



Impact of Integrated Agricultural Productivity Project on the Smallholder Beneficiaries in Mithapukur Upazila, Rangpur District of Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In Bangladesh, plenty of development projects are assumed, though success of very few is evaluated. This study was aimed to evaluate the impact of Integrated Agricultural Productivity Project (IAPP) on the smallholder beneficiaries. The proportionate random sampling technique was

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used to select 90 smallholder beneficiaries from seven project villages implemented. Data were collected during 2018 to 2019 using a predesigned interview schedule. The perceived advantages of the project and the beneficiaries' annual income change were utilized to assess the impact of the project on the smallholder beneficiaries. Majority (58.8%) of the smallholder project farmers were under young to middle age category, with literacy belonged to moderate family size, small farm category, average annual income of BDT 134989 and 227633 during before and after the project intervention, respectively. They showed moderate contact with the extension source (95.6%) and moderate organizational participation (64.5%). Benefits derived from different components of the project were caused change in the usages of different agricultural improved technologies by the beneficiaries. The technologies implemented were improved fish, crop, livestock and water technology. All technologies had statistically significant contributions to the beneficiaries. The changes were significant for all the cases, viz. improved fish technology ($t=13.65$), improved crop technology ($t=24.36$), improved livestock technology ($t = 20.43$) and improved water technology ($t=22.29$). There was also significant change in annual income comparing before and after the project intervention. Major problems faced during the intervention of the project were poor coordination of activities followed by training, poor quality deliverables and inadequate supply of project incentives. It is recommended that the authority needs to consider necessary measures to sustain the tempo and resolve the problems experienced by the beneficiaries in the future interventions.

Keywords: Beneficiary; impact; intervention; project; smallholder.

1. INTRODUCTION

Agriculture in Bangladesh is very important due to its role in food security, employment and livelihood [1]. During 1960s and 1970s Asian countries became successful following green revolution, which improve farmers income from agriculture, reduce poverty and improve food security [2,3,4] While Bangladesh has made impressive achievements over the last four decades, still a substantial proportion of rural household continues to experience chronic as well as transitory food insecurity. The primary strategies of developing countries government for improving the small beneficiary farmers livelihood are to facilitate more in agricultural development [5,6,7]. According to the MoA and MoFL [8], the government of the People's Republic of Bangladesh continues to be committed to food security through increased agricultural production, which has been reflected in major policy documents of the government. In light of this, the Government of Bangladesh (GOB) promoted the use of more productive technology and intensive agricultural practices during the project appraisal process in order to enhance food security and maintain economic growth through its National Strategy for Accelerated Poverty Reduction [9]. Accordingly, the Food and Agriculture Organization (FAO) was designated as the implementing agency for technical assistance, and the World Bank was designated as the supervising entity for the development of the Integrated Agricultural Productivity Project (IAPP), which was funded by a grant from the Global Agriculture and Food

Security program (GASFP). The project's primary focus was on a number of impoverished and vulnerable districts located in both the country's north and south [10].

Under the direction of the World Bank and the United Nations Food and Agriculture Organization and with financial support from the Global Agriculture and Food Security Program, the government carried out the Integrated Agriculture Productivity Project (IAPP) through the Ministries of Fisheries and Livestock and Agriculture. The project's goal is to increase fishery, livestock and agriculture output. It is occurring among marginal and small-scale farmers in Bangladesh's northern and southern districts, which are known for their high rates of food insecurity and poverty as well as their susceptibility to the damaging effects of natural shocks like flash floods and drought in the north and tidal surges in the south [11]. The IAPP was implemented to enhance the productivity of agriculture in agroecologically constrained and economically depressed areas to ensure better water management. The IAPP comprises of four major components, viz. Technology Generation and Adaptation, Technology Adoption, Water Management, Technical Assistance and Capacity Building. The IAPP operated on the overall objective of enhancing the productivity of agriculture (crop, livestock and fishery) in some selected areas of Rangpur, Kurigram, Nilphamari and Lalmonirhat districts in the North and Barisal, Patuakhali, Barguna and Jhalkathi districts in the South.

However, the geological location and geomorphological conditions along with too much water in the rainy season and too less water in dry season have made Bangladesh one of the most vulnerable countries to climate change [12]. The country susceptibility to natural hazards and climatic changes has already drawn national and international attention [13]. The northern part of Bangladesh suffers from drought and flash floods. On the other hand, southern part experiences cyclone, tidal surges and salinity intrusion. That provides the onus upon which the need to implement a development project for smallholder beneficiaries such like IAPP should be taken to center stage.

Beneficiaries are more likely to use environmentally friendly agricultural production techniques, highlighting the necessity of increased farmer participation in these initiatives to guarantee safe crop production and environmental health [14]. Furthermore, smallholder farm households' income and expenses have been positively impacted by agricultural diversification, with a large percentage of farmers participating in both farm and non-farm activities [15]. Additionally, it has been demonstrated that the execution of agricultural extension programs increases the income and food security of recipients, especially by giving women farmers in rural Bangladesh better access to technology and advisory services [16].

Although, the main implementation report by the World Bank [10] reflected satisfactory relative to the outlined indicators, the fact remains that the impact assessment of IAPP at the doorstep in terms of the changes due to the project and challenges faced during its implementation from the perspective of the smallholder beneficiaries is lacking. As a result, selected villages (Ekbarpur, Chuhura, Kaliganjpara, Moyenpur, Joyrampur, Tokeya and Khapur) from Mithapukur upazila

were considered to attempt towards addressing that gap. Which are agroecologically constrained and economically depressed areas. That's why the objective of the present study was to describe the socio-economic characteristics of the beneficiaries of IAPP, examine the status of the beneficiaries of IAPP before and after the intervention, determine the change in annual income of the beneficiaries before and after the IAPP and identify the problem faced by the beneficiaries during the execution of IAPP.

2. MATERIALS AND METHODS

2.1 Research Design and Study Site

The current study used a descriptive and diagnostic research approach [17,18,19]. The primary unit of analysis in this study was the family heads of the Integrated Agricultural Productivity Project beneficiaries. The study was conducted in Mithapukur upazila of Rangpur district. The researcher selected Rangpur district deliberately because of the availability of IAPP beneficiaries and also being a major agro-economically constrained area from the northern part of Bangladesh.

2.2 Population and Sample of the Study

The beneficiaries involved in IAPP in the selected village areas were the target population of the study. Mithapukur upazila was purposively selected as the locale of the study considering its communication facility and distance from the researcher's home. Seven villages were selected randomly from the upazila. A list of the beneficiaries was collected from the selected villages. Considering the abundance of the IAPP beneficiaries in these villages, proportionate random sampling technique was used [20,21,22] to select the respondents (Table 1).

Table 1. Distribution of the beneficiaries involved in IAPP

Upazila	Village	No. of population	No. of sample	Total no. of respondents
Mithapukur	Ekbarpur	107	10	90
	Chuhura	242	25	
	Kaliganjpara	151	15	
	Moyenpur	147	15	
	Joyrampur	53	05	
	Tokeya	94	10	
	Khapur	106	10	

Source: (Author's calculation, 2019)

2.3 Measurement of Variables

Independent factors were measured using standard ways [23,24,25]. The respondent's age was calculated from the time of investigation to the date of birth. The operational measurement of the respondent's education was allocating a score of 1 for every year of formal education. Each family member who cohabitated and shared meals was given a score of one (1), which served as the operational measure of family size. The actual number of persons in a respondent's family, including themselves and any dependents, during the interview period was used to calculate the size of the family. The whole land area inhabited by the farmer, including the homestead and farm, was measured in hectares. Using information on each respondent's memberships and positions in formal and informal groups, a social involvement score was calculated. Score '0' was assigned for not involved, score '1' was assigned for not member but attended occasionally if informed, score '2' was assigned for ordinary member and attended meeting occasionally, score '3' was assigned for ordinary member and attended meeting regularly and score '4' was assigned for active member of the executive committee and attending meeting regularly. Respondents were asked to rate their frequency of usage of various information medium on a 4-point rating scale, with a score of 1 for "Never," 2 for "Rare," 3 for "Occasionally," and 4 for "Always," in order to assess their interaction with extension sources. Each item's response was noted by placing a checkmark in the corresponding column. The sum of the individual scores for each category was used to determine the farmer's overall rank score. A respondent's family income was calculated using the respondent's stated taka in thousand per year. It was followed by Yeasmin [26] who divided the respondents' yearly income into three categories based on the mean and SD.

2.4 Assessment of Impact

A summated rating (Likert-type) scale was used to measure the respondents' attitude towards the extent of benefits. The scale was prepared with relevant items reflecting both positive and negative effects on a five-point continuum. The items covered all four components, with some sub components provided by IAPP. A respondent's attitude was measured by adding the total scores obtained for each of the four individual scale items, attributing scores of '5' for 'very high,' '4' for 'high,' '3' for 'medium,' '2' for 'low'

and '1' for 'very low' responses in the case of positive items. The total scores were calculated by adding the individual scores every respondent obtained for all components. The paired t-test was utilized to assess the variations in project benefits between the pre- and post-intervention periods.

2.5 Collection, Processing and Analyses of Data

The researcher conducted in-person interviews with the respondents to gather data for the study. To ensure correct information was obtained, a rapport was formed with the assistance of a Sub-Assistant Agricultural Officer (SAAO). Data collection was place over the course of one month between December 2018 and January 2019. Following data collection, the interview schedule's contents were all revised, double-checked, combined, coded and input into a computer system for analysis and interpretation using the SPSS program (version 26) [27,28]. The majority of the data were given in tabular form, and statistical measures such as number, range, mean and standard deviation were computed to describe the beneficiaries' chosen characteristics and changes in yearly income following their participation in the integrated agricultural productivity project. Pre- and post-project changes were compared using parametric statistics, such as the t-test.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Respondents

The distribution of farmers is displayed in Table 2 based on sociodemographic factors. Table 2 revealed that highest proportion (58.8%) of the respondents were of middle age. The present findings are in line with, Mujungu [29] that majority of the beneficiaries of donor funded projects in Babati cluster of Tanzania were 36 - 50 years. On the contrary, Rahman and Paul [30] reported that majority of the water safety plans beneficiaries in Bangladesh were \leq 35 years. However, the respondents are within the active age to engage in meaningful livelihood activities. Highest proportion 57.8 percent of the respondents got secondary level education. So, it was found that 78.9 percent of the respondents were educated beyond primary level. Amaza [31] and Hasan et al. [32] found that education has a positive and significant impact on farmers efficiency in production.

Table 2. Respondents socioeconomic and demographic characteristics

Characteristics	Scoring method	Categories	Respondents (n=90)		Mean	SD
			Number	Percent		
Age	Number of years	Young (≤ 35)	24	26.70	43.94	8.09
		Middle (36 - 50)	53	58.80		
		Old (>50)	13	14.50		
Education	Years of schooling	Primary (1-5)	19	21.10	4.99	2.06
		Secondary (6-10)	52	57.80		
		Higher secondary (11-12)	16	17.80		
		Graduate and above (13-21)	03	3.30		
Family size	Number of members	Small (less than 4)	16	17.80	4.73	1.26
		Medium (5-6)	64	71.10		
		Large (above 6)	10	11.10		
Farm size	Size in ha	Small farm (up to 1.00 ha)	86	94.80	0.52	0.49
		Medium farm (1.01-3.0 ha)	03	4.10		
		Large farm (Above 3.0 ha)	01	1.10		
		Low income (\leq Tk. 150,000)	62	68.80		
Annual Income (Before)	BDT	Medium income (Between Tk. 150,000 -300,000)	24	26.80	134989	99248
		High income (Above Tk. 300,000)	04	4.40		
		Low income (\leq Tk. 150,000)	34	37.60		
Annual Income (After)	BDT	Medium income (Between Tk. 150,000 -300,000)	43	47.60	227633	231113
		High income (Above Tk. 300,000)	13	14.80		
		Low experience (up to 16 year)	33	36.70		
		Medium experience (16-35 year)	53	58.90		
Farming experience	Years in cultivation	High experience (above 36 year)	04	4.40	1.6778	0.5574
		Low participation	23	25.60		
		Medium participation	58	64.50		
Organizational participation	Score	High participation	09	9.90	-	-
		Low contact (14 to 20)	04	4.40		
		Medium contact (20-30)	86	95.60		
Extension contacts	Score	High contact (above 30)	00	00	25.21	2.31

Source: (Author's calculation, 2019)

Table 3. Benefits derived by the beneficiaries of IAPP

SI#	Type	Components	Mean		t-value	Sig. (2 tailed)
			BIIAPP	AIIAPP		
01	Improved fish culture technology	Carp	1.4198	1.8247	15.92	.000
		Tilapia	1.0501	1.4388	12.72	.000
		Koi	1.0921	1.5301	11.90	.000
		Pungus	0.5445	0.9888	6.86	.000
		Fisheries equipment	0.4981	0.9908	6.00	.000
		Total	4.8608	6.5170	13.65	.000
02	Improved livestock technology	Cow/Buffalo	1.6898	2.0657	19.85	.000
		Goat/Sheep	1.7046	2.0732	20.37	.000
		Backyard poultry	1.412	1.787	16.92	.000
		Livestock equipment	1.4655	1.9123	15.02	.000
		Total	6.4258	7.6854	22.26	.000
03	Improved crop technology	Paddy	1.6952	2.0604	20.43	.000
		Wheat	1.4084	1.8138	15.79	.000
		Maize	1.6556	2.0555	18.44	.000
		Pulses	0.4988	0.9679	6.21	.000
		Oilseed	0.1431	0.4792	3.68	.000
		Vegetables	0.9085	1.4026	9.29	.000
		Fruits	0.1894	0.6421	3.65	.000
		Compost Farmyard manure	1.6699	2.0856	17.95	.000
		Green manure	1.5732	2.0268	15.77	.000
		Agricultural equipment	1.3022	1.7645	13.18	.000
		Total	12.093	14.241	24.36	.000
04	Water management technology	Buried pipe construction	1.8484	2.1071	30.38	.000
		Re-excavation of canals/ponds	0.1992	4.35	4.35	.000
		Alternate wetting and drying	1.2591	1.6520	14.72	.000
		Rainwater harvesting	0.0142	0.2302	2.25	.000
		Replacement of <i>Boro</i> by <i>Aus</i>	0.7360	1.1751	8.65	.000
		Total	4.4429	5.3126	22.29	.000

Source: (Author's calculation, 2019)

*BIIAPP = Before involvement in Integrated Agricultural Productivity Project

*AIIAPP = After involvement in Integrated Agricultural Productivity Project

Table 2 also revealed that highest proportion (71.1%) respondents fall under medium family size. In line with the present findings, Biradar [33] reported that majority (61.54%) of the beneficiaries of Kawad project in Bijapur and Bellary districts of Karnataka, India had medium size family. Majority of the respondents (94.8%) had small farm size. Similarly, it was found that almost half (75.9%) of the respondents were in small farm owners' category [32]. Highest proportion (68.8%) of the respondents had low annual income before the intervention of IAPP, this means that the distribution of annual income of the farmers has wide variation. Yeasmin [26], found the similar results. Highest proportion (47.6%) of the respondents had medium annual income after the intervention of IAPP. Khan et al. [34] found similar results where the majority of respondents fall under medium income category. Highest proportion (58.9%) of the respondents had medium farming experience with medium organizational participation (64.5%) and medium source of information category (95.6%). Similar findings were also reported by Kumar et al. [35].

3.2 Benefits Derived by the Beneficiaries of IAPP

The difference between before and after the intervention of IAPP in respect of the benefits was tested through paired sample t-test.

In case of improved fish technology, the t-value is 13.65, significant at $p \geq 0.05$ level with df 89. This implies that the respondents have benefitted positively after the project intervention. In line with the present findings, Islam [36] reported that significant increase in Tilapia, Thai koi and Pungus production as well as profit due to IAPP project intervention in Rangpur district. Also, Ahammad et al. [37] found that semi-intensive technology had a highly positive impact on fish production as well as it was more profitable for aquaculture in northeast region of Bangladesh.

In case of improved livestock technology, the t-value is 22.26, which was significant at $p \geq 0.05$ level with d. f. 89. Jabbar et al. [38] also reported that net changes in incidence of knowledge and adoption were quite high for some of the existing and newly promoted livestock technologies. Livestock and some farm related activities are the important sources of income for the people, especially for the landless and small landowners [39].

In case of improved crop technology, the t-value is 24.36, which is significant at $p \geq 0.05$ level with

df 89. Jabbar et al. [38] found that net positive yield changes for some of these crops in the project areas due to impact of agricultural productivity project. In line with present findings, Raj [40] reported positive change in respect of per hectare increase of crop production while conducting an assessment on enhancement of agricultural production and rural employment through extension of agricultural engineering technologies.

In case of improved water technology, the t-value is 22.29, which was significant at $p \geq 0.05$ level with df 89. Baako [41] reported that, the prudent utilization of improved water conservation practices like rainwater harvesting maximizes crop production under rainfed conditions. Thus, improved water conservation technology is a viable long-term strategy to tackle crop yield losses associated with moisture stress. Alam [42] found that improved water technologies like AWD method would render an eventual profit compared to the conventional irrigation method. Benson [43] also found that an agricultural water conservation policy prevalent worldwide encourages producers to improve on-farm irrigation efficiency.

The extent of benefit has changed significantly after the intervention of project. Mean value of the processing practices was found higher in case of after the project intervention than before the project intervention. Among the different practices, highest difference was found in case of 'Improved crop technology' and lowest difference was found in 'Improved Water technology. Islam and Jabbar [44] reported similar findings that beneficiaries have benefitted positively in terms of income, consumption and nutrition; empowerment of women has increased due to improved technology like smallholder poultry model. They also revealed that there is a significant difference of extent of benefits between before and after the project intervention. Regarding food security, Afrad and Barua [45] found that VGD performed satisfactorily in terms of food availability, access and stability, but poorly in terms of usage. Hossain et al. [46] conducted research on food security and nutrition in Bangladesh and reported that Bangladesh has striven to attain self-sufficiency in rice production for decades. Since there is little scope for extensive farming, most of the increased production is expected to come from the application of modern agricultural inputs and adoption of improved varieties and crop management technologies. Afrad [47] also found

positive significant result in a study of arsenic mitigation program.

3.3 Change in Annual Income due to IAPP

The mean annual income was 134889 BDT before intervention while 227633 BDT after integrated agricultural productivity projects were implemented. The income difference was statistically significant which was 92644 BDT additional incomes because of project intervention. The calculated t-value was 3.93, which was significant at $p \geq 0.05$ level with df 89.

So, there is a significant change in annual income comparing before and after the project intervention (Table 4). In line with the present findings, Kiratu [48] found that, the Kilimo Plus subsidy program also had a positive effect on the smallholder farmers by increasing their income. Together, these results imply that integrated agricultural projects might result in a significant increase in annual income by utilizing techniques like varied farming methods, effective resource management and training. It also emphasizes how integrated agricultural projects and higher farmers' yearly incomes are positively correlated.

3.4 Problems Faced by Beneficiaries during IAPP Intervention

Integrated Agricultural Productivity Projects aim to uplift farmers, yet beneficiaries often encounter various challenges during interventions. An open-ended question was set in the interview schedule to put the problems they faced. Thus, common problems were identified on the basis of farmers' opinion. The frequency of constraints was determined by percentage and rank order maintained on the basis of frequency

score. The common problems they raised in the interview schedule are listed along with frequency and presented in ascending order of importance in Table 5.

As indicated in Table 5, poor coordination of activities ranked 1st position because 46 respondents out of 90 faced this problem. For instance, the respondents stated that agri-equipment were given without justifying its need, power tiller was supplied where they needed tractor and also fish breeding materials were given late. In line with the present findings, Safa and Ories [49] reported that, because of poor coordination between the government and various non-governmental organizations operating in the agriculture sector, Bangladesh's agricultural industry is not producing the promised returns.

Unsustainability issues like inactiveness of organization after the project was ranked 2nd problem the beneficiaries faced. Sample farmers responses about training (duration shortage and limited number) such as need of more training, shortage of course duration etc. was in 3rd position they faced. In agreement with the present findings Sharma et al. [50] conducted research on stakeholder reflection of agricultural value chain project in Bangladesh and found that majority of the respondents demanded agricultural value chain project should increase the timeline. Poor-quality deliverable for example fish breeding material ranked in 4th problem and inadequate supply of project incentives ranked 5th problems. These problems need to be addressed squarely for a maximum success of intervention project.

Table 4. Change in annual income due to IAPP

Variable	Mean		t-value	Sig (2 tailed)
	BIIAPP	AIIAPP		
Annual income	134989	227633	3.93	0.0002

Source: (Author's calculation, 2019)

*BIIAAP = Before involvement in Integrated Agricultural Productivity Project

*AIIAAP = After involvement in Integrated Agricultural Productivity Project

Table 5. Rank order of problems faced by beneficiaries during intervention of agricultural productivity project

Sl#	Problem statements	Score	Rank
1	Poor coordination of activities	46	1 st
2	Unsustainability issues	21	2 nd
3	Training (Duration shortage and limited number)	20	3 rd
4	Poor quality deliverable	18	4 th
5	Inadequate supply of project incentives	14	5 th

Source: (Author's calculation, 2019)

4. CONCLUSION

The average age of beneficiaries was 44 years. The majority (57.8) were having secondary level of education. The average family size was about five which majorities have medium family size. About 94.8% had low farm size and the majorities about 58.9% were medium farming experience ranging 16 to 35 years. The moderate extension contacts and organizational participation, average annual income of BDT 134,989 and 227,633 before and after the project intervention, respectively. The respondents have benefitted positively from the project intervention due to the significant difference observed and there is also significant change in annual income before and after the project intervention. The major problems faced during the intervention of Integrated Agricultural Productivity Project were poor coordination of activities followed by unsustainability issues, training (duration shortage and limited number), poor quality deliverables and inadequate supply of project incentives. Enhanced training, support systems and information distribution may effectively address these difficulties and improve the efficacy of Integrated Agricultural Productivity Projects.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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