to impact of BARI Alu-25 on growers' livelihood has been discussed in this section.

Perceived changes in livelihood status

The livelihood status of a grower consists of different socio-economic activities of him/her and the society in which s/he lives. The changes in the livelihood assets position of the respondents were measured before and after cultivating BARI Alu-25.

Human capital

The findings presented in the Table 2 show that 80.2 percent of the respondents' access to human capital was increased after BARI Alu-25 cultivation, which represents a good range of improvement in access to information (96.3%), knowledge (95.0%), and employment generation (self) (90.0%).

The increase in growers' access to human capital may be attributed to the enhanced solvency resulting from BARI Alu-25 cultivation. It was observed by Tadesse *et al.* (2019) that more than half of the farmers, who sold comparatively higher amount of potatoes, sent their children to private college. The farmers' potato and maize consumption were also increased due to the income earned from the new potato technology.

Table 2. Perceived changes in human capital of respondents

Livelihood Assets	Degree of change		
	Increased/ Improved (%)	Decreased (%)	No change (%)
Human Capital			
Health	85.0	1.3	13.8
Education	75.0	8.8	16.3
Training	42.5	1.3	56.3
Decision-making	83.8	2.5	13.8
Employment generation (Self)	90.0	1.3	8.8
Employment generation (Hired)	78.8	5.0	16.3
Knowledge	95.0	-	5.0
Access to information	96.3	-	3.8
Clothing	85.0	1.3	13.8
Nutrition	77.5	3.8	18.8
Dietary diversity	73.8	3.8	22.5
Quality of food intake	80.0	2.5	17.5
Average	80.2	2.6	17.2

Social capital

The results presented in the Table 3 show that 90.8 percent of the respondents' access to social capital was increased after BARI Alu-25 cultivation, which represents notable improvement in prestige (96.3%), attitude (96.3%), cooperation from others (96.3%) and management (96.3%). This may be because the growers became more solvent than before due to higher income from BARI Alu-25, thus improving their social acceptability.

Table 3. Perceived changes in social capital of respondents

Livelihood Assets	Degree of change		
	Increased/ Improved (%)	Decreased (%)	No change (%)
Social Capital			
Association/ organizational participation	60.0	1.3	38.8
Networking	88.8	-	11.3
Prestige	96.3	-	3.8
Attitude	96.3	-	3.8
Social status and respect	95.0	1.3	3.8
Involvement in social activities	95.0	1.3	3.8
Cooperation from others	96.3	-	3.8
Leadership roles	95.0	2.5	2.5
Management	96.3	-	3.8
Women empowerment	88.8	-	11.3
Average	90.8	0.6	8.6

Natural capital

The information furnished in the Table 4 indicates that 42.0 percent of the respondents' access to natural capital was increased after cultivation of BARI Alu-25 variety. Their forestry / trees (68.8%) and leased cultivable land (65.0%) were increased more compared to other natural capital.

Table 4. Perceived changes in natural capital of respondents

Livelihood Assets	Degree of change		
	Increased/ Improved (%)	Decreased (%)	No change (%)
Natural Capital			
Own cultivable land	32.5	3.8	63.8
Leased cultivable land	65.0	6.3	28.8
Homestead land	13.8	-	86.3
Pond	12.5	-	87.5
Availability of irrigation water	53.8	1.3	45.0
Safe drinking water	47.5	-	52.5
Forestry/trees	68.8	6.3	25.0
Average	42.0	2.5	55.6

Majority (55.6%) of them experienced no change in different types of natural capital. The reason could be that the natural capital, such as land, ponds, trees, and so on, of the growers typically remains unchanged. The possession of one's own land, ponds, and so on is usually fixed. They either acquired those from their parents or purchased them on a limited scale. Perhaps, therefore, a considerable portion of the respondents experienced no change in their natural capital.

Physical capital

The results presented in the Table 5 indicate that 48.1 percent of the respondents' access to physical capital was increased after cultivation of BARI Alu-25 variety. They experienced more increases in electricity use (93.8%), furniture (77.5%), digital/electronic communication devices (73.8%) and housing condition (71.3%) compared to other physical capital.

Table 5. Perceived changes in physical capital of respondents

Livelihood Assets	Degree of change		
	Increased/ Improved (%)	Decreased (%)	No change (%)
Physical Capital			
Housing condition	71.3	-	28.8
Toilet	65.0	-	35.0
Furniture	77.5	1.3	21.3
Agricultural tools	60.0	2.5	37.5
Cattle	41.3	20.0	38.8
Poultry	22.5	8.8	68.8
Personal vehicles	42.5	2.5	55.0
Digital/ electronic communication devices	73.8	-	26.3
Livelihood assets	62.5	-	37.5
Jewelry	35.0	11.3	53.8
Electricity use	93.8	2.5	3.8
Shop	17.5	3.8	78.8
Cattle/poultry farm	8.8	1.3	90.0
Biogas	1.3	-	98.8
Average	48.1	3.9	48.2

About half (48.2%) of them experienced no change in different types of physical capital. Some of the respondents experienced decrease in different types of physical capital especially in jewelry (11.3%) and living assets like cattle (20.0%) and poultry (8.8%). The reason could be that they were more engaged in crop cultivation and may not have had sufficient time for livestock rearing. Consequently, they sold their livestock resulting in decrease of their livestock number. The respondents might have sold their jewelry for different purposes or gifted those to their daughters. Tadesse *et al.* (2019) reported that the increase in yields and incomes of the farmers due to the adoption of improved potato production technologies assisted them to develop their material assets. The additional income from potato were used by the farmers in many ways. The rich farmers used the income to improve their houses and increase their livestock. The poor farmers increased their furniture, cooking utensils, tools. The farmers experienced improvement in household condition, safe drinking water i.e., presence of tube well, electricity and sanitary toilet. Farmers' housing condition, using sanitary latrine and household furniture were improved after BARI Hybrid Tomato-3 and BARI Hybrid Tomato-4 cultivation (Karim *et al.*, 2009).

Financial capital

The results presented in Table 6 indicate that 48.4 percent of the respondents' access to financial capital was increased after BARI Alu-25 cultivation. The majority of the respondents experienced increases in annual agricultural income (80.0%) and cash in hand (67.5%) compared to other financial capital. The higher economic benefit from BARI Alu-25 might have assisted the growers to increase their financial capital. About half (42.3%) of them experienced no change in different types of financial capital. The reason many of the growers experienced no change in remittances from household members working outside the area (82.5%), business investment (57.5%), annual non-agricultural income (43.8%), and savings (42.5%) could be that they did not have any source of receiving remittance or business or non-agricultural income. Perhaps many of the growers could not save their money as they had to invest money gained from agricultural income in agricultural activities again. Consequently, they had no savings. Probably some growers did not experience any change in their non-agricultural income due to having a small-scale non-agricultural income source.

Table 6. Perceived changes in financial capital of respondents

Livelihood Assets	Degree of change		
	Increased/ Improved (%)	Decreased (%)	No change (%)
Financial Capital			
Annual agricultural income	80.0	10.0	10.0
Annual non-agricultural income	47.5	8.8	43.8
Cash in hand	67.5	15.0	17.5
Savings	46.3	11.3	42.5
Business investment	35.0	7.5	57.5
Remittances from household members working outside the area	13.8	3.8	82.5
Average	48.4	9.4	42.3

Some of the respondents experienced a decrease in cash in hand (15.0%) and savings (11.3%), which could be attributed to the fact that cash in hand and savings tend to fluctuate over time. They may have experienced loss in potato cultivation, leading to a decline in their cash in hand and savings. Perhaps other social and economic factors might have had an influence on their decrease in cash in hand and savings. Tadesse *et al.* (2019) reported that the increase in yields and incomes of the farmers due to the adoption of improved potato production technologies helped them to develop their financial assets. The poor farmers used their additional income from potato in the investment in small businesses such as selling (and buying) cereals, weaving products and milk products in the local markets.

Dolon (2018) observed that farmers found potato production as profitable business and potato production significantly contributed to their income.

Changes in participation in income generating activities

Findings presented in Table 7 indicate that the average score of participation in income generating activities after cultivation of BARI Alu-25 was higher than the average score of participation before cultivation of BARI Alu-25, and the changes were significant at the 1.0% level of probability. It can be concluded that cultivation of BARI Alu-25 had a potential influence on the respondents' increase in participation in income generating activities. The increased financial stability resulting from BARI Alu-25 cultivation might have assisted the growers to participate in more income generating activities and get more earnings.

Table 7. Changes in participation in income generating activities of the respondents after cultivation of BARI Alu-25

Category	Before			Category	After			% Changes	t-value (df = 79)
	No.	%	Mean		No.	%	Mean		
Low (up to 4)	16	20.0		Low (up to 6)	18	22.5			
Medium (5-14)	54	67.5	8.7	Medium (7-16)	49	61.3	11.2	28.7	5.370**
High (>14)	10	12.5		High (>16)	13	16.3			

** Significant at 0.01 level.

Conclusion

The cultivation of BARI Alu-25 has demonstrated a transformative impact on the socio-economic status of growers, significantly enhancing their access to livelihood capitals by 42.0% to 90.8%. The growers experienced improvement in access to information, knowledge, employment generation, prestige, attitude, cooperation, and management. They also experienced increases or improvement in forestry/trees, leased cultivable land, electricity use, furniture, electronic communication devices, housing condition, annual agricultural income, and cash in hand after BARI Alu-25 cultivation. BARI Alu-25 cultivation had a potential influence on the respondents' increase in participation in income generating activities. Further studies may be carried out to validate the findings of the study

in the other areas of the country having similar socio-economic status. Further research may also be conducted on other BARI technologies.

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