Anticipatory Cash Transfers in Climate Disaster Response
Pre-analysis Plan

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Abstract

Monsoon flooding has become more intense in recent years due to climate change and surpasses the ability of communities to cope, leading to the loss of livelihoods, assets and lives. It is often possible to predict severe monsoon flooding events. We exploit a natural experiment to explore the question of whether anticipatory cash transfers reduce the effects of a flooding shock on household economic outcomes and welfare. This document outlines our pre-analysis plan.

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1 Introduction

Monsoon flooding has become more intense in recent years due to climate change and surpasses the ability of communities to cope, leading to the loss of livelihoods, assets and lives. It is often possible to predict severe monsoon flooding events. A targeted anticipatory approach has the promise to offer a more timely and effective solution that reduces the effects of the shock on household economic outcomes and welfare.

In 2020, monsoon floods in Bangladesh were the second highest since 1989 and the second longest since 1998. Over 5.4 million people were affected. In July 2020, building on earlier experience of anticipatory action in Bangladesh piloted by IFRC/BDRCS, the United Nations piloted a novel approach to humanitarian financing by employing a data-driven forecast to predict the risk of excess flooding along the Jamuna River in Bangladesh. This forecast was used to trigger the release of anticipatory cash transfers worth $53 to 22,434 affected households a few days prior to and during the flooding shock. This approach contrasts to a traditional policy response, whereby a severe shock occurs first and the policy subsequently responds to a materialised need. We evaluate the effect of an anticipatory cash transfer on household behaviour and outcomes during one of the most severe and protracted flooding events in decades.

This document outlines our pre-analysis plan, summarising the intervention, experimental design, data and empirical strategy. Our experimental design takes the form of a quasi-natural experiment. We were not involved in the randomisation. Instead, we exploit the exogenous variation induced by administrative hurdles encountered by our implementation partner that prevented similar households from receiving the intervention. For this reason, we also outline how we intend to construct our treatment and counterfactual groups and the relevant robustness checks in the pre-analysis plan.

At present, there is a possibility that we may be able to evaluate the effect of a post-flood cash transfer that was delivered three months after the flood peak in late October 2020, following the same targeting strategy as the anticipatory cash transfer. Should this possibility materialise, we will submit a supplementary document pre-specifying our intended analysis.

2 Description of the intervention

2.1 Overview of anticipatory action approach

In the traditional policy model, a negative shock first occurs, which triggers a policy response to address the materialised need. In contrast, an anticipatory action approach provides a policy response to a risk in anticipation of a future need and enables households to cope with the shock on their own terms. This approach combines a robust forecasting and decision-making framework with established implementation plans and pre-arranged cash transfers. We expect an anticipatory action approach to reduce the effects of a shock on household economic outcomes and welfare.

The World Food Programme (WFP) at the United Nations piloted an anticipatory cash transfer in response to climate disasters in June and July 2020, drawing on $2.8 million from the Central Emergency Response Fund (CERF). A forecast triggered the release of unconditional cash transfers of 4,500 taka (ca. $53) by WFP to 22,434 households in five districts along the Jamuna River in Bangladesh. Water-tight storage and animal feed were also provided to 7,000 and 12,000 families respectively by Food and Agriculture Organization of the United Nations (FAO). Hygiene, dignity and health kits was provided to 15,000 women, girls and transgender people by United Nations Population Fund (UNFPA). There was little overlap between the cash and non-cash interventions, as the UN agencies mostly operated in different districts. This analysis focuses on the cash transfers made by WFP only.

2.2 A forecast-based trigger system

The timing of the anticipatory cash transfers was determined by a pre-defined set of forecasts and triggers, which were developed based on pre-existing studies by the Red Cross Red Crescent Climate Centre (RCCC) and government models. The forecasts led to a sequence of two different triggers in the run up to the cash transfers:

1. **The pre-activation ("readiness") trigger:** The pre-activation trigger was reached once water flows forecasted by the GloFAS[1] and/or the Bangladesh Flood Forecast and Warning Centre (FFWC) 15-day probabilistic warning model with a lead time of ten days was predicted to be more than 50 percent likely to cross the 1-in-5-year return period threshold (100,000 m^3/s) at a key gauging station (Bahadurabad) over a period

[1]GLOFAS is a global hydrological forecast and monitoring system that couples weather forecast with a hydrological model that is calibrated for the Jamuna river in Bangladesh.

of three days. Implementation partners commenced preparation activities in response to the trigger. The readiness trigger was activated on 4 July 2020.

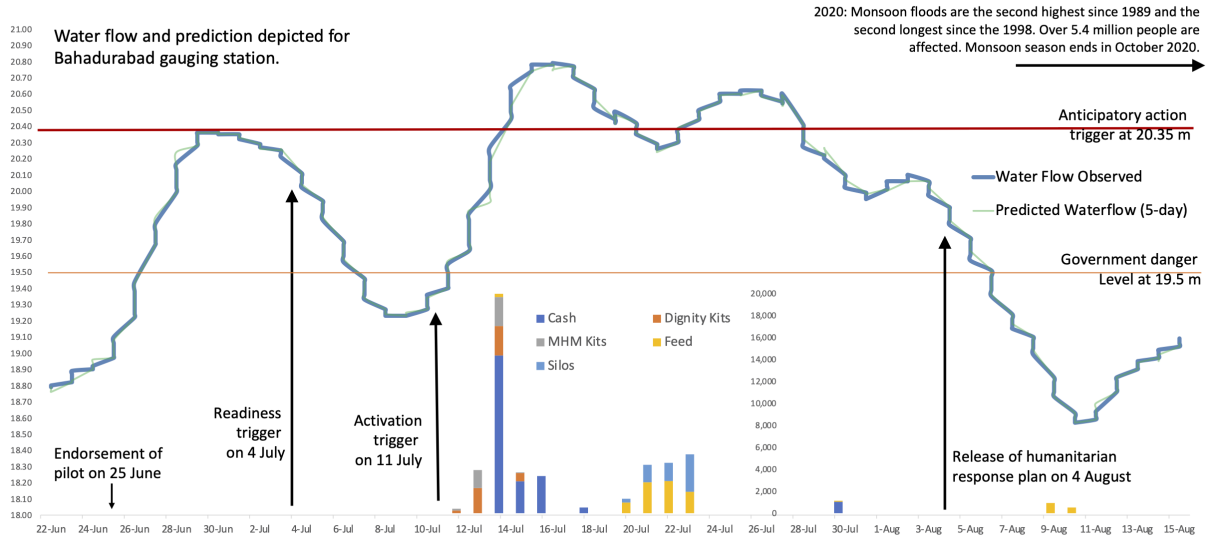
2. **The activation trigger:** The activation trigger was reached once the water level forecasted by the FFWC 5-day lead time model crossed the government-defined "Danger Level" by an additional 0.85 meters at the Bahadurabad gauging station. Once the activation trigger was reached, the implementation process commenced. The activation trigger was activated on 11 July 2020.

The peak of the flood was forecasted for 17 July 2020. Upon reaching the activation trigger, WFP delivered 4,500 Taka (ca. $53) to 22,434 households via their bKash mobile money accounts within flood-affected unions, commencing 14 July 2020. Households received anticipatory cash transfers on 14, 15, 16, 18 and 30 July. Table 1 summarises the breakdown of households reached by date. Figure 1 illustrates the timeline of triggers and the intervention.

Table 1: Number of households reached by anticipatory cash transfer date

Date	**Number of households reached**
14 July	14,345
15 July	2,903
16 July	3,384
18 July	513
30 July	1,036

Figure 1: Timeline of triggers and intervention



3 Design of the natural experiment

We exploit a natural experiment to explore the question of whether anticipatory cash transfers reduce the effects of a flooding shock on household economic outcomes and welfare. Section 3 outlines the quasi-experimental design, the construction of the treatment arms and sampling strategy.

3.1 Experimental design

The anticipatory cash transfer interventions were assigned at the household level. We construct quasi-treatment arms from the natural experiment, as follows:

1. **Treatment group:** Our treatment group received the cash transfer via their mobile money account just prior to and after the forecasted flood peak, i.e., on 14, 15, 16 and 30 July 2020.

2. **Control group:** The control group of households received no cash transfer.

We describe the construction of each treatment group below. Note that we will conduct

a series of robustness checks on the way we construct the treatment and control groups, as described in Section 3.5.

3.2 Construction of treatment group

Within the constraints imposed by the timeline and COVID-19, beneficiary households were defined as "vulnerable" households who were located in flood-affected unions and met a set of criteria. Unions - the smallest rural administrative and local government units in Bangladesh - were first ranked according to a joint assessment of their flood and poverty vulnerability risk. Within selected unions, all recipient households were chosen from pre-existing beneficiary lists of households who had benefited from CERF and government safety nets in the past. To select these households, WFP contacted households on these beneficiary lists via the phone within a period of two weeks. Households were chosen if the following criteria were met:

1. Correct phone number for the beneficiary;
2. Active bKash account;
3. Located in the same union as listed on the beneficiary list.

Not all households received the anticipatory cash transfer on 14 July 2020. Households who had not yet received the cash transfer due to time constraints and households who sought to re-activate their bKash accounts received the cash transfers on later dates: 15, 16, 18 and 30 July. Households who were unable to activate their bKash account before 17 July were grouped together and targeted in one go on 30 July.

Households who received an anticipatory cash transfer on 14, 15, 16 and 30 July form our treatment group. Given the relatively low number of households receiving cash on 18 July and the timing of this intervention, this group will be omitted for the sake of the research design.

The number of households who were selected for the anticipatory cash transfer intervention varied across unions. We dropped any union for which there were fewer than ten beneficiaries within the union and for which there was no relevant control group (see Section 3.3).

We will conduct a series of robustness checks to test whether selection by cash transfer date drives the results, as described in Section 3.5.

3.3 Construction of the control group

We employ the same beneficiary lists used for selecting treatment households to construct the control group. Households were not selected for treatment for a variety of reasons.[2] To construct a comparable control group, we sample households who were contacted from the raw beneficiary lists, but did not receive an anticipatory cash transfer for one of the following reasons:

1. **Category 1:** The households owned a mobile wallet account that was not bKash, e.g. Rocket or Nagad;
2. **Category 2**: The households owned a bKash wallet, but it had been frozen due to inactivity over the past six months;
3. **Category 3**: They were unreachable via the phone at the time that WFP tried to contact them in advance of the transfer date.

We combine all three categories in our main analysis. To address concerns of selection, we will conduct a series of robustness checks to test whether selection by mobile wallet status matters, as described in Section 3.5.

We will also verify that the responses provided by interviewed households match their assigned categories, such as the existence of a mobile wallet, its activity status and provider.

3.4 Sampling strategy

DATA, a well-reputed survey firm in Bangladesh, attempted to contact 15,236 households approximately ten weeks after the anticipatory cash transfer intervention. In total, 9,130 phone surveys were conducted across the treatment and control groups. We randomly sampled households within each treatment arm according to the following rules:

Treatment group:

1. Randomly sample all or 60 beneficiaries (whichever is smaller) from each union for households who received a transfer on 14, 15 and 16 July;

[2]Households were rejected for one or more of the following reasons: (1) they did not have a bKash account; (2) their bKash account was frozen; (3) more than one bKash wallet was issued against one phone number; (4) two beneficiaries from the same household were enlisted; (5) they had migrated from the union where they were originally listed; (6) they were not eligible in terms of vulnerability status; (7) they were not reachable by phone; (8) the incorrect person was contacted; (9) their phone number was incorrect; (10) they did not own the correct mobile money wallet, e.g. Nagad or Rocket.

2. Sample all beneficiaries from every union who received the cash transfer on 30 July.

Control group:

3. Sample all households in Categories 1 and 2 and randomly sample from households in Category 3 in equivalent proportions across unions to the treatment group.

Table 2 summarises the number of households surveyed by treatment arm.

Table 2: Number of households surveyed by treatment arm

Treatment Groups				
Group	Transfer date	Number of households on list provided by WFP (sub-sample)	Number of households contacted	Number of households surveyed
Treatment	14 July	5,927	4,080	3,543
	15 July	1,495	1,494	1,259
	16 July	1,698	1,348	1,108
	30 July	913	912	760
Total		**10,033**	**7,834**	**6,670**

Control Groups				
Group	Reason cash transfer not received	Number of households on list provided by WFP (sub-sample)	Number of households contacted	Number of households surveyed
Control	Wrong mobile wallet account	1,149	1,148	683
	Frozen bKash wallet	1,850	1,850	1,048
	Unreachable	1,105	1,105	87
Total		**4,104**	**4,103**	**1,818**

3.5 Alternative constructions of treatment and control groups

For robustness, we use alternative definitions for the treatment and control groups to check whether selection plays a role in driving our results in our main specifications outlined in Section 5. In this section, we outline three potential alternative constructions of the treatment and control group, as summarised in Table 3 below. Prior to conducting this analysis, we will check our key assumptions on mobile phone and mobile money usage across groups and revise the PAP accordingly, as outlined in Section 4 below.

Table 3: Alternative construction of treatment and control groups

Alternative definition	Affected group	Motivation	New definition
1	Treatment group	While a large share of households received an anticipatory cash transfer on the intended intervention date (14 July), many households were delayed in receiving the cash transfer, as they needed to reactivate their bKash account. Households with inactive bKash accounts may be different to those with active bKash accounts.	We exclude households who received an anticipatory cash transfer on 14 July in our alternative construction of the anticipatory action group. Our key assumption is that households who received the cash transfer on 15 and 16 July are comparable to households who received the cash transfer on 30 July and those who were not able to reactivate their bKash account.
2	Control group	Households who have inactive bKash accounts may be different from treated households, both on observable and unobservable characteristics.	We restrict the control group to those who owned a mobile wallet account that was not bKash (Category 1) and were not reachable during the intervention (Category 3), but report owning a mobile wallet.
3	Both treatment and control groups	A large share of our control group have an inactive bKash account (Category 2). A bKash account becomes inactive if there is no activity over the last six months on the platform. Hence, we restrict our sample to infrequent mobile money account users.	We restrict all the treatment and control groups to households who reported using a mobile money account only five months or longer prior to the phone survey. The treatment group of interest will now be households who received an anticipatory cash transfer but reported to be infrequent users of their mobile money accounts; many of whom needed to reactivate their accounts to receive the cash transfer. Similarly, the control group will be those households who own a mobile wallet account (bKash or otherwise), but they are infrequent users. Hence, many accounts remain frozen. Before conducting this analysis, we will first assess whether we have the sample size to be sufficiently powered, while remaining blind to treatment status.

4 Preparatory analysis

We plan to conduct two sets of checks on our data prior to our analysis. DATA will provide two sets of anonymised data for this purpose:

1. **Preparatory dataset 1:** The first dataset will comprise of all data, excluding the covariates listed in Table 6 below and treatment status. Blind to treatment status, we will use this data to assess whether the variables are poorly measured (e.g. variance is too high), contain very little variation (e.g. top or bottom-coded) or the existence of large outliers.

2. **Preparatory dataset 2:** The second dataset will comprise of the data on the covariates listed in Table 6 and treatment status. Firstly, we will compare data on mobile money and mobile phone ownership and usage across treatment and control categories to test whether they differ across groups and to refine our alternative construction of

the treatment and control group. Secondly, we will test balance in covariates across treatment and control groups (following Section 6.1) and assess whether there are any other robustness checks we should add to the PAP before proceeding with analysis. Thirdly, we will assess whether we will have a sufficiently large sample size to be powered in these calculations, given the variation in key outcome variables documented in 1. This analysis will help us refine the number of regressions to be run across the different constructions of our treatment and control groups.

We will then revise the PAP based on this analysis and make a second deposit with justifications prior to receiving the full dataset from DATA with treatment status.

5 Measurement

In this section, we define our primary and secondary outcomes of interest. Our key hypothesis is that anticipatory cash transfers reduces the effect of the flooding shock on household economic outcomes and welfare. We will construct three indices of primary outcome variables. For each of these outcomes, we will run the estimation and hypothesis tests outlined in Section 6. Our core analysis will be further complemented by exploratory analysis, where results should be treated as such.

5.1 Data collection

DATA conducted phone surveys with 9,130 households ten to twelve weeks after the intervention between 21 September and 8 October 2020. The phone surveys were conducted in Bangla by trained phone survey enumerators. We targeted the household member whose names were on the WFP list of potential beneficiaries. Respondents were asked a series of questions, including demographics, behavioural response to the flooding, food consumption, household assets, life satisfaction, work, and use of the cash transfer (if applicable). They received 100 Taka (ca. $1.18) in phone credit for completing the survey.

5.2 Index construction

We follow Kling et al. (2007) in constructing indices and take the following steps:

i. First ensure that all variables are consistently signed (e.g., a higher value is associated with higher wellbeing);

ii. Sum the individual response items within each scale;

iii. Standardize the summed scale by subtracting the control group mean and dividing by the control group standard deviation.

If there are multiple subscales within an index, we will also take steps (iv) and (v) below:

iv. Sum the standardized items;

v. Standardize the summed items again using the control group mean and standard deviation.

5.3 Primary outcomes

We are interested in four primary outcomes: (1) actions taken to reduce the impact of flooding, (2) child food consumption, (3) adult food consumption; and (4) wellbeing. Pre-emptive actions taken to reduce the impact of the flood (outcome 1) form one family, whereas outcomes 2-4 on child and adult food consumption and wellbeing form a second family. In the latter, we are interested in whether the cash transfer mitigates the negative effect of the shock on these outcomes. Table 4 outlines the survey questions used to construct each index.

As we describe in more detail in Section 6, we will apply a multiple hypothesis test correction across the indices within each family of outcomes. Moreover, we will analyse these primary outcomes in the overall sample first and then interact the treatment with two key variables of interest: land type and gender.

For the sake of completeness, we will report the results for each sub-index. These results should not be viewed as new primary outcome variables, but rather serve a descriptive purpose.

Table 4: Primary outcome variables

Family 1: Pre-emption		
Index	**Subscale**	**Question(s)**
1. Actions taken to reduce the impact of the flood	Number of preventive actions taken	Which actions did you take to prepare for the flooding? (count of the following actions taken): 1. Protect valuable assets 2. Evacuate household members/moved 3. Purchase food 4. Evacuate livestock 5. Protect roof/walls 6. Warn others

Table 4: Primary outcome variables (cont.)

Family 2: Mitigation		
Index	**Subscale**	**Question(s)**
2. Children's food consumption	Number of meals consumed by children in the previous day	How many meals did children (younger than 15 years old) eat yesterday? [Number of meals]
3. Adult food consumption	Number of days meat products were consumed over the last 7 days (the selection of meat will be confirmed by looking at the variation in frequency of consumption of all food items listed).	How many days over the last 7 days, did adult members (15 years or older than 15 years) of your household eat meat, fish, eggs (goat, beef, chicken, buffelo, fish, including tuna, dry fish, and/or other seafish, eggs)
	Food consumption score (FCS)	The following question will be used to construct the FCS. Items 1 and 2 will be combined and 10 omitted. The FCS will then be calculated according to the standard formula: $FCS = (starches * 2) + (pulses * 3) + vegetables + fruit + (meat * 4) + (dairy * 4) + (fats * .5) + (sugar * .5)$ How many days over the last 7 days, did adult members (15 years or older than 15 years) of your household eat the following food items, prepared and/or consumed at your home? 1. Rice 2. Cereals, excluding rice (Pasta, bread, sorghum, millet, maize, fonio, potato, yam, cassava, white sweet potato, parched rice (muri), chira) 3. Legumes/nuts (beans, peas, peanuts, lentils, mascalai, mung beans, khesari, ankar, arahar pulses, nut, soy, and / or other nuts) 4. Milk and other dairy products (fresh milk/sour, yogurt, cheese, other dairy products) (exclude margarine/butter or small amounts of milk if use in tea/coffee) 5. Meat, fish, eggs (goat, beef, chicken, buffelo, fish, including tuna, dry fish, and/or other seafish, eggs) 6. Vegetables and leaves (various spinach, onion, tomatoes, carrots, peppers, green beans, lettuce, etc.) 7. Fruits (banana, apple, lemon, mango, papaya, peach, etc.) 8. Oil, fat, butter (vegetable oil, palm oil, shea butter, margarine, other fats/oil) 9. Sugar or sweet (sugar, honey, jam, cakes, candy, cookies, pastries, cakes and other sweets including sugary drinks) 10. Condiments and spice (tea, coffee / cocoa, salt, garlic, spices, yeast/baking powder, lanwin, tomato/sauce, meat or fish as a condiment, condiments including small amount of milk/tea coffee)
4. Wellbeing	Life satisfaction	Please imagine a ladder with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. Which step of the ladder best represents the way you personally feel you stand these days? [0-10]
	Number of hours of sleep obtained the previous evening	How many hours of sleep were you able to get last night? [Hours]

Note that for questions on food consumption, respondents were encouraged to pass the phone to someone in the household who could respond the questions about food consumption with sufficient recall.

5.4 Secondary outcomes

We will also look at a host of secondary outcomes, including those pre-specified in Table 5. This analysis should be considered exploratory in nature and will extend beyond the parameters of this PAP.

Table 5: Secondary outcome variables

Outcome	Question of interest	Construction	Question(s)
Household asset loss or damage	Did the cash support allow households to mitigate asset loss or damage?	A standardised, weighted index (following Section 5.2) of the following variables:	
		Number of livestock that died over the past two months	How many cows, calves and buffalo that you owned died during the past two months (from July 15 to September 15)? How many goats, sheep and pigs that you owned died in the past two months(from July 15 to September 15)?
		Number of categories of household assets that were lost or damaged	Other than damage to your house and animals; were any assets damaged or lost due to the flooding? What assets were damaged/lost? Enter all that apply. 1. Poultry 2. Crop (stock in home) 3. Irrigation pump 4. Fruit plantation 5. Fish 6. Equipment for fishing i.e. fishing net 7. Vehicle by any animal 8. Boat 9. Rickshaw, van, or cycle etc. 10. Shop 11. Sewing machine 12. Furniture 13. Clothes 14. Household appliances like home utensils, mobile phone, television etc. 15. Ornaments (gold & silver) 16. Others: (specify)
		Amount of cultivated plots lost [in decimal]	Have you lost cultivated crops in the past two months (from July 15 to September 15) due to the flooding? [Yes/No] If yes: How much have you lost in cultivated plots in decimal?

Table 5: Secondary outcome variables (cont.)

Outcome	Question of interest	Construction	Question(s)
Costly borrowing	Did the cash support allow households to rely less on costly borrowing?	A standardised, weighted index (following Section 5.2) of the following two variables: 1. How much was borrowed in the last two months (Taka) 2. The highest interest rate charged (percent per month)	In the past two months (from July 15 to September 15), has your household borrowed any money from friends/family/credit institutions or groups - both formal and informal - to cover for basic needs? [Yes/No] If yes: How much did you borrow in the past two months (from July 15 to September 15)? [Taka] What is the highest interest rate you were charged on the loan(s) you received in the past two months (from July 15 to September 15)? [%] Was this interest rate per month or per year? [Monthly/Yearly]
Crowding out of remittances	Did households that received advance cash transfers receive less in remittances?	The amount received in remittances in the last two months (Taka).	Did you receive any remittances in the past two months (from July 15 to September 15)? [Yes/No] If yes: How much did you receive in the past two months (from July 15 to September 15)? [Taka]
Earned income	Have households who received cash been better able to earn money (as a result of lower asset losses or additional cash being available)?	A standardised weighted index (following Section 5.2) of the following two variables: 1. Able to replant (dummy variable taking the value of 1 if the household reported replanting) 2. Number of hours worked for an income in the last 7 days (hours)	Have you lost cultivated crops in the past two months (from July 15 to September 15) due to the flooding? [Yes/No] If yes: Have you been able to replant? [Yes/No] How many hours did you or someone in your household work towards an income in the past seven days?

5.5 Covariates

Table 6 outlines the survey questions used to construct the list of potential covariates under consideration.

Table 6: Potential covariates

Variable	Description	Question	Variable construction	Time invariant?
Age	Age of respondent	How old are you?	18-100 years	✓
Gender	Gender of respondent	What is your sex?	Dummy variable for whether respondent is female	✓
Relationship to household head	Respondent is a household head	What is your relationship to the head of the household?	Dummy variable for whether respondent is household head	✓
Gender of respondent who answered food consumption questions	Gender of respondent for food section - note that for questions on food consumption, respondents were encouraged to pass the phone to someone in the household who could respond the questions about food consumption with sufficient recall.	What is your sex?	Dummy variable for whether respondent is female	✓
Education	Highest level of education of the respondent	What is the highest level of education that you have completed?	0-9	✓
Household size	Number of household members	How many people live in your household, including yourself? Note that a household is a group of people who live together and take food from the "same pot"	Number of people	✓
Dependency ratio	Number of children under the age of 15 and adults over the age of 60 years old divided by the total household size less the numerator.	How many people are under the age of 15 years in your household? How many people are 60 years or older in your household?	Number of children < 15 years + number of adults > 60 years	✓
Household structure	Household structure in the typical residence of the respondent	In the place you typically live, would you classify your house structure as which of the follow? 1. Raw/Kacha house (Wall made of mud/straw/bamboo / roof made of tin, straw) 2. Tin made house (both wall and roof) 3. Semi paka house (ceiling is tin, others are made in brick) 4. Brick house 5. Others (specify)	Dummy taking the value of 1 if a household lives in a raw/kacha house	

Table 6: Potential covariates (cont.)

Variable	Description	Question	Variable construction	Time invariant?
Land asset	Land owned plus land rented in or used as a homestead	How much land do you have, including land that you own, rent in or out or use as a homestead? 1. 0 - less than 5 dec 2. 5 - 49 dec 3. 50 - 249 dec 4. More than 249 dec	Dummy for large land asset (more than 50 decimals)	
Mobile money account	Whether the respondent has a mobile wallet	Do you have a digital wallet, whether active or frozen?	Dummy for ownership	
Frequency of mobile phone usage	Frequency of mobile phone usage	How often do you use a mobile phone? 1. Every day 2. Several times a week 3. Once a week 4. Once every two to three weeks 5. Once a month 6. Once every 2-6 months 7. Once every 6-12 months 8. Once every 12+ months	Dummy for frequent usage (once a week or more)	
Frequency of mobile money usage	Frequency of mobile money usage	Not counting the transfer received from WFP when was the last time you used your mobile money account? 1. Today 2. Yesterday 3. In the past week 4. In the past month 5. In the past two months 6. In the past three months 7. In the past four months 8. In the past five months 9. In the past six months 10. More than six months ago -but less than a year ago 11. More than a year ago Not applicable (no transaction before receiving this money / did not have account)	Dummy for recent use (in the last six months)	
Type of land	Char land (high flood exposure)	[Defined at a mauza level]	Dummy variable for whether the land is characterised as "char" land	✓
	Land that is outside the embankment (medium flood exposure)	[Defined at a mauza level]	Dummy variable for whether the land is characterised as outside the embankment protection on mainland	✓
	Protected/embanked mainland or land that is deemed outside of the flood zone (low flood exposure)	[Defined at a mauza level]	Dummy variable for whether the land is characterised as protected/embanked mainland or land that is deemed outside of the flood zone	✓

5.6 Flood timing

Households received anticipatory cash transfers at different times in advance of the forecasted flood peak for their area. The timing is determined by (1) the transfer date determined by administrative challenges on the part of WFP and (2) natural variation in flood timing due to geographic parameters, such as elevation and location along the Jamuna River. The second source of variation is likely to be strongly correlated with other factors of local development as the river provides a measure of access to the centre of the country and to Dhaka. This source of variation is controlled for by the inclusion of union fixed effects. The first source of variation is administrative and more likely to be exogenous to household characteristics. We examine how the impact of the cash varied based on the date in which the cash was given (see Section 6).

6 Empirical strategy

6.1 Testing balance

In the absence of a baseline survey, we will test for balance by reporting balance statistics on time-invariant variables across all treatment arms. Table 6 in Section 5.5 lists the time-invariant variables that will be used for testing balance.

We will estimate the following regression, in which y_i denotes the time-invariant variables.

$$y_i = \beta_0 + \beta_1 \cdot treat_1 + \beta_2 \cdot treat_2 + \beta_3 \cdot treat_3 + \gamma_1 \cdot control_1 + u_i \tag{1}$$

For each variable, we will run a Wald test of the joint hypothesis: $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \gamma_1 = 0$. We will report the p-value from this test in an extended table of descriptive statistics. Given that these variables were not directly used during a randomisation process, we will not be surprised if some variables reject this null hypothesis. We will present results with and without unbalanced variables and a set of key covariates in our main analysis (see Section 6.4 for more details).

6.2 Testing for differential attrition

Given the challenges experienced with a severe flooding event (such as mass displacement), we expected low response rates. We sampled a large number of households to account for

low response rates. However, we will check for differential attrition by treatment status. By attrition, we mean being unable to interview sampled respondents for the follow-up interview. To test for differential attrition, we will create a dummy variable for whether the household's interview is missing and regress this dummy on the treatment dummies. If and only if we find significant differential attrition by treatment status, we will report Lee (2009) bounds.

6.3 Empirical specifications

1. Does an anticipatory cash transfer mitigate the impact of the flood shock?

Specification 1: Cash versus no cash

In our first specification, we pool all treatment arms to estimate the overall effect of receiving an anticipatory cash transfer on our primary outcomes of interest, compared to the control group who received no cash transfer:

$$Y_i = \beta_0 + \beta \cdot T_i + \gamma \cdot X_i + \varepsilon_i \tag{2}$$

Where Y_i is the outcome of interest for household i. T_i is a dummy variable indicating whether a household received an anticipatory cash transfer from WFP. X_i is a vector of controls and strata variables used in sampling to increase precision of our estimates and soak up any imbalance across treatment groups. ε_i is a mean zero error term.

β measures the average treatment effect of receiving an anticipatory cash transfer during an extreme flooding event relative to the control group. For every primary outcome, we test the null hypothesis that the cash transfer has no impact. We will estimate robust standard errors to correct for heteroskedasticity.

For robustness, we will use alternative constructions of the treatment and control groups, as defined in Sections 3 and 4.

2. Do small changes in the timing of the anticipatory cash transfer matter for the mitigation of the flood shock?

Anticipatory action interventions trade off targeting accuracy in forecasting need with effectiveness of the interventions. In our second set of specifications, we test whether the timing of the anticipatory cash transfer matters for our primary outcomes of interest.

Specification 2: Anticipatory versus early action

In our second specification, we restrict our sample to treated households. We test the effects of receiving an anticipatory cash transfer on our primary outcomes of interest before the flood peak relative to a household receiving a cash transfer immediately after the flood peak:

$$Y_i = \beta_0 + \beta_1 \cdot T_{1i} + \beta_2 \cdot T_{2i} + \delta \cdot X_i + \varepsilon_i \tag{3}$$

Where Y_i is the outcome of interest for household i. T_{1i} is a dummy variable indicating whether a household received an anticipatory cash transfer from WFP on 14, 15 or 16 July 2020. T_{2i} is a dummy variable indicating whether a household received a cash transfer from WFP on 30 July 2020. X_i is a vector of controls and strata variables used in sampling to increase precision of our estimates and soak up any imbalance across treatment groups. ε_i is a mean zero error term.

β_1 measures the average treatment effect of receiving an anticipatory cash transfer before the anticipated flood peak relative to the control group. β_2 measures the average treatment effect of receiving a cash transfer immediately after the anticipated flood peak relative to the control group. For every primary outcome, we test the null hypothesis that the cash transfer has no impact. We also test whether the timings of the cash transfer pre or post-flood peak are significantly different to each other, $\beta_1 \neq \beta_2$. We will estimate robust standard errors to correct for heteroskedasticity.

For robustness, we will use alternative constructions of the treatment and control groups, as defined in Sections 3 and 4.

Specification 3: Timing of anticipatory cash transfers

There are small variations in the timing of the anticipatory cash transfers due to the administrative challenges faced by WFP and the geographic variation in flooding. In our third specification, we restrict our sample to treated households that received cash transfers on 14, 15 or 16 July. We test the effect of small changes in the timing of the cash transfer on our primary outcomes of interest:

$$Y_i = \alpha_0 + \alpha_1 \cdot T_i + \delta \cdot X_i + \varepsilon_i \tag{4}$$

Where Y_i is the outcome of interest for household i. T_i is a continuous variable indicating

the number of days before the peak flooding during which a household received an anticipatory cash transfer from WFP. X_i is a vector of controls and strata variables used in sampling to increase precision of our estimates and soak up any imbalance across treatment groups. T_i then will take three values reflecting whether a household received a transfer on the 14, 15 or 16 July. ε_i is a mean zero error term.

α_1 measures the marginal effect of receiving the anticipatory cash transfer a day earlier among households that received a pre-flood transfer. For every primary outcome, we test the null hypothesis that small variations in the timing of the anticipatory cash transfer has no impact. We will estimate robust standard errors to correct for heteroskedasticity.

For robustness, we will use alternative constructions of the treatment group, as defined in Sections 3 and 4.

6.4 Covariates

In our analysis, we first present all specifications with union fixed effects. The union dummies control for any variation arising purely due to a household's location.

To increase the precision of our estimates and soak up any imbalance across treatment groups, we also present results including a set of imbalanced covariates following our balance tests, following our balance tests.

Moreover, we will also control for the following covariates summarised in Table 6, irrespective of imbalance:

1. Gender of respondent for main survey
2. Gender of the respondent who reported on food consumption questions
3. Type of land
4. Household size
5. Dependency ratio

6.5 Multiple hypothesis testing

Following Benjamini et al. (2006), we will use false discovery rate corrections to account for multiple hypothesis testing across our primary outcome variables within each family. Therefore, for each hypothesis test, we will report two values:

1. The usual p-value from a Wald test;

2. False Discovery Rate q-values, taken across outcomes within each family.

7 Heterogeneity

In our heterogeneity analysis, we will explore whether the impact of the intervention was different for different groups, and in particular what impact it had on vulnerable households to whom the transfer was made. We explore two key sources of heterogeneity that proxy for vulnerability:

1. **Type of land:** Households are located on three types of land: (1) char lands; (2) land outside the embankment; (3) protected/embanked mainland or land that is deemed outside of the flood zone. The flood is expected to affect each type of land with increasing intensity, with the char islands most exposed to flooding. We create dummy variables for each land type and include two dummies in a fully interacted model.

2. **Gender of respondent:** We create a dummy for whether the respondent is female. Respondents are the same names as on the original WFP beneficiary lists used for targeting. For the treatment households, respondents are also the beneficiaries of the cash transfers.

To conduct heterogeneity analysis, we run a fully interacted model, whereby the key coefficients are on the treatment, the dummy(s) and their interaction. Given that we do not hold strong priors on the direction of these differential treatment effects, we treat this analysis as exploratory.

References

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