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Natural Disasters, Relief Aid, and Household Vulnerability in Pakistan: Evidence from a Pilot Survey in Khyber Pakhtunkhwa

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Abstract:

Based on a pilot survey, we analyze the damages caused by floods in Pakistan, 2010, the distribution of aid, and the extent of recovery at the household level. With regard to the nature of damages, we show that flood damages had both between-village and within-village variation, and damages to houses, land (crops), livestock, and other business assets were not highly correlated. In the distribution of aid from outside, we again find substantial between-village and within-village variation − the aid distribution across villages appeared well-targeted toward the severely affected villages, while aid within villages was targeted toward households with larger house damages, but not toward households with larger damages to land, crop, or other assets. The positive aid response to house damages and the negative aid response to the initial wealth level were found but the marginal response of aid to these characteristics was not large. With regard to the recovery from flood damages, we find that aid recipients did not show higher or lower recovery than non-recipients, especially for house damages, which could be due to mixing of a recovery-promoting effect of aid and a selection effect of aid toward households that have more difficulty in recovery. We also show that households who had initially fewer assets and hit by larger flood damages had more difficulty in recovery.

JEL classification codes: O12, D12, D91.

Keywords: natural disaster, relief distribution, resilience, Pakistan.

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1. Introduction

In attacking poverty in developing countries, due attention should be paid to the fact that the life of the poor is characterized not only by low levels of income or consumption but also by the risk of further downturn (or vulnerability). One of potential threats that bring such downturn is natural disasters. How poor households with few assets are affected by natural disasters? In coping with such disasters, what role can a relief play? How is the relief allocated in the field across households and villages? Given such reliefs and mutual help based on community-based reciprocity networks, how resilient are the affected households? These are issues addressed in this paper.

In the economics literature on household vulnerability, the impact of idiosyncratic shocks has been analyzed thoroughly (Townsend, 1994; Fafchamps, 2003; Dercon, 2005), while the literature on the impact of aggregate shocks such as natural disasters is scarce (Sawada, 2007). As summarized by Sawada (2007), the impact of idiosyncratic risks and nondiversifiable aggregate risks are distinctively different, and the role of self-insurance becomes more important against large-scale disasters because formal or informal mutual insurance mechanisms are largely ineffective.

To cope with such covariate shocks, aid from outside is expected to play an important role in supplementing local reciprocity networks and self-insurance. Especially during the emergency relief phase, quick and efficient distribution of aid is critically important; the aid remains important in the later phases of recovery and reconstruction.[1] Nevertheless, the economics literature on aid is limited and in infancy (Jayne et al., 2002; Morris and Wodon, 2003; Takasaki, 2011).

The village economy and individual households are expected to recover from natural disasters by combining their own coping strategies and aid from outside. In the ecology literature, the concept of resilience is often employed to describe the extent and speed of such recovery (e.g., Gunderson and Pritchard, 2002). In economics research as well, the extent and speed of recovery is an important topic, for which both empirical and theoretical work is limited.

To fill these gaps in the literature, we analyze the impact of floods, the distribution of aid, and the extent of recovery in rural Pakistan, based on a pilot survey conducted in January-February 2011. In July-August 2010, Pakistan experienced “the worst floods in its history... The floods have affected 84 districts out of a total 121 districts in Pakistan, and more than 20 million people − one-tenth of Pakistan’s population... More than 1,700 men, women and children have lost their lives, and at least 1.8 million homes have been damaged or completely

[1] See de Ville de Goyet (2008) for typical phases after a natural disaster.

destroyed" (UN, 2010, p.1). Our pilot survey was conducted in Khyber Pakhtunkhwa,[2] which was hit by the floods most severely. There are several studies that analyzed household vulnerability to idiosyncratic shocks in rural Pakistan (e.g., Kurosaki, 2010), but very few studies analyzed the impact of aggregate shocks. The only study we know − the one by Kurosaki (2011) − focused on the village-level shocks so that his framework is not readily applicable to the analysis of the 2010 floods. Furthermore, we do not know any economic study on the relief aid in Pakistan, mostly due to the lack of data.[3] Because of this scarcity, the evidence shown in this paper is expected to shed light on the issue of natural disasters and relief allocation, despite the small sample size.

The rest of the paper is organized as follows. After this introductory section, Section 2 describes the study area, focusing on the 2010 floods. Section 3 explains the survey design. Sections 4-6 provide the results of descriptive analysis, in the order of the extent of damages caused by the floods, the distribution of aid, and the level of recovery. Section 7 contains summary and conclusion.

2. The 2010 Pakistani Floods

2.1 Floods and aftermaths

The 2010 floods that hit Pakistan were indeed unprecedented and affected all over the country. Heavy torrential rains and flash floods in July-August 2010 severely hit human lives, livestock, infrastructure, crops, and livelihoods all over the country. By November 2010, the Government of Pakistan assessed that more than 20 million Pakistanis were affected, approximately 1.88 million houses damaged, 1,767 persons killed or missing, and 2,865 persons injured (GOP, 2010).

Region-wise damages to different sectors of the economy are shown in Table 1. The table shows that the worst affected sector by the floods is agriculture (including crop and livestock subsectors), followed by the housing sector. Damages to infrastructure such as roads and canals were also serious.

The province of Khyber Pakhtunkhwa stands as the worst affected province, keeping in view the magnitude of human casualties, displacement, and damages to other infrastructure. The main reason for this was the fact that the province was directly showered by the rains and no flood warning was issued in most part of the province. Furthermore, floods with 15 to 25 feet intensity hit most parts of the province during the night time, making it difficult for residents to

[2] Khyber Pakhtunkhwa is one of the four provinces that comprise Pakistan. The province was formerly known as North-West Frontier Province (NWFP). In April 2010, the constitution of Pakistan was amended and the former NWFP was renamed Khyber Pakhtunkhwa.

[3] Amin (2008) provides important evidence of problems faced by relief agencies working in Pakistan in managing data during the relief activities after the 2005 Kashmir Earthquake.

cope with the disaster. The absolute level of damages in Punjab and Sindh was larger than that in Khyber Pakhtunkhwa. However, since the population size in these two provinces is much larger than in Khyber Pakhtunkhwa, per-capita damages were larger in Khyber Pakhtunkhwa than in Punjab and Sindh. Within the region indicated as "Others" in Table 1, Azad Jammu & Kashmir was seriously hit in terms of damages to housing and health facilities.

2.2 Relief activities

To tackle the difficult situations, relief activities were quickly organized both from abroad and within Pakistan. Apart from the foreign aid announced by different countries, a number of international NGOs rushed toward flood-affected areas of Pakistan. Similarly, local, regional, and national NGOs working in the country also divert their development funds toward the relief of flood-affected people. It is worth mentioning that fellow Pakistanis who were not affected extended their full support toward the affected people by providing food, shelter, and cash.

However, considering the intensity of the damages, all these aid inflows were not sufficient. For example in Khyber Pakhtunkhwa, the damages were estimated to be Rs. 37 billion while the aid inflow received by the provincial government was Rs. 5 billion, only one seventh of the total damages. The insufficiency of aid inflows further aggravated the already precarious situation, with an increasing notion among the affected people that the aid was not distributed properly.

Among the government initiatives in flood reliefs, the system of *Watan* cards merits detailed explanation. In order to provide relief to the flood-affected population, in particular for the reconstruction of damaged houses, the government of Pakistan, in collaboration with the provincial governments of each province, started the Watan Card Scheme. Under this scheme, flood-affected families were registered by the National Database and Registration Authority (NADRA) and were issued ATM cards. A total of Rs. 100,000 was to be paid to each flood-affected family in five equal installments of Rs. 20,000 each. Money was to be directly transferred to their bank accounts from the public treasury in order to assure transparency.

The first Watan installment was paid in February 2011. Due to the paucity of funds, the rest of the payment has not yet been paid at the time of this writing. The detail of the beneficiaries was launched on the websites of each provincial disaster management authority. Nevertheless, the whole procedure of Watan card distribution was not regarded by many people as transparent and many complaints were addressed (e.g., *Dawn*, 2010).

2.3 Situations in Khyber Pakhtunkhwa

As confirmed in Table 1, the province of Khyber Pakhtunkhwa was the most affected

− for example, standing crops on 121.4 thousand hectares of land were destroyed in this province alone and irrigation channels were seriously damaged, which threatened the future growth of the crop sector. According to an alternative estimate by an NGO, approximately 1.5 million people were displaced and 156,934 houses were fully or partly destroyed in Khyber Pakhtunkhwa (PRDS, 2010). The floods affected all areas in the province, including large cities like Peshawar City but the main damages occurred in rural areas.

As shown in Table 2, the flood intensity differed from district to district. Ten districts were designated as the worst hit, while 9 were designated as "medium" and 5 as "least" in the extent of damages, assessed by the Provincial Disaster Management Authority (PDMA). In Peshawar District, where we conducted our pilot survey, it is estimated that approximately 57% of the population was directly affected by the floods. PDMA data show that the floods affected 52 union councils of the district out of 60 councils.

PDMA statistics also reveal that more than 3.8 million people in the province were affected by the floods to a varying extent. Approximately 180,000 houses were completely damaged and another 40,000 partially damaged. Standing crops on 466,626 acres were destroyed, whereas more than 10,000 heads of livestock were reported to be killed or drained by the flood water. Looking at the damages to infrastructure, approximately 2,000 km of major and link roads, 40 major bridges, and 40 minor bridges were destroyed, whereas about 700 educational, 150 health units, and 158 public buildings were damaged.

In the province of Khyber Pakhtunkhwa, 47,559 families were issued a Watan card by the time of this writing. Assuming the average family size of 8 persons, this implies that Watan cards in the province benefited approximately 380,000 persons. The district-wise detail of Watan card distribution is given in Table 2. The largest recipient district is Charsadda, followed by Nowshera, D.I.Khan, and Kohistan, all were "Worst" damaged by the floods. Therefore, as far as the Watan card distribution across districts is concerned, more damaged districts received more Watan cards.[4] In this sense, Watan cards are well-targeted toward the needy. However, the table is silent on within-district distribution. For such assessment, we need micro data.

3. Pilot Survey of Village Economies

3.1 Village survey

In order to assess the vulnerability and resilience of rural economy against unexpected natural disasters, we conducted a pilot survey of village economies in Peshawar District, Khyber Pakhtunkhwa, Pakistan. The objectives of the survey are: First, it is designed as a fact finding survey on the topic; second, it is designed as a survey meant for the preparation of the panel

[4] If we assign 1 for "Least", 2 for "Medium", and 3 for "Worst" in the second column of Table 2 and calculate the bivariate correlation coefficient between the second and third column variables, the coefficient is 0.432, statistically significant at the 5% level.

survey of rural households.

The pilot survey covered 10 sample villages and 100 sample households (10 each from each sample village). The sample villages were chosen in a way similar to the way the authors surveyed villages in the same district in 1996/97 and 1999/2000 (Kurosaki and Hussain, 1999; Kurosaki and Khan, 2001). We chose villages with different characteristics in terms of economic development but with similar characteristics in terms of ethnicity and culture in order to elicit the dynamic implications of economic development from a cross-section. Out of the three villages surveyed in the previous panel surveys, two villages (Tarnab and Damane Hindko) were successfully re-surveyed in this pilot survey. One village (Yousuf Khel) was not covered by the pilot survey because of security reasons. As replacement for this village, Shahi Bala was surveyed in the pilot survey since the agronomic and socioeconomic conditions are relatively similar to those of Yousuf Khel. However, Shahi Bala village is slightly different in the sense that some of the agricultural land in this village has canal irrigation system while agricultural land in Yousuf Khel is completely rain-fed.

Additional criterion of the village selection was to include villages with different levels of damages due to the floods. Although the Pakistani Floods of 2010 were unprecedented and damaged the province widely, not all villages were damaged with the same intensity. Therefore, in the pilot survey, we intentionally selected villages with different levels of flood damages on houses and infrastructure, based on the information we collected before the survey. Table 3 shows the list of surveyed villages. Two of them (Jala Bela and Mian Gujar) were reported to have been seriously damaged in houses and infrastructure. Village Dag was chosen as a village that was reported to have been damaged the least. The remaining seven villages are located in between these two extremes. In the survey, village-level information was collected from knowledgeable villagers[5] using a structured questionnaire.

3.2 Sample households

From each of these ten sample villages, ten sample households were chosen for the survey. They were selected to represent various levels of flood damages within a village as much as possible. A structured questionnaire for households was used in the survey. Summary statistics of several key variables of the sample households are given in Table 4. Since the probability of being in our sample differs from village to village, we report both unweighted and weighted statistics in Table 4 but we mainly discuss the unweighted results below because the weighting did not affect the discussion qualitatively.

[5] In each village, a group comprising 2 to 5 villagers who knew the village well was interviewed for the survey. Such knowledgeable villagers included social workers appointed by the government, union councilors, traditional village leaders such as members of *Jirga* or village *Malik*, and Islamic leaders.

The average age of the household head is 47 years and their literacy rate is 62%. In comparison with the average literacy rate in the province, the sample household heads are slightly better educated. However, their literacy rates are similar to the village averages, as shown in Table 3. These patterns could be attributed to the fact that these villages are located close to the provincial capital where access to educational institutions is easy, resulting in higher educational achievement than the average in the province. Education represents the quality of human capital in the modern context. In the traditional context of the study area, the quality of human capital can be measured by the head's social status. As shown in the table, 16% of the sample household heads are the leader in the traditional village power structure. The household size captures the quantity aspect of human capital. The median household size is 9 persons, out of which 5 are males and 4 are females. The mean household size is 9.45 persons (4.94 of which is males and 4.51 of which is females).

Table 4 also summarizes major assets before the floods. First, the majority of households owned their house building, whereas several of them did not own it and the rest had two buildings. The average number of owned house buildings is slightly below one. Second, the average land holding size is 3.7 acres, but it is associated with a large standard deviation and skewed distribution − 58% of households are landed and the inequality within the landed class is substantial, with the median land ownership size is 1 acre against the mean at 3.7 acres. The average land asset value is Rs. 4.6 million (mean) or Rs. 1.0 million (median).[6] Large animals such as cattle and buffaloes are important as productive assets for farming and dairy activities, while small animals such as goats/sheep and chickens are an important saving device. Livestock assets are more equally distributed than land assets, but still their distribution is not egalitarian − about three fourths of households owned some livestock and its average value is around Rs. 74,000 (mean) or Rs. 34,000 (median). The sample includes two exceptional households who operated a poultry business with 2,000 and 5,000 chickens, respectively. To eradicate the influence of these outliers, the table also shows summary statistics for the livestock value excluding chickens. These statistics show that two important forms of asset in the study area, i.e., land and livestock, are distributed with a substantial variation.

4. Extent of Flood Damages

4.1. Flood damages at the village level

Human damages: Table 5 shows the extent of human damages caused by the floods in each village. The incidence of death or injury was low according to the village survey result. Reflecting this, the household dataset contains no household with death and at most one or two households with injuries in a village. On the other hand, the incidence of disease was very high.

[6] "Rs." implies the currency of Pakistan Rupees. At the time of our survey, US$ 1.00 = Rs. 86.

In all villages, more than half of our sample households reported the prevalence of diseases. Most of the diseases were with skin or eyes.

House buildings: Table 6 shows how much the 2010 floods damaged houses. Three categories are differentiated: "Destroyed" means that the house was destroyed completely so that it was not suitable for residence; "Major damage" means that the house was destroyed partially and it required repair before rehabilitation; "Minor damage" means that the house was destroyed and required repair but suitable for accommodation. Village Jala Bela was the most seriously affected in terms of the incidence of "Destroyed" while village Mian Gujar was the most seriously affected in terms of the absolute number of houses damaged by the flood regardless of its severity.

When the sample household head was able to report the monetary estimate for the house damage, the information was recorded, whose statistics are shown in the right columns of Table 6. The within-village averages of household damages were in the range from Rs. 73,000 (village Masma) to Rs. 195,000 (village Dag). Although the incidence of house damages was the least in Dag (6 households out of 10 reported the damage), the damage estimates were not low in this village, because their house buildings were generally better than in other villages. It is likely that house damages were larger than these ranges for households in Jala Bela, for which the information was missing.

Agricultural land: The extent of flood damages to agricultural land among sample households is shown in Table 7. At the village level (not shown in Table 7), agricultural land in all ten villages was damaged by the floods. For instance, in Tarnab, one acre of crop land was completely eroded while 250 acres of orchard land was damaged heavily; in Masma, 300 acres of crop land and 75 acres of orchard land were affected partially. The household-level data shown in Table 7 suggest that sample households in village Dag experienced the severest damages to their agricultural land, followed by those in village Urmar Miana and village Damane Hindko. In Dag, the average land damage value among those with positive damages was Rs. 700,000, which is a substantial amount compared with the mean land asset value at Rs. 4 million (Table 4). Therefore, land damages due to the floods were heterogeneous not only across villages but also within villages.

Crop loss: Flood damages to standing crops at the household level were summarized in the right half of Table 7. Sample households in village Dag experienced the largest damages to their standing crops, followed by those in village Shahi Bala and village Budni. In Dag, all sample households suffered from crop losses, whose average value was Rs. 1.73 million. This was indeed a huge loss. In this village, most of the agricultural land was cropped with cash crops of sugarcane and yam. Since the expected gross output value of these crops is high,[7] the

[7] In usual year, the gross output value of sugarcane is Rs. 250,000 per acre on average while that of yam

value of crops destroyed by the 2010 floods was also high in this village.

In other villages as well, crop damages were substantial for several households. The average crops loss among landed households was approximately 8.2% of their land values in nine villages except for Dag. In Dag, the corresponding number was approximately 32.7%. Therefore, crop damages were more prevalent and their size was significant in this village.

Livestock: Both of the village and household surveys show that Damane Hindko experienced the largest loss of livestock assets (Table 8). From the village-level survey, a loss of Rs. 9,000 per household was indicated while from the household-level survey, a loss of Rs. 47,000 per household was suggested. In comparison with the size of the initial livestock reported in Table 4, the loss amount was huge. Across all ten villages, the livestock loss calculated from the household-level data indicates that on average 24% of the initial livestock assets were lost by the floods. In both datasets, no livestock loss was reported from village Dag.

Other rural business: In the study area, several villagers ran a rural and agro business such as dairy, bee-keeping (apiculture), and poultry farms. The floods brought damages to these facilities. According to the village-level data, dairy farm damages were reported in Masma, Urmar Miana, and Damane Hindko; apiculture farm damages were observed in Tarnab and Masma; poultry farm damages were reported in Urmar Miana, Mera Kachori, Damane Hindko, Mian Gujar, and Budhni. Each case resulted in a loss ranging from Rs. 0.2 to 3 million. The household dataset contains two cases of poultry farms damaged by the floods in Damane Hindko, which reported the estimated damage of Rs. 400,000 and Rs. 1 million, respectively.

Infrastructure: Roads were damaged in Tarnab, Damane Hindko, and Shahi Bala. Health facilities were partially affected in Tarnab. In Damane Hindko, all educational institutions were partially damaged, while in Jala Bela, the floods brought a minor damage to boys' primary school. In all villages except for Budhni, electricity, gas, and phone service were suspended for several days due to floods and heavy rains.

Summary: As shown above, damages were widespread in the ten villages. The pattern of damages differed from village to village. House damages were the most serious in Jala Bela, while damages to agricultural land and crops concentrated in Dag and livestock damages concentrated in Damane Hindko. A large within-village variation was also found for each type of damages, except for human damages. Therefore, in the next subsection, we further analyze the within-village variation of flood damages.

4.2. Flood damages variation across households within a village

This subsection analyzes the intra-village distribution for variables except for human

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is Rs. 300,000 per acre.

damages, since we have less variation across households in terms of human damages. Our analysis is implemented in two ways.

The first is a bivariate correlation analysis between a flood damage variable and another, both of which are transformed as the deviation from the village-level means. Table 9 reports the correlation matrix. We took the sum of the five variables of each damage category to obtain the aggregate measure of flood damages in terms of asset losses. By construction, the last category (*fd_total_vd*) tends to be positively correlated with individual components. This is indeed the case except for livestock. The livestock loss occurred independently of house, land, and crop losses, while its occurrence was negatively correlated with other asset damages. Because of this, the livestock loss was not correlated with the total flood damage.

Looking at the correlation coefficients among the first five flood damage variables, there is one significant coefficient, in addition to the negative correlation between livestock and other asset damages already discussed. That is the correlation between the land damages and crop damages − the two variables were correlated with the correlation coefficient of 0.309, statistically significant at the 1% level. Therefore, when a flood occurs, it tends to bring damages to both land and standing crops. This is as expected, but its quantitative magnitude is confirmed by our study. The complete absence of correlation between house damages, land/crop damages, and livestock damages is a finding that has been addressed nowhere in the existing literature as far as we know. This suggests that damages of floods are heterogeneous within a village so that a relief of one kind may not be useful to all flood victims.

Second, to investigate which households are vulnerable to each category of flood damages, we estimated a multivariate regression model in which the damage variable of concern is regressed on village fixed effects (a full set of village dummies) and several variables that are expected to affect the damage and have intra-village variation. As the latter, we employ the following variables that characterize asset positions before the floods: human capital indicators, such as household size (quantity of human capital), household head's education (quality of human capital in the modern context), and household head's village leader dummy (quality of human capital in the traditional context); physical capital indicators such as the number of house buildings, value of land, and value of livestock owned by each household before the floods.

Regression results are given in Table 10. The table shows that each of the five damages is associated positively with one type of capital that has a natural connection with the damage. That is, the number of houses is significantly correlated with the house damage, land asset with the land damage (although significant only at the 20% level in Table 10 but at the 10% level if other insignificant initial assets are excluded), land asset with the crop damage, and livestock with the other asset damage. In other words, those households that already had a larger asset of one kind suffered more damages to that type of asset. Human capital variables are

insignificant in explaining the flood damages, which appears to indicate that human capital is not useful in reducing the damages when they are caused by a very emergent arrival of floods. Unexpectedly, the initial holding of livestock has an insignificant coefficient in the livestock damage regression. The reason for this absence of correlation is left for further research.

5. Availability and Targeting of Flood Relief

5.1. Availability of flood relief at the village level

In our survey, we distinguished initial emergency relief and aid for recovery/ reconstruction in the later phases. In all ten villages, the initial relief by local people to the affected started just after the floods hit, such as the provision of foods, clothes, labor, and shelter (see subsection 6.1). Then came the emergency flood relief provided by the government and NGOs, such as food, clothes, shelter, and medical services. Two or three months after the floods, government rehabilitation aid began to reach the affected villages including Watan cards, while NGOs moved to the provision of construction materials and cash/credit, in response to the different needs during the recovery phase.

Government emergency aid: Table 11 summarizes the emergency relief provided by the government. All villages except for Dag had government relief activities inside the village. Two out of ten sample households in village Dag received government relief from camps outside the village. Both village-level and household-level data show that the government emergency relief was more available in villages Jala Bela and Masma than in other eight villages. In these two villages, beneficiary households received approximately Rs. 12,000 value of emergency relief on average. The government emergency relief was provided on the assessment basis or the first-come-first-served basis. Only one case out of 100 was recorded in the household-level data that the relief request was rejected with reasons unknown to the household.

NGO emergency aid: Emergency aid from NGOs is distributed across villages in a way similar to the government relief. As shown in Table 12, NGO emergency relief was more available in villages Jala Bela and Masma than in other eight villages. According to the household dataset, the transfer amount per household from NGOs is similar to that from the government. NGO emergency relief was also provided on the assessment basis or the first-come-first-served basis, and the claim of being rejected with reasons unknown to the household was found only sporadically.

Government rehabilitation aid: On the contrary, the distribution of government rehabilitation aid during the recovery phase was controversial. Table 13 shows that in all villages, such aid was distributed. Its incidence was higher in villages Jala Bela, Mian Gujar, and Mera Kachori.

The most important component of the government rehabilitation aid was Watan cards. Watan cards were to be provided on the assessment basis but many of the sample households reported that their Watan card application was rejected with reasons unknown. Such complaints are more frequently found in villages Damane Hindko and Budhni, where the village-level availability of Watan cards was less than in other villages.

NGO rehabilitation aid: The availability of reconstruction aid from NGOs across villages is shown in Table 13. According to the village dataset, the NGO presence remained strong in village Masma while it became weaker in village Jala Bela than before. However, according to the household dataset, the majority of our sample households in Jala Bela continued to benefit from NGOs. This may suggest a possibility that the targeting of aid by NGOs across villages and households is different between the emergency and recovery phase, as demonstrated by Takasaki (2011) for the case of cyclone relief in Fiji.

5.2. Targeting of flood relief within a village

The discussion in the previous subsection appears to suggest the existence of unequal access to aid, both across and within villages. Therefore, in this subsection, we first examine whether a household that receives one type of flood relief (say relief A) is more likely to receive another type of flood relief (relief B) than a household that does not receive relief A. In other words, we examine whether a situation with "aid duplication" is observed. If the aid duplication occurs due to the targeting of aid to severely affected people, it may not be a serious concern. On the other hand, if the aid duplication occurs due to the capture by politically-influential households in a village, it indicates a serious problem of mistargeting (Jayne et al., 2002; Takasaki, 2011).

There are four types of flood reliefs whose distribution across villages has been examined in the previous subsection: government emergency aid, NGO emergency aid, government recovery aid including Watan cards, and NGO recovery aid. Panel A of Table 14 shows a 4-way cross table of the 100 sample households regarding the aid recipient status. As shown in the panel, 30 households received no aid at all, while 12 received all four types of aid. There is a tendency to concentrate on the diagonal, indicating aid duplication. In panels B and C of Table 14, we aggregate the information in panel A into a 2-way cross table and implement a test for the independence hypothesis. As shown in the table, when a household receives aid from the government, it tends to receive aid from NGOs as well (statistically significant at the 1% level both in the emergency and recovery phase); when a household receives aid from NGOs in the emergency phase, it tends to receive aid from NGOs in the recovery phase as well (significant at 1%); similar correlation between aid receipt from the government during the two phases (significant at 5%). Thus aid duplication is observed at the household level.

How much of this aid duplication is due to the concentration of aid to households in severely damaged villages and how much is attributable to allocation within a village to severely affected households? To examine this issue, we calculated the bivariate correlation between the aid recipient statuses, after taking the deviations from the village averages (Table 15). As in Table 9, we also compiled an aggregate dummy variable, *aid_d*. By construction, the last (fifth) category of *aid_d* tends to be positively correlated with individual component, 3 out of 4 with statistical significance at the 1% level. All of the six correlation coefficients among the first four aid recipient statuses are positive but only two of them are statistically significant − when a household received emergency aid from NGOs (*aid_em_pd*=1), it tends to receive rehabilitation aid both from the government (*aid_rc_gd*=1) and NGOs (*aid_rc_pd*=1) in later periods. Although statistically weaker than indicated by Table 14, Table 15 suggests the existence of aid duplication within a village.

Does the within-village aid duplication indicate the existence of mistargeting? To examine this issue parametrically, we estimated a linear probability model of receiving flood relief. All models include village fixed effects. Therefore, we can investigate what type of characteristics is associated with the aid allocation within a village. Regression results using observed values of flood damages as explanatory variables are shown in Table 16. The table shows a contrast between house damages and other types of damages. House damages are with positive coefficients, indicating that households whose house was more damaged were more likely to receive aid, especially from the government. If the house damage due to the floods had been larger by Rs. 100,000 (this figure is close to the mean reported in Table 6), the probability for the household to receive government emergency aid would have been higher by 5.1 percentage points and the probability to receive government rehabilitation aid would have been higher by 9.0 percentage points. Thus the house damage was associated with damage-based targeting moderately. On the other hand, flood damages to land and crops are associated with lower probability of receiving aid, and the negative coefficients on crop damages were statistically significant in explaining the probability of obtaining the government emergency aid.

One of the problems in the regression results of Table 16 is that they ignore the possibility of a fine-tuned targeting where households with larger flood damages but with superior asset base for recovery were given lower priority in aid distribution. To address this possibility, we estimate another regression model, in which two groups of household-level explanatory variables are included. The first group contains exactly the same list of household-level initial asset variables used in Table 10. The second group contains the fitted residuals from regression models in Table 10. The fitted residuals contain the component of variation in flood damages not explained by village fixed effects and households' initial assets. Therefore, coefficients on the fitted residuals can be interpreted as the aid response to flood

damages, after controlling for the flood damages endogenously determined by households' initial assets.

Regression results using the fitted residuals of flood damages are shown in Table 17. The six variables of households' initial assets (human and physical capital) are associated with a negative coefficient except for a few cases, indicating that poorer households were targeted within a village for relief, after controlling for the flood damages. However, only four of them are statistically significant and three of the four are on the land asset. For example, if the land asset had been larger by Rs. 1 million (this figure is close to the median reported in Table 4), the probability for the household to receive government emergency aid would have been lower by 0.89 percentage points, the probability to receive NGO emergency aid would have been lower by 1.21 percentage points, and the probability to obtain government rehabilitation aid would have been lower by 0.77 percentage point. Although statistically significant, the coefficients are generally small and economically insignificant. The dummy for a traditional leader status has insignificant and negative coefficient, which could be interpreted as the absence of clear evidence for elite capture.

Flood damages captured by the fitted residuals have similar coefficients as in Table 16, confirming the contrast between house damages and other types of damages. Households whose house was more damaged were more likely to receive aid, especially from the government. On the other hand, flood damages to land, crops, and other assets were associated with lower probability of receiving aid. Regarding the other asset damages, the households that experienced these damages were engaged in modern agribusiness and better-off than other villagers. This could be the reason that even when their assets were damaged by floods, they were not given relief. A similar interpretation could be possible for crop losses, since the larger crop losses were experienced by more capitalistic farmers than other farmers in the same village. However, this is only a conjecture. Our results may suggest a serious failure in targeting in that those households whose standing crops were seriously damaged were not given priority in receiving aid.

To summarize the subsection,[8] the extent of aid duplication observed in our dataset was partially explained by village-level allocation of aid (more aid to heavily damaged villages) and by within-village household-level allocation of aid (more aid to initially poor households and to households whose house was destroyed). In this sense, we were not able to find evidence for obvious mistargeting. However, the response of aid receipt probability to these household-level indicators was weak and the response to other indicators, especially crop loss, was with the wrong sign. In this sense, targeting of aid within villages does not appear efficient. This inefficiency could be one of the reasons why the affected persons in Pakistan (and several

[8] The results in this subsection, namely those in Tables 16-17, remained qualitatively unchanged when we replaced the government rehabilitation aid recipient dummy by the Watan card recipient dummy. The results using the Watan dummy are available on request.

of our sample households) had expressed a feeling of unfair distribution of government aid such as Watan cards (e.g., *Dawn*, 2010).

6. Level of Recovery

6.1. Risk coping and self-insurance within a village against flood shocks

Aid from outside is not the only means to cope with damages caused by a natural disaster. Risk coping within a village across neighbors and self-insurance mechanisms are another means. Before discussing the level of recovery, we briefly sketch these means in this subsection.

Although the recovery phase is usually regarded as a period beginning several weeks to a few months after a natural disaster (de Ville de Goyet, 2008), rehabilitation activities by villagers can start earlier. According to our village data, such activities began the earliest in village Urmar Miana, about 15 days after the floods. Two villages that were hit by the floods most seriously, i.e., villages Jala Bela and Mian Gujar, observed the start of rehabilitation activities later: 2 months after the floods in Jala Bela and 1.5 months after the floods in Mian Gujar. By this time, recovery aid from NGOs and the government also began to arrive, as we already examined in Section 5. In addition to these mutual insurance measures, households can also use self-insurance mechanisms such as withdrawal of money from savings, sales of assets, short-term migration, and withdrawal of children from schools.

We did not observe out of 100 sample households a single case of a household that used migration or children's schooling reduction to cope with the shock. On the other hand, we observed some variation in the use of other measures (Table 18). Out of 100 sample households in our dataset, 51 reported the receipt of emergency aid from neighbors, while 68 reported the giving of such aid. Only 13 households were involved in neither of such reciprocity-based transactions. Personal relief from others was more popular in village Jala Bela, which was hit by the floods seriously, that in other villages. In Jala Bela, asset sales, credit, and money withdrawal from savings were infrequent. Asset sales were found frequently in village Masma while withdrawal from savings was found frequently in village Tarnab. For these means to be effective, the initial asset positions had to be sufficiently high. This condition appears satisfied in villages Tarnab and Masma, which were wealthier than other villages before the floods.[9] As shown in the right columns of Table 18, the receipt amount from credit or asset sales was quite large − in Shahi Bala, the average receipt of the four households that were associated with these transactions was Rs. 365,000, comparable to the average damages reported in Tables 6-7.

[9] Another possibility is the lack of market for the sale of assets. Since villages Tarnab and Masma are close to the main road and city centre, villagers have good access to market.

6.2. Level of recovery

With these coping and rehabilitation activities and aid from outside agencies, how much the survey villages and households were able to recover from flood damages at the time of our survey in January-February 2011? Since we were not able to obtain quantitative data on recovery at the village-level, this subsection is based on our household-level dataset only.

Table 19 shows the distribution of the overall recovery percentages reported by the sample households. It is a self assessment, taking one of the eleven percentage point categories from 0 (no recovery) to 100 (complete recovery). Out of 100 households, one household reported a zero value of flood damages. Therefore, the overall recovery percentage concept was applicable to the remaining 99 households. Village Urmar Miana reported the highest recovery percentage (92% on average) while the lowest average at 52% was reported from village Damane Hindko.

The overall recovery was decomposed into recovery in houses, land, two cropping seasons of Rabi 2010/11 and Kharif 2011,[10] and livestock. Each recovery percentage is applicable only to those households that suffered the damage in each category. As shown in Tables 7-8, the number of such households was small in the case of land damages and livestock damages. Therefore, instead of showing the village-wise distribution, we report their aggregate statistics in Table 20. The table indicates that crop damages were already recovered at the time of our survey. Sample households expected their 2011 *Kharif* cropping to be back to normal (the average recovery rate was close to 100%). On the other hand, livestock damages did not recover much. The average recovery rate was around 50%. In between, house and land recovery was at around 60% on average. However, as shown in the standard deviation in Table 20, variation across households is also substantial.

We examine in two steps which factor is associated with the variation in recovery across households. First, we simply compare the average recovery rates between two types of households: those who received aid or used coping methods and those who did not. If this difference is positive and statistically significant, we may conclude that aid or coping methods were effective in helping households recover from flood disasters. Second, we use multiple regression analyses.

The results of the first step are shown in Table 21.[11] Unexpectedly, none of the four types of coping (emergency aid from neighbors, sales of assets, receipt of informal credit, and

[10] The *Kharif* crop is the monsoon or autumn crop for which harvests come in September-November; rice, cotton, and maize are major Kharif crops. The *Rabi* crop is the spring crop of the dry season for which harvests come in March-June; wheat and gram pulse are major *Rabi* crops. The 2010 Pakistani floods destroyed the 2010 *Kharif* crops, whose information was already given in Table 7.

[11] The results remained qualitatively unchanged when we replaced the government rehabilitation aid recipient dummy by the Watan card recipient dummy. The results using the Watan dummy are available on request.

withdrawal from savings) is associated with a significantly positive difference. Out of 24 differences shown in Table 21, only one is statistically significant but with a seemingly wrong sign − those who borrowed money from others had a livestock recovery rate *lower* by 42.9 percentage points. Aid receipts appear to have performed better, especially on land recovery, Rabi crop recovery, and livestock recovery. On the other hand, all four aid recipient dummies are associated negatively with house recovery, with statistical significance. This implies that the average recovery rate from house damages was lower among those who received aid from outside than the recovery rate among those who did not.

In addition to this bivariate examination, we also estimated a multivariate regression model with the recovery percentage as the dependent variable and several of the aid and coping dummies as explanatory variables. The results were qualitatively similar to the one reported in Table 21, suggesting the absence of positive correlation between the recovery and aid/coping dummies.

These results could be interpreted as either the real absence of aid impact on recovery, or, the endogenous placement bias (the direct impact of aid/coping on recovery was positive but cancelled by the negative selection effect due to the tendency that aid or informal help was given with priority to those households who had more difficulty in recovery). Due to the small size of our sample, it is not possible to identify the two effects econometrically (using the instrumental variables, for example).

As side evidence of the aid or informal help given with priority to those households who had more difficulty in recovery, we estimated a more reduced-from regression model. The dependent variable is the recovery percentage as before. Explanatory variables are now those used in explaining the distribution of aid in Table 17 − village fixed effects, initial assets of the household, and the flood damages (not the observed values but the residuals after controlling for village fixed effects and the initial assets).

The regression results are reported in Table 22. Household size has positive and significant coefficients on the overall recovery, land recovery, and Kharif 2011 crop recovery. For instance, if a household had one more member, the overall recovery percentage would have been 1.01 percentage points higher. This suggests that labor force availability within a household helps households recover from the flood damages. The education of household heads has a positive effect on the overall recovery − if a household head had one more year of education, the overall recovery percentage would have been 0.81 percentage point higher. This suggests that modern human capital quality helps households recover from the flood damages. The village leader dummy has a positive coefficient, which is statistically significant (though the significance level was low) − if a household head was a traditional village member, the overall recovery percentage would have been 11.5 percentage points higher. This may suggest a

sign of elite capture or superiority of such households in mobilizing resources for recovery. The initial livestock assets contributed to the livestock recovery. This is natural because compensating for the loss of one animal is easier for households with larger initial livestock than for households with smaller stock.

Most of the flood damage variables have negative coefficients as expected, indicating that those households who had a larger damage than the damage predicted by their initial assets and village fixed effects had more difficulty in recovery. Two of the negative coefficients were statistically significant − if the house damage had been Rs. 100,000 larger, the household's house recovery percentage would have been lower by 5.2 percentage points; if the crop damage had been Rs. 100,000 larger, the household's Rabi crop recovery percentage would have been lower by 1.0 percentage point.

The regression results in Table 22 thus confirm that households with initially better assets were quicker in recovery while those with larger flood damages were more lagging in recovery. This supports the interpretation that since aid was targeted toward households with larger house damages and smaller initial assets (households that have inherent difficulty in recovering from flood damages), the positive correlation between aid and recovery was not observed in Table 21.

7. Conclusion

This paper analyzed the damages caused by floods in Pakistan, 2010, the distribution of aid, and the extent of recovery at the household level, based on a pilot survey. With regard to the nature of damages, we found that flood damages had both between-village and within-village variation, and damages to houses, land (crops), livestock, and other business assets were not highly correlated. These two findings suggest a possibility of within-village coping measures to function against flood shocks.

In the distribution of aid from outside, we again found substantial between-village and within-village variation. Between villages, different types of aid (government or NGOs; emergent or recovery aid) were overlapping each other, indicating the targeting toward heavily affected villages. Within villages, aid was targeted toward households with larger house damages, while households with larger damages to their land, crop, or other assets were not given priority in aid distribution. We found evidence (though not very strong) that within-village, across-households, aid was targeted toward households with smaller initial assets. These two findings appear to suggest that targeting was in the right direction. However, the marginal response of aid to these characteristics was not large, which could be a reason for the often-heard complaint that aid was distributed unequally and politically.

With regard to the recovery from flood damages, we found that the recovery

percentage was higher for crops than for houses, land, and livestock. Aid recipients did not show higher or lower recovery than non-recipients, especially for house damages, which could be due to mixing of a recovery-promoting effect of aid and a selection effect of aid toward households that inherently have more difficulty in recovery. We found that households who had initially lower assets and hit by larger flood damages had more difficulty in recovery. This suggests that such households need to be supported in the longer horizon.

Because of the small sample size and non-representative nature of the household dataset, we cannot claim the general applicability of our findings. Nevertheless, the empirical patterns found in this paper are suggestive in understanding the impact of natural disasters and its relation with relief allocation. Providing further support to the findings shown in this paper and analyzing the dynamics of recovery process in more detail are left for further research, which is planned with new rounds of household surveys.

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Table 1: Damages due to the 2010 floods in Pakistan

	Four provinces of Pakistan				Federally Administered Tribal Areas	Others #	Total #
	Punjab	Sindh	Khyber Pakhtunkhwa	Baluchistan			
Population in millions (2010)*	94.7	41.3	23.3	8.8	4.1	1.3	173.5
Flood damage assessment, November 2010							
Agriculture sector							
Crop area damaged (1000 ha)	746.8	1043.5	121.4	132.4	7.2	41.0	2092.3
Watercourses damaged (numbers)	2598	6990	1790	47	0	1347	12772
Livestock animals killed (1000 heads)	4.8	175.6	140.2	1176.3	14.6	12.7	1524.2
Poultry perished (1000 heads)	2012.0	6895.1	621.3	625.5	101.2	24.6	10279.7
Irrigation, drainage, and flood sector							
Barrages/dams damaged (numbers)	1	0	14	30	0	1	46
Canal breaches (numbers)	7	6	13	6	0	4	36
Flood embankments (numbers)	87	6	7	55	52	0	207
Irrigation schemes damaged (numbers)	0	0	0	50	66	194	310
Housing sector							
Number of houses damaged	375773	879978	257294	79720	5419	10000	1608184
Education sector							
Schools damaged (numbers)	2817	5655	870	557	176	273	10348
Colleges damaged (numbers)	4	0	13	0	0	6	23
Vocational institutions damaged (numbers)	4	0	17	0	0	0	21
Health sector							
Health facilities damaged (numbers)	57	151	190	45	30	42	515
Health facilities damaged (% to the total)	1.97	11.57	10.93	2.17	8.24	3.12	5.30
Transport sector							
National highways (km affected)	53	265	402	5	0	68	793
Provincial highways (km affected)	281	1925	259	367	294	0	3126
District roads (km affected)	2485	6277	5850	1705	963	3889	21169
Private losses							
Industrial units damaged (numbers)	41	16	89	0	0	0	146
Shops and markets damaged (numbers)	40322	54283	17617	6519	217	530	119488
Mines damaged (numbers)	0	0	236	0	0	0	236
Hotels and motels damaged (numbers)	0	0	85	0	0	0	85

Source: Prepared from data in GOP (2010). * The population data are from GOP (2011) (estimates extrapolated from the latest census of 1998).

"Others" in the population include Islamabad only while "Others" in the damage assessment include Islamabad, Azad Jammu & Kashmir (AJK), and Gilgit Baltistan (GB). Therefore, "Total" covers different areas depending on the variables. The population of AJK and GB is approximately 4 million and 1 million respectively.

Table 2: Flood damages and the distribution of Watan cards in Khyber Pakhtunkhwa, Pakistan

Name of the district	Flood damage assessment by the government	Number of beneficiaries of Watan cards
Abbottabad	Least	383
Bannu	Medium	660
Battagram	Medium	435
Buner	Least	64
Charsadda	Worst	17,766
Chitral	Medium	13
D.I.Khan	Worst	5,559
Dir Lower	Worst	55
Dir Upper	Worst	203
Hangu	Least	88
Haripur	Least	763
Karak	Medium	373
Kohat	Medium	527
Kohistan	Worst	4,515
Lakki Marwat	Medium	1,614
Malakand	Medium	273
Mansehra	Medium	645
Mardan	Least	92
Nowshera	Worst	7,644
Peshawar	Worst	2,294
Shangla	Worst	1,902
Swabi	Medium	291
Swat	Worst	1,121
Tank	Worst	279

Source: Web sites of Provincial Disaster Management Authority, the Government of Khyber Pakhtunkhwa (http://www.pdma.gov.pk/), accessed on June 30, 2011.

Table 3: Characteristics of sample villages

		Reported damages caused by the floods:		Geographical area		Demography		
	Village name	House damages	Infrastructure damages	Total acres (1000)	Irrigation ratio (%)	Number of households	Population	Adult literacy rate (%)
1	Tarnab	Partly affected	Minor damages	4.0	100	2000	10000	70
2	Masma	Partly affected	Minor damages	0.7	94	120	1000	55
3	Urmar Miana	Partly affected	Minor damages	3.0	50	1200	12000	40
4	Mera Kachori	Partly affected	Minor damages	10.0	10	3500	45000	60
5	Damane Hindko	Partly affected	Minor damages	6.0	58	1500	22000	40
6	Shahi Bala	Partly affected	Minor damages	5.0	64	300	4000	40
7	Jala Bela	Heavily affected	Major damages	1.2	92	450	4000	58
8	Mian Gujar	Heavily affected	Major damages	4.5	78	3500	40000	60
9	Budhni	Partly affected	Minor damages	3.5	86	4500	25000	30
10	Dag	Minor damages	Minor damages	1.6	75	300	3500	8

Source: Pilot survey data (same for the following tables).

Table 4: Characteristics of sample households

Variable	Unweighted			Weighted			Minimum	Maximum
	Mean	(Std.Dev.)	Median	Mean	(Std.Dev.)	Median		
1. Characteristics of the household head								
Age	46.8	(13.9)	46.5	47.5	(14.4)	47.0	20	80
Literacy dummy	0.62	(0.49)	1	0.60	(0.49)	1	0	1
Years of education	6.88	(6.03)	8.00	6.93	(6.17)	10.00	0	16
Village leader dummy*	0.16	(0.37)	1.00	0.20	(0.40)	1.00	0	1
2. Household size								
Total household members	9.45	(5.01)	9.00	9.47	(4.19)	9.00	2	38
Male members	4.94	(2.70)	4.50	5.14	(2.37)	5.00	1	16
Female members	4.51	(2.87)	4.00	4.33	(2.37)	4.00	1	22
3. House building assets before the floods								
Number of house buildings owned	0.91	(0.35)	1.00	0.95	(0.31)	1.00	0	2
4. Land assets before the floods								
Land ownership dummy	0.58	(0.50)	1	0.54	(0.50)	1	0	1
Owned land in acres	3.74	(7.26)	1.00	2.70	(5.83)	0.25	0	40
Owned land value (Rs.100,000)	45.5	(92.0)	10.3	43.3	(105.2)	6.9	0	600
5. Livestock assets before the floods								
Livestock ownership dummy	0.78	(0.42)	1	0.76	(0.43)	1	0	1
Number of large animals#	1.41	(2.01)	1.00	1.53	(2.27)	1.00	0	12
Livestock asset value (Rs.1,000)	73.9	(150.0)	34.3	71.6	(140.5)	35.5	0	1250
Same but excluding chicken (Rs.1,000)	55.2	(72.9)	34.0	55.7	(70.4)	34.0	0	310

Notes: The number of observations is 100 (10 from each sample village). In "Weighted mean (std.dev.)", the summary statistics were weighted using the inverse of the sampling probability of a household (i.e., 10 divided by the number of households reported in Table 3) as the weight.

* When the household head is either village malik (=village head), jirga leader, or jirga member, the dummy takes the value of one. Jirga is a traditional dispute solving institutions in Pakhtun society.

Large animals include buffaloes, cattle, horses, and mules.

Table 5: Human damages caused by the 2010 floods

		Village data						Household data		
		Number of persons			% to the population			Number of hhs reporting the damage (out of 10)		
	Village name	Killed	Serious injury	Minor injury	Killed	Serious injury	Minor injury	Serious injury	Minor injury	Disease
1	Tarnab	1	3	20	0.010	0.030	0.200	0	0	10
2	Masma	0	4	10	0.000	0.400	1.000	0	0	10
3	Urmar Miana	0	0	40	0.000	0.000	0.333	1	0	6
4	Mera Kachori	1	20	1000	0.002	0.044	2.222	0	0	10
5	Damane Hindko	0	0	100	0.000	0.000	0.455	0	0	10
6	Shahi Bala	1	0	5	0.025	0.000	0.125	0	0	10
7	Jala Bela	1	0	30	0.025	0.000	0.750	0	0	9
8	Mian Gujar	0	0	50	0.000	0.000	0.125	0	0	10
9	Budhni	1	0	4	0.004	0.000	0.016	1	2	8
10	Dag	0	0	10	0.000	0.000	0.286	0	0	9

Table 6: House damages caused by the 2010 floods

		Village data						Household data						
		Number of houses			% to the number of households			Number of households reporting the damage (out of 10)				Damage amount# (in Rs.100,000)		
	Village name	Destroyed	Major damage	Minor damage	Destroyed	Major damage	Minor damage	Any damage	Destroyed	Major damage	Minor damage	NOB	Mean	(Std.Dev.)
1	Tarnab	304	496	669	15.2	24.8	33.5	10	4	2	4	10	1.360	(1.31)
2	Masma	15	50	7	12.5	41.7	5.8	8	5	1	2	10	0.732	(0.60)
3	Urmar Miana	80	120	700	6.7	10.0	58.3	8	1	2	5	9	1.233	(1.94)
4	Mera Kachori	540	600	200	15.4	17.1	5.7	8	3	4	2	10	1.840	(1.96)
5	Damane Hindko	80	250	100	5.3	16.7	6.7	9	1	5	2	10	1.475	(1.17)
6	Shahi Bala	20	100	100	6.7	33.3	33.3	9	3	2	4	10	1.596	(1.43)
7	Jala Bela	110	115	200	24.4	25.6	44.4	10	4	6	0	0		
8	Mian Gujar	65	120	2800	1.9	3.4	80.0	10	1	7	2	6	1.167	(0.26)
9	Budhni	40	350	200	0.9	7.8	4.4	9	2	5	2	1	0.000	(0.00)
10	Dag	30	50	100	10.0	16.7	33.3	6	3	3	4	10	1.949	(2.62)

Notes: In this table, the house refers to the one where the household lived at the time of the floods. The house building may have been a rented one.

The damage amount in rupees was not reported by some of the sample households. The column "NOB" reports the number of observations out of 10 for which we obtained the information.

Table 7: Agricultural damages caused by the 2010 floods

		Household data								
		Number of households reporting the land damage (out of 10)	Damage amount (in Rs.100,000)				Number of households reporting the crop damage (out of 10)	Damage amount (in Rs.100,000)			
			All sample households (mean over 10 observations)		Sample households with a positive amount of land damage			All sample households (mean over 10 observations)		Sample households with a positive amount of crop damage	
	Village name		Mean	(Std.Dev.)	Mean	(Std.Dev.)		Mean	(Std.Dev.)	Mean	(Std.Dev.)
1	Tarnab	2	0.056	(0.16)	0.280	(0.31)	6	1.733	(2.56)	2.888	(2.79)
2	Masma	2	0.060	(0.16)	0.300	(0.28)	8	0.664	(0.64)	0.829	(0.61)
3	Urmar Miana	4	1.920	(3.13)	4.800	(3.31)	8	0.284	(0.26)	0.355	(0.24)
4	Mera Kachori	1	0.050	(0.16)	0.500		5	0.411	(0.76)	0.822	(0.95)
5	Damane Hindko	4	1.250	(2.04)	3.125	(2.17)	10	5.540	(6.05)	5.540	(6.05)
6	Shahi Bala	1	0.100	(0.32)	1.000		7	5.860	(15.97)	8.371	(18.92)
7	Jala Bela	0	0.000	(0.00)			7	0.880	(1.84)	1.257	(2.12)
8	Mian Gujar	2	0.200	(0.48)	1.000	(0.71)	5	2.220	(4.98)	4.440	(6.59)
9	Budhni	0	0.000	(0.00)			9	6.848	(16.09)	7.608	(16.88)
10	Dag	3	2.110	(6.29)	7.033	(11.23)	10	17.270	(17.88)	17.270	(17.88)

Table 8: Livestock damages caused by the 2010 floods

	Village data							Household data				
	Number of animal losses					Damage amount# (Rs.1,000)			Damage amount# (Rs.1,000)			
								Number of households reporting the damage (out of 10)	All sample households (mean over 10 observations)		Sample households with a positive amount of livestock damage	
Village name	Cattle	Buffaloes	Goats/ sheep	Horses/ mules	Chickens	Total	Per household		Mean	(Std.Dev.)	Mean	(Std.Dev.)
1 Tarnab	2	0	2	0	15	75.8	0.038	1	1.10	(3.48)	11.00	
2 Masma	2	0	2	0	30	79.5	0.663	5	13.75	(23.46)	27.50	(27.66)
3 Urmar Miana	5	95	0	0	8100	7895.0	6.579	1	0.50	(1.58)	5.00	
4 Mera Kachori	0	0	0	0	2700	675.0	0.193	2	0.21	(0.49)	1.05	(0.64)
5 Damane Hindko	200	100	130	31	100	13395.0	8.930	6	46.90	(42.90)	78.17	(19.50)
6 Shahi Bala	0	0	0	0	50	12.5	0.042	2	6.50	(13.75)	32.50	(3.54)
7 Jala Bela	3	2	1	0	0	224.0	0.498	6	14.55	(25.67)	24.25	(30.06)
8 Mian Gujar	3	0	0	0	1500	477.0	0.136	3	7.28	(22.05)	24.27	(39.62)
9 Budhni	0	0	0	18	115	208.8	0.046	2	3.35	(9.43)	16.75	(18.74)
10 Dag	0	0	0	0	0	0.0	0.000	0	0.00	(0.00)		

Note: # In calculating the total value of livestock loss, the following unit price for each animal was assumed: Rs.34,000 = cattle, Rs.60,000 = buffalo, Rs.2,000 = goat, Rs.10,000 = horse/mule, Rs.250 = chicken.

Table 9: Bivariate correlation among different types of flood damages

		fd_house_vd	fd_land_vd	fd_crop_vd	fd_animal_vd	fd_asset_vd	fd_total_vd
Damages in monetary terms:							
House damages#	fd_house_vd	1.000					
Land damages	fd_land_vd	0.052	1.000				
Crop damages	fd_crop_vd	0.106	0.309 ***	1.000			
Livestock damages	fd_animal_vd	-0.016	-0.134	-0.029	1.000		
Other asset damages	fd_asset_vd	0.118	0.137	0.140	-0.187 *	1.000	
Total of the five	fd_total_vd	0.244 **	0.499 ***	0.963 ***	-0.056	0.259 ***	1.000

Notes: This table shows bivariate correlation coefficients after all variables are transformed by subtracting village-level means.
The number of observations is 100. The coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level.

Missing observations for house damage amounts (see Table 6) were replaced by the predicted loss value, using the regression coefficients: 170.73 per destroyed house, 135.27 per severely damaged house, and 31.55 per partially damaged house (the unit is Rs. 1,000).

Table 10: Multiple regression results to explain different types of flood damages

	Dependent variable: Flood damages in Rs. 1,000.				
	House damages	Land damages	Crop damages	Livestock damages	Other asset damages
Household's initial capital					
Number of household members	-1.850	-5.151	8.236	0.478	0.978
	(2.311)	(4.422)	(13.069)	(0.680)	(2.188)
Years of education of the hh head	-2.036	1.997	21.864	-0.368	1.445
	(2.274)	(4.044)	(15.009)	(0.426)	(0.979)
Village leader dummy of the hh head	-68.291	13.924	-363.064	0.035	-10.510
	(42.807)	(58.030)	(229.354)	(6.024)	(13.248)
Number of house buildings owned	103.775 **	-30.246	-211.486	9.500	-5.260
	(44.598)	(29.500)	(134.648)	(6.761)	(22.225)
Owned land value (Rs.100,000)	-0.181	0.462	6.843 ***	-0.006	-0.004
	(0.130)	(0.369)	(2.110)	(0.011)	(0.043)
Livestock asset value (Rs.1,000)	0.050	0.131	-0.019	0.007	0.629 ***
	(0.059)	(0.122)	(0.284)	(0.033)	(0.140)
Village fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.154	0.173	0.566	0.373	0.771
F-statistics for zero slopes	2.12 **	1.30	8.57 ***	1.72 *	2.49 ***
F-statistics for zero village fixed effects	0.68	1.05	2.55 **	2.05 **	1.20

Notes: Huber-White robust standard errors are shown in parenthesis. OLS regression with village fixed effects is employed.
The number of observations is 100. The regression coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) levels.

Table 11: Government's emergency relief given to the sample villages

	Village data				Household data					
							Receipt in money equivalent (Rs.1,000)			
							All sample households (mean over 10 observations)		Sample households with a positive amount of receipt	
Village name	Availability dummy	Arrival timing (days after the flood)	Total number of beneficiaries	Per household	Number of households receiving the relief (out of 10)	Number of households whose relief request was rejected (out of 10)	Mean	(Std.Dev.)	Mean	(Std.Dev.)
1 Tarnab	1	8	550	0.275	0	1	0.00	(0.00)		
2 Masma	1	7	250	2.083	10	0	11.50	(6.33)	11.50	(6.33)
3 Urmar Miana	1	7	150	0.125	0	0	0.00	(0.00)		
4 Mera Kachori	1	14	400	0.114	0	0	0.00	(0.00)		
5 Damane Hindko	1	14	200	0.133	3	0	3.05	(6.73)	10.17	(9.75)
6 Shahi Bala	1	3	70	0.233	6	0	8.40	(8.25)	14.00	(5.33)
7 Jala Bela	1	3	660	1.467	9	0	12.60	(7.41)	14.00	(6.30)
8 Mian Gujar	1	7	280	0.080	6	0	8.50	(8.18)	14.17	(4.92)
9 Budhni	1	5	100	0.022	7	0	6.30	(5.19)	9.00	(3.46)
10 Dag	0		0	0	2	0	2.40	(5.06)	12.00	(0.00)

Table 12: NGOs' emergency relief given to the sample villages

	Village data			Household data					
						Receipt in money equivalent (Rs.1,000)			
						All sample households (mean over 10 observations)		Sample households with a positive amount of receipt	
Village name	Number of NGOs	Gross number of beneficiaries served by them	Per household	Number of households receiving the relief (out of 10)	Number of households whose relief request was rejected (out of 10)	Mean	(Std.Dev.)	Mean	(Std.Dev.)
1 Tarnab	4	n.a.	n.a.	7	0	11.18	(13.42)	15.97	(13.46)
2 Masma	4	200	1.667	6	0	8.50	(10.06)	14.17	(9.26)
3 Urmar Miana	2	200	0.167	1	2	0.26	(0.82)	2.60	
4 Mera Kachori	2	400	0.114	2	2	1.25	(3.17)	6.25	(5.30)
5 Damane Hindko	1	100	0.067	1	0	1.50	(4.74)	15.00	
6 Shahi Bala	2	50	0.167	2	0	1.50	(3.37)	7.50	(3.54)
7 Jala Bela	3	975	2.167	10	0	14.20	(3.29)	14.20	(3.29)
8 Mian Gujar	6	2250	0.643	9	0	14.00	(9.52)	15.56	(8.65)
9 Budhni	1	200	0.044	8	0	8.80	(7.38)	11.00	(6.50)
10 Dag	1	200	0.667	0	0	0.00	(0.00)		

Table 13:Recovery/rehabilitation aid given to the sample villages

		Government aid					NGO aid			
		Village data		Household data			Village data			Hh data
					Watan card distribution					
	Village name	Total number of Watan card recipients	Per household	Number of households receiving aid including Watan card (out of 10)	Number of households who received the card (out of 10)	Number of households whose card request was rejected (out of 10)	Number of NGOs that worked in the recovery/ rehabilitation activities	Gross number of beneficiries served by them	Per household	Number of households who receved the aid (out of 10)
1	Tarnab	850	0.425	3	3	0	1	204	0.102	1
2	Masma	40	0.333	6	4	0	4	46	0.383	4
3	Urmar Miana	120	0.100	4	4	1	2	100	0.083	0
4	Mera Kachori	400	0.114	7	7	0	1	50	0.014	1
5	Damane Hindko	80	0.053	1	1	6	0	0	0.000	0
6	Shahi Bala	50	0.167	4	3	1	1	30	0.100	0
7	Jala Bela	350	0.778	8	3	3	1	50	0.111	9
8	Mian Gujar	280	0.080	7	7	0	2	40	0.011	3
9	Budhni	430	0.096	3	3	5	1	60	0.013	1
10	Dag	80	0.267	1	1	0	0	0	0.000	0

Table 14: Cross-tabulation of different types of flood relief recipients

A. All four types of aid

			Recipient status in the recovery phase				
		Govt:	Yes		No		Total
Govt relief	NGO relief	NGO aid:	Yes	No	Yes	No	
Recipient status in the emergency phase							
Yes	Yes		12	7	3	7	29
	No		0	6	0	8	14
No	Yes		1	8	2	6	17
	No		1	9	0	30	40
Total			14	30	5	51	100

B. Correlation between government and NGO aids within a phase

		NGO		Total	*p* -value
	Govt	Yes	No		
Emergency phase:					
	Yes	29	14	43	
	No	17	40	57	
	Total	46	54	100	0.000
Recovery phase:					
	Yes	14	30	44	
	No	5	51	56	
	Total	19	81	100	0.004

C. Correlation between recipient status in two phases

		Recovery phase		Total	*p* -value
	Emergency phase	Yes	No		
Government relief/aid:					
	Yes	25	18	43	
	No	19	38	57	
	Total	44	56	100	0.013
NGO relief/aid:					
	Yes	18	28	46	
	No	1	53	54	
	Total	19	81	100	0.000

Notes: *p* -value reports the probability for the hypothesis that the row and column variables of the 2-way contingent table are distributed independently, according to the chi2 test.

Table 15: Within-village correlation among different types of aid recipient status

		aid_em_gd	aid_em_pd	aid_rc_gd	aid_rc_pd	aid_d
Emergency phase						
Dummy for govt relief recipient	aid_em_gd	1.000				
Dummy for NGO relief recipient	aid_em_pd	0.128	1.000			
Recovery phase						
Dummy for govt aid recipient	aid_rc_gd	0.176	0.192 *	1.000		
Dummy for NGO aid recipient	aid_rc_pd	0.041	0.223 **	0.081	1.000	
Dummy for any type of recipient	aid_d	0.540 ***	0.423 ***	0.516 ***	0.064	1.000

Notes: This table shows bivariate correlation coefficients after all variables are transformed by subtracting village-level means.
The number of observations is 100. The coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level.

Table 16: Aid recipient status and observed flood damages

	Dependent variable: Dummy for the aid receipt (x100)			
	Emergency, govt	Emergency, NGO	Recovery, govt	Recovery, NGO
Flood damages in Rs.100,000 (observed values)				
House damages	5.071 **	2.502	8.975 ***	2.961
	(2.415)	(2.452)	(3.334)	(1.895)
Land damages	-0.176	0.104	-1.657	0.104
	(0.735)	(0.860)	(1.564)	(0.270)
Crop damages	-1.128 ***	-0.621	-0.598	-0.211
	(0.259)	(0.406)	(0.420)	(0.148)
Livestock damages	1.586	-11.039	9.783	0.870
	(20.194)	(23.807)	(18.779)	(13.667)
Other asset damages	-4.718	-1.805	-1.125	-0.206
	(2.937)	(1.994)	(1.790)	(0.577)
Village fixed effects	Yes	Yes	Yes	Yes
R-squared	0.599	0.535	0.306	0.485
F-statistics for zero slopes	254.58 ***	122.80 ***	5.69 ***	7.19 ***
F-statistics for zero village fixed effects	122.27 ***	44.07 ***	2.96 ***	10.73 ***

Notes: Huber-White robust standard errors are shown in parenthesis. A linear probability model (OLS regression) with village fixed effects is employed.

The number of observations is 100. The regression coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level.

Table 17: Aid recipient status, flood damages, and initial assets

	Dependent variable: Dummy for the aid receipt (x100)			
	Emergency, govt	Emergency, NGO	Recovery, govt	Recovery, NGO
Household's initial capital				
Number of household members	-0.373	-0.490	-1.182	-0.873
	(1.082)	(0.796)	(0.834)	(0.659)
Years of education of the hh head	-0.983	0.552	-1.054	-1.165
	(0.645)	(0.781)	(0.802)	(0.780)
Village leader dummy of the hh head	-3.032	-9.965	-10.212	-2.729
	(11.802)	(9.114)	(10.921)	(4.939)
Number of house buildings owned	3.078	-13.746	-33.265 **	-10.511
	(5.855)	(15.715)	(15.701)	(11.057)
Owned land value (Rs.100,000)	-0.089 ***	-0.121 ***	-0.077 **	-0.012
	(0.031)	(0.034)	(0.034)	(0.017)
Livestock asset value (Rs.1,000)	-0.029	0.013	-0.007	0.003
	(0.023)	(0.015)	(0.019)	(0.016)
Flood damages in Rs.100,000 (fitted residual from Table 10)				
House damages	4.488 *	1.607	9.139 **	2.710
	(2.697)	(2.457)	(3.874)	(1.810)
Land damages	-0.142	-0.037	-1.806	-0.013
	(0.655)	(0.859)	(1.391)	(0.359)
Crop damages	-0.942 *	0.042	-0.243	0.010
	(0.522)	(0.401)	(0.697)	(0.197)
Livestock damages	2.969	-19.838	20.654	1.712
	(23.205)	(25.849)	(16.430)	(18.156)
Other asset damages	-3.034	-12.025 *	1.780	-0.361
	(7.387)	(7.132)	(7.554)	(7.450)
Village fixed effects	Yes	Yes	Yes	Yes
R-squared	0.607	0.587	0.394	0.527
F-statistics for zero slopes	67.76 ***	35.28 ***	7.01 ***	7.86 ***
F-statistics for zero village fixed effects	34.64 ***	32.30 ***	2.70 ***	9.71 ***

Notes: Huber-White robust standard errors are shown in parenthesis. A linear probability model (OLS regression) with village fixed effects is employed.

The number of observations is 100. The regression coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level.

Table 18: Coping with floods within a village

	Household data									
	Number of sample households using the measure					Total value of receipt from (3) and (4) in Rs.100,000				
						All sample households (mean over 10 observations)		Sample households with a positive amount of receipt		
Village name	(1) Personal relief from others	(2) Personal relief given to others	(3) Sold assets	(4) Borrowed money from others	(5) Withdrawal from savings	Mean	(Std.Dev.)	NOB	Mean	(Std.Dev.)
1 Tarnab	2	5	0	0	6	0.000	(0.00)	0		
2 Masma	7	7	4	2	2	0.184	(0.23)	6	0.307	(0.23)
3 Urmar Miana	2	5	1	1	2	0.203	(0.64)	1	2.032	
4 Mera Kachori	1	6	1	0	4	0.055	(0.17)	1	0.550	
5 Damane Hindko	9	10	1	3	1	0.542	(0.78)	4	1.355	(0.58)
6 Shahi Bala	4	5	2	3	3	1.460	(3.31)	4	3.650	(4.71)
7 Jala Bela	10	3	1	0	0	0.050	(0.16)	1	0.500	
8 Mian Gujar	8	7	2	0	1	0.054	(0.12)	2	0.270	(0.06)
9 Budhni	8	10	1	1	2	0.060	(0.13)	2	0.300	(0.14)
10 Dag	0	10	1	0	2	0.060	(0.19)	1	0.600	

Table 19: Extent of overall recovery from floods (self-assessment by the household)

	Household data													
	Number of sample households with flood damages	Distribution of households by their recovery status											Summary statistics for the recovery status (% points)	
Village name		0	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Mean	(Std.Dev.)
1 Tarnab	10	0	0	0	0	0	2	0	3	4	0	1	73.0	(14.9)
2 Masma	10	0	0	0	1	0	1	0	0	4	1	3	79.0	(22.8)
3 Urmar Miana	10	0	0	0	0	0	0	0	1	2	1	6	92.0	(11.4)
4 Mera Kachori	9	1	1	0	0	1	2	0	0	1	0	3	58.9	(38.6)
5 Damane Hindko	10	0	1	0	0	1	4	1	3	0	0	0	52.0	(18.1)
6 Shahi Bala	10	2	0	0	0	0	2	0	2	2	0	2	60.0	(35.9)
7 Jala Bela	10	0	0	0	1	0	2	1	1	3	1	1	69.0	(21.3)
8 Mian Gujar	10	0	0	0	1	0	3	1	0	2	1	2	69.0	(24.2)
9 Budhni	10	0	0	0	0	0	3	1	0	3	1	2	74.0	(20.1)
10 Dag	10	0	0	0	0	1	5	0	2	0	1	1	62.0	(19.9)

Table 20: Extent of recovery from floods differentiated by damage types (self-assessment by the household)

Recovery type	Household data: Number of sample households with flood damages (out of 100)	Summary statistics for the recovery status (% points): Unweighted Mean	Unweighted (Std.Dev.)	Weighted Mean	Weighted (Std.Dev.)	Minimum	Maximum
Overall	99	69.0	(25.3)	68.8	(25.5)	0	100
House	87	60.1	(27.8)	57.4	(28.9)	0	100
Land	19	55.8	(43.8)	59.9	(43.6)	0	100
Crop, 2010/11 Rabi	75	84.9	(28.8)	88.1	(26.8)	0	100
Crop, 2011 Kharif*	75	96.0	(15.2)	97.0	(13.5)	0	100
Livestock	28	46.4	(48.5)	50.5	(48.1)	0	100

Note: * At the time of the survey, the cultivation of 2011 Kharif crops did not begin. The reported percentages are expectation based on the farmers' situations in the 2010/11 Rabi season.

Table 21: Bivariate comparison of recovery and aid/coping

	Recovery status in percentage points					
	Overall (n=99)	House (n=87)	Land (n=19)	Crop-2010/11 Rabi (n=75)	Crop-2011 Kharif (n=75)	Livestock (n=28)
Receiving aid						
Emergency, government	-2.74	-10.39 *	49.67 ***	19.22 ***	4.02	-5.56
Emergency, NGO	-1.77	-15.01 **	27.43	8.05	0.71	43.59 **
Rehabilitation, government	-3.50	-11.26 *	32.71	10.55 *	-1.30	10.00
Rehabilitation, NGO	-3.31	-10.92 *	46.67 n.a.	12.42 **	-0.67	17.86
Use of within-village coping measures						
Personal relief from others	-0.75	-3.59	2.14	7.18	-3.57	16.67
Sold assets	4.50	-4.66	-6.47	1.77	-6.00	15.20
Borrowed money from others	-3.33	7.78	-27.22 n.a.	7.58	-0.31	-42.86 **
Withdrawal from savings	1.88	1.32	13.45	-10.77	-0.62	-48.15 n.a.

Notes: The numbers show the difference of the recovery status between households with aid/coping and households without aid/coping. For instance, -2.74 in the first cell means that the average overall recovery rate among those who received the government emergency aid was *lower* by 2.74 points than the average overall recovery rate among those who did not receive the government aid.

Using the *t*-test allowing for the unequal variance, the null hypothesis of the same average recovery rate is tested: the null is rejected at the 1% (***), 5% (**), and 10% (*) level. When one of the two groups (with vs. without) had only one observation, *t*-test cannot be performed so that "n.a." is entered.

Table 22: Recovery from floods, size of flood damages, and households' initial capital

	Dependent variable: Recovery status in percentage points						
	Overall	Overall	House	Land	Crop-2010/11 Rabi	Crop-2011 Kharif	Livestock
Household's initial capital							
Number of household members	1.014 **	1.024 **	1.005	5.080 **	-0.192	1.313 **	0.130
	(0.452)	(0.477)	(0.604)	(1.862)	(1.157)	(0.655)	(2.753)
Years of education of the hh head	0.814 **	0.813 *	0.524	1.263	-0.382	0.213	3.353
	(0.395)	(0.412)	(0.584)	(1.766)	(0.660)	(0.310)	(2.525)
Village leader dummy of the hh head	11.494 *	11.226	14.339	9.859	-7.181	2.300	-43.533
	(6.689)	(6.911)	(9.032)	(17.330)	(7.750)	(2.925)	(31.511)
Number of house buildings owned	-12.000	-12.121	-8.972	9.727	-2.199	-1.113	23.161
	(8.042)	(8.208)	(12.135)	(23.789)	(7.023)	(3.799)	(27.709)
Owned land value (Rs.100,000)	0.039	0.039	0.027	0.017	0.003	-0.006	-0.439
	(0.028)	(0.030)	(0.026)	(0.028)	(0.031)	(0.009)	(0.382)
Livestock asset value (Rs.1,000)	0.017	0.017	0.004	-0.013	-0.015	0.020	0.149 *
	(0.013)	(0.013)	(0.017)	(0.019)	(0.027)	(0.015)	(0.077)
Flood damages in Rs.100,000 (fitted residual from Table 10)							
House damages	-2.102		-5.171 *				
	(1.907)		(3.009)				
Land damages	-0.748			-0.577			
	(0.651)			(1.161)			
Crop damages	0.023				-1.003 **	-0.296	
	(0.323)				(0.397)	(0.189)	
Livestock damages	7.758						11.609
	(10.048)						(38.832)
Other asset damages	-5.818						
	(4.451)						
All damages aggregated		-0.282					
		(0.246)					
Village fixed effects	Full	Full	Full	Village 3,5	Full	Full	Village 5,7
R-squared	0.370	0.332	0.321	0.837	0.443	0.255	0.414
F-statistics for zero slopes	4.54 ***	3.35 ***	3.04 ***	17.81 ***	4.74 ***	0.56	4.10 ***
F-statistics for zero village fixed effects	4.69 ***	4.49 ***	1.26	4.24 *	3.10 ***	0.71 ***	1.50
Number of observations	99	99	87	19	75	75	28

Notes: Huber-White robust standard errors are shown in parenthesis. OLS regression with village fixed effects is employed (a village fixed effect was included when the observation in the village was more than four). The regression coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level.