



Research article

Discrepancy of Adopting Cropping Patterns between Beneficiary and Non-Beneficiary of Agricultural Extension Programs Conducted by NGO

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ABSTRACT

The southwestern coastal region of Bangladesh is hardly suitable for agriculture due to high salinity, drought and shortage of soft irrigation water. The study aimed to identify the different climate-resilient cropping patterns, assess the impacts obtained due to the various extension services, find the causes of adopting resilient cropping patterns and figure out the problems faced by the farmers during adoption. A total of eighty-two (41 NGO-beneficiary and 41 non-beneficiary) respondents were selected randomly. In the study area, most beneficiary farmers practiced 'Fallow-T.Aman-Vegetable' while most non-beneficiary farmers practiced 'Fallow-T.Aman-Fallow'. The cropping intensity of beneficiary respondents (214.8%) was higher than non-beneficiary respondents (176%) and also the benefit-cost ratio was higher (3.67) than non-beneficiary (3.13). Both beneficiary and non-beneficiary farmers' agricultural knowledge was high (92.7%). Beneficiary respondents mentioned ten causes for adopting climate-resilient cropping patterns among which the most important was 'crops are less prone to natural disasters' (index 87.32%) where most of the non-beneficiary respondents (99.51%) notified the cause as 'an increase in cropping intensity as they adopt it by observing the benefits obtained by the beneficiary farmers. Soil salinity is the major problem among fifteen problems for both respondents when adopting a climate-resilient cropping pattern while no farmers were found to face no problem. Thus, from the above findings, it might be concluded that the NGO beneficiaries are receiving ample extension benefits which should be nurtured and improved by the government.

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Introduction

It is impossible to increase the amount of land, thus, there is no way to use this limited amount of land properly. So, changes must be brought into the cropping pattern so that the cropping intensity (CI) can be increased. A large number of crops are cultivated under different cropping patterns in different parts of Bangladesh with variability from one region to another where both beneficiary (the ones who interact with different NGOs and government organizations and take their services) and non-beneficiary farmers (who didn't take services) are involved.

The cropping pattern in Bangladesh agriculture mostly consists of rice (Haque, 1998). In the country-wide data collection, it was noticed that *Boro-Fallow-T.Aman* was the most dominant cropping pattern

covering 2.31 million ha (27%) of the Net Cropped Area (NCA) in the country with its distribution in 426 Upazilas of 63 districts (Nasim et al., 2017). Variation in cropping pattern depends on several factors i.e., climate, soil structure and soil water, the severity of salinity, rainfall, pest and insect incidence, availability of irrigation facilities and other inputs, availability of technologies, skill and experience of the farmers, marketing and transport facilities, subsistence pressure and the growth of agro-industries (Rashid et al., 2005).

Satkhira is the country's coastal region, which has been identified as an underprivileged region in terms of poverty, food insecurity, vulnerability to the environment and limited opportunities for livelihood. Rahman and Ahsan (2001) found that the low land use in the region is mainly due to salinity and peculiar hydrology, waterlogging in *Kharif-2* and early *Rabi* seasons and lack

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of proper quality irrigation or drought conditions in *Rabi* and *Kharif-1* seasons and also responsible tidal storm. SRDI (2010) found that the southwestern part Khulna, Bagerhat and Satkhira districts are the worst hit by water and soil salinity.

The major cropping pattern of Shyamnagar and Kaliganj is Fallow-T.*Aman*-Vegetables. During the *Kharif-2* season, T.*Aman* is the dominant crop because about more than 70% of both beneficiary and non-beneficiary farmers cultivate T.*Aman*, BR10, BR11, BRR1 dhan30, Swarna and some local varieties of T.*Aman* rice are mainly practiced during this season and some of them practiced summer vegetables and also practiced fish and shrimp. Different types of vegetables are cultivated by the majority of farmers during *Rabi* seasons, some of them also cultivate *Boro* rice and few farmers practice oil seed crops. The area and production of HYV *Boro* rice in the Khulna region were 5,51,345 metric tons from 2,80,210 acres whereas T.*Aman* rice was 16,98,337 metric tons from 15,17,075 acres respectively (BBS, 2015).

The farmers of Shyamnagar and Kaliganj Upazila have been changing their cropping patterns due to climate change. The severity of salinity intrusion and the increase of soil salinity have negative influences on agriculture. So, they practiced a resilient cropping pattern that tolerates drought and the severity of salinity. The average cropping intensity of the country was 200% in 2014, whereas BBS (2014) found 128-147% cropping intensity in southwestern districts. It is not possible to justify the entire Satkhira district based on the cropping intensity information of two Upazilas. Similarly, the entire Bangladesh cannot be justified in the light of the Satkhira district.

Biswas et al. (2022) recommended that the respective authorities i.e., the Department of Livestock Services, the Department of Agricultural Extension and NGOs might foster different agricultural activities (e.g., livestock rearing, etc.) to enhance the livelihood in the southwestern coastal area. From the background and facts stated till now, it can be seen that in the coastal region of Bangladesh, there is a great change in cropping pattern. Once upon a time, rice was the main dominating annual crop in this region but after the change in cropping pattern vegetables are also cultivated year-round. Along with government extension groups, a large number of non-governmental organizations (NGOs) are attempting to address these issues in this area by providing extension services whose effects have not yet been evaluated. Pertaining to this change, the study was conducted in the Satkhira district. Given the above-mentioned statements, the following objectives were formulated to give proper direction to the study:

- i. To identify the various climate-resilient cropping patterns that have been used by farmers over the past five years and on which NGOs have intervened.
- ii. To explain the discrepancies of impacts between farmers who received extension services and those who did not.
- iii. To explore the different causes of adopting climate-resilient cropping patterns.

- iv. To find out the problems confrontation of the respondents during adopting a resilient cropping pattern.

Methodology

The study was carried out in Shyamnagar and Kaliganj upazila of Satkhira district in Bangladesh. To conduct the investigation, we purposively chose a few villages from Shyamnagar and Kaliganj. We observed in the region that the NGO known as Nowabanki Gonomukhi Foundation (NGF) works incredibly hard to enhance agriculture there and that the farmers heavily rely on that NGO for their agricultural needs. There were several farmers who were the beneficiaries of the NGO- NGF. Among those, a total of 41 farmers were purposively selected based on convenience of access for the research, and another 41 non-beneficiary common farmers were purposively selected for making a comparison regarding the discrepancy between NGO beneficiary and non-beneficiary. However, randomization was ensured during the interviewing of the respondents. An interview schedule was prepared to collect data considering the objectives of the research. A face-to-face interview was conducted among the farmers from the different unions in the area. The data was collected from the respondents through direct conversation. Data for the study were collected between April 2021 and April 2022. Interviews were conducted during the daytime and lasted, on average, roughly 30 minutes.

Different climate-resilient cropping patterns

Last five-year cropping pattern: Three types of cropping patterns were observed under the *Kharif-1*, *Kharif-2* and *Rabi* seasons among the respondents. So, we have categorized the cropping pattern from the year 2016-2020 into *Aus*, vegetables, *Aus*+vegetables under the season of *Kharif-1*; *Aman*, vegetables, *Aman*+vegetables under the season of *Kharif-2* and *Boro*, vegetables, *Boro*+vegetables under the season of *Rabi*, respectively.

Technologies and new varieties used during the last five years:

Different types of technologies and new varieties of crops were used by the respondent in the area under study such as pheromone trap, yellow trap, light trap, *vermicompost*, red cabbage, broccoli, etc. The used technologies and varieties from the year 2016-2020 were observed and calculated (year-wise percentages) among the respondents.

Discrepancies of impacts obtained due to the different extension services

Simple statistics and/or calculation tools, such as cropping intensity (%), benefit-cost ratio, annual income ('000' BDT), training frequency, innovativeness score (%), and agricultural knowledge score were used for measuring the discrepancies of impacts obtained due to the different extension services.

Cropping intensity during the last five years: The cropping intensity of the respondent was calculated by

measuring the net cropped area (NCA) and the total cropped area (TCA) in three different seasons i.e. *Kharif-1*, *Kharif-2* and *Rabi* and then dividing TCA by the NCA of the respondent. The cropping intensity was expressed in percentages.

Benefit-cost ratio: The benefit-cost ratio (BCR) is a ratio used in a benefit-cost analysis to summarize the overall relationship between the relative costs and benefits of a proposed project. The BCR is calculated by dividing the proposed total cash benefit of a project by the proposed total cash cost of the project.

$$\text{BCR} = \frac{\text{Net benefit}}{\text{Net cost}}$$

Annual income: We have categorized the sources into two major types such as agricultural and non-agricultural sources and it was measured in terms of thousand Taka (BDT). The annual income of the respondents was categorized into three i.e. low, medium and high income.

Training exposure: Training exposure was measured by asking the respondent about the name of the organization from which they receive the training with the topic, duration and frequency of the training of the individual respondent.

Innovativeness: The innovativeness of the respondents was measured by asking about the year in which they heard about the technologies and varieties and the year from which they started using them and measuring the differences between these two years. According to the differences in the year, the respondents were categorized as highly innovators, innovators, early adapters, early majority, late majority and laggards.

Agricultural knowledge: To measure the knowledge of the respondent about agriculture, ten questions on different aspects of agriculture were asked. Based on their agricultural knowledge, the respondents were categorized into three categories i.e., poor, good, and excellent.

Causes of adopting resilient cropping pattern

Ten causes were included in the interview schedule with a five-point rating scale against the causes. The rating scale was strongly disagreed, disagree, undecided, agree and strongly agree. Adopting resilient cropping pattern causes index was calculated by using the observed score of the respondents against the potential score. The following formula was used to calculate the index score (Sheel et al., 2019).

$$\begin{aligned} &\text{Adopting resilient cropping pattern causes index (\%)} \\ &= \frac{\text{observed score}}{\text{possible score}} \times 100 \end{aligned}$$

Problem confrontation of the farmers while adopting different resilient cropping patterns

Fifteen problems were included in the interview schedule with a five-point rating scale against the problems. The rating scale was not severe (0), less severe (1), moderately severe (2), severe (3) and highly severe (4). We have ranked the problems according to their score by formulating a problem confrontation index as mentioned below. The problem confrontation index was calculated

by using the following formula described by Sheel et al. (2019) and Biswas et al. (2022). Problem severity was calculated by modifying the method suggested by Ara et al. (2021).

$$\begin{aligned} &\text{Problem Confrontation Index (\%)} \\ &= \frac{\text{observed score}}{\text{possible highest score}} \times 100 \end{aligned}$$

Data analysis

Data analysis was performed by using the SPSS (Statistical Package for Social Science), Computer Package and Microsoft Excel. Number, frequency, percentage, means, maximum, minimum, range and standard deviation were used for statistical analysis. All the interview schedules were prepared for data tabulation after completing the field study.

Results and discussion

Different climate-resilient cropping patterns

Last five-year cropping pattern: From the Table 1 of the beneficiary respondents, we can see that most of the farmers are involved with only vegetable cultivation in *Kharif-1* and this cultivation increasing each year. We notice that only 43.9% of the respondents were engaged with only vegetable cultivation in 2016 whereas in 2020 it increased to 60.98%. Only *Aus* cultivation has decreased day by day as combined cultivation of *Aus* and vegetables is adopted. In *Kharif-2* more than one-half (56.09%) of the respondents were involved with *Aman* cultivation in 2016 whereas in 2020, it gradually decreased to 46.34% as vegetables and combined *Aman* and vegetable cultivation are increasing consistently. During the *Rabi* season, most of the beneficiary farmers cultivated only vegetables in 2016 which reaches 60.98% in 2020. The amount of combined *Boro* and vegetable cultivation also increased significantly.

On the contrary in the case of non-beneficiary respondents in *Kharif-1*, most of the farmers in 2016 were involved in only vegetable cultivation (21.9%), which increases up to 26.8% in 2020. Only *Aman* cultivation decreases from 53.7% to 43.9% whereas combined *Aman* and vegetables cultivation increases from 29.3% to 39%. In the *Rabi* season from the year 2016 to 2020 both only vegetable cultivation and combined *Boro* and vegetable cultivation increased from 56.1% to 58.5% and from 17.1% to 21.95%, respectively.

We also found both differences and similarities between the beneficiary and non-beneficiary respondents regarding the use of cropping patterns (Table 1). The rate of only vegetable cultivation is increased every year in *Kharif-1* by both beneficiary and non-beneficiary respondents but this increasing rate is comparatively higher in beneficiary than non-beneficiary respondents. Similarly, in *Kharif-2*, combined *Aman* and vegetable cultivation is increasing and only *Aman* cultivation is decreasing every year whereas in the *Rabi* season, only vegetable cultivation and combined *Boro* and vegetable cultivation have increased consistently but this rate is higher for beneficiary respondents. We know that when someone makes a profit by adopting a new method or by cultivating a new variety then others follows the same method. For this reason, the method of cultivation of both beneficiary and non-beneficiary respondents is almost

similar but the rate is comparatively higher for beneficiary respondents.

Used technologies and new varieties in the last five years: Table 2 shows the use of technologies and new varieties during the last five years (2016- 2020) by both beneficiary and non-beneficiary respondents. In the case of beneficiary respondents, it is noticed that most of the farmers use a pheromone trap whose rate was highest (31.7%) in 2018 and it increased again in 2020 with 17.1%. The second highest using technology is

vermicompost which was the maximum in 2016 (31.7%). Apart from the pheromone trap and *vermicompost*, the beneficiary respondents use a yellow trap, light trap, mini pond and twelve other technologies and varieties.

On the other hand, in the case of non-beneficiary respondents, most of the farmers use the pheromone trap which was the maximum used in 2018 (34.2%) and the second highest using technology is *vermicompost* which was maximum during 2019 with 12.2%.

Table 1: Last five-year cropping pattern of both beneficiary and non-beneficiary respondents

Years	Kharif-1			Kharif-2			Rabi		
	Aus (%)	Vegetables (%)	Aus+Vegetables (%)	Aman (%)	Vegetables (%)	Aman+Vegetables (%)	Boro (%)	Vegetables (%)	Boro+Vegetables (%)
Beneficiary									
2016	7.3	43.9	2.44	56.09	7.3	21.95		56.09	21.95
2017	4.88	48.78	2.44	56.09	7.3	21.95		56.09	24.39
2018	4.88	53.65	2.44	56.09	9.76	24.39	2.44	56.09	26.83
2019	4.88	58.54	2.44	48.78	9.76	29.27		60.98	26.83
2020	4.88	60.98	2.44	46.34	12.2	31.7		60.98	26.83
Non-beneficiary									
2016	0	21.95	7.3	53.7	4.88	29.3	4.88	56.1	17.1
2017	0	19.5	7.3	53.7	4.88	29.3	4.88	56.1	17.1
2018	0	24.4	7.3	51.2	4.88	34.1	4.88	56.1	21.95
2019	0	26.8	7.3	43.9	4.88	39	2.44	58.5	21.95
2020	0	26.8	7.3	43.9	4.88	39	2.44	58.5	21.95

Table 2: Technology and new varieties used in the last five years by both beneficiary and non-beneficiary respondents

Technology		2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)
Beneficiary						
1.	Pheromone trap	17.1	9.8	31.7	12.2	17.1
2.	<i>Vermicompost</i>	31.7	9.8	29.3	14.6	14.6
3.	Yellow trap	7.3		2.44	2.44	12.2
4.	Light trap			4.9	2.44	
5.	Mini-pond	2.44	2.44			2.44
6.	Bagging vegetables				2.44	2.44
7.	Biopesticides		2.44	4.9	4.9	
8.	Biofertilizer		2.44	4.9	2.44	
9.	Naphthalene		2.44			
10.	Neemfol [<i>Azadirachta indica</i>]				2.44	2.44
11.	HYV				2.44	2.44
12.	Red cabbage				7.3	
13.	Summer tomato	26.8			26.8	2.44
14.	Broccoli			2.44	4.9	
15.	Beetroot				2.44	2.44
16.	<i>Sangki</i> [earthen pot used for poison bait to produce safe food]		2.44	2.44		
17.	Copper sulfate		2.44			
Non-beneficiary						
1.	Pheromone trap	14.6	9.8	34.2	24.4	31.7
2.	<i>Vermicompost</i>	2.44	2.44	7.3	12.2	9.8
3.	Yellow trap	2.44				2.44
4.	Broccoli				2.44	4.9

Table 2 also reveals that the beneficiary respondents use more technology and new variety than non-beneficiary respondents. It was observed that the beneficiary respondents use about twenty types of technologies and varieties whereas non-beneficiary respondents use only four types of technologies and varieties. But both beneficiary and non-beneficiary respondents use the pheromone trap the most because of the positive influence of the beneficiary farmers on non-beneficiary farmers. The highest technology usage was in 2018 which decreased in the following year because most of the farmers feel the use of pesticides and insecticides leads to faster pest control and better yield. That is why they stop using new technology and focus on using pesticides, Insecticides, and fertilizers. This prevalence is comparatively higher in non-beneficiary than beneficiary respondents.

Impacts obtained due to the different extension services

Cropping intensity during the last five years: The cropping intensity of the beneficiary respondents during the years 2016 to 2020 are ranged from 186.95% to 214.8%, respectively at the same time cropping intensity

of the non-beneficiary respondents during the years 2016 to 2020 is 173% to 172%, respectively (Table 3). Cropping intensity of the beneficiary respondents is increasing year by year where it remains constant or in some cases decreases also in case of non-beneficiary respondents. The cropping intensity of the beneficiary during the year 2020 was about 14% more than the standard cropping intensity of Bangladesh whereas the same was about 22% less than the standard cropping intensity of Bangladesh. So, from these two tables, we can easily identify the differences in the cropping intensity between the beneficiary and non-beneficiary respondents. The difference is about 26% which is due to the transfer of technologies and new varieties through the extension officers in that area. The beneficiary respondents were well exposed to the extensive media and contact through the extension work which benefits them in increasing their cropping intensity through adopting resilient cropping patterns, technologies and new varieties of crops. And due to the less exposure to the extension media contact, the non-beneficiary respondents might be unable to adopt the resilient cropping pattern, technologies, and new varieties of crop which results in poor cropping intensity.

Table 3: Cropping intensity of the beneficiary respondents during the last five years

Years	NCA	TCA= the sum of cultivated land in one agricultural year			CI (%) = TCA/NCA
		<i>Kharif-1</i> (mid-Mar-mid July)	<i>Kharif-2</i> (Mid July-mid Oct)	<i>Rabi</i> (mid Oct-mid Mar)	
Beneficiary					
2016	170.8	45.09	146.09	133.95	186.95
2017	171.2	59.36	144.68	141.32	186.98
2018	172.63	61.12	154.05	146.25	198.85
2019	183.83	66.72	143.93	170.22	211.28
2020	181.1	69.27	147.32	171.41	214.8
Non-Beneficiary					
2016	166.41	22.21	125.34	140.5	173
2017	166.61	22.21	123.34	140.5	173
2018	170.1	23.43	128.95	146.7	176
2019	172.88	23.92	131.1	146.7	174
2020	174.1	23.92	131.1	145.5	172

Benefit-cost analysis

The benefit-cost ratio of the beneficiary respondents is observed 3.67, whereas it is obtained 3.13 in the case of non-beneficiary respondents (Figure 1). So, there is a significant difference among them in respect of cost, benefit and benefit-cost ratio. This is due to the transfer of technologies and new varieties through the extension

officers in the study area. Beneficiary respondents, with good exposure to extension media and contact, increased their cropping intensity by adopting resilient cropping patterns, technologies, and new crop varieties. In contrast, non-beneficiary respondents, with less exposure to extension media and contact, struggled to adopt these practices, resulting in poor cropping intensity.

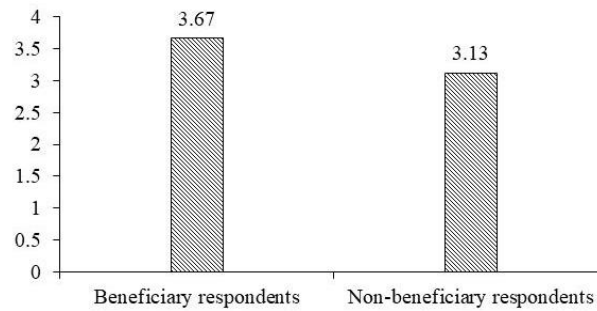


Figure 1. Comparison of benefit-cost ratio between the beneficiary and non-beneficiary respondents

Here, the benefit, cost, and benefit-cost ratios of the beneficiary respondents are 2,04,57,884 BDT, 55,99,800 BDT, and 3.67, respectively, whereas those of the non-beneficiary respondents are 1,60,45,000 BDT, 51,16,000 BDT, and 3.13, respectively. Therefore, there are significant differences among them in terms of cost, benefit, and benefit-cost ratio. We found that for (3.67–3.13=) 0.54 differences in the benefit-cost ratio the beneficiary respondents get benefits of BDT 4,412,884. So, we can say that for every 0.01 increase in the benefit-cost ratio, the increasing benefit will be $\frac{0.01}{0.54} \times 4,412,884$ or 81,720.07 BDT.

Annual income: The annual income of both beneficiary and non-beneficiary respondents from agricultural sources was presented in thousands of BD (Table 4). From agricultural, sources the minimum annual income of the beneficiary respondents was BDT 73.07 thousand

and the maximum of BDT 3683.23 thousand with the mean and standard deviation being 633.74909 thousand and 606.20009 thousand, respectively. It was also found that 73.2% of the respondents were in the high-income category from agricultural sources, while the medium, low- and none-income categories were 14.6%.12.2% and 0%, respectively. On the contrary, the Table shows the non-beneficiary respondents had an annual income of BDT 19,125 thousand and a maximum of BDT 2216.00 thousand from agriculture sources with a mean and standard deviation were 515.57634 thousand and 414.080 thousand, respectively. It was also found that more than one-half (53.7%) of the respondents were under the high-income category considering the agricultural sources, while the medium, low, and none income categories were 19.5%, 26.8% and 0%, respectively.

Table 4: Distribution of both respondents according to their annual income from an agricultural source

Categories	Score ('000')	Respondents N=41		Mean±SD	Range	
		Frequency	%		Range (observed)	
Beneficiary					Range (observed)	
None	00	00	00	633749.09±606200.09	Min.	Max.
Low	<180	5	12.2		73070.0	3683230.0
Medium	180-300	6	14.6		Range (possible)	
High	>300	30	73.2		Min.	Max.
Non-beneficiary					Range (observed)	
None	00	00	00	515576.34±414080.0	Min.	Max.
Low	<180	11	26.8		19125.00	2216000.00
Medium	180-300	8	19.5		Range (possible)	
High	>300	22	53.7		Min.	Max.
					0	Unknown

From Table 4, it can be inferred that the annual income of the beneficiary respondents is higher than that of the non-beneficiary respondents from agricultural sources with a mean income of about BDT 6, 33,749.09 and BDT 5, 15,576.34, respectively. In many studies, it is found that the income of the farmers increases significantly as a result of the changes in the cropping pattern such as the financial cash capital which has increased by 47.03% in all farmers (Pervez et al., 2017). The increase in the annual income of beneficiary

respondents, as well as the income differences between beneficiary and non-beneficiary respondents, is attributed to changes in cropping patterns through the adoption of resilient cropping patterns, new technologies, new crop varieties, and effective extension services.

Training exposure of the respondents: Here, the training exposure of the respondent is discussed in two ways first one is training provided by organizations and

the other one is topic-wise training received by the farmers:

Training providing organizations from where the respondents received training: The Table shows the organization which provides training to the beneficiary and non-beneficiary respondents (Table 5). The highest training-providing organization was the NGF with an index and score of 56.1% and 23; and the second highest-providing organization was DAE with an index and score of 14.63% and 6; and the Bangladesh Institute of Nuclear Agriculture stands in the third position. On the contrary, in the case of non-beneficiary respondents, the highest training-providing organization was NGF with an index of 21.95% and 9; the second highest was Social Development Foundation (SDF) and DAE with index and score of 9.76% and 4; Nobojatra and Department of Livestock Officer (DLO) provided with index 4.87% and 2 having the third position.

From Table 5 it can be inferred that both of the beneficiary and non-beneficiary respondents got most of the training from NGF. The DAE provided the second-highest training to beneficiary farmers whereas non-beneficiary respondents got the second-highest training from SDF. The beneficiary respondents got training from nine different organizations whereas non-beneficiary respondents got it from 6 different organizations.

Table 5: Training provided from where the beneficiary and non-beneficiary respondents received training

Sl. No.	Organization	Score	Index (%)	Rank
Beneficiary				
1.	NGF	23	56.1	1 st
2.	DAE	6	14.63	2 nd
3.	IPM	2	4.87	3 rd
4.	BINA	2	4.87	3 rd
5.	VSO	1	2.44	4 th
6.	World Vision	1	2.44	4 th
7.	DLO	1	2.44	4 th
8.	DAO	1	2.44	4 th
9.	SUS	1	2.44	4 th
Non-beneficiary				
1.	NGF	9	21.95	1 st
2.	SDF	4	9.76	2 nd
3.	DAE	4	9.76	2 nd
4.	Nobo Jatra	2	4.87	3 rd
5.	DLO	2	4.87	3 rd
6.	Pushti	1	2.44	4 th

Topic-wise training received by the beneficiary and non-beneficiary farmers: The beneficiary respondents received the highest frequency of training on pheromone trap (15 times) and the second highest was received on *vermicompost* and 3rd was on (*yellow trap, broccoli, HYV*), 4th was on (*vegetables, modern vegetables*), 5th was on [*light trap, biopesticides, summer tomato, mini pond, tobacco (tamak), Azadirachta fruit (neem-fo), red*

cabbage], and 6th was on (*dairy poultry, safe vegetables, biofertilizer, beetroot, sanitization, bagging vegetables*) (Table 6). About 36.5% of the farmers received training on pheromone traps and 31.59% received on *vermicompost*. Training received on the yellow trap, broccoli and HYV was about 12.19% and 9.76% on vegetables and modern vegetables.

On the other hand, the non-beneficiary respondents received the highest training on pheromone trap 15 times and the second highest received on *vermicompost* and 3rd, 4th and 5th received on vegetables 3 times, (broccoli, ornamentals, fish culture, poultry rearing) 2 times, (yellow trap, safe vegetables, sanitization) 1 time respectively. More than one-third (36.59%) of farmers received training on pheromone traps and 14.63% received on *vermicompost*. Training received on vegetables was 7.32% and 4.87% on broccoli, ornamental, fish culture and poultry rearing.

Here we found that the training received by both beneficiary and non-beneficiary respondents is mainly on pheromone trap, *vermicompost*, yellow trap and vegetables. However, the rate of training received is comparatively higher in beneficiary respondents than in non-beneficiary respondents. The beneficiary respondents received training on 20 types of different technologies and social activities whereas non-beneficiary respondents received half of these as compared to the beneficiary.

Table 6: Topic-wise training received by the beneficiary and non-beneficiary farmers

Sl. No.	Topic	Score	Index (%)	Rank
Beneficiary				
1.	Pheromone trap	15	36.59	1 st
2.	<i>Vermicompost</i>	13	31.70	2 nd
3.	Yellow trap	5	12.19	3 rd
4.	Broccoli	5	12.19	3 rd
5.	HYV	5	12.19	3 rd
6.	Vegetables	4	9.76	4 th
7.	Modern vegetables	4	9.76	4 th
8.	Light trap	2	4.87	5 th
9.	Biopesticides	2	4.87	5 th
10.	Summer tomato,	2	4.87	5 th
11.	Mini-pond	2	4.87	5 th
12.	Tobacco (<i>Tamak</i>)	2	4.87	5 th
13.	Neem (<i>Azadirachta</i>) oil	2	4.87	5 th
14.	Red cabbage	2	4.87	5 th
15.	Dairy poultry	1	2.44	6 th
16.	Safe vegetables	1	2.44	6 th
17.	Biofertilizer	1	2.44	6 th
18.	Beetroot	1	2.44	6 th
19.	Sanitization	1	2.44	6 th
20.	Bagging vegetables	1	2.44	6 th
Non-beneficiary				
1.	Pheromone trap	15	36.59	1 st
2.	<i>Vermicompost</i>	6	14.63	2 nd
3.	Vegetables	3	7.32	3 rd
4.	Broccoli	2	4.87	4 th
5.	Ornamental	2	4.87	4 th
6.	Fish culture	2	4.87	4 th
7.	Poultry rearing	2	4.87	4 th
8.	Yellow trap	1	2.44	5 th
9.	Safe vegetables	1	2.44	5 th
10.	Sanitization	1	2.44	5 th

Innovativeness of the respondents: Both beneficiary respondents were innovators, early adopters, early majority, late majority and laggards with 90.24%, 4.87%, 0%, 0%, and 7.31%, respectively. And the non-beneficiary respondents were innovators, early adopters, early majority, late majority and laggards with 36.58%, 0%, 2.43%, 2.43% and 24.39%, respectively (Figure 2). So, the beneficiary respondents were much early adopter than the non-beneficiary respondents as they adopt the new cropping pattern, technologies and varieties as soon as they hear about them from the extension workers.

Agricultural knowledge: Table 7 displays the agricultural knowledge both of the beneficiary and non-beneficiary respondents. It shows that the beneficiary respondent’s minimum observed knowledge in

agriculture was 9 and maximum 20 with the mean and standard deviation being 18.36 and 2.49, respectively. The majority (92.7%) of the respondents had high knowledge of agriculture, while about 7.3% had medium knowledge of agriculture and there were no respondents that didn’t know about agriculture. On the other hand, on the other, it also displays that the non-beneficiary respondent’s minimum observed knowledge in agriculture was 14 and maximum 20 with the mean and standard deviation being 18.46 and 2.02 respectively. This Table also indicates that more than nine-tenths (92.7%) of the respondents had high knowledge of agriculture, while about 7.3% had medium knowledge of agriculture and there were no respondents that didn’t know about agriculture.

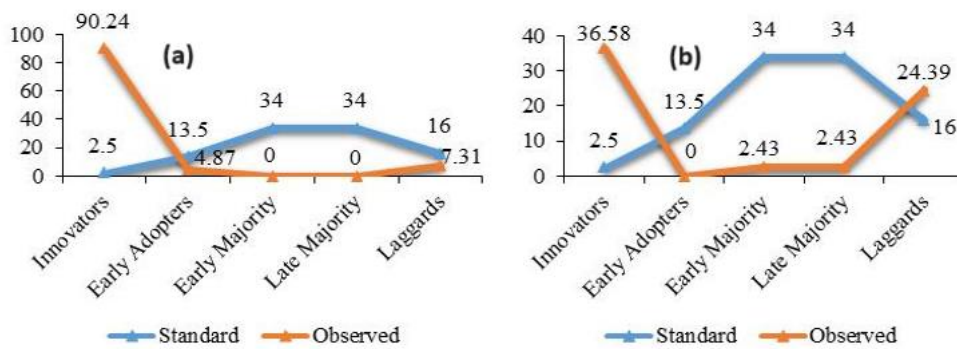


Figure 2. Comparison of innovativeness between the (a) beneficiary and (b) non-beneficiary respondents based on the standard provided by Rogers (1983)

The results of Table 7 show that the agricultural knowledge of both beneficiary and non-beneficiary is similar; both have high agricultural knowledge about 92.7%. The people who engage in agricultural work traditionally have general agricultural knowledge and also Bangladesh is an agricultural country is another reason for the similar knowledge of the beneficiary and

non-beneficiary respondents. Some studies also found that the majority of farmers have agricultural knowledge as about 88.3% of respondents have high agricultural knowledge as found by Hossain and Hossain (2016). Rahman et al. (2018) found that the majority of respondents about 57% had more than 10 years of experience.

Table 7: Distribution of the beneficiary and non-beneficiary respondents according to their knowledge of agriculture

Categories	Score (year)	Respondents N=41		Mean±SD	Range	
		Frequency	%		Min.	Max.
Beneficiary					Range (observed)	
Poor	<7	00	00	18.36 ±2.49	9	20
Good	7-14	3	7.3		Range (possible)	
Excellent	>14	38	92.7		0	unknown
Non-Beneficiary					Range (observed)	
Poor	<7	00	00	18.46 ± 2.02	14	20
Good	7-14	3	7.3		Range (possible)	
Excellent	>14	38	92.7		0	unknown

The causes of adapting resilient cropping pattern
Both beneficiary and non-beneficiary respondents received resilient cropping patterns for 10 different reasons (Table 8). The most important cause was crops

are less prone to natural disasters (87.32%) among them. The second, third, and fourth important reasons were the livelihood status of people increasing due to high income per unit area of land (83.41%), neighborhood collateral

positive influence inducing other farmers to adopt (79.51%) and short life cycle of resilient varieties (75.21%) respectively and the other causes are shown in the Table 8 respectively.

On the other hand, in the case of non-beneficiary respondents, the most important cause for adopting a resilient pattern was an increase in cropping intensity (99.51%) among them. The second, third and fourth important reasons were the livelihood status of people increasing due to high income per unit area of land (98.05%), neighborhood collateral positive influence inducing other farmers to adopt (93.65%) and crops are less prone to a natural disaster (85.85%) respectively.

Other causes are shown within the non-beneficiary part respectively.

From Table 8 it was found that both beneficiary and non-beneficiary respondents' main reasons behind adopting the resilient cropping pattern are different. Beneficiary respondents adopted mainly as the crops are less prone to natural disasters whereas non-beneficiary respondents adopted due to the increase in cropping intensity but 2nd adopting reasons are the same for both beneficiary and non-beneficiary respondent which is the livelihood status of people increasing due to high income from per unit area of land.

Table 8: Causes of adopting resilient cropping pattern of the beneficiary and non-beneficiary respondents

Sl. No.	Causes	Score	Causes adaptation Index (%)	Rank
Beneficiary				
1.	Crops are less prone to natural disaster	179	87.32	1 st
2.	The livelihood status of people increasing due to high income per unit area of land	171	83.41	2 nd
3.	Neighborhood collateral positive influence induces other farmers to adopt	163	79.51	3 rd
4.	The short life cycle of resilient varieties	154	75.12	4 th
5.	The year-round distribution of laborers and machinery	145	70.73	5 th
6.	Disease and insect-pest infestation are not a big problem	144	70.24	6 th
7.	The lower yield of climate-susceptible cropping patterns	143	69.75	7 th
8.	Increase in cropping intensity	142	69.27	8 th
9.	Sustainably increase in agricultural productivity	142	69.27	8 th
10.	Easily adapted to any type of land topography	142	69.27	8 th
Non-beneficiary				
1.	Increase in cropping intensity	204	99.51	1 st
2.	The livelihood status of people increasing due to high income per unit area of land	201	98.05	2 nd
3.	Neighborhood collateral positive influence induces other farmers to adopt	192	93.65	3 rd
4.	Crops are less prone to natural disaster	176	85.85	4 th
5.	The year-round distribution of laborers and machinery	166	80.98	5 th
6.	The lower yield of climate-susceptible cropping patterns	153	74.63	6 th
7.	The short life cycle of resilient varieties	146	71.22	7 th
8.	Easily adapted to any type of land topography	133	64.88	8 th
9.	Sustainable increase in agricultural productivity	129	62.93	9 th
10.	Disease and insect-pest infestation are not a big problem	125	60.98	10 th

The adoption of resilient cropping patterns among both beneficiary and non-beneficiary respondents reveals distinct primary motivations. Beneficiary respondents primarily adopted these patterns due to the crops' reduced vulnerability to natural disasters, while non-beneficiary respondents were chiefly motivated by an increase in cropping intensity. Despite these differences, both groups shared a common secondary reason: improved livelihood status resulting from higher income per unit area of land. Additionally, neighborhood influence played a significant role in encouraging farmers to adopt these practices in both groups. These findings highlight the varied but overlapping factors driving the adoption of resilient cropping patterns in different contexts.

Problems confrontation of the farmers during adopting different resilient cropping patterns

Both beneficiary and non-beneficiary farmers faced fifteen problems to a different extent (Table 9). In the case of beneficiary respondents, the most severe problem

was saline soil (86.59%) while difficulty to shift to resilient variety (12.81%) was the least severe problem. Some of the major problems were the shortage of water during the *Boro* seasons (55.48%), the Problem of pests and diseases (31.70%), the higher cost of agricultural inputs (31.09%), etc. Other problems included misappropriation of funds and unavailability of credit (31.09%), lack of marketing facilities (29.27%), non-availability of inputs in time (28.05%), lack of information about climate resilient cropping pattern (24.39%), lack of training facilities (23.78%), lack of understanding about resilient cropping pattern and improved techniques (23.78%) and poor contact with extension staff (18.90%) are shown in the beneficiary Table.

On the contrary, the non-beneficiary Table shows that saline soil (94.25%) was also the most severe problem as well as the shortage of water during *Boro* seasons (84.75%) was the second most severe problem while the lower yield of resilient variety (3.05%) was the least severe problem. Other major problems included a

lack of understanding about resilient cropping patterns and improved techniques (84.17%), non-availability of inputs in time (50.61%), the problem of pest and disease (45.12%), lack of information about climate resilient cropping patterns (41.46%), misappropriation of funds and unavailability of credit (34.35%) and also other problem was lack of marketing facilities, lack of training facilities, poor contact with extension staff, higher cost of agricultural inputs etc.

From the Table 9, we found that soil salinity is the major problem for both beneficiary and non-beneficiary respondents and shortage of water during *Boro* seasons

is 2nd major problem for both types of respondents but 3rd major problem is different. From the Table, it can be seen that beneficiary farmers face twelve out of fifteen problems whereas non-beneficiary farmers face fifteen out of fifteen problems. Beneficiary farmers face relatively few problems than non-beneficiary farmers. Ali (2012) found a similar type of result where soil and water salinity is the major problem as also drought conditions during winter *Boro* crops seasons. Rahman (2012) found that more than one-half (53%) of coastal areas are affected by salinity.

Table 9: The severity of different problem confrontations of the beneficiary respondents during adopting a resilient cropping pattern

Sl. No.	The Problems	Score	Problem confrontation Index (%)	Rank
Beneficiary				
1.	The problem of saline soil	142	86.59	1 st
2.	Shortage of water during <i>Boro</i> seasons	91	55.48	2 nd
3.	The problem of pests and disease	52	31.70	3 rd
4.	Higher cost of agricultural inputs	51	31.09	4 th
5.	Misappropriation of funds and unavailability of credit	51	31.09	4 th
6.	Lack of marketing facilities	48	29.27	5 th
7.	Non-availability of inputs on time	46	28.05	6 th
8.	Lack of information about climate-resilient cropping pattern	40	24.39	7 th
9.	Lack of training facilities	39	23.78	8 th
10.	Lack of understanding about resilient cropping patterns and improved techniques	39	23.78	8 th
11.	Poor contact with extension staff	31	18.90	9 th
12.	Difficulty to shift to a resilient variety	21	12.81	10 th
Non-beneficiary				
1.	The problem of saline soil	174	94.25	1 st
2.	Shortage of water during <i>boro</i> seasons	139	84.75	2 nd
3.	Lack of understanding about resilient cropping patterns and improved techniques	79	84.17	3 rd
4.	Non-availability of inputs in time	53	50.61	4 th
5.	The problem of pests and disease	74	45.12	5 th
6.	Lack of information about climate-resilient cropping pattern	68	41.46	6 th
7.	Misappropriation of funds and unavailability of credit	57	34.75	7 th
8.	Lack of marketing facilities	51	31.09	8 th
9.	Lack of training facilities	51	31.09	8 th
10.	Poor contact with extension staff	44	26.83	9 th
11.	Higher cost of agricultural inputs	41	25	10 th
12.	Lack of information about long-term climate change	32	19.51	11 th
13.	Weak leadership	29	17.68	12 th
14.	Difficulty to shift to a resilient variety	25	15.25	13 th
15.	The lower yield of the resilient variety	5	3.05	14 th

Conclusions

Reviewing the overall findings, it can be said that the adoption of climate-resilient cropping patterns is spreading more quickly among beneficiary farmers in

coastal areas than it is among non-beneficiary farmers. Additionally, beneficiary respondents use about twenty types of new technologies and varieties, whereas non-beneficiary respondents only use six types. The cropping

intensity of beneficiary respondents climbed to 214.8% during the past five years, whereas it only reached 172% for non-beneficiary respondents. Beneficiary respondents received more training on various topics from various organizations than non-beneficiary respondents. Both beneficiary and non-beneficiary respondents received the majority of their training from NGF, with DAE coming in second. Beneficiary respondents were more innovative than non-beneficiary respondents because these NGOs encourage farmers in adopting resilient agricultural patterns as well as new technologies and diversity. With a benefit-cost ratio of roughly 3.67 compared to 3.13 for non-beneficiary respondents, the beneficiary respondents benefited more from their agricultural operations. The annual income from agricultural sources is significantly higher for the beneficiary respondents than for the non-beneficiary respondents. The majorities of the responders were under 30 and employed in agriculture. In comparison to non-beneficiary respondents, beneficiary showed higher levels of engagement (65.9%) with a different organization. The most important reason for adopting resilient cropping patterns was less prone to a natural disaster for the beneficiary respondents whereas increased cropping intensity was the main cause for non-beneficiary respondents. Major problem confrontations encountered during the adoption of climate-resilient cropping patterns were soil salinity, shortage of water during *Boro* seasons, and attack of pests and disease

whereas difficulty to shift to resilient variety and lower yield of resilient variety was the minor problem. With the help of the NGOs, beneficiary farmers faced twelve problems out of fifteen in adopting the resilient cropping pattern while non-beneficiary faced fifteen out of fifteen problems. Despite all these, the non-beneficiary farmers were not abstained from receiving climate-resilient cropping patterns compare to beneficiary respondents because we know that, when someone makes a profit by adopting a new method or by cultivating a new variety, then others follow the same method. These NGOs must step up to help the government to increase food security since the extension services provided by the government are insufficient for the people. However, the NGOs are required to operate within governmental laws and guidelines.

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Conflict of Interests

No competing interests exist amongst the authors of this research work.

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