Impact of Integrated Agricultural Productivity Project on the Smallholder Beneficiaries in MithapukurUpazila, underRangpur District of Bangladesh

Abstract

In Bangladesh, plenty of development projects are assumed, though success of very few are evaluated. The present assessed the impact of Integrated Agricultural Productivity Project (IAPP) on the smallholder beneficiaries. Proportionate random sampling technique was used for selection of 90smallholder beneficiaries from seven project villages. 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 IAP project on the smallholder beneficiaries. Majority (58.8%) of the smallholderproject 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 IAP projectwere caused change in the usages of different agricultural improved technologies by 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 for 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 IAPP project were poor coordination of activities followed by training, poor quality deliverables and inadequate supply of project incentives. Hence,Itis 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.

Key words: 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 beneficiariessuch 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 make an 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 IAPPandidentify 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 project beneficiaries in these villages, proportionate random sampling technique was used [20,21,22]to select the respondents.

Table 1. Distribution of the beneficiaries involved in IAPP

Upazila	Village	No. of respondents	Total no. of respondents
Mithapukur	Ekbarpur	10	90
	Chuhura	25	
	Kaliganjpara	15	
	Moyenpur	15	
	Joyrampur	05	
	Tokeya	10	
	Khapur	10	

Source of the Table?

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. Yeasmin [26] 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 toward 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 1 based on sociodemographic factors. Table 1 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 ≤ 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 1 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].

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	26.7	43.94	8.09
		Middle (36 - 50)	53	58.8		
		Old (>50)	13	14.5		
Education	Years of schooling	Primary (1-5)	19	21.1	4.99	2.06
		Secondary (6-10)	52	57.8		
		Higher secondary (11-12)	16	17.8		
		Graduate and above (13-21)	03	3.3		
Family size	Number of members	Small (less than 4)	16	17.8	4.73	1.26
		Medium (5-6)	64	71.1		
		Large (above 6)	10	11.1		
Farm size	Size in ha	Small farm (up to 1.00 ha)	86	94.8	0.52	0.49
		Medium farm (1.01-3.0 ha)	3	4.1		
		Large farm (Above 3.0 ha)	1	1.1		
Annual Income (Before)	BDT	Low income (≤ Tk. 150,000)	62	68.8	134989	99248
		Medium income (Between Tk. 150,000 -300,000)	24	26.8		
		High income (Above Tk. 300,000)	4	4.4		
Annual Income (After)	BDT	Low income (≤ Tk. 150,000)	34	37.6	227633	231113
		Medium income (Between Tk. 150,000 -300,000)	43	47.6		
		High income (Above Tk. 300,000)	13	14.8		
Farming experience	Years in cultivation	Low experience (up to 16 year)	33	36.7	1.6778	0.5574
		Medium experience (16-35 year)	53	58.9		
		High experience (above 36 year)	4	4.4		
Organizational participation	Score	Low participation	23	25.6	-	-
		Medium participation	58	64.5		
		High participation	9	9.9		
Extension contacts	Score	Low contact (14 to 20)	4	4.4	25.21	2.31
		Medium contact (20-30)	86	95.6		
		High contact (above 30)	0	0		

Source of the Table?

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.

Table 3.Benefits derived by the beneficiaries of IAPP

Sl#	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 manage-ment 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 *Boro* by *Aus*	0.7360	1.1751	8.65	.000
		Total	**4.4429**	**5.3126**	**22.29**	**.000**

***BIIAAP** = Before involvement in Integrated Agricultural Productivity Project
***AIIAAP** = After involvement in Integrated Agricultural Productivity Project
Source of the Table?

In case of improved fish technology, the t-value is 13.65, significant at p ≥ 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 thatsignificant 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 ≥ 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 ≥ 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 ≥ 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 benefited 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

In case of annual income, the calculated t-value was 3.93, which was significant at p ≥ 0.05 level with df 89.

Table 4. Change in annual income due to IAPP

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

***BIIAAP** = Before involvement in Integrated Agricultural Productivity Project
***AIIAAP** = After involvement in Integrated Agricultural Productivity Project

Source of the Table?

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 IAPPIntervention

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.

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	1st
2	Unsustainability issues	21	2nd
3	Training (Duration shortage and limited number)	20	3rd
4	Poor quality deliverable	18	4th
5	Inadequate supply of project incentives	14	5th

Source of the Table?

Findings contained in Table 5 show that 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 is over ranked in 2nd position because 21 respondents out of 90 faced this problem.Farmers responses about training (duration shortage and limited number) such as need of more training, shortage of course duration etc. was in 3rd position because 20 respondents out of 90 faced this problem. 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 position because 18 respondents out of 90 faced this problem. Farmers' also faced problem concerning inadequate supply of project incentives 14 respondents out of 90 faced this problem

because they needed more fund to further facilitate their benefit from the IAPP. These problems need to be addressed squarely for a maximum success of intervention project.

4. CONCLUSION

Majority of the beneficiaries were < 50 years, having secondary level of education, < 6 family members, > 90 percent had low farm size, < 35-year farming experience, 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.

REFERENCES

1. Sarma PK., Alam MJ, Begum I, McKenzie AM. The effect of total factor productivity on the food security and livelihood vulnerability of farm households in Bangladesh. *Frontiers in Sustainable Food Systems*. 2024; *8*: 1395897.

2. Pinstrup-Andersen P. Future perspectives on food supply in developing countries—Outlook on Agriculture 1993; 22: 225–232.

3. Hamdan MF, Mohd Noor SN, Abd-Aziz N, Pua TL, Tan BC. Green revolution to gene revolution: technological advances in agriculture to feed the world. Plants 2022; 11: 1297.

4. John DA, Babu GR. Lessons from the aftermaths of green revolution on food system and health. Front. Sustain. Food Syst. 2021; 5: 644559.

5. Ortiz-Miranda D, Moreno-Pérez O,Arnalte-Mur L,Cerrada-Serra Martinez-Gomez V, Adolph B,Atela J,Ayambila S, Baptista I, Barbu R, Bjørkhaug H. The future of small farms and small food businesses as actors in regional food security: A participatory scenario analysis from Europe and Africa. J. Rural Stud. 2022; 95: 326–335.

6. Giller KE, Delaune T, Silva JV,Descheemaeker K,Van de Ven G, Schut AG, van Wijk M, Hammond J,Hochman Z,Taulya G. The future of farming: Who will produce our food? Food Secur. 2021; 13: 1073–1099.

7. Hlatshwayo SI,Ngidi M,Ojo T,Modi AT,Mabhaudhi T,Slotow RA.Typology of the level of market participation among smallholder farmers in South Africa: Limpopo and Mpumalanga Provinces. Sustainability. 2021; 13: 7699.

8. Ministry of Agriculture and Ministry of Fisheries and Livestock. *Annual Report 2012-2013 and 2013-2014.* Dhaka, Bangladesh:Integrated Agricultural Productivity Project. 2015.

9. GED. Steps towards change: National Strategy for Accelerated Poverty Reduction (FY2009-11). General Economics Division (GED) of the Planning Commission, Dhaka, Bangladesh. 2009.

10. World Bank. Implementation completion and results report (TF-10378). The World Bank, Washington DC, USA. 2017.

11. Jones M, Kondylis F, Mobarak M, Stein D. Evaluating the integrated agriculture productivity project in Bangladesh. Innovation for Poverty Action (IPA), Connecticut, USA. 2015.

12. Tushar AH, Parvin RA. Bangladesh's climate vulnerability and overseas migration: navigating challenges and paving the way forward. Indonesian Journal of Innovation and Applied Sciences (IJIAS). 2024;4(1):69-78.

13. Azam G, Huda ME, Bhuiyan MA, Mohinuzzaman M, Bodrud-Doza M, Islam SD. Climate change and natural hazards vulnerability of Char Land (Bar Land) communities of Bangladesh: application of the livelihood vulnerability index (LVI). Global social welfare. 2021; 8:93-105.

14. Hasan MM, Farouque MG, Sarker MA. An assessment of using eco-friendly crop production practices by the project beneficiaries and non-beneficiaries in Bangladesh. Discover Agriculture. 2024;2(1):21.

15. Akter A. Impact of farm diversification on income and expenditure of small-scale farm households in Rangpur District of Bangladesh. Journal of Agriculture, Food and Environment (JAFE)| ISSN (Online Version): 2708-5694. 2023;4(2):8-15.

16. Lee HB, McNamara PE, Bhattacharyya K. Women farmers' access to integrated livestock extension services and the impact on livelihoods in Bangladesh. Journal of Gender, Agriculture and Food Security (Agri-Gender). 2017;2(3):19-42.

17. Islam MR, Hoque MZ, Alam MZ, Afrad MSI, Haque ME, Hasan S. Pest risk analysis and management practices for increasing profitability of lemon production. Journal of Agriculture and Ecology Research International. 2021 Mar 20;22(1):26-35.

18. Hasan S, Haque ME, Afrad MSI, Alam MZ, Hoque MZ, Islam MR. Influences of socio-economic factors on lemon pest management practices in Tangail district of Bangladesh. South Asian Journal of Social Studies and Economics. 2021;10(3):59-67.

19. Hasan S, Hasan SS, Saha S, Islam MR. Identify problems and suggest possible solutions for safe pineapple production in Madhupur tract. European Journal of Agriculture and Food Sciences. 2022 Oct 7;4(5):68-74.

20. Hasan S, Saha S, Afrad MSI, Islam MR, Sadi RS, Labib MT. Present status of pineapple cultivation in Bangladesh: case of Madhupur Tract. Turkish Journal of Agriculture-Food Science and Technology. 2023 Aug 31;11(8):1304-1309.

21. Afrad MS, Khan MA, Mannan MA, Hasan S, Saha S. Farmers' preference analysis of selected rice varieties at Mirzaganj upazila of Patuakhali district. 2021; 423-430.

22. Saha S, Hasan SS, Hasan S, Sadi RS, Labib MT, Saha S. Ecosystem service preference of forest people: a study in Madhupur Sal Forest of Bangladesh. European Journal of Agriculture and Food Sciences. 2022 Nov 10;4(6):20-25.

23. Parveen N, Hoque MZ, Afrad MS, Hossain MM, Nasim FA, Haque ME, Hossain MF, Prodhan FA, Hasan S, Saha S. Consumers' perception on safety of vegetables in the urban markets of Mymensingh city in Bangladesh. Asian Journal Agricultural Extension Economics Sociology. 2023;41(4):112-122.

24. Hoque MZ, Mahmud AA, Haque ME, Afrad MSI, Hossain MF, Yeasmin F, Prodhan FA, Rahman MS, Hasan S, Saha S. Adoption of Climate Smart Agricultural Practices by Charland Farmers in Charfasson, Bangladesh. Journal of Agriculture and Ecology Research International. 2023 Jul 10;24(5):87-97.

25. Hoque MZ, Lota ZN, Yeasmin F, Hossain MS, Hasan S, Hossain MF, Rahman MS, Reza S, Prodhan FA, Haque ME, Afrad MSI. Attitude of aromatic rice farmers towards good agricultural practices in Dinajpur, Bangladesh. South Asian Journal of Social Studies and Economics. 2024 May 9;21(6):26-37.

26. Yeasmin F, Yasmin S, Nahar K. Factors influencing farmers practices in using pesticide for vegetable cultivation at Sadar upazila of Gazipur district in Bangladesh. Progressive Agriculture. 2018 Sep 27;29(3):259-66.

27. Hasan S, Afrad MSI, Hoque MZ, Saha S. Use of social media by the farmers in Gazipur district of Bangladesh. Annals of Bangladesh Agriculture. 2023;27(1):105-20.

28. Saha S, Hasan SS, Haque ME, Ahamed T, Hasan S. Status and trend of ecosystem services of Madhupur Sal forest in Bangladesh. Geografia-Malaysian Journal of Society and Space. 2024;20(2):53-68.

29. Mujungu PP. Socio-Economic impacts of donor funded projects on beneficiaries–the case of Babati cluster in World Vision Tanzania (Doctoral dissertation, The Open University of Tanzania).

30. Rahman MM, Paul CK. Implementation of water safety plans in Bangladesh: situation and need analysis. Journal of Science Foundation. 2011;9(1-2):141-61.

31. Amaza PS, Olayemi JK. Technical efficiency in food crop production in Gombe State Nigeria. Nigeria Agricultural Journal. 2001;32.

32. Hasan K, Abu Habib M, Abdullah DB, Afrad MSI. Impact of alternate wetting and drying technique on rice production in the drought prone areas of Bangladesh. Indian Research Journal of Extension Education. 2016 Jan 15;16(1):39-48.

33. Biradar BN, Manjunath L, Yadav VS. Impact of income generating activities on rural livelihoods of KAWAD project beneficiaries. (2011): 182-184.

34. Khan AR, Dubey MK, Bisen PK, Saxena KK. Constraints faced by farmers of NasrinKheda village of Sihore district. Indian Research Journal of Extension Education. 2016 Jan 16;7(1):57-59.

35. Kumar D, Shrivastava KK, Shrivastava P, Shori RK. Profile of farmers and their attitude towards mass information sources. Journal of Plant Development Sciences. 2012;4(4):605-611.

36. Islam MN. Stakeholders' reflection of agricultural value chain project in Bangladesh. Internship report, BRAC Business School BRAC University, Dhaka, Bangladesh. 2017

37. Ahammad B, Khandaker M, Hamom A, Sourove M, Islam SA, Hemal S, Bhattacharjee D. Impact of technology on fish production in north east region of Bangladesh. Int. J. Fish. Aquat. Stud. 2017;5(4):112-117.

38. Jabbar MA, Ziauddin AT, Abedin MZ. Impact of an agricultural development project on technology adoption and crop yields of resource poor farmers in Bangladesh. Bangladesh Journal of Agricultural Economics. 2011 Dec 31;34(1-2):55-75.

39. Bhattacharjee M, Mehta S, Singh P, Singh M, Pongener N. Diversification of livelihood from animal waste and by-product for small and marginal farmers in India. Asian Journal of Dairy and Food Research. 2023;42(4):564-569.

40. Raj V. Effectiveness of agricultural extension programs on crop productivity in India. International Journal of Agriculture. 2024 May 3;9(2):1-2.

41. Baako AM. Promoting on-farm water harvesting and conservation techniques for sustainable agricultural production systems through capacity development of field extension officers and farmers. Journal of Developments in Sustainable Agriculture. 2015;10(1):55-60.

42. Alam MS, Islam MS, Salam MA, Islam MA. Economics of alternate wetting and drying method of irrigation: evidences from farm level study. The Agriculturists. 2009:82-89.

43. Benson A, Huffaker R. The impact of agricultural water conservation policy on economic growth. The Open Hydrology Journal. 2012 Nov 30;6(1).

44. Islam SF, Jabbar MA. Smallholder poultry model for poverty alleviation in Bangladesh: a review of evidence on impact. Livestock Research for Rural Development. 2005 Dec 14;17(10):112.

45. Afrad MSI, Barau AA. Performance of vulnerable group development towards food security. Annals of Bangladesh Agriculture. 2018;22(2):21-28.

46. Hossain M, Naher F, Shahabuddin Q. Food security and nutrition in Bangladesh: progress and determinants. EJADE: Electronic Journal of Agricultural and Development Economics. 2005;2(2):103-132.

47. Afrad MSI. Impact of arsenic mitigation program on attitude of the beneficiaries. The Agriculturists. 2010;8(2):35-42.

48. MurathiKiratu N. An Assessment of the Impact of Kilimo Plus Subsidy Program on smallholder farmers' food security and income in Nakuru North District, Kenya. 2014.

49. Safa NT, Ories MR. A holistic overview of agricultural practices among CDIP beneficiaries in Salimgonj area: current status, persistent problems, and promising prospects. Research in Agriculture Livestock and Fisheries. 2023;10(3):277-284.

50. Sharma D, Alam MJ, Begum IA, Ding S, McKenzie AM. A value chain analysis of cauliflower and tomato in Bangladesh. Sustainability. 2023 Jul 22;15(14):11395.

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