

Forecast-based Financing Bangladesh



Evaluation of the Cyclone Early Action Protocol (EAP)

Quantitative Impact Assessment of the 2020 EAP Activation for Cyclone "AMPHAN"

EAP2018BD01



This report was written by Andrea Pronti (lead author and analyst; independent consultant) and Clemens Gros (Red Cross Red Crescent Climate Centre) with inputs from the BDRCS FbF Team. The activation of BDRCS' Cyclone EAP was funded by IFRC's Forecast-based Action by the DREF. Since this is still a new funding mechanism the initial activations include an evaluation of the EAPs to assess their implementation.

With special thanks to Mohammad Shahjahan (BDRCS Assistant Director & FbF Project Coordinator), Mohammad Salauddin (BDRCS FbF Project Support Officer), and Hassan Ahmadul (RCRC Climate Centre Technical Adviser) for the continuous support during the data collection and analysis.

Further thanks to Md. Rafiqul Islam (BDRCS Deputy Secretary General), Belal Hossain (former BDRCS DRM Director), Ekram Elahi Chowdhury (BDRCS DRM Director), Tuhin Samaddar (Swiss Red Cross), and Razib Bari (IFRC Bangladesh Senior Manager, Response & Shelter), as well as Audrey See Tho (IFRC PMER Manager a.i.) and Raymond Zingg (IFRC Regional FbF Coordinator). Nina Conrad (Climate Centre) supported the finalization of the report; her support is gratefully acknowledged.

Acknowledging the challenging operational context during the COVID-19 pandemic, special thanks to the BDRDS volunteers whose tireless effort ensured that the survey data collection was successful and timely.

MAY 2021

ACKNOWLEDGMENT



Early warning and evacuation to cyclone shelters

- Of those who received an early warning, 33% of FbA beneficiaries said **they were warned by BDRCS** vs. only 13% of the comparison group were warned by BDRCS (+20%); 81% of FbA beneficiaries were **warned by CPP¹** vs. 92% of the comparison group (-11%); and 46% of FbA beneficiaries vs. 32% of the comparison group were **warned by mobile phone (+14%)**.
- 100% of FbA beneficiaries reported that they **evacuated to a cyclone shelter**, whereas 97% of comparison households declared the same (+3%). This means that FbA assistance appears to have been effective in making sure everyone evacuates (without FbA, 3% of households might not have evacuated).
- FbA beneficiaries who declared to have evacuated animals are less than the comparison group (-11%).
- However, **transportation assistance did not play a role** in supporting evacuation. Only 8% of FbA beneficiaries said they received transportation assistance to evacuate (and many said it was from family and friends), vs. 5% of comparison group respondents (the difference is not statistically significant).

Services at the cyclone shelter

- The **overall shelter experience was rated better** by FbA beneficiaries, with an average score of 6.2 (out of 10) vs. 5.33 (out of 10) for the comparison group (+0.87 points).
- 75% of FbA beneficiaries reported that they received water at the cyclone shelter (serviced with support from BDRCS), vs. only 58% from the comparison group who were at a shelter not supported by BDRCS (+17%)
- Because of the Covid-19 pandemic, the FbA assistance was expanded to include other services which are reflected in the results:
 - 62% of FbA beneficiaries said to have received **masks and hand sanitizer** at the shelter vs. 33% of comparison households (+29%);
 - 41% of FbA beneficiaries received **hygiene items such as soap** vs. 29% of comparison households (+12%);
 - 73% of FbA beneficiaries said that **light** was provided at the shelter vs. 60% of comparison households (+13%). This matches reports from BDRCS who indicated that flood lights were provided at selected shelters.
- However, only 30% of FbA beneficiaries said there was a **place for their livestock** at the shelter vs. 44% of the comparison group (-14%), although the provision of shelter space for livestock is included in the EAP.

¹ Cyclone Preparedness Programme (CPP) is a joint initiative of BDRCS and Government

Problems at the cyclone shelter

- Overall, 28% of FbA beneficiaries said there were **'no problems'** at the cyclone shelter vs. only 14% of comparison respondents (+14%)
- However, among those who indicated there were problems at the shelter, 29% of FbA beneficiaries said there was a **lack of water** at the shelter vs. 41% of comparison group households (-12%)
- A **lack of sanitation facilities** was experienced by 43% of FbA beneficiaries vs. 61% of the comparison group (-18%)
- 60% of FbA beneficiaries at shelters supported by BDRCS complained about the **lack of space at the shelter** (overcrowding) vs. 74% of the comparison group who experienced the same at shelters without BDRCS support (-14%)

Impacts on assets, health and coping strategies

- 69% of FbA beneficiaries indicated that their **houses were damaged** to some degree and needed to be repaired, vs. 58% of comparison households (+11%). It is important to note that *protecting housing structures* was not one of the objectives of the EAP.
- 15% of FbA beneficiaries reported to have sustained **physical injuries** (e.g. bruises, fractures) because of the cyclone, vs. 27% of comparison households (-12%)
- 4% of the FbA stated to have sold house items (such as cook stoves, furniture, etc.) to cope with the effects of the cyclone against 58% of the comparison group (difference of -54%).
- FbA beneficiaries sold more personal assets (the 'other assets' category including small personal valuables and clothes) as a coping strategy (24%) than the comparison group (2%), with a statistically significant difference of +22%.

Livestock and agricultural impacts

- 49% of the FbA beneficiaries stated that they experienced the death or loss of at least one animal because of the cyclone, against 63% of respondents from the comparison group (-14%).
- FbA beneficiaries indicated to have lost 29% of their **ducks** vs. the comparison group losing almost half (46%) of their ducks (-17%). Differences for other animals were not observed or statistically significant.
- About one quarter of the survey respondents said they used land (owned or rented) to cultivate crops or aquaculture (mainly shrimp farming). The respondents were asked if they **lost any of their cultivated crops/aquaculture** because of the cyclone. FbA beneficiaries reported to have lost an average of 52 decimals of cultivated crops/aquaculture vs. 109 decimals for the comparison group (-57 decimals).

KEY FINDINGS	1
1. BACKGROUND	3
2. AIMS OF THE STUDY AND RESEARCH QUESTIONS	4
3. DATA DESCRIPTION AND DATA CLEANING	6
4. METHOD	8
5. DATA BALANCING	9
6. MAIN FINDINGS	13
7. IMPACTS OF THE INTERVENTION	25
8. REFERENCES	26
ANNEXES	27

SUMMARY REPORT

EAP CYCLONE Intervention

1. Background

Bangladesh is strongly exposed to cyclone disasters. Over the past ten years, cyclones have affected more than a million people in Bangladesh, with severe impacts on the whole country in terms of casualties, loss of livelihoods, disruptions, damages, and economic losses. The coast of Bangladesh is densely populated and highly exposed to cyclones, and every year cyclone causes enormous damages in the area. The population of the coastal area is particularly vulnerable to cyclones associated with tidal surges in the pre-monsoon months of April-May, and in the post-monsoon months of October-November (EAP Summary report, 2020). Cyclones can negatively impact personal security - by causing deaths, injuries, or health issues; infrastructure and assets – being responsible for damages or destruction; and agricultural activities - causing damages or loss of grains, crops, and livestock. The highest impacts are experienced by people living in coastal and vulnerable areas, below the poverty line, in fragile households, and with a significant number of dependents.

Forecast-based Actions (FbA) and Early Action Protocols (EAP) are a climate-related disaster interventions aiming to anticipate disaster through the implementation of planned

activities based on weather forecast information, with the final objective of reducing both the risks associated with the extreme event, and its negative consequences. The Bangladesh Red Crescent Society (BDRCS), in collaboration with other partners, organised the EAP actions for both flood and cyclones, to help vulnerable households reduce the anticipated climate-related impacts in vulnerable areas of Bangladesh. The EAP for Amphan Cyclone was activated on 18th May 2020 with technical support from the German Red Cross (GRC), the Red Cross Red Crescent Climate Centre (RCCC), and other partners.² BDRCS reached 192 shelters in 64 Unions under 10 Districts with Early Actions before the landfall. Around 36,500 beneficiaries were reached and provided dry food, safe drinking water, masks, hand sanitiser, and soap to cope with hygiene security due to Covid-19 pandemic. Shelters were disinfected before the evacuation. Livestock were also evacuated to shelters.

The EAP state that, by providing early assistance before a cyclone event, households should experience the effects of the event less harshly, in terms of fewer: deaths and injuries, damages to their assets, deaths and losses of animals.

² German Red Cross (GRC), Red Cross Red Crescent Climate Centre (RCCC), International Federation of the Red Cross Red Crescent (IFRC), American Red Cross (AmCross), Swiss Red Cross (SRC), Government of Bangladesh's Ministry of Disaster

Management and Relief and Department of Disaster Management (DDM), Bangladesh Meteorological Department (BMD), Flood Forecasting and Warning Centre (FFWC), World Food Programme (WFP).

Moreover, the FbA intervention should improve the resilience of the household after the event by reducing external money borrowing with unfavourable interest rates, the selling of valuable items (to earn money), food-based coping strategies, and the number of days household members are unable to work. At the same time, the intervention should improve the general psychological and household distress conditions (Red Cross International, 2021). After the trigger activation,³ the FbA intervention area is selected by employing (a) a forecast map identifying the areas with the highest impact levels, and (b) an exposure map estimating the percentage of houses that could be at risk of destruction in each Union. All Unions with over 25% of houses at risk are ranked as “priority” according to a vulnerability index. Subsequently, and following the order of vulnerability, the anticipatory actions are activated in all the

2. Aims of the study and research questions

The aim of this study is to assess whether the activation of the FbA intervention by the BDRCS has been effective for the beneficiaries, by conducting a counterfactual analysis using a quasi-experimental design.

The first phase of this study consisted of data cleaning and analysis of two subsample of beneficiaries and non-beneficiaries of the intervention, considering key descriptive statistics to identify the main differences between the groups. The second and main phase was the application of the best available statistical techniques to account for the main differences between the two groups.

³ The trigger will be activated when BMD issues a forecast of a cyclone making landfall in Bangladesh with wind speeds greater than 125km/h by using with global forecast models and after the consultation of relevant key stakeholders.

Unions in the list. The FbA envisage the following as key early actions at the cyclone shelters at community level: distribution of food (flattened rice, sugar, high-energy biscuits) and drinking water, provision of basic first aid, installation of artificial light facilities at night, and evacuation transportation with local tractors of people with their movable assets and livestock to the cyclone shelters (EAP Summary report, 2020). The early actions are aimed at reducing the impact of the cyclone by incentivising the population to evacuate to the cyclone shelters. The underlying rationale is that by providing evacuation transportation (for people and livestock) and emergency assistance, the evacuation ratio can be increased, thereby reducing both the loss of life and the loss of livelihood due to livestock mortality.

After the preliminary data analysis, the study explored several research questions to determine the effectiveness of the anticipatory intervention, using different outcome variables as proxies of cyclone effects to the households; such as action strategies, health and injuries, psychological distress, assets damages, animal losses, and mortality. Moreover, the study analysed the effects of the intervention on the beneficiaries’ resilience using a comparison (non-beneficiary) group as a benchmark for evaluating different indicators of resilience and recovery: external money borrowing causing indebtedness, inability to work, and emergency household assets selling.

The main research questions of the study are:

- **Did the FbA interventions reduce the impact of the cyclone on beneficiary households**, in comparison to similar households that did not receive the FbA intervention (considering damages on assets, agricultural losses, loss of animals, health problems, injuries, and personal feelings)?
- **Did the anticipatory interventions improve the conditions of recovery in the aftermath of the cyclone event for households beneficiaries of the FbA intervention**, in comparison to similar households that did not receive the FbA intervention (considering working inability, financial conditions, food-based coping strategies, destitution sales of assets)?

The main research questions split into specific objectives are the following:

- Rq 1:** *Were FbA beneficiaries better equipped and informed to evacuate than non-FbA-assisted households?*
- Rq 2:** *Did FbA beneficiaries suffer less injuries and health problems than non-FbA-assisted households in the aftermath of the cyclone?*
- Rq 3:** *Did FbA beneficiaries experience less psychological distress than non-FbA-assisted households after the cyclone event occurred?*
- Rq 4:** *Did FbA beneficiaries experience less damages to household assets than non-FbA-assisted households?*
- Rq 5:** *Did FbA beneficiaries experience lower rates of animal mortality than non-FbA-assisted households?*
- Rq 6:** *Did FbA beneficiaries accrue fewer debts during the cyclone period than non-FbA-assisted households?*
- Rq 7:** *Did FbA beneficiaries have a better experience at the shelter in terms of better services and less problems?*
- Rq 8:** *Did FbA beneficiaries make fewer destitution sales of valuable assets to cope with the cyclone impacts than non-FbA-assisted households?*
- Rq 9:** *Did FbA beneficiaries resume productive activities sooner than non-FbA-assisted households after the cyclone period?*

3. Data description and data cleaning

The study is based on a direct survey conducted in January and February 2021⁴ in the area affected by the cyclone event. The survey was developed on the field by BDRCS volunteers and it collected several demographic, social, economic, and geographical information on each respondent and her/his connected household. Additionally, several questions were asked related to the effect of the cyclone on the lives of the components of the households, damages to household assets, and coping strategies in the aftermath of the cyclone.

The respondents of the survey were divided into two groups: (a) beneficiaries of the FbA anticipatory actions considered as ‘intervention’ group, and (b) a comparison group with similar socio-economic and geographical characteristics. The survey sampling was made drawing a random sample⁵ of the shelters proportional to the total number of shelters and beneficiaries per district. For each shelter within the random sample, a team of BDRCS volunteers identified both its catchment area, beneficiaries (defined as individuals who were present at the shelter), and non-beneficiaries – both to be interviewed considering the four most vulnerable Districts (Bagerhat, Barguna, Khulna and Satkhira). Around ten beneficiaries and ten non-beneficiaries of the FbA intervention were interviewed

in each of the 28 sampled shelters. The final sample was composed of 466 households, with 275 FbA beneficiaries and 191 comparison households. The sample resulted well-balanced, with high comparability observed between the two groups. Table 1 describes the geographical distribution of the two groups by Unions.

The raw data from the survey were controlled, cleaned, and processed to create a usable dataset for standard statistical and econometric analysis. The main variables identified for the analysis were divided into confounding characteristics - used for the matching method, and outcome variables - used for measuring the impacts of the early actions on FbA beneficiaries. The final dataset is composed of 186 variables for 466 observations. Annex Tables 2 and 3 describe the main variables used in the analysis. Annex Table 2 outlines the main socio-economic, demographic, and geographical characteristics, whereas Annex Table 3 shows the main outcome variables that were analysed to assess the effectiveness of the interventions.

⁴ The survey started on the 27th of January 2021 and ended on the 6th of February 2021.

⁵ The random sampling collected data of 20 out of the 195 shelters on the list.

Table 1. Geographical distribution of FbA beneficiaries and comparison group at Union level.

Union	Comp. group	FbA	Total	Union	Comp. group	FbA	Total
Barguna	0	10	10	Maharajpur	10	13	23
Buri Goalini	10	11	21	Malliker Ber	0	40	40
Burir Char	0	10	10	Munshiganj	10	0	10
Chandpi	3	7	10	Nishanbaria	20	0	20
Chila	0	20	20	Royenda	37	0	37
Dhalua	0	8	8	Sharankhola Range	1	10	11
Dhansagar	23	0	23	Sonakata	6	0	6
Gabura	0	10	10	South Khali	16	25	41
Ishwaripur	0	10	10	Sundarban	0	10	10
Kaikhali	14	0	14	Sutarkhali	2	10	12
Kamarkhola	0	16	16	Uttar Bedkashi	30	20	50
Koyra	8	23	31	Ward No-03	0	2	2
M.baliatali	0	20	20	Ward No-04	1	0	1
Total	58	145	203	Total	133	130	263

4. Method

Because of the differences between the two groups, a “balancing method” was employed to ensure that the intervention group and the comparison group had comparable background characteristics. Otherwise, differences in their baseline or “starting conditions” could influence the extent to which the intervention affected outcomes (for example, the number of young children or elderly may affect different the early actions undertaken by the household to those without children or elderly), and therefore the analysis of the effectiveness of the intervention. The balancing method allows to simulate a randomisation of the intervention assignment by recreating random conditions; thanks to this process, the main differences in key variables can be associated only to the intervention itself. To assess the actual impact of the FbA anticipatory actions, a matching method was then employed; this consisted in developing a pairwise comparison of ‘twins’ in the two groups by combining each observation in the intervention group (households receiving the FbA anticipatory actions) with a similar observation in the comparison group (similar households for demographic, socio-economic and geographical characteristics, which did not receive the FbA intervention).

The methodological framework considered for this study is the quasi-experimental design, which recreates a randomised situation by balancing the two sample group, with the objective of reducing distortions and biases in the process of

comparison. The method which was adopted is the Propensity Score Matching (PSM) approach, which consists in using the two nearest neighbour algorithm (2NN) for comparing the two groups.⁶ As abovementioned, this method allowed to simulate an experimental and randomised situation by controlling for confounding factors which can lead to biased estimations. The use of PSM for comparing different groups is a well-established non-parametric technique method commonly used in policy evaluations and econometric analysis. This method does not rely on any distributional assumption, and it allows the identification and correction of the selection process and the imbalance of the data, thus ensuring the comparability of the two groups. This method consists in selecting sub-samples in each groups to be used for comparison, by combining the groups by similar socio-economic characteristics and then calculating the main differences between the two groups in each variable of interest. By doing this, the final difference between the two groups can be considered as caused by the implementation of the FbA intervention. In analyst jargon this difference is called ‘average treatment effect on treated’ (ATT) which in this study can be defined as the average impact of EAP and FbA anticipatory actions on beneficiaries.

The PSM method involves two steps. First, a probit regression⁷ is run which calculates the probability of being a beneficiary of EAP and FbA by conditioning on different socio-economic, demographic and geographical characteristics which might

⁶ When data were scarce 1NN was implemented when 2NN was limiting the analysis (see Cerulli, 2015).

⁷ A probit model is a non-linear regression using a dummy (0 or 1) as dependent variable describing a qualitative characteristic, in our case the characteristic is receiving the FbF (dummy=1) or not (dummy=0). The probit regression results must

be interpreted in terms of probability of the dummy of assuming the value of 1. Therefore, the estimated coefficients of the regression indicate how much each regressor contributes to the probability of having a dummy equal to 1 and it should be interpreted as ‘determinant’ or driving factor if its coefficient is statistically significant (see Wooldridge, 2013).

otherwise lead to bias in the estimations due to selection issues and unobservable characteristics (for example congenital specific skills, propensity to take risks). The resulting probability of the probit model represents a synthetic measure of all the different observable descriptive characteristics of each household considered in the survey (such as income, family status, number of family components, number of children, and education). This probability of 'being assisted' by the EAP anticipatory actions is called Propensity Score (PS) and it is used to match the two groups by finding similar 'twins' for the EAP and FbA beneficiaries households in the comparison group.

5. Data balancing

The first step of the analysis was to balance the sample in order to obtain unbiased results. Following the quasi-experimental framework, confounder variables are employed for matching the two groups which have all those characteristics approximating at most the similarities between the beneficiary group (FbA) and the comparison group (non-FbA). In this study, the following household characteristics were used as confounders: District, Upazila, shelter distance, cyclone risk index (measured on a scale from one (low exposure) to three (high exposure) depending on the level of local wind exposure)¹⁰, age of the head of the household, job type (Factor), head of the household is a female (Dummy), number of individuals living in the household, number of children in the

With the 2NN algorithm, a household in the beneficiary group is compared with the two most similar 'twins' identified by the closest distance⁸ between the levels of the PS. Then, the average of the differences between the FbA beneficiary and the two closest observations of the comparison group in terms of PS in different variables of interest used as measure of the impact of the intervention (for example level of damages, external money borrowing) is calculated, thus giving the value of the impact for that variable⁹ (for further information on PSM see Cerulli, 2015; Angrist and Pischke, 2009).

household, number of elderly in the household, presence of a widow or divorced member in the household (Dummy), presence of household components with mental health problems (Dummy), the respondent has not primary education (Dummy), the income level of the previous month, the food spending of the previous week, and whether the household is engaged in agricultural activities (Dummy).

Subsequently, the main descriptive statistics between the two groups were compared, to identify statistically significant differences which might distort the analysis. Table 4 shows the confounding variables used for matching the samples of the two groups. No evident, significant distortions between the two

⁸ 1 FbF beneficiary vs 2 observations of the comparison group with the closest PSM (Euclidean distance from the PSM of the treated). The observations not matched are discarded from the 'common support' used for the analysis.

⁹ In order to do not lose many observations we processed the analysis using different outcome variables (our variables on which consider the effectiveness of the policy) considering the different level of missing data in relation to the survey structure.

¹⁰ The scale of cyclone risk followed the scale based on local wind exposure at Union level: Wind expose area (1 - low risk), Moderate surge expose area (2 – moderate risk), High surge expose area (3 – high risk).

Table 4. Confounding variables by treatment status.

		observations		Means		Diff	St Err	t value	p value
		FbA	Comp.	FbA	Comp.				
District	Geographic indication	275	191	2.12	2.2	.08	.1	.8	.43
Upazila	Administrative indication	275	191	4.8	5.51	.71	.2	3.55***	0
Union	Administrative indication	275	191	13.08	15.72	2.64	.63	4.2***	0
Village	Village of the Hh	275	191	36.41	45.03	8.62	1.96	4.4***	0
Shelter Distance	Distance from shelter	275	160	.84	.74	-.1	.06	-1.6	.11
Cyclone risk index	Scale 1-3	275	191	1.45	1.6	.14	.07	2.05**	.04
Head age	Age of the Head of Hh	274	190	47.5	47.33	-.17	1.22	-.15	.89
Female	Hh head is female	275	190	.18	.23	.04	.04	1.2	.24
Hh people	Number of people of Hh	275	190	4.63	4.72	.08	.15	.55	.59
N children	Number of children of Hh	275	190	1.4	1.5	.1	.1	1	.31
N elderly	Number of elderly of Hh	275	190	.57	.53	-.04	.07	-.55	.59
No education	No primary education	275	191	.23	.23	0	.04	-.1	.92
Income past month	Income of the past month	264	185	7568.18	8221.62	653.44	528.36	1.25	.22
Divorce Widow i	Divorced or widow in hh	275	191	.23	.25	.02	.04	.55	.58
Mental Prob	Mental problems in hh	275	191	.16	.15	-.01	.03	-.4	.69
house type	Type of house	275	190	2.04	2.24	.2	.09	2.35**	.02
food spending	Food spending past week	271	190	1310.92	1335	24.08	76.74	.3	.75
Job Type	Main employment	275	190	6.41	6.92	.51	.36	1.4	.16
Agriculture	Hh employed in agriculture	275	191	.3	.27	-.04	.04	-.8	.42
Animals owned	Type of animals owned	275	190	42.24	41.18	-1.06	1.61	-.65	.51
N Ducks	Number of animals	275	190	.68	.64	-.03	.04	-.75	.44
N Cows & Calves	Number of animals	275	191	.26	.29	.03	.04	.7	.48
N Goats & Sheeps	Number of animals	275	191	.31	.33	.02	.04	.55	.58
N Chickens & Pigeons	Number of animals	275	191	.74	.74	0	.04	0	1

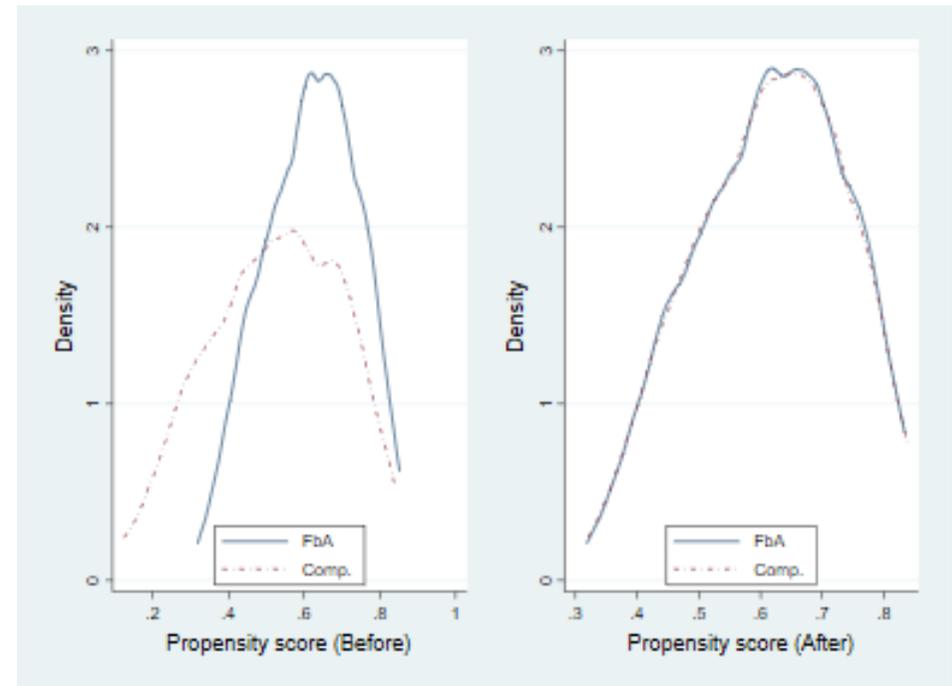
Notes: Group Means comparisons by intervention. FbA = having received the Forecast-based-Action (FbA) T-test results $H_0: \text{mean} = 0$ with unequal variance. Balance is reached when no statistically significant differences emerged between the two groups. Significant differences are indicated respectively with *90%, **95% and ***99% level of significance.

groups emerged; in other words, the data appears to be overall balanced and comparable. The two groups are not statistically different apart from few geographical confounding characteristics. The variables with statistically significant differences (meaning that data are not balanced for those characteristics) are: Upazila (t-stat > 3.55 P-Val =0), Union (t-stat > 4.2 P-Val=0), Village (t-stat > 4.4 P-Val=0) and Cyclone risk index (t-stat > 2.05 P-Val<0.5).

Although the two groups are similar, some adjustments had to be made in the two sub-sample distributions, in order to properly assess the actual effects of the FbA anticipatory actions on the beneficiaries. This is also evident when considering the kernel densities¹¹ of each variable of the two different groups. Even though the sample is well balanced, any statistically significant difference should be considered as possible bias which can lead to a 'naïve' evaluation of the intervention. The confounders (characteristics) of the two groups do not look dissimilar in their density patterns (Figure 11 in Appendix), but after the PS 'adjustment' the overlapping and balancing of the two groups substantially improved (Figure 1 and 2). That is evident in Figure 1, which shows the PS of the two groups for different outcome variables, and which clearly illustrates the improvement in terms of data comparability. Additional graphs of PSM overlapping and statistical balancing tests for the main analysis are available in the Appendix. After the matching process the two groups became strictly comparable in terms of overlapping and balancing of the PS. This indicates a good combination of 'twins' for the comparison,

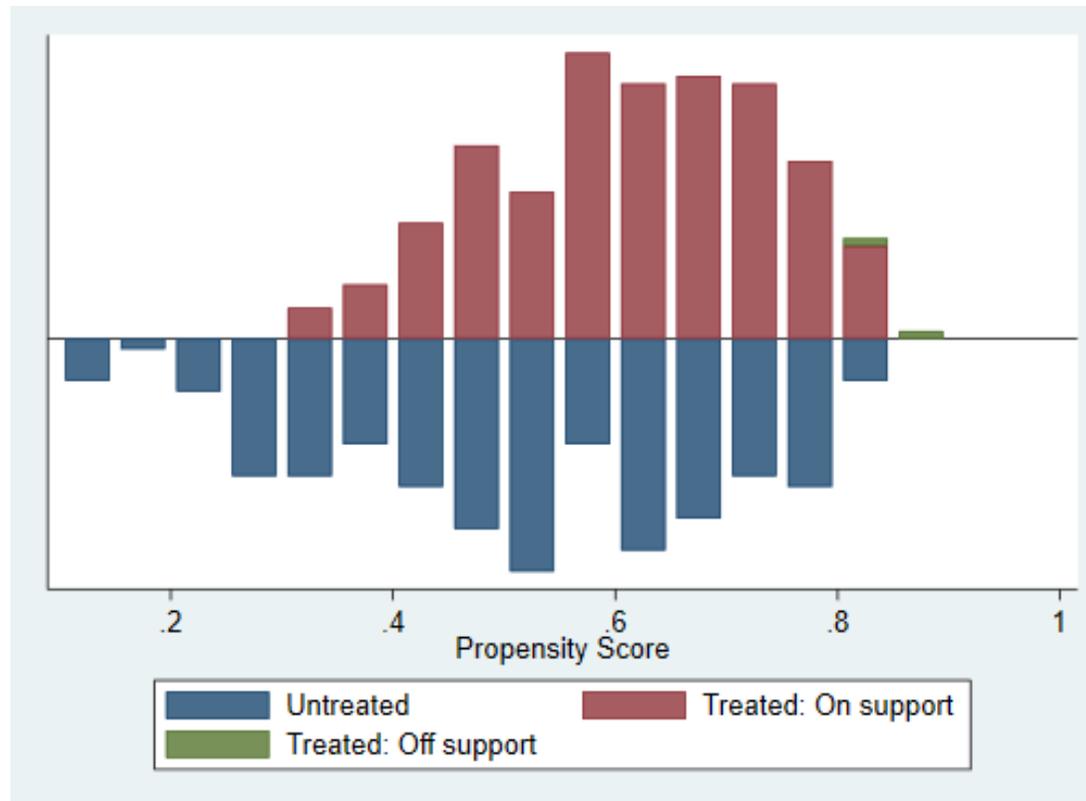
thus providing robust results on the effects of the anticipatory actions on beneficiaries.

Figure 1. PSM before matching and after matching.



¹¹ Kernel density is a graphical description of the distribution of the data.

Figure 2. Balancing and overlapping of the matching by group FbA (Treated) and Comparison group (Untreated).



6. Main Findings

The main results of the study are reported in Table 5 and in the rest of this section. The most significant expected effects and unexpected findings are highlighted. The tables only show statistically significant results and findings related to the key

variables. The main findings are further explored and discussed in detail in the following subsections with the help of graphs, tables are available in Appendix.

Table 5. Main results

Variable	Description	Unit	FbA	Comp	ATT	S.E.	T-stat	sign	n obs
Desirable effects (sign in the “correct” direction)									
Early warning and evacuation to cyclone shelters									
EvacuatedD	HH had been evacuated	Dummy	1.00	0.97	0.03	0.01	2.03	**	422
EW_sourceBRCS	Early Warning source (BRCS)	Dummy	0.33	0.13	0.20	0.05	3.87	***	416
EW_sourceMobile	Early Warning source (Mobile phone)	Dummy	0.46	0.32	0.14	0.07	2.1	**	416
EW_sourceCPP	Early Warning source (CPP)	Dummy	0.81	0.92	-0.11	0.04	-3.07	***	416
Mitigated damages and losses									
HouseRepairedD	HH repaired the house	Dummy	0.69	0.58	0.11	0.06	1.74	*	422
Livestock and agricultural impacts									
Died_AnimalsD	HH experienced death of animals	Dummy	0.49	0.63	-0.14	0.06	-2.47	**	422
ReplantD	HH replanted crops after the cyclone	Dummy	0.14	0.06	0.08	0.03	2.43	**	422
PercDied_Ducks	Died Ducks	%	0.29	0.46	-0.17	0.06	-2.98	***	278
Agriculture_Lo~t	Agricultural losses	Decimals	51.92	108.98	-57.06	33.38	-1.71	*	95
Impacts on people (health, feelings, and working activities)									

HealthProblems~l	Injury and health problems after cyclone (physical)	Dummy	0.15	0.27	-0.12	0.06	-1.8	*	211
Coping strategies and resilience after the cyclone event									
AssetSell_Hous~s	Sold assets (house items)	Dummy	0.04	0.58	-0.54	0.17	-3.12	***	81
Experience at the cyclone shelter									
ShelterExperie~e	Shelter overall experience	Scale 1-10	6.20	5.33	0.87	0.30	2.87	***	394
Services_Sh~ater	Services at shelter (Water)	Dummy	0.75	0.58	0.17	0.08	2.06	**	394
Services_Shelt~e	Services at shelter (Hygiene)	Dummy	0.41	0.29	0.12	0.07	1.69	*	394
Services_Shelt~q	Services at shelter (Sanitary equipments)	Dummy	0.62	0.33	0.29	0.06	4.59	***	394
Services_Shelt~s	Services at shelter (Lights)	Dummy	0.73	0.60	0.13	0.05	2.77	***	394
ShelterProb_No	No problems at the shelter	Dummy	0.28	0.14	0.15	0.05	2.96	***	394
ShelterProb_La~d	Problems at the shelter (Lack of Food)	Dummy	0.29	0.49	-0.20	0.06	-3.09	***	394
ShelterProb_La~r	Problems at the shelter (Lack of Water)	Dummy	0.29	0.41	-0.12	0.07	-1.77	**	394
ShelterProb_La~n	Problems at the shelter (Lack of Sanitation)	Dummy	0.43	0.61	-0.18	0.07	-2.67	***	394
ShelterProb_La~e	Problems at the shelter (Lack of Space)	Dummy	0.60	0.74	-0.14	0.06	-2.27	**	394
Unexpected effects (in the “opposite” direction)									
Damage_Vehicle	Damaged assets (Vehicles)	Dummy	0.10	0.03	0.07	0.03	2.32	**	267
AssetSell_Other	Sold assets (Others)	Dummy	0.24	0.02	0.22	0.07	3.33	***	81
Services_Shelt~k	Services at shelter (Livestock place)	Dummy	0.30	0.44	-0.14	0.07	-2.18	**	394
Action_takenEv~l	Evacuation of Animals after EW	Dummy	0.42	0.53	-0.11	0.06	-1.89	*	409

Note: The effect of the intervention is shown in column six (ATT) where the Average Treatment Effect on Treated is shown which measures the impact of the intervention as the average difference between FbA and comparison group for each variable. The t-statistics and the significance level (* 90%, ** 95%, ***99%) are shown in column eight (T-stat) and column nine respectively, while column ten (n.obs) shows the number of

observations used for the analysis of each specific variable. Shelter overall experience is measured on scale of 1 (very bad) to 10 (very good); Died Ducks in % of Died animals over total animals owned before the event.

6.1. Early warning and evacuation to cyclone shelters

The type of sources for early warning (EW) to households did not highlight any statistically significant differences between FbA beneficiaries and the comparison group. The sources of EW checked in the survey were: TV/Radio, Union Disaster Management Committee (UDM), CPP, BDRCS, Other volunteers (CDMC, others), Mobile phone, Word of mouth (neighbours, family members, friends, etc.), Looking at the weather / traditional signs.

Of those who received an early warning (98.3% of those interviewed), 33% of FbA beneficiaries said they were warned by BDRCS vs. only 13% of the comparison group were warned by BDRCS (+20%); 81% of FbA beneficiaries were warned by CPP vs. 92% of the comparison group (-11%); and 46% of FbA beneficiaries vs. 32% of the comparison group were warned by mobile phone (+14%). None of the other source of EW resulted in a statistically significant difference between the two groups, as shown in Figure 3.

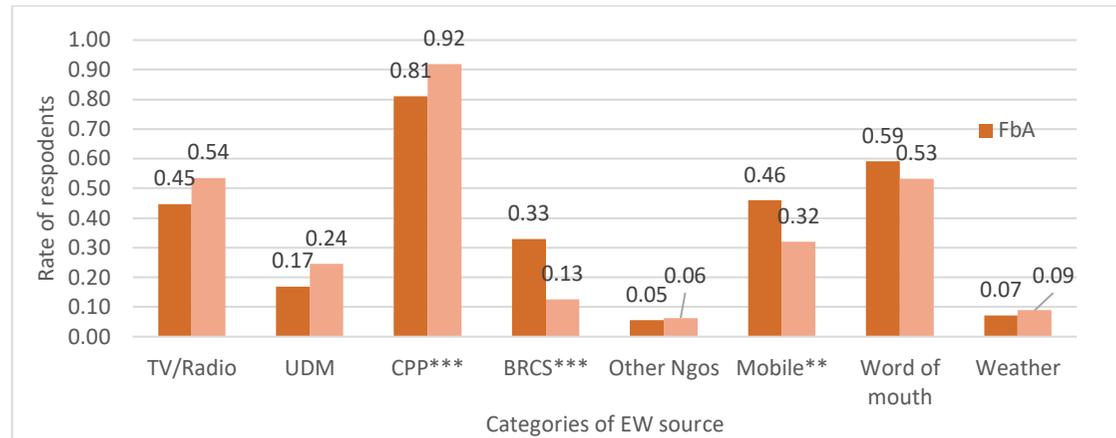
FbA assistance was effective in boosting the evacuation of households, as a statistically significant difference emerged between the two groups. Specifically, 100% of FbA beneficiaries

reported that they **evacuated to a cyclone shelter**, whereas 97% of comparison households declared the same (+3%). This means that FbA assistance appears to have been effective in making sure that *everyone* evacuates (whereas without FbA, 3% of households might not have been evacuated). The analysis thus indicates that FbA intervention successfully enabled beneficiary households to evacuate the cyclone-affected area where needed (Dummy). At the same time, other specific variables related to the action taken by the household after the EW were not statistically different between the two groups, apart from evacuation of animals; this lower among FbA beneficiaries (42%) than in the comparison group (53%) with a difference of -11%.

However, **transportation assistance did not play a role** in supporting evacuation. Only 8% of FbA beneficiaries reported that they received transportation assistance to evacuate (and many said it was from family and friends), vs. 5% of comparison group respondents (the difference is not statistically significant)¹² (Table 9 in Appendix).

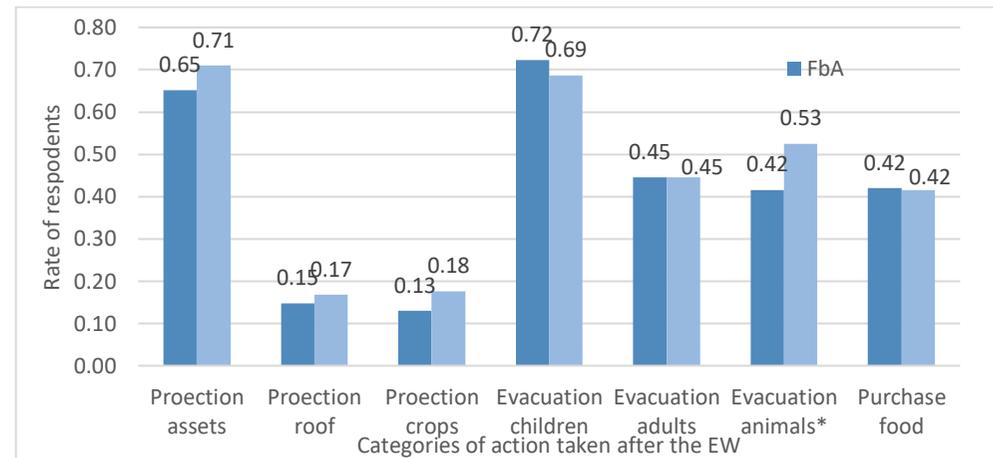
¹² This seems to be in line with information from BDRCS that no – or only very limited – evacuation transport was offered to beneficiaries. In this case, this EAP was not suitable to test the effectiveness of evacuation assistance.

Figure 3. Early Warning source by group.



Note: see Table 10 in Appendix for further detail.

Figure 4. Categories of early actions taken by households after receiving EW by group (FbA beneficiaries and comparison group).



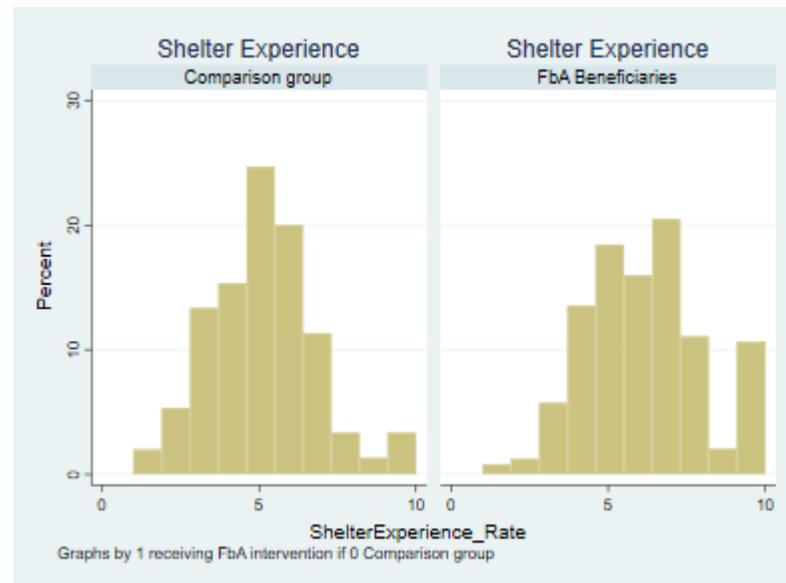
Note: see Table 11 in Appendix.

6.2. The shelter experience of households

For what concerns the experience of households at the shelter, the analysis highlighted some statistically significant differences between the two groups under analysis. In particular, FbA beneficiaries reportedly received a higher level of assistance at the shelters, they had an overall better

experience with less problems, and access to more services. The **overall shelter experience was rated better** by FbA beneficiaries, with an average score of 6.2 (out of 10) vs. 5.3 (out of 10) for the comparison group (**+0.9 points**) (Figure 9).

Figure 6. Shelter experience by groups.



Note: This variable is the declared overall level of satisfaction on a scale from 1 to 10.

6.2.1 Services at the cyclone shelter

- 75% of FbA beneficiaries reported that they received **water** at the cyclone shelter (serviced with support from BDRCS), vs. only 58% from the comparison group who were at a shelter not supported by BDRCS (+17%);
- Because of the Covid-19 pandemic, the FbA assistance was expanded to include other services which are reflected in the results:
 - 62% of FbA beneficiaries said to have received **masks and hand sanitiser** at the shelter vs. 33% of comparison households (+29%);
 - 41% of FbA beneficiaries received **hygiene items such as soap** vs. 29% of comparison households (+12%);
 - 73% of FbA beneficiaries said that **light** was provided at the shelter vs. 60% of comparison households (+13%). This matches reports from

6.2.2 Problems at the cyclone shelter

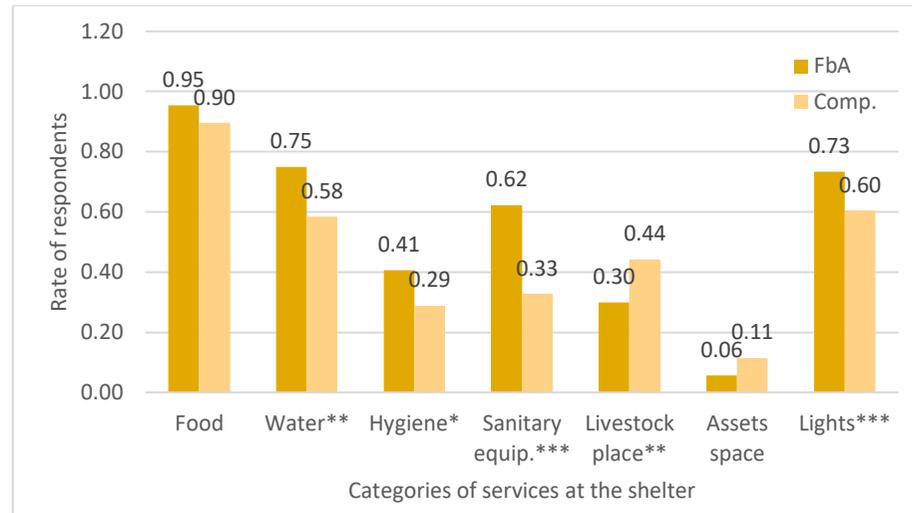
- Overall, 28% of FbA beneficiaries declared to have not faced any problem during their sheltering period vs. only 14% of comparison respondents (+15%). Among those who indicated that there were problems at the shelter:
 - 29% of FbA beneficiaries said there was a **lack of water** at the shelter vs. 49% of comparison group households (-20%);

BDRCS, who indicated that lights were provided at selected shelters.

- However, only 30% of FbA beneficiaries said there was a **place for their livestock** at the shelter vs. 44% of the comparison group (-14%), although the provision of shelter space for livestock is included in the EAP. This mainly depended on the fact that BDRCS was not able to select the shelters at which to provide services and that in many cases, these shelters were far away and difficult to reach, thus livestock shelters could not be built there.
- There is no evidence of a statistically significant difference among the two groups for what concerns food provision (Figure 10).

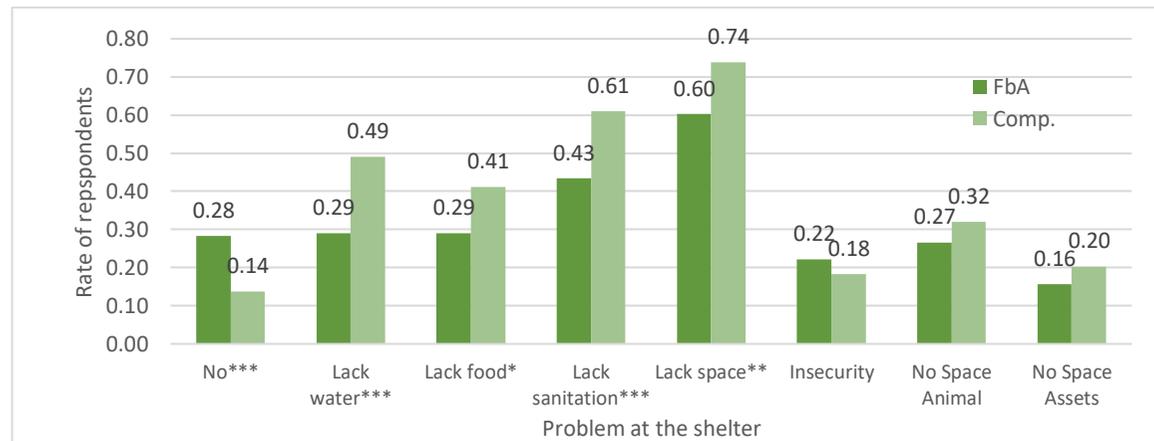
- A **lack of sanitation facilities** was experienced by 43% of FbA beneficiaries vs. 61% of the comparison group (-18%);
- 60% of FbA beneficiaries at shelters supported by BDRCS complained about the **lack of space at the shelter** (overcrowding) vs. 74% of the comparison group who experienced the same at shelters without BDRCS support (-14%) (Figure 11).

Figure 7. Services at shelter by group.



Note: Table 12 in Appendix.

Figure 8. Problems at shelter by group.

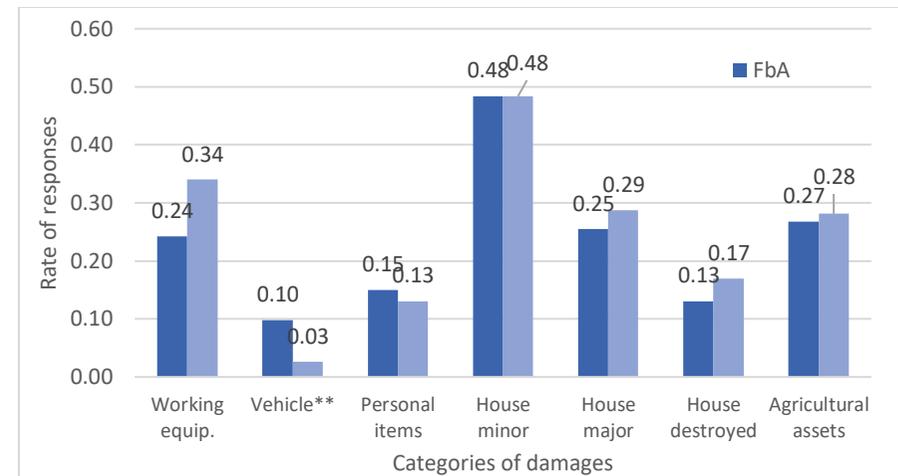


Note: Table 13 in Appendix.

6.3. Impacts on household assets

From this study, a significant difference emerged in terms of damages to houses; with the FbA beneficiaries seemingly experiencing more severe cyclone impacts on their houses than the comparison group. In fact, 69% of FbA beneficiaries indicated that their **houses were damaged** (Dummy) to some degree and needed to be repaired, vs. 58% of comparison households **(+11%)**.¹³ The analysis did not indicate further statistical differences regarding damages to households assets (personal assets, house items, working equipment) between FbA beneficiaries and the comparison group. The only significant result in terms of damages is unexpected and it is related to damages to vehicles¹⁴: FbA beneficiaries evidenced a higher level of damages (10%) than the comparison group (3%), with a statistical significant difference of **+7%**. The analysis thus suggests that anticipatory actions did not influence the level of protection of household assets and the relative impacts on those. Notably, this was not the aim of the intervention, but there is room for improvement around this aspect and consequently for increasing the positive impact of the intervention on the household's resilience level.

Figure 9. Distribution of damages categories by group.



Note: Only the difference for Damage to vehicles (opposite to what expected) is statistically significant, see Table 14 in Appendix for details.

¹³ It is important to note that protecting housing structures was not one of the objectives of the EAP.

¹⁴ This variable is a dummy indicating if the cyclone had damaged at least a vehicle owned by the household. Nobody in the sample owns a car, for vehicles has been

considered the following categories: vehicle by any animal traction (e.g., horse-drawn cart), boat, rickshaw, van (tricycle), or cycle.

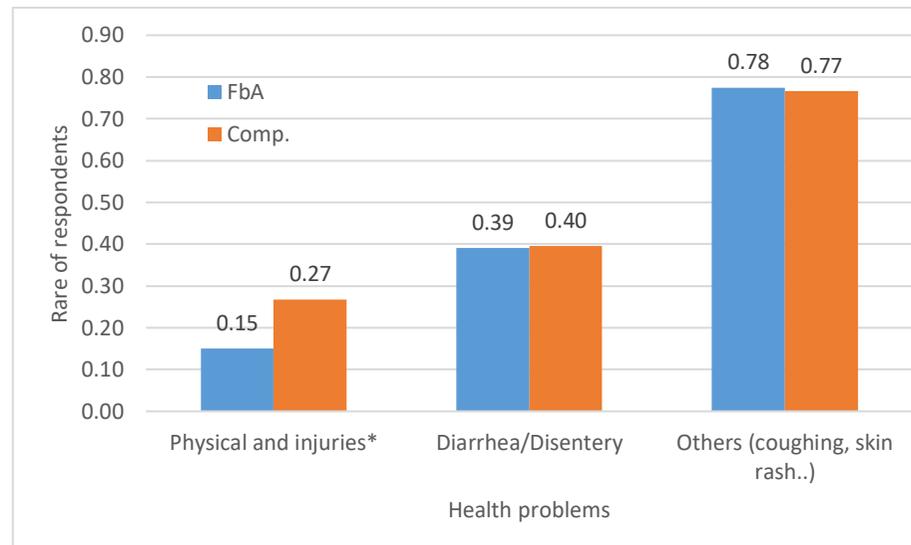
6.4. Impacts on people (health, feelings, and working activities)

FbA beneficiaries reported better physical and psychological conditions than non-beneficiaries. In particular, 15% of FbA beneficiaries reported to have experienced **health problems and physical injuries** (such as bruises and fractures) after and because of the cyclone, vs. 27% of comparison households - with a statistically significant (90% level) difference of **-12%**. With regards to the other health problems categories (“Other health problem” such as coughing, skin rash; and “Digestive health problem” such as diarrhoea, dysentery), no statistically significant differences were observed.

With regards to **personal feelings** and psychological distress in the aftermath of the cyclone event, the analysis did not evidence statistically significant differences between the two groups.

Considering effects on working activities, no statistically significant differences emerged for working activities (Dummy) and working days of inability. Indeed, there was no difference in the number of days that households were unable to work, reported at an average of 40 days per household.

Figure 10. Health problems by group.



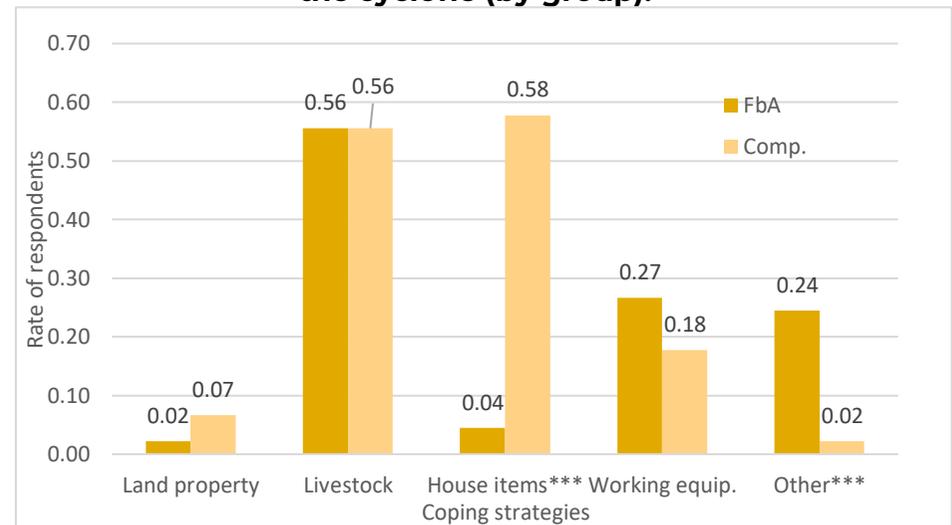
Note: Only the differences for Physical health problems (e.g. Broken bones, brouses, etc..) are statistically significant. See Table 15 in Appendix for details.

6.5. Coping strategies and resilience after the cyclone event

Anticipatory actions had an impact on coping strategies in the aftermath of the cyclone event, even if the results highlighted contrasting evidence. The analysis shows that FbA beneficiaries resorted to the destitution selling of house assets (such as cooking stoves, radios, fridges, beds, furniture) for gathering external financial resources less than the households in the comparison group: only 4% of the FbA stated to have sold house items to cope with the effects of the cyclone against 58% of the comparison group, with a statistically significant (99%) difference of **+54%**. Conversely, FbA beneficiaries sold more personal assets (the ‘other assets’ category including jewellery and clothes) as a coping strategy (24%) than the comparison group (2%), with a statistically significant difference of **+22%**. Therefore, the main coping strategy of FbA beneficiaries was apparently the destitution selling of items which can be categorised as not-primary-needs items, differently from the comparison group (Figure 11).

The analysis does not indicate that FbA beneficiaries reduced external borrowing of money to cope with financial constraints and economic issues experienced by the household because of the cyclone. A comparison of borrowing households showed no statistical differences for both the amount of money borrowed (FbA mean: 43,313 BDT, median: 25,000 BDT, std: 10,8173; Comparison group mean: 32,705 BDT, median: 20,000 BDT, std: 35,890 BDT) (Figure 12 in Appendix) and interest rates of the borrowing (FbA mean: 9.6, median: 10, std: 3.8; Comparison group mean: 9.8, median: 10, std: 3.9) (Figure 13 in Appendix).

Figure 11. Categories of HH assets sold in the aftermath of the cyclone (by group).



Note: only selling of working equipment is statistically significant, Table 16 in Appendix.

6.6. Livestock and agricultural impacts

The anticipatory interventions were effective in reducing impacts on agricultural activities. About one quarter of the survey respondents (29% of the total) said they used land (owned or rented) to cultivate crops or for aquaculture (mainly shrimp farming). The respondents were asked if they **lost any of their cultivated crops/aquaculture** because of the cyclone. FbA beneficiaries reported to have lost an average of 52 decimals of cultivated crops/aquaculture vs. 109 decimals for the comparison group (**-57 decimals**). It should be noted that the cyclone occurred during a time when there was no rice on the paddies, therefore the reported losses must refer to aquaculture (shrimp farming). Cyclone-induced losses can occur when storm surge flooding increases the water salinity to a level which is above the shrimp's tolerance. However, given that the average landholding size in Bangladesh is only 74 decimals (0.74 acres or 0.3ha), the losses of 109 decimals reported by the highly vulnerable comparison group are likely too unrealistic (Asian NGO Coalition, 2012). Moreover, the analysis evidenced that more FbA beneficiaries had to replant their crops as consequence of the cyclone (14%) than respondents in the comparison group (6%), with a statistically significant difference between the two groups of **+8%**.

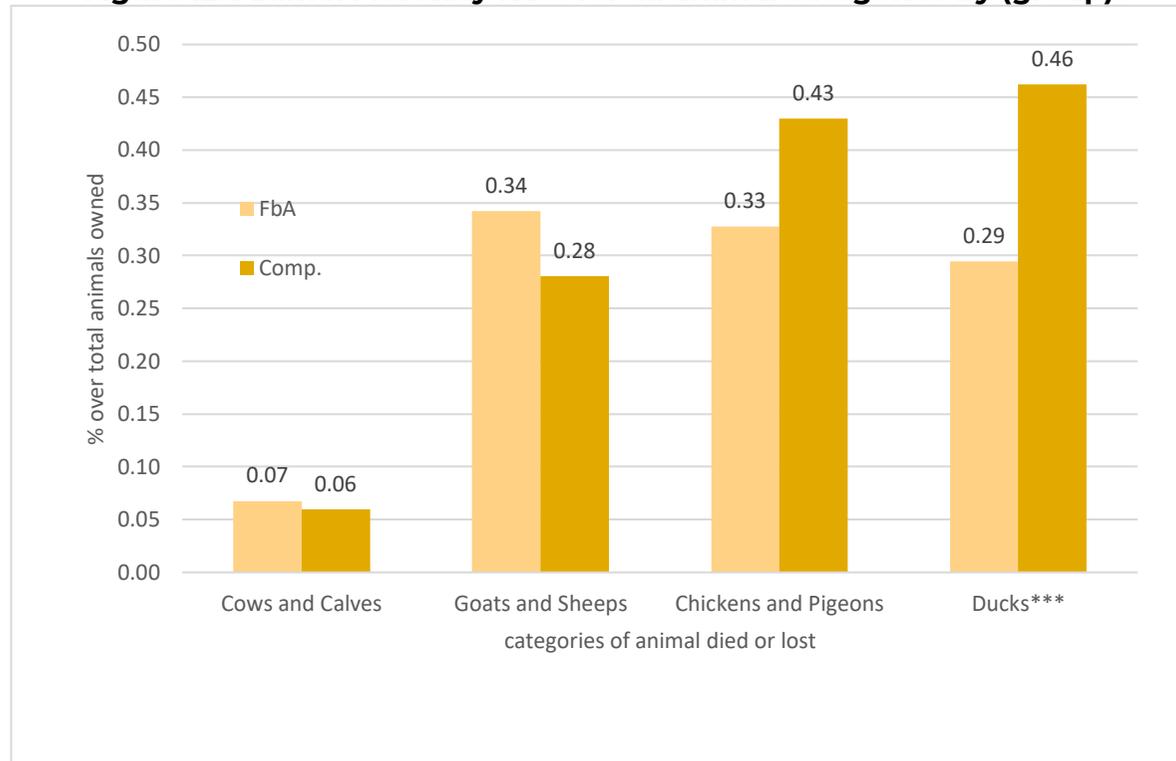
Another important impact of the cyclone has been the effect on livestock, with the FbA beneficiaries reportedly experiencing

a lower level of overall animal mortality (Dummy). The results of the analysis highlighted that 29% of the FbA beneficiaries stated that they experienced the death or loss of at least one animal because of the cyclone, against 63% of respondents from the comparison group; with a statistically significant difference of **-14%**.

The anticipatory interventions were effective in helping households protect their livestock only for the **“ducks”** category, with statistically significant differences between FbA beneficiaries and the comparison group. Out of the 69% of households in the survey who declared to have at least one duck before the cyclone (68% of EAP beneficiaries owned a duck vs 64% of the comparison group), with regards to the animal mortality rate¹⁵, the FbA beneficiaries declared to have lost 29% of their **ducks**, whereas the households in the comparison group declared a percentage death rate of 46%, with a significant statistical difference (99% level) between the two groups of **-17%**. With regards to the other categories of animals **“chickens and pigeons”**, **“cows and calves”**, and **“sheeps and goats”**, no differences emerged between the two groups in terms of animal mortality.

¹⁵ Number of dead animals over total number of animals owned before the cyclone event occurred.

Figure 12. Animal Mortality Rate for all animal categories by (group).



Note: See table 17 in Appendix for details.

7. Impacts of the intervention

Summarising the above-discussed findings, **there is statistical evidence to conclude that the FbA anticipatory actions have been effective**. The main benefits of the FbA intervention were:

1. Helping households to evacuate adult members (RQ1)
2. Reducing the overall impacts of the cyclone on the health conditions of household members (RQ2)
3. Reducing the impacts of the cyclone on livestock and agricultural activities (RQ5);
4. Improving the overall shelter experience of the household, with less problems experienced and more services received (RQ7); and
5. Reducing the selling of household assets as a coping strategy for financial and economic constraints after the cyclone event (RQ8).

No evidence was found of the effectiveness of the intervention in:

1. Improving the general psychological conditions after the cyclone event (RQ3);
2. Reducing the impacts of the cyclone on household assets (RQ4);
3. Reducing the borrowing of money and the selling of household assets as coping strategies after the cyclone event (RQ6); and
4. Improving the resilience of the household in terms of resuming working activities (RQ9).

8. References

- Angrist J.D., Pischke J.S., 2009. Mostly Harmless Econometrics. An Empiricist's companion, Princeton University Press (US).
- Asian NGO Coalition for Agrarian Reform and Rural Development (2012). *Securing the Right to Land: An Overview on Access to Land in Asia* 2nd ed. Quezon City: ANGOC. (<https://angoc.org/where-we-work/south-asia/bangladesh/>)
- Cerulli G., 2015. Econometric Evaluation of Socio-Economic Programs. Theory and Applications. Advanced Studies in Theoretical and Applied Econometrics, Springer-Verlag, Berlin (GER).
- EAP Summary report, 2020. Bangladesh: Cyclone Early Action Protocol Summary, International Federation of Red Cross and Red Cross Crescent Societies.
- Red Cross International, 2021. FbA Manual Introduction, available at <https://climatecentre.org/training/module-2/subitem-2a> (accessed on April 2021)
- Wooldridge J.M., 2013. Introductory Econometrics A Modern Approach, fifth Edition, Nelson Education, Ltd (CAN).

Annexes

A.1. Other tables

Table 2. Descriptive statistic of the variables detailing socio-economic, demographic and geographic characteristics used for matching the two groups.

Variable	Type	Description	Obs	Mean	Median	Std. Dev.	Min	Max
DistrictC	Factor	District where household (HH) is located	466	2.15	2	1.111	1	4
UpazilaC	Factor	Upazila where HH is located	466	5.09	5	2.155	1	8
UnionC	Factor	Union where HH is located	466	14.161	15	6.822	1	26
VillageNameC	Factor	Village where HH is located	466	39.94	41	21.177	1	78
Shelter Distance	Km	Distance from the shelter	435	0.801	.5	0.638	0.01	5
risk index	Factor	Scale of risk to cyclone hazard	466	1.513	1	0.731	1	3
head age	Numeric	Age of the HH head	464	47.431	46	12.912	17	90
female	Dummy	HH head is female	465	0.2	0	0.4	0	1
hh people	Numeric	Number of person living in the HH	465	4.667	4	1.637	1	11
hh children	Numeric	Number of children in the HH	465	1.443	1	1.007	0	5
hh elderly	Numeric	Number of elderly in the HH	465	0.553	0	0.693	0	3
noeduc	Dummy	HH head received no education	466	0.227	0	0.42	0	1
Income pastmonth	Numeric	Income of the past month (in BdT)	449	7837	7000	5513	1000	30000
DivorceWidowD	Dummy	divorced or widow in HH	466	0.238	0	0.426	0	1
MentalProbD	Dummy	mental problem in HH	466	0.155	0	0.362	0	1
house typeC	Factor	Type of house	465	2.123	2	0.912	1	5
food spending Amount	Numeric	Money spent for food past week	461	1320	1100	810	150	7000
Job typeC	Factor	Main work occupation in the HH	465	6.617	5	3.834	1	15
AgricultureD	Dummy	HH is employed in agriculture	466	0.288	0	0.453	0	1
Animalsbefore C	Factor	Type of animals owned by HH before the cyclone	465	41.809	44	17.051	1	70
AnimalsbeforeN Ducks	Dummy	Type of animals owned (Ducks)	465	0.662	1	0.473	0	1
AnimalsbeforeCows ~s	Dummy	Type of animals owned (Cows/Calves)	466	0.27	0	0.445	0	1
AnimalsbeforeGoats~p	Dummy	Type of animals owned (Goats/Sheeps)	466	0.315	0	0.465	0	1
AnimalsbeforeChick~s	Dummy	Type of animals owned (Chickens/Pigeon)	466	0.738	1	0.44	0	1

Table 3. Descriptive statistics of the main variables for the analysis.

Variable	Type	Description	Obs	Mean	Median	Std. Dev.	Min	Max
Damage WorkEquip	Dummy	Working equipment damaged	297	0.263	0	0.441	0	1
Damage Vehicle	Dummy	Vehicle damaged	297	0.064	0	0.245	0	1
Damage items	Dummy	Household assets damaged	297	0.141	0	0.349	0	1
OtherDamage Hous~nor	Dummy	Minor damages to house	297	0.498	0	0.501	0	1
OtherDamage Hous~jor	Dummy	Major damages to house	297	0.256	0	0.437	0	1
OtherDamage HouseD~d	Dummy	Destroyed house	297	0.155	0	0.362	0	1
Damage items Agric	Dummy	Agricultural assets damaged	297	0.286	0	0.453	0	1
PercDied CowsCalves	Fractional	Animal death rate (Cows and Calves)	126	0.057	0	0.185	0	1
PercDied GoatsSheep	Fractional	Animal death rate (Goats and Sheeps)	147	0.357	.25	0.386	0	1
PercDied ChickenPi~s	Fractional	Animal death rate (Chickens and Pigeons)	344	0.368	.25	0.397	0	1
PercDied Ducks	Fractional	Animal death rate (Ducks)	308	0.341	.052	0.401	0	1
BorrowedMoney Amount	Numerical	Amount of money borrowed (in BdT)	200	29310	24500	22399	40	100000
Interest Rate	Numerical	Interest rate of borrowing	162	9.69	10	3.875	1	20
EW ReceivedD	Dummy	HH received EW	466	0.983	1	0.13	0	1
EvacuatedD	Dummy	HH evacuated members	466	0.938	1	0.242	0	1
Action takenD	Dummy	HH take any actions	466	0.968	1	0.177	0	1
Died AnimalsD	Dummy	HH experienced animal losses	466	0.5	.5	0.501	0	1
Agriculture LostD	Dummy	HH experienced losses of grains, crops or stocks	466	0.215	0	0.411	0	1
BorrowedMoneyD	Dummy	HH borrowed money	466	0.429	0	0.495	0	1
ReplantD	Dummy	HH replanted crops	466	0.116	0	0.32	0	1
OtherDamageD	Dummy	HH experienced other damages	466	0.637	1	0.481	0	1
SoldAssetsD	Dummy	HH sold assets	466	0.2	0	0.4	0	1
HealthProblemsD	Dummy	HH had health problem	466	0.457	0	0.499	0	1
UnableWorkD	Dummy	HH had a member unable to work	466	0.646	1	0.479	0	1
HouseRepairedD	Dummy	HH had to fix part of the house	466	0.648	1	0.478	0	1
AssetSell Landprop	Dummy	Sold assets (Land prop.)	93	0.075	0	0.265	0	1
AssetSell Livestock	Dummy	Sold assets (Livestock)	93	0.548	1	0.5	0	1
AssetSell HouseItems	Dummy	Sold assets (house items)	93	0.086	0	0.282	0	1
AssetSell WorkEquip	Dummy	Sold assets (Agricultural equipment)	93	0.194	0	0.397	0	1
AssetSell Other	Dummy	Sold assets (Other)	93	0.237	0	0.427	0	1
HealthProblems Phy~l	Dummy	Injury after flood (physical injuries)	213	0.183	0	0.388	0	1
Health Diarrhea	Dummy	Illness after flood (digestive system)	213	0.394	0	0.49	0	1
Health Others	Dummy	Illness after flood (others e.g. cough, skin rash)	213	0.765	1	0.425	0	1
Feeling scale	Scale 1-5	Personal feelings and psychological distress	466	2.803	3	1.109	0	5

Notes: the abbreviation HH indicates Household. For the full table see Annex table A.1

Table 6. Descriptive statistics for the outcome variables considering the whole sample.

Variable	Type	Description	Obs	Mean	Std. Dev.	Min	Max
EW sourceTVRadio	Dummy	Early Warning source (TV/Radio)	458	0.493	0.501	0	1
EW sourceUDM	Dummy	Early Warning source (UDM)	458	0.207	0.406	0	1
EW sourceCPP	Dummy	Early Warning source (CPP)	458	0.858	0.349	0	1
EW sourceBRCS	Dummy	Early Warning source (Other Ngos)	458	0.229	0.421	0	1
EW sourceOtherNGO	Dummy	Early Warning source (BRCS)	458	0.059	0.236	0	1
EW sourceMobile	Dummy	Early Warning source (Mobile phone)	458	0.463	0.499	0	1
EW sourceWordmouth	Dummy	Early Warning source (Word of mouth)	458	0.596	0.491	0	1
EW sourceWeather	Dummy	Early Warning source (Looking weather)	458	0.085	0.279	0	1
EW sourceOthers	Dummy	Early Warning source (Others)	458	0.002	0.047	0	1
Action takenProtAs~t	Dummy	Action taken after EW (Protection assets)	451	0.656	0.475	0	1
Action takenProtRoof	Dummy	Action taken after EW (Protection roof)	451	0.164	0.371	0	1
Action takenProtCr~s	Dummy	Action taken after EW (Protection crop)	451	0.151	0.358	0	1
Action takenEvaChild	Dummy	Action taken after EW (Evacuation children)	451	0.703	0.457	0	1
Action takenEvaAdult	Dummy	Action taken after EW (Evacuation adults)	451	0.463	0.499	0	1
Action takenEvaAni~l	Dummy	Action taken after EW (Purchasing food)	451	0.435	0.496	0	1
Action takenPurchF~d	Dummy	Action taken after EW (Evacuation animals)	451	0.432	0.496	0	1
Action takenOther	Dummy	Action taken after EW (Other)	451	0.002	0.047	0	1
Damage WorkEquip	Dummy	Working equipment damaged	297	0.263	0.441	0	1
Damage Vehicle	Dummy	Vehicle damaged	297	0.064	0.245	0	1
Damage items	Dummy	Household assets damaged	297	0.141	0.349	0	1
OtherDamage Hous~nor	Dummy	Minor damages to house	297	0.498	0.501	0	1
OtherDamage Hous~jor	Dummy	Major damages to house	297	0.256	0.437	0	1
OtherDamage HouseD~d	Dummy	Destroyed house	297	0.155	0.362	0	1
Damage items Agric	Dummy	Agricultural assets damaged	297	0.286	0.453	0	1
PercDied CowsCalves	Fractional	Animal death rate (Cows and Calves)	126	0.057	0.185	0	1
PercDied GoatsSheep	Fractional	Animal death rate (Goats and Sheep)	147	0.357	0.386	0	1
PercDied ChickenPi~s	Fractional	Animal death rate (Chickens and Pigeons)	344	0.368	0.397	0	1
PercDied Ducks	Fractional	Animal death rate (Ducks)	308	0.341	0.401	0	1
BorrowedMoney Amount	Numerical	Amount of money borrowed	200	29310	22399	40	100000
Interest Rate	Numerical	Interest rate of borrowing	162	9.69	3.875	1	20
EW ReceivedD	Dummy	HH received EW	466	0.983	0.13	0	1

EvacuatedD	Dummy	HH evacuated members	466	0.938	0.242	0	1
Action takenD	Dummy	HH undertake actions	466	0.968	0.177	0	1
Died AnimalsD	Dummy	HH experience animal losses	466	0.5	0.501	0	1
Agriculture LostD	Dummy	HH experience losses of grains, crops or stocks	466	0.215	0.411	0	1
BorrowedMoneyD	Dummy	HH borrowed external money	466	0.429	0.495	0	1
ReplantD	Dummy	HH replant crops	466	0.116	0.32	0	1
OtherDamageD	Dummy	HH experienced other damages	466	0.637	0.481	0	1
SoldAssetsD	Dummy	HH sold assets	466	0.2	0.4	0	1
HealthProblemsD	Dummy	HH had health problem	466	0.457	0.499	0	1
UnableWorkD	Dummy	HH had a component unable to work	466	0.646	0.479	0	1
HouseRepairedD	Dummy	HH had to fix part of the house	466	0.648	0.478	0	1
AssetSell Landprop	Dummy	Sold assets (Land prop.)	93	0.075	0.265	0	1
AssetSell Livestock	Dummy	Sold assets (Livestock)	93	0.548	0.5	0	1
AssetSell HouseItems	Dummy	Sold assets (house items)	93	0.086	0.282	0	1
AssetSell WorkEquip	Dummy	Sold assets (Agriculture equipment)	93	0.194	0.397	0	1
AssetSell Other	Dummy	Sold assets (Other)	93	0.237	0.427	0	1
HealthProblems Physical	Dummy	Injury after cyclone (physical injuries)	213	0.183	0.388	0	1
Health Diarrhea	Dummy	Injury after cyclone (digestive system)	213	0.394	0.49	0	1
Health Others	Dummy	Injury after cyclone (others e.g. cough, skin rash)	213	0.765	0.425	0	1
Feeling scale	Scale 1-5	Personal feelings and psychological distress	466	2.803	1.109	0	5
ShelterProb No	Dummy	HH did not have problems at shelter	435	0.232	0.423	0	1
ShelterProb LackFood	Dummy	Problem(food)	435	0.363	0.481	0	1
ShelterProb LackWater	Dummy	Problem(water)	435	0.34	0.474	0	1
ShelterProb LackSan	Dummy	Problem(sanitary items)	435	0.476	0.5	0	1
ShelterProb LackSpace	Dummy	Problem(soap and hygiene)	435	0.628	0.484	0	1
ShelterProb Insecurity	Dummy	Problem(security)	435	0.209	0.407	0	1
ShelterProb SmallSpace	Dummy	Problem(no space animal)	435	0.285	0.452	0	1
ShelterProb SmallAssets	Dummy	Problem(no space assets)	435	0.175	0.38	0	1
Services ShelterFood	Dummy	Service at shelter(food)	435	0.922	0.269	0	1
Services ShelterWater	Dummy	Service at shelter(water)	435	0.678	0.468	0	1
Services ShelterHygiene	Dummy	Service at shelter(hygiene items)	435	0.336	0.473	0	1
Services ShelterSanitary	Dummy	Service at shelter(soap and sanitary)	435	0.462	0.499	0	1
Services ShelterLivestock	Dummy	Service at shelter(livestock space)	435	0.333	0.472	0	1
Services ShelterAssets	Dummy	Service at shelter(assets space)	435	0.053	0.224	0	1
Services ShelterLights	Dummy	Service at shelter(lights)	435	0.71	0.454	0	1
Services ShelterOthers	Dummy	Service at shelter(others)	435	0.005	0.068	0	1

A.2 Graphs and balancing tests

Figure 13. K-density of the characteristic of Table 1.

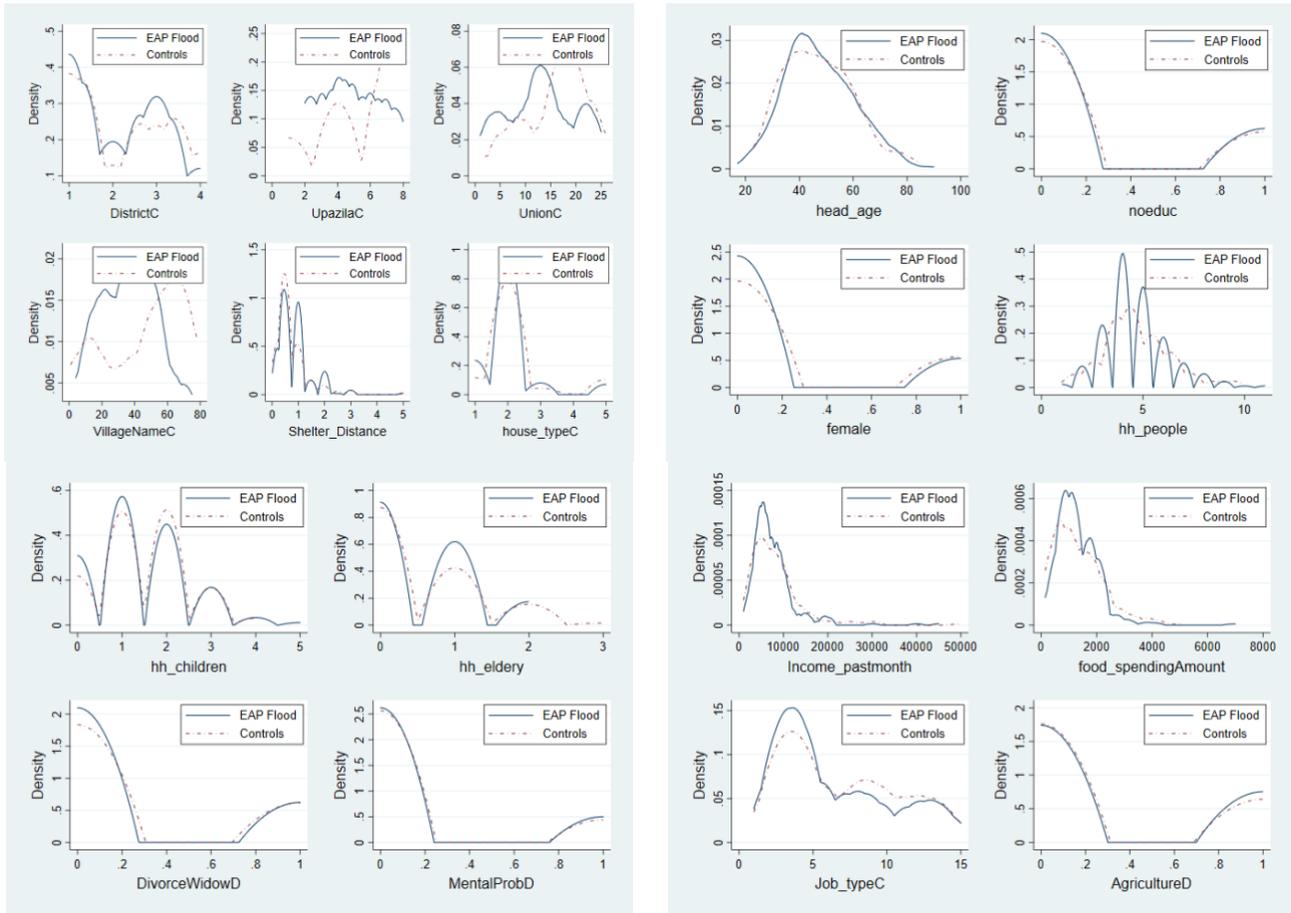


Figure 13. PSM balancing test for action taken after EW.

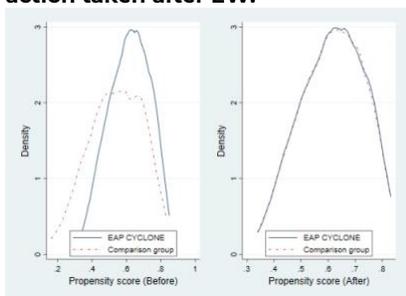


Figure 14. PSM balancing test for agricultural damages.

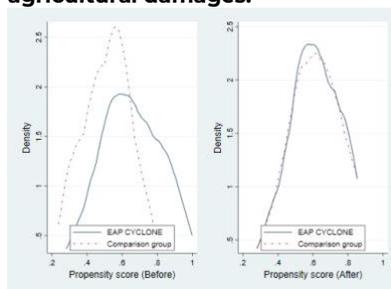


Figure 15. PSM balancing test for Animal Death Rate (Cows and Calves).

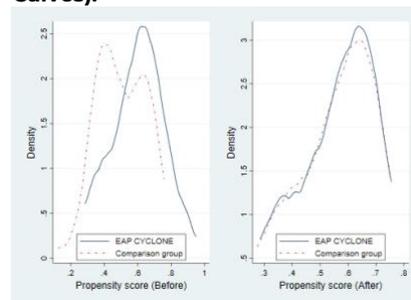


Figure 16. PSM balancing test for health problems.

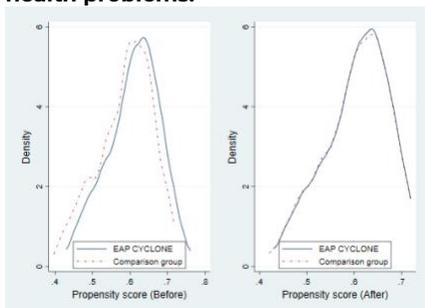


Figure 17. PSM balancing test for unable to work (dummy).

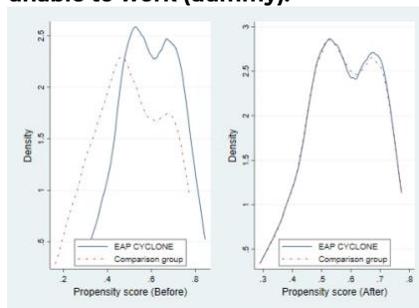


Figure 18. PSM balancing test for sold any assets (dummy).

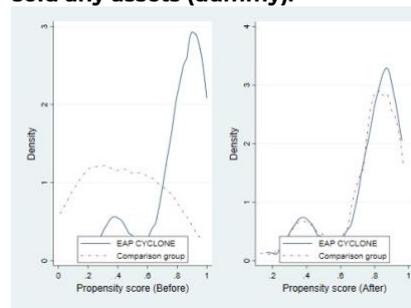


Table 7. Probit regression as first step for PSM calculus for full observed outcome variable (with non-missing).

treated	Coef.	Std.	Err.	z	P>z	[95%Conf.Interval]
UpazilaC	-0.13276	0.033547	-3.96	0	-0.19852	-0.0670121
Shelter_DistanceC	-0.23515	0.070677	-3.33	0.001	-0.37368	-0.0966266
risk_index	-0.32183	0.102764	-3.13	0.002	-0.52324	-0.1204163
house_typeC	-0.10378	0.070838	-1.47	0.143	-0.24262	0.0350607
head_age	0.001203	0.005525	0.22	0.828	-0.00962	0.0120316
female	-0.21119	0.175219	-1.21	0.228	-0.55462	0.1322325
hh_people	0.005924	0.053891	0.11	0.912	-0.0997	0.1115475
hh_children	-0.014	0.081716	-0.17	0.864	-0.17416	0.1461578
hh_elderly	0.003158	0.107749	0.03	0.977	-0.20803	0.2143419
noeduc	-0.04128	0.15706	-0.26	0.793	-0.34911	0.2665539
Income_pastmonth	-1.8E-05	1.32E-05	-1.34	0.179	-4.4E-05	8.17E-06
food_spendingAmount	0.000111	9.42E-05	1.18	0.238	-7.4E-05	0.0002958
AgricultureD	0.04284	0.154825	0.28	0.782	-0.26061	0.346292
DivorceWidowD	-0.12621	0.159018	-0.79	0.427	-0.43787	0.1854639
MentalProbD	0.060116	0.179774	0.33	0.738	-0.29223	0.4124658
_cons	1.980953	0.45214	4.38	0	1.094774	2.867131
Obs	422					
Pseudo R2	0.072					

Table 8. Balancing test for the confounders used in the probit (fig.6).

	Unmatched	Mean	%reduct	t-test				
Variable	Matched	FbA	Comparison	%bias	bias	t	p>t	V(T)/V(C)
UpazilaC	U	4.9098	5.5449	-29.6	-3.03	0.003	0.74*	
	M	4.9215	4.8368	3.9	86.7	0.42	0.674	0.67*
Shelter_DistanceC	U	1.5738	1.8989	-33.7	-3.53	0	0.41*	
	M	1.5785	1.5227	5.8	82.8	0.78	0.434	0.8
risk_index	U	1.4385	1.5787	-19.8	-2	0.046	1.03	
	M	1.4421	1.5	-8.2	58.7	-0.85	0.398	0.83
house_typeC	U	2.0492	2.2247	-18.9	-1.94	0.053	0.73*	
	M	2.0579	2.0744	-1.8	90.6	-0.23	0.821	1.29*
head_age	U	47.701	47.174	4.1	0.42	0.678	0.98	
	M	47.607	47.432	1.4	66.7	0.15	0.882	0.94
female	U	0.17213	0.22472	-13.2	-1.35	0.178	.	
	M	0.17355	0.16942	1	92.1	0.12	0.904	.
hh_people	U	4.6926	4.6573	2.1	0.22	0.827	0.83	
	M	4.6818	4.5847	5.9	-174.9	0.62	0.536	0.70*
hh_children	U	1.4385	1.4607	-2.2	-0.22	0.823	1.2	
	M	1.4339	1.4793	-4.6	-105.2	-0.5	0.618	1.19
hh_elderly	U	0.56148	0.53371	3.9	0.4	0.687	0.82	
	M	0.55785	0.55579	0.3	92.6	0.03	0.975	0.75*
noeduc	U	0.22541	0.24157	-3.8	-0.39	0.699	.	
	M	0.21901	0.20248	3.9	-2.3	0.44	0.657	.
Income_pastmonth	U	7485.7	8238.8	-13.3	-1.37	0.171	0.65*	
	M	7497.9	7833.7	-5.9	55.4	-0.74	0.462	1.02
food_spendingAmount	U	1311.7	1298	1.7	0.17	0.864	0.69*	
	M	1306	1332.2	-3.2	-91.4	-0.34	0.735	0.62*
AgricultureD	U	0.29098	0.25281	8.6	0.87	0.387	.	
	M	0.28926	0.28719	0.5	94.6	0.05	0.96	.
DivorceWidowD	U	0.21311	0.25843	-10.7	-1.09	0.277	.	
	M	0.21488	0.20868	1.5	86.3	0.17	0.868	.
MentalProbD	U	0.15574	0.1573	-0.4	-0.04	0.965	.	

Note: after the matching a balancing test is run to test the overall pping. Rule of thumb is not having a statistically significant difference after matching (M), to see that one should look at t-stat and p-val after matching (M). Here is evident how the balancing worked well as no there are not differences after matching.

A.3 Results table and graphs.**Table 9. Transportation assistance: Frequencies, percentage and cumulated frequencies.**

Transportation assistance	Freq.	Percent	Cum.
Bangladesh Red Crescent Society	2	7.41	7.41
Cyclone Preparedness Programme (CPP)	6	22.22	29.63
Don't know	1	3.7	33.33
Family / friends / neighbours	10	37.04	70.37
Government	7	25.93	96.3
Other	1	3.7	100
Total	27	100	

Table 10. Categories of Early Warning (EW) source by group (C comparison group, FbA Forecast Based Actions).

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
TV/Radio	0.45	0.54	-0.09	0.07	-1.31		416
UDM	0.17	0.24	-0.08	0.06	-1.26		416
CPP	0.81	0.92	-0.11	0.04	-3.07	***	416
BRCS	0.33	0.13	0.20	0.05	3.87	***	416
Other Ngos	0.05	0.06	-0.01	0.03	-0.31		416
Mobile	0.46	0.32	0.14	0.07	2.1	**	416
Word of mouth	0.59	0.53	0.06	0.07	0.87		416
Weather	0.07	0.09	-0.02	0.04	-0.47		416
Others	0.00	0.00	0.00	0.00	1		416

Table 1. Type of action undertaken by the HH after the EW by group.

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
Proection assets	0.65	0.71	-0.06	0.06	-0.99		409
Proection roof	0.15	0.17	-0.02	0.04	-0.52		409
Proection crops	0.13	0.18	-0.05	0.04	-1.07		409
Evacuation children	0.72	0.69	0.04	0.06	0.61		409
Evacuation adults	0.45	0.45	0.00	0.06	0		409
Evacuation animals	0.42	0.53	-0.11	0.06	-1.89	*	409
Purchase food	0.42	0.42	0.00	0.06	0.07		409
Other	0.00	0.00	0.00	0.00	1.22		409

Note: Comp. = comparison group

Table 2. Type of service at shelter by group.

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
Food	0.95	0.90	0.06	0.05	1.24		394
Water	0.75	0.58	0.17	0.08	2.06	**	394
Hygiene	0.41	0.29	0.12	0.07	1.69	*	394
Sanitary equip.	0.62	0.33	0.30	0.06	4.59	***	394
Livestock place	0.30	0.44	-0.14	0.07	-2.18	**	394
Assets space	0.06	0.11	-0.06	0.04	-1.6		394
Lights	0.73	0.60	0.13	0.05	2.77	***	394
Others	0.00	0.01	-0.01	0.01	-1.22		394

Note: *Comp.* = comparison group

Table 3. Type of problem at shelter by group.

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
No	0.28	0.14	0.15	0.05	2.96	***	394
Lack water	0.29	0.49	-0.20	0.06	-3.09	***	394
Lack food	0.29	0.41	-0.12	0.07	-1.77	*	394
Lack sanitation	0.43	0.61	-0.18	0.07	-2.67	***	394
Lack space	0.60	0.74	-0.14	0.06	-2.27	**	394
Insecurity	0.22	0.18	0.04	0.06	0.67		394
No Space Animal	0.27	0.32	-0.05	0.06	-0.84		394
No Space Assets	0.16	0.20	-0.05	0.06	-0.78		394

Note: *Comp.* = comparison group

Table 14. Categories of damages (dummies).

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
Working equip.	0.24	0.34	-0.10	0.08	-1.2		267
Vehicle	0.10	0.03	0.07	0.03	2.32	**	267
Personal items	0.15	0.13	0.02	0.06	0.33		267
House minor	0.48	0.48	0.00	0.08	0		267
House major	0.25	0.29	-0.03	0.07	-0.44		267
House destroyed	0.13	0.17	-0.04	0.06	-0.66		267
Agricultural assets	0.27	0.28	-0.01	0.08	-0.16		267

Note: *Comp.* = comparison group

Table 15. Health problems by groups.

Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs	
Physical and injuries		0.15	0.27	-0.12	0.06	-1.8	*	205
Diarrhea/Disentery		0.39	0.40	0.00	0.09	-0.05		205
Others (coughing, skin rash..)		0.78	0.77	0.01	0.08	0.11		205

Note: *Comp.* = comparison group

Table 16. Assets sold by category and group.

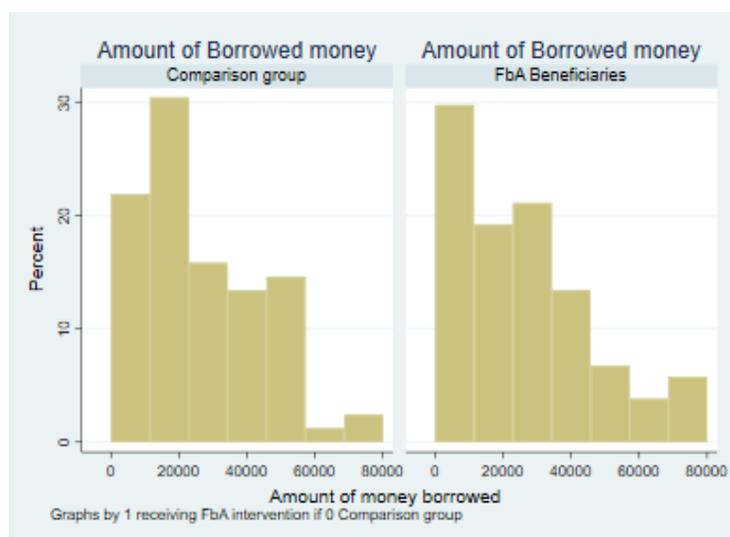
Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
Land property	0.02	0.07	-0.04	0.05	-0.82		81
Livestock	0.56	0.56	0.00	0.31	0		81
House items	0.04	0.58	-0.53	0.17	-3.12	***	81
Working equip.	0.27	0.18	0.09	0.15	0.61		81
Other	0.24	0.02	0.22	0.07	3.33	***	81

Note: *Comp.* = comparison group

Table 4. Animal mortality rate by groups.

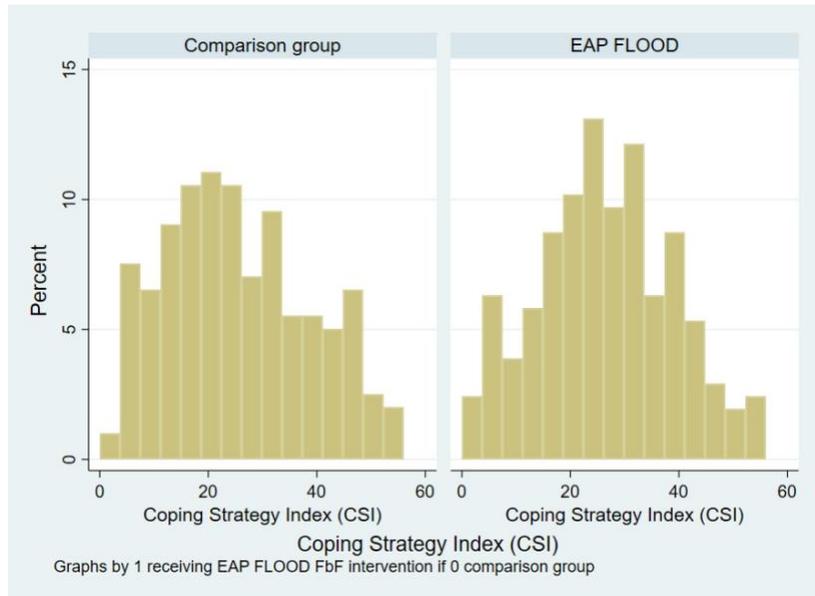
Variable	FbA	Comp.	ATT	S.E.	T-stat	sign	n.obs
Cows and Calves	0.07	0.06	0.01	0.05	0.16		110
Goats and Sheeps	0.34	0.28	0.06	0.08	0.77		133
Chickens and Pigeons	0.33	0.43	-0.10	0.07	-1.53		311
Ducks	0.29	0.46	-0.17	0.06	-2.98	***	278

Note: *Comp.* = comparison group

Figure 19. Amount of money borrowed by group (no significant differences).

Note: *Neither the amount of money borrowed is significant nor the dummy indicating whether the household borrowed money or not.*

Figure 22. Coping Strategy Index (CSI) by group(no significant differences).



Note: CSI is a composite indicator related to the number of days spent in changing diet or other food-based coping strategy (Maxwell and Caldwell, 2008).