WEATHER SHOCKS

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Weather Shocks, Unconditional Cash Transfers and Household Food Outcomes

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ABSTRACT

Weather shocks have become a colossal threat to Pakistan due to its limited financial and technical ability to mitigate and adapt to extreme weather events. These threats are expected to be increasingly scaled up in the coming years.

Food insecurity is one of the most significant aspects of household wellbeing, directly affected by climatic variability. The ultra-poor segment of households is highly susceptible to increasing weather shocks. In such a scenario, the role of the Benazir Income Support Program (BISP) cash transfer scheme is inevitably essential.

Hence, this study explores the moderating role of BISP unconditional cash transfer against the adverse impacts of climatic variability on calorie intakes and food diversity scores of poor households. Tehsil level weather shocks are merged with the four waves of the household survey dataset. The application of tehsil fixed effect indicates the adverse effects of shocks in rainfall and temperature norms on food outcomes. Likewise, the results estimated from instrumental tehsil fixed effect (IV-TFE) demonstrate that BISP cash transfer plays a significant moderating role against rainfall and temperature shocks to determine the food outcomes of the program's beneficiaries.

1. INTRODUCTION

Cash transfer programs, which are typically either unconditional or conditional, are increasingly used by policy-makers to address various development issues. Conditional cash transfers (CCTs) are usually conditioned and require that the recipients meet various conditions, such as the adoption of specific technology for agricultural purposes and child enrolment. On the other hand, unconditional cash transfers (UCTs) do not require the fulfilment of specific conditions besides meeting a set of eligibility criteria (Asfaw, et al. 2017). Although expensive to implement, cash transfer programs have gained increased popularity, and large-scale applications across various developing countries have led to a growing body of literature that examines the effectiveness of cash transfer interventions.

To date, evidence on the effectiveness of cash transfers remains mixed. Some studies report development-enhancing effects of cash transfers by focusing on outcomes such as consumption, income and child outcomes (see, e.g., Attanasio and Mesnard, 2006; Mustafa, et al. 2019), while others find that cash transfers can undermine development (see, e.g., Banda, 2021). Overall, differential effects of cash transfer programs have been observed depending on the size, nature (i.e., conditional vs. unconditional), and country contexts, among others (see, e.g., Davies and Davey, 2008; Miller, et al. 2011; Bastgali and Holmes, 2014; Asfaw, et al. 2014; Brugh, 2016; Bhala, et al. 2018; Handa, et al. 2018; Ambler and de Brauw, 2019; Mustafa, et al. 2019).

A large body of literature on the effectiveness of cash transfer interventions has examined the impact of weather shocks and climate change on various development outcomes. A subset of this literature has examined the impact of weather variations on food security and the health outcomes of households. In a recent review of this literature, Firdaus, et al. (2019) show that climate change tends to leave households vulnerable to various development issues. Thus, beyond the direct effects of climate change or weather shocks on outcomes such as food utilization, weather shocks generally increase the vulnerability of household thus negatively impacting on wellbeing (see e.g., Deschenes, et al. 2009; Gregori, et al. 2005; Thurlow, et al. 2012; Wang and Qin, 2017; Shah, et al. 2019; Muoghalu, 2019; Patail, et al. 2020). This has led to a growing interest among researchers and policymakers in understanding how households can build resilience against adverse shocks from climate change.

A small strand of literature has explored the role of cash transfer programs in helping households build resilience against weather shocks and the resulting negative effects on development outcomes. For instance, Asfaw, et al. (2017) find that

unconditional cash transfer programs can effectively insulate against adverse weather-related shocks and related socioeconomic poor outcomes of rural households in Zambia.

Specifically, cash transfers enable targeted households to manage weather shocks by enhancing their resilience via income effects. More recently, Gros, et al. (2019) evaluated the effects of cash transfers in building resilience against flood-related shocks in Bangladesh and found that cash transfers are effective and help lessen the harmful effects of flood occurrence on welfare outcomes.

This paper aims to advance our knowledge of the interplay between cash transfers, weather shocks and food outcomes. Using data from Pakistan's BISP, South Asia's largest social protection program, we examine if UCTs can help households build resilience against weather shocks and promote food outcomes. Specifically, we augment the standard models that examine the impact of weather shocks on food outcomes to examine the moderating role of cash transfers. We empirically test this relationship by using Instrumental Variable Tehsil Fixed Effect (IV-TFE). We find that UCTs in Pakistan are instrumental in helping households build resilience against temperature shocks and promote food outcomes.

The motivation for focusing on Pakistan is twofold. First, Pakistan is one of the world's most vulnerable to climate change, currently placed among the top 5 most vulnerable countries according to the Global Climate Risk Index. Between 1999 and 2018, Pakistan experienced 152 extreme weather events, leading to over $3.8 billion in economic losses and nearly 10,000 deaths (Eckstein, et al. 2019). There is also evidence of significant negative effects of weather shocks on agriculture, and food security in Pakistan (Khan, et al. 2019; Adnan, et al. 2017; Ahmed, et al. 2016). This has led to increased attention on building resilience against weather shocks. Second, Pakistan hosts the BISP, one of the world's most extensive unconditional cash transfer programs and the largest in South Asia, covering more than 5 million households.

We contribute to multiple strands of literature. First, we contribute to the growing literature that has examined the impact of weather shocks on various development outcomes, particularly food outcomes (see, e.g., Devereux, 2007; Gregory, et al. 2005; Wheeler and Von Braun, 2013; Bandara and Cai, 2014; Smith and Frankenberger, 2018). This literature generally points to negative effects of weather shocks. Our study relates to this strand of literature given that we also model the impact of weather shocks on food outcomes and examine the moderating role of cash transfers. Second, our study contributes to the literature that has examined the impact of the various cash transfer programs. Within this literature, our study is closely related to those that examine effects on food outcomes and those that focus on the impact of the BISP (see, e.g., Mustafa, et al. 2019; Waqas and Awan, 2019; Iqbal and Nawaz, 2021; Nawaz and Iqbal, 2021).

The closest studies in the literature to ours are Asfaw, et al. (2017) and Gros, et al. (2019). Using data from Zambia, Asfaw, et al. (2017) find that social cash transfer programs play mitigating roles against the harmful effects of weather shocks on household food outcomes. Gros *et al*. (2019) examine the effectiveness of forecast-based cash grants in helping recipients prepare for floods' negative effects on household welfare and food outcomes. We differ from these studies, given that we

present evidence from a large-scale cash transfer program. Asfaw, et al. (2017) focus on evidence from three districts in Zambia, while Gros, et al. (2019) focus on four communities in Bangladesh. Compared to the cash transfer programs studied in Asfaw, et al. (2017) and Gros, et al. (2019), the BISP is a large-scale program with national coverage. Thus, its impacts are likely to differ from smaller cash transfer programs focusing on selected households within a few districts or communities. Importantly, the different geographic context is likely to offer additional insights that could support or refute the existing narrative on the role of cash transfers in insuring against weather shocks.

The remainder of the paper is structured as follows. Section 2 provides an overview of BISP design and data. Section 3 discusses the conceptual framework that guides the study, while Section 4 discusses climate change trends in Pakistan. Section 5 discusses the data and variables, while the empirical strategy is discussed in Section 6. Section 7 presents the results, while Section 8 concludes the study.

2. DESIGN AND COVERAGE OF BISP: AN OVERVIEW

The BISP is designed to accomplish two crucial short-and long-term objectives. The short-term goal is to maintain consumption smoothing and offset the adverse impacts of food inflation (Pakistan, 2016). In the long-term, the program seeks to empower women and move beneficiaries out of chronic poverty (Ambler and de Brauw, 2017; Afzal, et al. 2019). The BISP started as an unconditional transfer program, although a conditional component was recently introduced. The BISP covers impoverished households, and its scope and coverage rank it as South Asia's most extensive public safety net program (Watson, et al. 2017). The CCT targets two million families and is conditioned on child enrolment and schooling. The relatively extensive UCT targets over 5.2 million households (Pakistan, 2016).

Household eligibility to benefit from the BISP is based on a Proxy Mean Test (PMT), widely used in the development community and the World Bank (Ambler and de Brauw, 2019). The PMT is computed using data from the National Socioeconomic Registry (NSER), which contains demographic and socioeconomic data on about 80 per cent of households in Pakistan. The PMT criteria rely on an eligibility threshold of 16.17; thus, households below this threshold are eligible for the BISP cash transfer, while those above the cut-off are not. Additionally, eligibility requirements ensure that only ever-married women of eligible households with valid Computerized National Identity Card (CNIC) are beneficiaries.

The BISP commenced with quarterly payments of PKR 3000 which eventually increased to PKR 5500 (approximately $37). This amount is equivalent to 20 per cent of the average worker's daily wage (Saleem, 2019). Beneficiaries are able to access funds through one of four avenues, including:

(1) Pakistan Post Money Orders, smart card payment dispersal system.
(2) Mobile banking system.
(3) A debit card system provided by the BISP.
(4) A Bio-Metric Verification System (BVS).

3. CONCEPTUAL FRAMEWORK

This paper draws on the conceptual framework proposed by Asfaw, et al. (2017), which explains the channels through which weather variability influences consumption, food security, and health outcomes of households. Within this conceptual framework, weather shocks can impact food security and human health directly or indirectly via various channels. The indirect channels highlight the impact of weather shocks on both off-farm and on-farm income, which could consequently affect the ability of households to be resilient against shocks. Specifically, weather shocks negatively influence income, which is very relevant in building resilience. When weather shocks negatively impact household income, they are vulnerable to poor welfare outcomes, including food and health outcomes. In this study, the expectation is that weather shocks are likely to influence food outcomes via effects on income (Jones and Olken, 2010; Skoufias, et al. 2011; Shumetie, et al. 2017; Kinda and Badolo, 2019).

Weather shocks have been hypothesized also to influence food outcomes directly. In agriculture-based economies, extreme weather events affect food production, affecting food availability and related food outcomes (Ericksen, 2008; Ziervogel and Ericksen, 2010; Abbade, 2017; Asfaw, et al. 2017; Firdaus, et al. 2019). Indeed, evidence suggests that climatic shocks are linked with undernourishment among children (Wheeler, et al. 2013; Allen and Prosperi, 2016; Firdaus, et al. 2019).

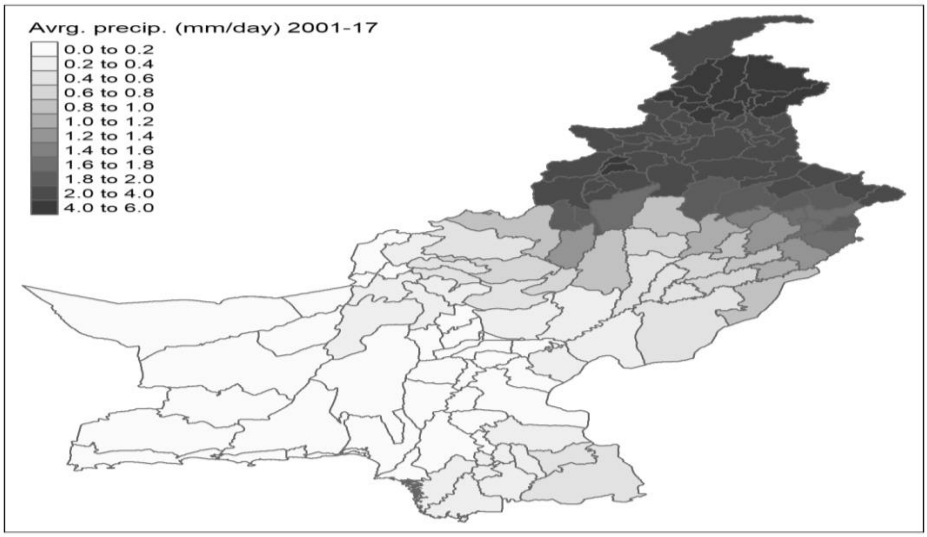
In this study, we argue that cash transfers can help vulnerable households build resilience in coping with weather shocks. Given that weather shocks tend to influence household welfare via income effects negatively, cash transfers can ease income-related constraints and thus, help build resilience against shocks. Notably, in the presence of weather shocks, social cash transfers can enable households to scale up food consumption which improves calorie intake, dietary diversity, and health (Asfaw, et al. 2017).

4. WEATHER VARIABILITY IN PAKISTAN

Pakistan is one of three South Asian countries most vulnerable to climate change and extreme weather events. A diverse climate characterizes Pakistan. Notably, the Northern regions tend to experience excessive rainfall, with some mountainous areas also characterized by heavy snowfalls. Temperature and rainfall patterns generally vary significantly. On average, between 2001 and 2017, 0 to 6 millimetres of rainfall is observed across the country's different regions (see, Figure 1).

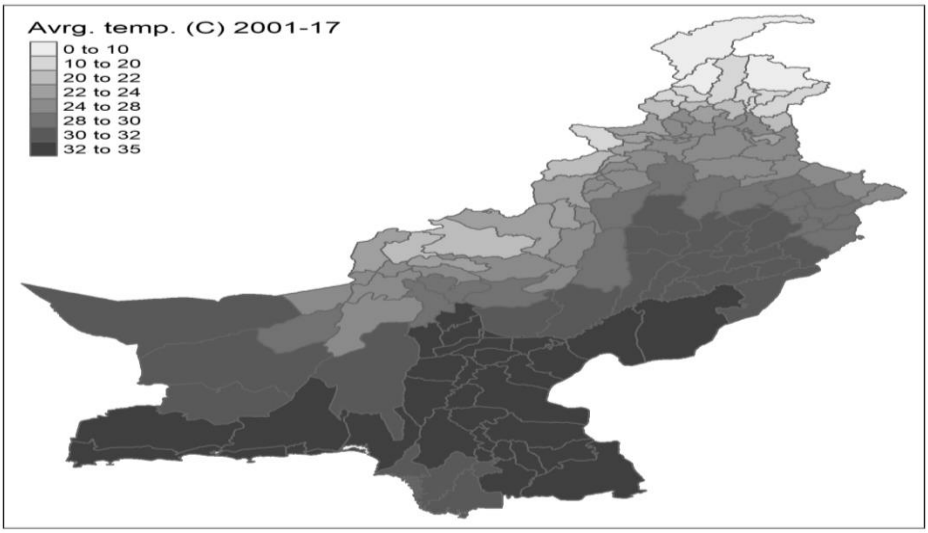
Rainfall patterns are typically used to categorize seasons which include pre-monsoon (April-June), monsoon (July-September), post-monsoon (October-December), and winter (January-March) (Faisal and Sadiq, 2009; Adnan, et al. 2017). Irregular rainfall patterns usually characterize the monsoon seasons with some years recording extremely heavy rainfalls linked with flooding. The pre-monsoon seasons are sometimes known for unexpected heavy rainfalls with stormy winds that tend to be disastrous (Faisal and Sadiq, 2009).

Fig. 1. Average Daily Rainfall (2001–017) in Pakistan



Temperature variability is also relatively higher in Pakistan (Figure-2). Notably, the average temperature in Pakistan has been on the rise, with a projection that the average temperature will increase by 3-4^{o} C in the next couple of decades and by 5-6^{o} C before the century ends. The months of May to July tend to be the warmest, while December to February is the coolest (Ahmed, et al. 2016). The severity of the winter and summer months has increased vulnerability, especially among poor households. For instance, the intense weather cycles have resulted in rising sea levels, abnormality in precipitation patterns, catastrophic waves of flooding, and depletion of environmental resources (Ahmed, et al. 2016; Eckstein, et al. 2019).

Fig. 2. Average Temperature (2001–017) in Pakistan



5. DATA AND VARIABLES

5.1. Description of Data Sources

Data used for this study are drawn from multiple sources. We use four rounds (2011, 2013, 2014, and 2016) of household panel data collected by the Oxford Policy Management (OPM) to evaluate the BISP. The baseline survey, conducted in 2011 covers 8675 households from 90 districts in Pakistan's four provinces (Punjab, Sindh, KPK, and Balochistan). The follow-up survey in 2013 covered 8221 households, while the survey in 2014 covered 7759 households with a 10 per cent attrition rate. In 2016, the follow-up survey included additional households which were not surveyed as part of the baseline survey bringing the total number of households to 11,395 (Ambler and Brauw, 2019; Pakistan, 2016).

On average, the distributions suggest about 60 per cent of the sample are BISP beneficiaries while 40 percent are non-beneficiaries. For our analysis, we have pooled together these four waves, thus reaching a total sample of 35,348 households. From these surveys, we obtain data on the demographic and socioeconomic profiles of beneficiaries and non-beneficiaries of BISP. The description and summary statistics of these variables are presented in Table 1. The household surveys provide information on the tehsils in which households live.[1] Such identification of tehsils allows us to estimate the impact of weather shocks at the tehsil level. The data on average rainfall and temperature at the tehsil level are taken from the European Center for Medium-Range Weather Forecasts (ECMWF) from 1990 to 2016. Using the tehsil identifiers in the household survey data, we merge the rainfall and temperature data with the household survey.

Table 1

Summary Statistics: Base Year (2010-11)

	(1) Beneficiaries	(2) Non-beneficiaries	(1)-(2) Mean Difference	p-value
Daily per adult Kilo calorie intakes	1972.304	1985.122	–12.818	0.525
Food diversity score	5.510907	5.586911	–0.076004	0.109
Household size	7.587253	7.093875	0.493378	0.000
Dependency ratio	1.207877	1.382223	*–0.174346*	0.000
Female ratio	1.190612	1.192214	–0.001602	0.938
Unemployed ratio	1.762281	2.003495	–0.241214	0.000
Head age	45.0531	46.40717	–1.35407	0.000
Head education	2.007157	2.468231	–0.461074	0.000
Livestock ownership	1.072819	1.226579	–0.15376	0.133

5.2. Weather Shocks

We use four weather shock indicators to capture temperature and rainfall shocks. The first indicator of weather shocks is a rainfall shock measure calculated as the long-run mean deviation. This measure of rainfall shocks is typically used in the literature (e.g., Ahmed, et al. 2016). Consistent with the existing literature (see, e.g., Asfaw, et al. 2017), the second indicator of weather shocks is the seasonal variation index, which captures the short-term seasonal rainfall variations in a year.

[1]Tehsils are sub-administrative unit of districts in Pakistan. They are the second tier of local government directly below districts.

Third, we focus on the pre-monsoon and monsoon period and examine rainfall shocks consistent with these seasons. Significant flooding in Pakistan tends to occur during the pre-monsoon and monsoon periods. Thus, by focusing on these periods, we provide additional insight into how excessive rainfall shocks impact food outcomes. Fourth, the indicator of temperature shock is calculated as the deviation from the long-run average of temperature. A description of the variables used is presented in Table 2.

Table 2

Brief Description of the Variables

Variable Name	Brief Description of Variables	Unit
Outcome Variables		
Food/Dietary Diversification Score	Counting 13 food groups gives food or dietary diversity score for household. The higher value of score, the more food diversification.	Number
Kilocalorie Intakes	Kilocalories of consumed food commodities are multiplied by consumption of respective food items, and divided by per adult equivalent score.	Kilogram
BISP Variable		
Treatment Variable	It takes value 1 for beneficiaries of BISP, and 0 for non-beneficiaries	Binary
Other Household Specific Variables		
Household Size	Total family members in a household	Number
Female Ratio	The ratio of total female members to total male members	Ratio
Gender of Head	Binary variable takes 1 for male, 0 otherwise	Binary
Age of Head	Age of household head up to survey is being conducted	Years
Head Education	Completed years of schooling	Years
Unemployed Ratio	The ratio of unemployed to the employed members	Ratio
Rural Area	A binary variable takes value 1 if household is living in rural area	Binary
Climatic Variables		
Long rainfall shock	Tehsil level annual 30 years mean deviation of the rainfall for each sampled years household survey	mm
Pre-monsoon Rainfall Shocks	Tehsil level 30 years mean deviation of the rainfall in pre-monsoon season for each sampled years household survey	mm
Monsoon Rainfall Shocks	Tehsil level 30 years mean deviation of the rainfall in monsoon season for each sampled years household survey	mm
Seasonal Index (SI)	SI is the sum of the absolute deviation of average monthly rainfall from the overall monthly average divided by the average of annual rainfall	index
Temperature Shocks	Tehsil level 30 years mean deviation from annual temperature for each sampled years household survey	℃

5.3. Food Outcomes

We adopt two measures of food outcomes using the household surveys. Our first indicator of food outcomes is the food diversity score, which is derived as the count of the thirteen major food groups each household consumes (Jamaluddine *et al.*, 2020). The second indicator captures daily adult equivalent kilo calorie intakes.

6. Econometric Strategy

This study aims to identify the impact of weather shocks on food outcome and the moderating role of cash transfers.

To achieve this, we specify the following empirical model:

$$logY_{h,i,t} = \beta_0 + \alpha_1 BISP_{h,i,t} + \gamma_i C_{i,t} + \sum \beta_{i1} X_{h,i,t} + \sum \beta_{i2} Z_{h,i} + \eta_h + \mu_s + \delta_t + \mu_{i,t} \quad (1)$$

where denotes log of outcome variables for household, at time in location. BISP is a binary variable that captures the beneficiary status of households. It is set equal to one of the household is a beneficiary and zero otherwise. denotes the indicator for climatic shocks. is a vector of household characteristics which include household size, household gender ratio, unemployment, age, and education status of household head, while is a vector of community-based capturing land type (e.g., plain land, plateau, desert area, mountainous, and hilly area), rurality, irrigated area, and availability of metallic road. We control for fixed effects together with state fixed effects () and time fixed effects (), which absorb the effects of unobservable time-invariant state or time characteristics; denotes the error term. We follow the literature and estimate Equation (1) using a fixed effect approach that controls for household, location and year fixed effects with standard errors clustered at the tehsil level (see, e.g., Dell et al., 2012; Deschênes & Greenstone, 2007; Hirvonen, 2016).

In order to capture the moderating role of weather shocks, we augment Equation (1) to include an interaction term that captures the interaction of BISP with the climatic-shocks variables to derive Equation (2) as follows:

$$logY_{h,i,t} = \beta_0 + \alpha_1 BISP_{h,i,t} + \gamma_i C_{i,t} + \lambda_i BISP_{h,i,t} * C_{i,t} + \sum \beta_{i1} X_{h,i,t} + \sum \beta_{i2} Z_{h,i} + \eta_h + \mu_s + \delta_t + \mu_{i,t}$$

Where all variables remain as previously defined; is the interaction term, while is the parameter that identifies the moderating role of BISP.

$$logY_{h,i,t} = \beta_i + \alpha_1 BISP_{h,i,t} + \sum \gamma_i C_{i,t} + \sum \lambda_i BISP_{h,i,t} * C_{i,t} + \sum \beta_i Z_{i,t} + \mu_{i,t} \quad (2)$$

The Equation (2) includes the vector of interactive terms of BISP with climatic variables (), where parameter identifies the mediating role of BISP if it is positive () and statistically significant as suggested by Asfaw, et al. (2017).

7. RESULTS AND DISCUSSION

7.1. Impact of Weather Shocks on Food Outcomes

In order to establish the impacts of weather shocks on calorie intakes and food diversity score, we have estimated the effects of long run and seasonal variations in rainfall and long run temperature shocks on aforementioned food outcomes. For this purpose, we estimate different specifications without inclusion of BISP cash transfer variable. The estimated results obtained from tehsil fixed effect is suggesting that long run rainfall shocks have negative and significant effects on food diversity score, which implies that household's food diversity is adversely influenced by long run rainfall shocks. Likewise, long run temperature

shocks are also adversely affecting the food diversity. Hence, this evidence establishes the detrimental effects of the long run weather shocks on food diversity score, which is also known as dietary diversity score. Moreover, the calorie intakes are significantly influenced by long run rainfall, while long run temperature shocks do not have any significant effect, although the coefficient is found negative (see table-3). Such findings, by and large, conclude that weather shocks throw adverse impacts on determining households' food outcomes like calorie intakes and food diversity. These both outcomes are indicating the food security at household level, which is influenced acrimoniously by weather shocks.

In addition to above discussed climatic variables, the second specification includes annual seasonal variations in rainfall, which measures the short-term variations in a year. Seasonal variation in rainfall is demonstrating the negative and adverse influences on food diversity score. It implies that similar to long run rainfall shocks, short-term rainfall variations are harmfully influencing the food diversity score. The impacts of long run rainfall and temperature shocks remain same as the case of previous specification. Despite such significant impacts on food diversity, the calorie intakes are not significantly affected by short-term seasonal variations in rainfall. In third specification, long run average temperature and rainfall is introduced in above mentioned variables. The empirical findings are suggestive that inclusion of the average temperature and rainfall does not alter the previous findings for both calorie intakes and food diversity score (see Table 3).

Table 3

Impact of Weather Shocks on Food Outcomes

	(1) Food Diversity	(2) Calorie Intakes	(3) Food Diversity	(4) Calorie Intakes	(5) Food Diversity	(6) Calorie Intakes
Long Run Rainfall Shocks	-0.0531***	-0.0711***	-0.0461**	-0.0688***	-0.0251	-0.0597***
	(0.019)	(0.024)	(0.019)	(0.025)	(0.017)	(0.021)
Long Run Temperature Shocks	-0.0425***	-0.0176	-0.0362***	-0.0157		
	(0.011)	(0.017)	(0.011)	(0.018)		
Seasonal Variation Rainfall (SI)			-0.0456**	-0.0143	-0.0618***	-0.0213
			(0.022)	(0.031)	(0.022)	(0.029)
Household Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Tehsil FE	Yes	Yes	Yes	Yes	Yes	Yes

Household Characteristics: household size, gender of head, head age, head education, female ratio, unemployed to employed ratio.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

By concluding the above discussion, results obtained from tehsil fixed effect have established that climatic shocks are found adversely affecting the household's food security, and the ultra-poor households are extremely susceptible to these negative shocks. In the face of such adverse shocks, the role of cash transfer is more likely to help the poor households to manage against weather shocks. So, the study extends the discussion to the next section in order to exploring the mediating role of BISP cash transfer against such adverse effects of climatic shocks.

7.2. Mediating Role of BISP against Weather Shocks

Table 4 comprises the estimated results of BISP mediating role for calorie intakes against weather shocks. The results obtained from instrumental variable tehsil fixed effect (IV-TEF) indicate that BISP cash transfer is displaying the significant mediating role against short-term seasonal variations in rainfall in order to determine calorie intakes. It establishes that BISP is helping the poor households to manage against the short-term seasonal variations in rainfall. Being the largest social safety net of the country, BISP involves improving the adaptive capacity of the poor against negative weather shocks owing to its extensive and community-based deep rooted infrastructure. Moreover, the positive impact indicates that BISP can help the beneficiaries to improve their calorie intake by 13 per cent against the impact of seasonal variations in rainfall. Similarly, the interactive term of BISP and seasonal variation in rainfall has positive and significant influences on food diversity score among cash recipients, which implies the appeasing impacts of BISP against short-term variations in rainfall. On the whole, positive and mediating role of cash transfer has been explored against aforementioned rainfall shocks (see Table 5). Asfaw, et al. (2017) have found similar sorts of the findings for Zambia, in order to, maintain household's wellbeing.

Apart of abovementioned rainfall factor, the underlying paper makes endeavor to weave up the role of cash transfer against both pre-monsoon and monsoon rainfall seasons. In Pakistan, these two seasons play significant impact on household' lives, because any extreme and frequent occurrence of rainfall events can cause flooding, while the low occurrence of rainfall durations may cause drought. Hence, the mediating role of BISP against the rainfall shocks in monsoon seasons is estimated significantly, despite the magnitude of the co-efficient is small.

Although, it does not have any significant mediating role against the long run rain fall shocks. The insignificant impact implies that the interaction term of BISP with long run rainfall becomes insignificant against negative against the negative impacts of long run rainfall, which demonstrates BISP mediates and makes the interactive term insignificant. Such result may reflect the weak mediating role of BISP against the negative effects of the long run rain fall (Tables 4 and 5).

After discussing the role of cash transfer against rainfall shocks, BISP is exhibiting the significant mediating role against long run temperature shocks. The findings indicate that BISP is helping the poor households to manage the negative and adverse impacts of long run temperature shocks for calorie intakes (Table 5). Similarly, in order to maintain food diversity, BISP demonstrates significant soothing role against long run temperature shocks (Table 6). We can explain these positive effects as the beneficial role of cash transfer in determining the calorie intakes and dietary diversity. It is supporting the proposition that BISP can play important role to ensure food security of those beneficiaries who are highly exposed to temperature variability.

Table 4

Mediating Role of BISP Cash Transfer on Calorie Intakes against Weather Shocks

Variables	(1) RE	(2) TFE	(3) IV-TFE	(4) RE	(5) TFE	(6) IV-TFE	(7) RE	(8) TFE	(9) IV-TFE
BISP	-0.00771	-0.0125*	-0.123***	-0.330**	-0.347**	-1.707***	-0.0049	-0.0092	-0.116***
	(0.007)	(0.006)	(0.016)	(0.151)	(0.150)	(0.353)	(0.006)	(0.005)	(0.016)
BISP*rainfall shock	0.0240	0.0168	-0.0185						
	(0.018)	(0.018)	(0.034)						
BISP* Seasonal rain SI				0.0282**	0.0291**	0.137***			
				(0.013)	(0.013)	(0.030)			
BISP*monsoon rain							7.76e-05	8.84e-05	0.0012***
							(0.0001)	(0.0001)	(0.0002)
BISP*pre-monsoon							-6.54e-05	-6.35e-05	-5.15e-05
							(0.0002)	(0.0003)	(0.0005)
BISP*temp. shocks	0.0050	0.0086	0.0866***	0.0011	0.0095	0.110***	-0.0017	0.0013	0.0903***
	(0.010)	(0.009)	(0.023)	(0.007)	(0.007)	(0.020)	(0.008)	(0.008)	(0.022)
LR temperature shock	-0.0210	-0.0147	-0.0563***	0.00657	0.0131	-0.0395**	0.00137	-0.00570	-0.0554***
	(0.018)	(0.020)	(0.021)	(0.015)	(0.016)	(0.017)	(0.014)	(0.015)	(0.018)
LR rainfall shock	-0.089***	-0.0710***	-0.0677**						
	(0.0261)	(0.0260)	(0.0272)						
LR mean rainfall	0.0159*	0.159**	0.178**	0.0143	0.152**	0.176**			
	(0.008)	(0.075)	(0.078)	(0.009)	(0.075)	(0.079)			
LR mean temperature	0.0004	-0.145	-0.218**	-0.0007	-0.226**	-0.293**			
	(0.002)	(0.099)	(0.109)	(0.002)	(0.102)	(0.115)			
Seasonal rainfall (SI)				-0.0038	-0.0578*	-0.124***			
				(0.025)	(0.033)	(0.036)			
Monsoon rain shock							0.0006***	0.0007***	0.0001
							(0.0001)	(0.0001)	(0.0002)
Pre monsoon rain shock							0.0001	0.0002	0.0003
							(0.0002)	(0.0003)	(0.0003)
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional (rural=1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tehsil FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5

Mediating Role of BISP Cash Transfer on Food Diversity Score (FDS) against Weather Shocks

Variables	(1) RE	(2) FE	(3) IV-FE	(4) RE	(5) FE	(6) IV-FE	(7) RE	(8) FE	(9) IV-FE
BISP	-0.0095**	-0.0112***	-0.0779***	-0.256**	-0.269**	-1.011***	-0.0059	-0.0069**	-0.0677***
	(0.004)	(0.003	(0.010)	(0.128)	(0.129)	(0.304)	(0.004)	(0.003)	(0.010)
BISP*Rainfall Shocks	0.0103	0.00428	-0.0146						
	(0.012)	(0.013)	(0.027)						
BISP*Seasonal Rain (SI)				0.0215*	0.0223**	0.0808***			
				(0.011)	(0.011)	(0.026)			
BISP*Monsoon Shock							9.03e-05	9.92e-05	0.0008***
							(0.0001)	(0.0001)	(0.0002)
BISP*Pre-monsoon Shock							-0.0003*	-0.0003*	-0.0002
							(0.0001)	(0.0001)	(0.0004)
BISP*Temperature Shocks	0.0028	0.0047	0.0310**	0.0022	0.0071	0.0436***	-0.0006	0.0005	0.0282**
	(0.006)	(0.007)	(0.014)	(0.006)	(0.006)	(0.013)	(0.005)	(0.006)	(0.012)
LR Temperature Shocks	-0.0401***	-0.0429***	-0.0592***	-0.0191*	-0.0204	-0.0388***	-0.0130	-0.0210*	-0.0374***
	(0.012)	(0.015)	(0.018)	(0.010)	(0.012)	(0.014)	(0.011)	(0.012)	(0.013)
LR Rainfall Shocks	-0.0580***	-0.0521**	-0.0571**						
	(0.019)	(0.021)	(0.025)						
LR Mean Rainfall	0.0008	0.170*	0.186*	-0.0033	0.199**	0.206**			
	(0.006)	(0.093)	(0.102)	(0.007)	(0.085)	(0.089)			
LR Mean Temperature	-0.0073***	-0.0642	-0.0661	-0.0073***	-0.0881	-0.106			
	(0.001)	(0.097)	(0.103)	(0.001)	(0.098)	(0.102)			
Seasonal Rain Index (SI)				-0.0470**	-0.0857***	-0.117***			
				(0.019)	(0.025)	(0.027)			
Monsoon Shocks							-0.0002**	-0.0003**	-0.0006***
							(0.0001)	(0.0001)	(0.0001)
Pre-monsoon Shocks							0.0004*	0.0003	0.0004
							(0.0002)	(0.0002)	(0.0003)
Household Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional (rural=1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tehsil FE	NO	Yes	Yes	NO	Yes	Yes	NO	yes	Yes

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 6

Impact of Mediating Role of BISP Cash Transfer on Calorie Intakes against Rainfall Shocks

Variables	(1) RE	(2) FE	(3) IV-FE	(4) RE	(5) FE	(6) IV-FE	(7) RE	(8) FE	(9) IV-FE
BISP	-0.310**	-0.309**	-1.278***	-0.00636	-0.0100**	-0.107***	-0.00523	-0.00900*	-0.103***
	(0.149)	(0.147)	(0.353)	(0.004)	(0.004)	(0.013)	(0.004)	(0.004)	(0.0143)
BISP*Seasonal index (SI)	0.0276**	0.0266**	0.101***						
	(0.0131)	(0.0129)	(0.0311)						
BISP*negative Shock	6.64e-06	3.54e-06	-1.21e-06						
	(4.85e-06)	(4.62e-06)	(1.31e-05)						
BISP*rainfall shocks				0.0210	0.0127	-0.0550			
				(0.016)	(0.016)	(0.034)			
BISP*Monsoon							0.000080	0.00008	0.0010***
							(0.0001)	(0.0001)	(0.0002)
BISP*Pre-monsoon							-0.00007	-0.00005	0.0001
							(0.0002)	(0.0002)	(0.0005)
Seasonal Index (SI)	-0.00752	-0.0677**	-0.119***						
	(0.025)	(0.031)	(0.035)						
Neg. Rainfall Shocks	-1.49e-05**	-6.25e-06	-3.14e-06						
	(6.34e-06)	(6.68e-06)	(8.47e-06)						
LR mean Rainfall	0.0141**	0.242***	0.276***	0.0139***	0.212***				
	(0.006)	(0.059)	(0.060)	(0.005)	(0.058)				
LR Rainfall (MD)				-0.0775***	-0.0650***	-0.0420*			
				(0.022)	(0.021)	(0.024)			
Monsoon Shock							0.0006***	0.0007***	0.0001
							(0.0001)	(0.0001)	(0.0002)
Pre-monsoon Shock							0.0001	0.0001	0.0002
							(0.0002)	(0.0002)	(0.0003)
Household Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region (Rural=1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tehsil FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Moreover, in order to check the sensitivity of the results against rainfall shocks, we have estimated all previously discussed models by dropping temperature. The estimated results are suggesting the similar sorts of mediating role of BISP against rainfall shocks on both calorie intakes (see Table 6) and food diversity score (see Table 7) as earlier findings have suggested.

In conclusion, BISP cash transfer demonstrates a significant mediating role against weather shocks. Specifically, against long-run temperature, it has a stronger mediating role than long-rung run rainfall shocks. Nonetheless, the BISP cash transfer holds strong implications against short-term seasonal variations and temperature, while the positive mediating role is estimated against rainfall shocks in the monsoon season. IV-TFE estimation further suggests that such weather shocks have negative and significant impacts on respective outcome variables, when these variables are being used alone.

Table 7

Mediating Role of BISP Cash Transfer on Food Diversity Score (FDS) against Rainfall Shocks

Variables	(1) RE	(2) FE	(3) IV-FE	(4) RE	(5) FE	(6) IV-FE	(7) RE	(8) FE	(9) IV-FE
BISP	-0.187*	-0.186	-0.723***	-0.0089***	-0.0096***	-0.072***	-0.0061	-0.0068**	-0.0641***
	(0.112)	(0.114)	(0.281)	(0.003)	(0.003)	(0.009)	(0.004)	(0.003)	(0.010)
BISP* seasonal rain (SI)	0.0179*	0.0175*	0.0610**						
	(0.008)	(0.009)	(0.024)						
BISP*-ve rainfall shocks	1.33e-05***	1.18e-05***	2.49e-05***						
	(3.24e-06)	(3.16e-06)	(9.02e-06)						
BISP* rain shock (MD)				0.0093	0.0033	-0.0169			
				(0.011)	(0.012)	(0.024)			
BISP*monsoon							8.20e-05	8.42e-05	0.0007***
							(0.0001)	(0.0002)	(0.0002)
BISP*pre-monsoon							-0.0003*	-0.0003*	-0.0001
							(0.0001)	(0.0001)	(0.0005)
Seasonal index (SI)	-0.0594***	-0.0922***	-0.120***						
	(0.019)	(0.024)	(0.026)						
Negative rain shocks	-3.66e-07	4.43e-06	-4.88e-06						
	(3.67e-06)	(3.92e-06)	(5.24e-06)						
LR mean rain	0.0176***	0.233***	0.233***	0.0221***	0.187***				
	(0.004)	(0.067)	(0.072)	(0.003)	(0.067)				
LR rain shock (MD)				-0.0381**	-0.0301*	-0.0323			
				(0.016)	(0.017)	(0.019)			
Monsoon shocks							-0.0002**	-0.0002**	-0.0006***
							(0.0001)	(0.0001)	(0.0001)
Pre-monsoon shock							0.0004*	0.0005*	0.0003
							(0.0002)	(0.0002)	(0.0003)
Household variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region (rural=1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tehsil FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.

8. CONCLUSION

Weather shocks have become a colossal threat to Pakistan owing to her limited financial and technical ability to mitigate and adapt it. These threats are expected to be increasingly scaled up in the coming years. The ultra-poor segment of households is highly susceptible to increasing weather-shocks. Food insecurity is one of the most significant aspects of household wellbeing which is directly affected by climatic variability. In such scenario, the role of BISP cash transfer is inevitably important. This study proposes the positive and significant mediating role of BISP to improve calorie intakes and food diversity against intimidating weather-shocks. In this regard, this study explores the impact of climatic-variability on calorie intakes and food diversity score of poor households, and then mediating role of the BISP cash transfer is established against such shocks.

The application of instrumental variable tehsil fixed effect (IV-TFE) demonstrates the significant and adverse effects of the negative rainfall and temperature shocks on the food security of the poor households. Then, we introduce the interactive terms of BISP with climatic-indicators in order to gauge the mediating role of BISP. The findings are

suggestive of the positive and significant influences of mediating role of the BISP cash transfer which improves the calorie-intakes and food diversity score. BISP does not have any significant mediating role against long run rainfall shocks. However, cash transfers do have significant mediating role against seasonal and short-term rainfall shocks. Likewise, we have found significant mediating influences against monsoon rainfall season. Moreover, BISP cash transfers have the strongest mediating impacts against the temperature shocks. These positive and significant impacts are recommending that social protection programs are important policy mechanism which needs to be designed particular to climatic shocks as well, especially country like Pakistan which is highly exposed to the weather-risks.

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