RESEARCH ARTICLE

Floods, Relief Aid, and Household Resilience in Rural Pakistan: Findings from a Pilot Survey in Khyber Pakhtunkhwa

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Abstract: Based on a pilot survey conducted in early 2011, in ten villages in the province of Khyber Pakhtunkhwa, Pakistan, we analysed the damage caused by floods in Pakistan in 2010, the distribution of aid, and the extent to which households recovered from flood damage. Our findings are as follows. Flood damage within a village was disuniform. Aid from outside was distributed to households that had suffered larger damage to their houses than others, but not to households with large damage to land, crops, or other assets. Aid distribution was targeted slightly in favour of households with lower initial assets. With regard to recovery from flood damage, we found that recipients of aid did not show higher or lower recovery than non-recipients, especially in respect of damage to houses. This could be due to the mix of recovery-promoting aid and selective aid directed towards households for whom recovery was more difficult than others. We also found that households who had fewer initial assets and were hit by greater flood damage had more difficulty in recovering from the damage caused by floods.

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

Introduction

In July–August 2010, Pakistan experienced

> the worst floods in its history … The floods have affected 84 districts out of a total of 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 destroyed. (UN 2010, p. 1)

Given the paucity of empirical studies on the economic impact of such a disaster on rural economies and agrarian relations, we conducted a pilot survey, in

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January–February 2011, of ten villages in the province of Khyber Pakhtunkhwa, which was most severely hit by the floods.[1] In the pilot survey, we collected information on how poor households were affected by the floods, how flood relief was allocated, and how resilient the affected households were. In this article, we summarise the preliminary findings from the survey.[2]

The economics literature on household vulnerability to risk has expanded recently, but studies on the impact of natural disasters (see, for instance, the survey in Sawada 2007) are not numerous. As summarised by Sawada (2007), the impact of idiosyncratic risks and of non-diversifiable aggregate risks are distinctively different, and the role of self-insurance against large-scale disasters becomes important 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. Nevertheless, the economics literature on aid is limited and in its 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, the extent and speed of recovery from natural disasters is another important topic on which both empirical and theoretical work is limited. Because of these gaps in the literature, the evidence presented in this article is expected to shed light on the issue of natural disasters and relief allocation, despite the small sample size of the survey on which it is based.

The 2010 Pakistan Floods

The 2010 floods were unprecedented and affected all of Pakistan. Torrential rains and flash floods in the months of July and August severely hit human lives, causing damage to livestock, infrastructure, crops, and livelihoods all over the country. By November 2010, the Government of Pakistan assessed that more than 20 million Pakistanis had been affected, approximately 1.88 million houses damaged, 1,767 persons killed or missing, and 2,865 persons injured (GOP 2010). Khyber Pakhtunkhwa stands out as the worst affected province: it was directly affected by the rains and no flood warnings were issued in most parts of the province.

In order to tackle the difficult situation, relief activities were quickly organised both within Pakistan and from abroad. However, considering the intensity of the damage, the aid inflows were insufficient. The insufficiency of aid further aggravated

[1] 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.

[2] Full results are available in Kurosaki *et al.* (2011).

an already precarious situation, with increasing numbers of the affected people believing that even the available aid was not distributed properly.

Among the government initiatives in flood relief, the system of *Watan* cards merits detailed examination. In order to provide relief – particularly for the reconstruction of damaged houses – to the flood-affected population, 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 Automated Teller Machine (ATM) cards. A total of PKR 100,000 were to be paid in five equal instalments of PKR 20,000 to each flood-affected family.[3] In order to assure transparency, the money was to be transferred directly to recipients' bank accounts from the public treasury. The first *Watan* instalment was paid in February 2011.

Pilot Survey of Village Economies

In order to assess the vulnerability and resilience of the rural economy with respect to the unexpected floods, we conducted a pilot survey of village economies in Peshawar district, Khyber Pakhtunkhwa, Pakistan. The survey covered 10 sample villages and 100 sample households (10 households from each sample village).

The sample villages included villages that had been surveyed by the authors in 1996–97 and 1999–2000 (Kurosaki and Khan 2006), and additional villages that were chosen in a similar way. Before the floods, the area under study was under the suburban influence of Peshawar, with different levels of access to the city and different agronomic conditions across villages. The sample included villages that were rainfed and subsistence-oriented, as well as villages that were completely irrigated, and characterised by commercially oriented farming activities such as fruit nurseries and other types of horticulture. The land tenure structure was similar across villages – small-scale owner farm households and owner-cum-tenant households dominated, without the existence of very large landlords. We added villages with different characteristics in terms of economic development, but similar characteristics in terms of ethnicity and culture, in order to elicit the dynamic implications of economic development from a cross-section. An additional criterion in village selection was to include villages with different levels of damage caused by the floods. Although the floods of 2010 in Pakistan were unprecedented and caused widespread damage in the province of Khyber Pakhtunkhwa, not all villages had suffered damage of the same intensity. Therefore, in the pilot survey, we intentionally selected villages with different levels of flood damage to houses and infrastructure, based on information collected before the survey. Village-level information for the survey was collected from knowledgeable village residents, using a structured questionnaire.

[3] PKR = Pakistan Rupees. At the time of our survey, USD 1 was equal to PKR 86.

From each of the 10 sample villages, 10 sample households were chosen for the more detailed survey, with another structured questionnaire used for the households. Since we use variables characterizing household assets in a broad sense as explanatory variables in our analysis below, their average values are shown in Table 1 and discussed here. The mean level of schooling of the heads of the sample households is 6.9 years, which is slightly higher than the provincial average, reflecting better access to educational institutions in the provincial capital of Peshawar. Sixteen per cent of the sample household heads are leaders in the traditional village power structure. The median household size is nine persons. The average land-holding size is 3.7 acres, but it is associated with a highly skewed distribution – 58 per cent of the households are landed and the inequality within the landed class is substantial, with the median land-ownership size only 1 acre. The average land asset value is PKR 4.6 million (mean) or 1.0 million (median). Large animals, including different types of cattle, are important as productive assets for farming and dairy activities, while small animals such as goats, sheep, and chickens are an important means of savings. Livestock assets are more equally distributed than land assets, but their distribution is still not egalitarian – about three-fourths of the households owned some livestock and its average value was around PKR 74,000 (mean) or 34,000 (median). These statistics show that the distribution of two important forms of assets in the study area, i.e. land and livestock, is characterised by substantial inequality.

Flood Damage at the Village Level

Human Damage

Table 2 shows the extent of human damage caused by the floods in each village. Our survey showed that the incidence of death or injury was low. Reflecting this, the household data-set contains no household in which a person died, and at most only one or two households in a village in which people sustained injuries. By contrast, the incidence of disease was very high. In all the villages, more than half the sample households reported the prevalence of disease. Most of the diseases had to do with the skin or eyes.

Damage to Houses

Table 3 shows the extent of damage caused to houses by the 2010 floods. Three categories are differentiated: "destroyed" means that the house was completely destroyed and was unsuitable for residence; "major damage" means that the house was partially destroyed and required repair before reoccupation; and "minor damage" means that the house was partially destroyed and required repair, but was suitable for accommodation. Jala Bela was the most seriously affected village in terms of the incidence of "destroyed" houses, while Mian Gujar village was the most seriously affected in terms of the absolute number of houses damaged by the floods, regardless of its severity.

Table 1 *Characteristics of sample households*

Variable	Unweighted			Weighted			Minimum	Maximum
	Mean	(Std. Dev.)	Median	Mean	(Std. Dev.)	Median		
1. Characteristics of the household head								
Age	46.80	(13.90)	46.50	47.50	(14.40)	47.00	20	80
Literacy dummy	0.62	(0.49)	1.00	0.60	(0.49)	1.00	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)	1.00	0.54	(0.50)	1.00	0	1
Owned land in acres	3.74	(7.26)	1.00	2.70	(5.83)	0.25	0	40
Owned land value (PKR 100,000)	45.50	(92.00)	10.30	43.30	(105.20)	6.90	0	600
5. Livestock assets before the floods								
Livestock ownership dummy	0.78	(0.42)	1.00	0.76	(0.43)	1.00	0	1
Number of large animals#	1.41	(2.01)	1.00	1.53	(2.27)	1.00	0	12
Livestock asset value (PKR 1,000)	73.90	(150.00)	34.30	71.60	(140.50)	35.50	0	1250
Same but excluding chickens (PKR 1,000)	55.20	(72.90)	34.00	55.70	(70.40)	34.00	0	310

Notes: The number of observations is 100 (10 from each sample village). Under "Weighted Mean (Std. Dev.)", the summary statistics are weighted using the inverse of the sampling probability of a household (i.e. 10 divided by the number of households reported in Table A3) as the weight.

* When the household head is either a village *malik* (village head), *jirga* leader or *jirga* member, the dummy takes the value of 1. *Jirga* is a traditional dispute-solving institution in Pakhtun society.

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

Table 2 *Human damage caused by the 2010 floods*

Village name		Village data						Household data		
		Number of persons			% of the population			Number of households reporting damage (out of 10)		
		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 3 *House damage caused by the 2010 floods*

Village name		Village data						Household data						
		Number of houses			% of the number of households			Number of households reporting damage (out of 10)				Damage amount# (in PKR 100,000)		
		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, house refers to where the household was living at the time of the floods. The house building may have been a rented one.

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

When the head of a sample household was able to report a monetary estimate of house damage, the information was recorded, and the statistics are shown in the right-hand columns of Table 3. The within-village averages of damage to houses were in the range of Rs 73,000 (Masma village) to Rs 195,000 (Dag village). Although the incidence of damage to houses was the least in Dag (6 out of 10 households reported damage), the damage estimates were not low in this village because the buildings were generally better than in other villages. It is likely that damage to houses was larger than this range for households in Jala Bela, for which information is missing.

Damage to Agricultural Land

The extent of flood damage to agricultural land among sample households is shown in Table 4. At the village level (not shown in the table), agricultural land in all 10 villages was damaged by the floods. For instance, in Tarnab, 1 acre of crop land was completely eroded while 250 acres of orchard land were heavily damaged; in Masma, 300 acres of crop land and 75 acres of orchard land were partially affected. The household-level data shown in Table 4 suggest that the sample households in Dag village experienced the most severe damage to their agricultural land, followed by the households in Urmar Miana village and Damane Hindko village. In Dag, the average land damage value among those with positive damage was Rs 700,000, which is a substantial amount when compared with the mean land asset value, Rs 4 million (Table 1). Therefore, land damage due to the floods was heterogeneous not only across villages, but also within villages.

Damage to Crops

Flood damage to standing crops at the household level is summarised on the right half of Table 4. Sample households in Dag village experienced the largest damage to their standing crops, followed by those in Shahi Bala village and Budni village. In Dag, all the sample households suffered crop losses, of an average value of Rs 1.73 million. This was indeed a huge loss. In this village, most of the agricultural land had been planted with the cash crops of sugarcane and yam. Since the expected gross output value of these crops is high, the value of crops destroyed in this village by the 2010 floods was also high.[4]

In the other villages as well, crop damage was substantial for several households. The average crop loss among landed households was approximately 8.2 per cent of their land value in nine villages other than Dag. In Dag, the corresponding proportion was approximately 32.7 per cent. Therefore, crop damage was more prevalent and its magnitude was significant in this village.

[4] In a usual year, the gross output value of sugarcane is Rs 250,000 per acre on average, while that of yam is Rs 300,000 per acre.

Table 4 *Agricultural damage caused by the 2010 floods*

Village name		Household data								
		Number of households reporting the land damage (out of 10)	Damage amount (in PKR 100,000)				Number of households reporting crop damage (out of 10)	Damage amount (in PKR 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	
			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	0.06	(0.16)	0.300	(0.28)	8	0.664	(0.64)	0.829	(0.61)
3	Urmar Miana	4	1.92	(3.13)	4.800	(3.31)	8	0.284	(0.26)	0.355	(0.24)
4	Mera Kachori	1	0.05	(0.16)	0.500		5	0.411	(0.76)	0.822	(0.95)
5	Damane Hindko	4	1.25	(2.04)	3.125	(2.17)	10	5.540	(6.05)	5.540	(6.05)
6	Shahi Bala	1	0.10	(0.32)	1.000		7	5.860	(15.97)	8.371	(18.92)
7	Jala Bela	0	0.00	(0.00)			7	0.880	(1.84)	1.257	(2.12)
8	Mian Gujar	2	0.20	(0.48)	1.000	(0.71)	5	2.220	(4.98)	4.440	(6.59)
9	Budhni	0	0.00	(0.00)			9	6.848	(16.09)	7.608	(16.88)
10	Dag	3	2.11	(6.29)	7.033	(11.23)	10	17.27	(17.88)	17.270	(17.88)

Damage to Livestock

Both the village and the household surveys show that Damane Hindko experienced the largest loss of livestock assets (Table 5). The village-level survey indicated a loss of Rs 9,000 per household, while the household-level survey indicated a loss of Rs 47,000 per household. In comparison with the size of initial livestock owned, reported in Table 1, the loss amount was huge. Across all 10 villages, loss of livestock calculated from household-level data indicates that, on average, 24 per cent of initial livestock assets were lost due to the floods. No livestock loss was reported from Dag village in both data-sets.

Damage to Other Rural Businesses

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

Damage to 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 caused minor damage to a primary school for boys. In all villages other than Budhni, electricity, gas, and phone services were suspended for several days due to the floods and heavy rain.

Summary

As shown above, the damage caused by the floods was widespread in all 10 villages. The pattern of damage differed from village to village. Damage to houses was most serious in Jala Bela, while damage to agricultural land and crops was concentrated in Dag, and damage to livestock concentrated in Damane Hindko. A large within-village variation was also found for every type of damage other than human damage.

In the next section, we further analyse the within-village variations. The justification for this focus is the knowledge gap, for very little is known about the potentially disuniform or heterogeneous impact of a natural disaster within a village.

Table 5 *Livestock damage caused by the 2010 floods*

Village name	Village data							Household data				
	Number of animals lost					Damage amount# (PKR 1,000)		Number of households reporting damage (out of 10)	Damage amount# (PKR 1,000)			
	Cattle	Buffaloes	Goats/ sheep	Horses/ mules	Chickens				All sample households (mean over 10 observations)		Sample households with a positive amount of livestock damage	
						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 Bala	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: cattle= Rs 34,000, buffalo= Rs 60,000, goat= Rs 2,000, hourse/mule= Rs 10,000, chicken= Rs 250.

Table 6 *Average loss due to floods, by type of asset, survey households, Khyber Pakhtunkhwa, Pakistan, 2010*

Type of asset	Average	(Standard deviation)
House	139.1	(140)
Land	57.5	(236)
Crop	417.1	(1035)
Livestock	9.4	(23)
Other assets	17.9	(109)
All assets	641.0	(1189)

Source: Calculated from the 2011 pilot survey. Unit is PKR 1,000.

Extent of Flood Damage

Table 6 reports the average flood damage: the mean of the total damage among 100 sample households was PKR 641,000, a substantial amount in comparison with the average income level in the region.[5]

Then, how correlated was the damage within a village? If the correlation is high, neighbours are hit in a similar way, so that insurance and risk-coping within the village are of little use. If the correlation is low, within-village insurance measures can play a role in coping with natural disasters. To examine this issue, we first calculated a bivariate correlation coefficient between a flood damage variable and another, both of which are transformed as the deviation from the village-level means. Table 7 reports the correlation matrix. By construction, the last category, titled "Total of the five," tends to be positively correlated with individual components. This is indeed the case, except for livestock. Loss of livestock occurred independently of house, land, and crop losses, while its occurrence was negatively correlated with damage to other assets. Looking at the correlation coefficients among the first five variables of flood damage, there was one significant coefficient, in addition to the negative correlation between livestock and other assets damage already discussed. This was the correlation between damage to land and damage to crops – the coefficient of correlation between the two variables was 0.309, statistically significant at the 1 per cent level.

When a flood occurs, it tends to damage both the land and the standing crops. This is as expected, but the quantitative magnitude of the damage is confirmed by our study. The complete absence of correlation between damage to houses, damage to

[5] The assessments of flood damage are self-assessments by the respondents, verified by the investigator team on the spot. They correspond to the market value of the asset when it was completely lost, and to the rehabilitation/repair cost when it was partially damaged. With regard to land damage, several households reported land erosion, for which the assessment of damage was based on the market value of the land; other households reported destruction of bunds and irrigation canals, for which the damage assessment was based on the repair cost.

Table 7 *Bivariate correlation between different types of flood damage at the household level in Khyber Pakhtunkhwa, Pakistan, 2010*

	Damage in monetary terms to					
	House	Land	Crop	Livestock	Other assets	Total
House damage	1.000					
Land damage	0.052	1.000				
Crop damage	0.106	0.309***	1.000			
Livestock damage	−0.016	−0.134	−0.029	1.000		
Other assets damage	0.118	0.137	0.140	−0.187*	1.000	
Total of the five	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. In other words, each of the correlation coefficients correspond to the within-village correlation. The number of observations is 100. The coefficient is significantly different from 0 at the 1 per cent (***), 5 per cent (**), and 10 per cent (*) levels.
Source: Calculated from the 2011 pilot survey.

land and crops, and damage to livestock is a finding that, as far as we know, has not been addressed elsewhere in the existing literature. This suggests that flood damage is heterogeneous or disuniform within a village, so that relief of a single kind may not be useful to all flood victims.

Secondly, to investigate which households were vulnerable to each category of flood damage, 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 household-level variables that are expected to affect the damage. For the latter, we employed the following variables, which characterise asset positions before the floods: human capital indicators such as household size (quantity of human capital), level of education of the head of the household (quality of human capital in the modern context), and a dummy variable representing whether or not the household head is a traditional village leader (quality of human capital in the traditional context); and physical capital indicators such as the number of buildings on the homestead, the value of land, and the value of livestock owned by each household before the floods.

The regression results are given in Table 8. The table shows that each of the five types of damage 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 damage to houses, land assets with the damage to land (significant only at the 20 per cent level in Table 8, but at the 10 per cent level if other insignificant initial assets are excluded), land assets with the damage to crops, and livestock with the damage to other assets. In other words, households that already had a relatively large asset of one kind suffered more damage to that asset than to others. Human capital variables were insignificant in explaining the flood damage, which seems to indicate that human capital is not useful in reducing damage when it is caused by a very

Table 8 *Multiple regression results to explain different types of flood damage*

Dependent variable: Flood damage in PKR 1,000					
	House damage	Land damage	Crop damage	Livestock damage	Other assets damage
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 household 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 household 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 (PKR 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 (PKR 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 parentheses. 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 per cent (***), 5 per cent (**), and 10 per cent (*) levels.
Source: Calculated from the 2011 pilot survey.

rapid and unexpected arrival of floods. Unexpectedly, the initial holding of livestock had an insignificant coefficient in the livestock damage regression. The reason for this absence of correlation is a matter for further research.

Availability and Targeting of Flood Relief

Given the magnitude of flood damage, how was aid distributed? In our survey, we distinguished between aid for initial emergency relief, and aid for recovery and reconstruction in the later phases. We also classified the donors into those related to the government and those related to NGOs. As shown in Table 9, out of 100 sample households, 43 received government emergency aid, 46 received NGO emergency aid, 44 received government recovery aid (including *Watan* cards), and 19 received NGO recovery aid.

The amount of aid received by households in these four categories from the two types of donors was similar. By design, the amount received by *Watan* card-holders was

Table 9 *Cross-tabulation of different types of flood relief recipients*

A. *Correlation between government aid and NGO aid within a phase*

	Govt	NGO		Total	*p*-value
		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

B. *Correlation between recipient statuses in two phases*

	Emergency phase	Recovery phase		Total	*p*-value
		Yes	No		
Govt 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

Note: p-value reports the probability for the hypothesis that the row and column variables of the two-way contingent table are distributed independently, according to the chi2 test.
Source: Calculated from the 2011 pilot survey.

the same. With regard to emergency aid, the sample means of the money equivalents of aid provided by the government and NGOs were approximately PKR 12,000 and PKR 13,000 respectively, and the difference was not statistically significant.

The distribution of government rehabilitation aid during the recovery phase was controversial. *Watan* cards were to be provided on the basis of direct assessment, but many sample households reported that their *Watan* card applications were rejected for reasons unknown. Such complaints were more frequently encountered in villages where the village-level issue of *Watan* cards was lower than in other villages. All cash transfers were unconditional, in the sense that there were no further conditions imposed on recipients once they were designated as aid recipients.

Table 9 also shows whether a household that received one type of flood relief (say, relief A) was more likely to receive another type of flood relief (relief B) than a

household that did not receive relief A. In other words, we examined whether aid duplication occurred. If aid duplication occurred because the aid was targeted at severely affected people, it is not a serious concern. On the other hand, if it occurred because of the capture of aid by politically influential households in a village, it indicates a serious problem of mis-targeting (Jayne *et al.* 2002, Takasaki 2011). As shown in the table, there was a tendency to concentrate on the diagonal, indicating aid duplication. When a household received aid from the government, it tended to receive aid from NGOs as well (statistically significant at the 1 per cent level both in the emergency and recovery phases). Further, when a household received aid from NGOs in the emergency phase, it tended to receive aid from NGOs in the recovery phase as well (significant at 1 per cent). There was a similar correlation between aid receipts from the government during the two phases (significant at 5 per cent). Thus aid duplication was observed at the household level.

How much of this aid duplication was due to the concentration of aid to households in severely damaged villages, and how much of it is attributable to allocation to severely affected households within a village? To examine this issue, we calculated the bivariate correlation between the aid recipient statuses after taking the deviations from the village averages (Table 10). As in Table 8, we also compiled an aggregate dummy variable for the recipient of any type of relief. By construction, the last (fifth) category was positively correlated with individual components. All of the six correlation coefficients among the first four aid recipient statuses were positive, but only two of them were statistically significant – when a household received emergency aid from NGOs, it tended to receive rehabilitation aid from both the

Table 10 *Within-village correlation among different types of aid recipient status*

	Emergency phase		Recovery phase		Any type of recipient
	Govt relief	NGO relief	Govt aid	NGO aid	
Emergency phase					
Dummy for govt relief recipient	1.000				
Dummy for NGO relief recipient	0.128	1.000			
Recovery phase					
Dummy for govt aid recipient	0.176	0.192*	1.000		
Dummy for NGO aid recipient	0.041	0.223**	0.081	1.000	
Dummy for any type of recipient	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 per cent (***), 5 per cent (**), and 10 per cent (*) levels.
Source: Calculated from the 2011 pilot survey.

government and NGOs in later periods. Although statistically weaker than indicated by Table 9, Table 10 suggests the existence of aid duplication within a village after controlling for village-level allocation.

Does within-village aid duplication indicate mis-targeting? To examine this issue parametrically, we estimated a linear probability model of receiving flood relief. All models included village fixed effects, thus allowing us to investigate the characteristics associated with aid allocation within a village. In addition to village-level fixed effects, two groups of household-level explanatory variables are included. The first group contains exactly the same list of household-level initial assets variables used in Table 8. The second group contains the fitted residuals from regression models in Table 8. The fitted residuals contain the component of variation in flood damage not explained by village fixed effects and households' initial assets. Coefficients on the fitted residuals can thus be interpreted as the aid response to flood damage after controlling for the flood damage endogenously determined by households' initial assets.

The regression results are shown in Table 11. The six variables of households' initial assets (human and physical capital) were associated with a negative coefficient (other than in a few cases), indicating that poorer households within a village were targeted for relief after controlling for flood damage. However, only four of them were statistically significant, and three of the four were significant in respect of land asset. For example, if the land asset had been larger by PKR 1 million (this figure is close to the median), the probability of the household receiving government emergency aid would have been lower by 0.89 percentage point, the probability of it receiving NGO emergency aid would have been lower by 1.21 percentage points, and the probability of it obtaining government rehabilitation aid would have been lower by 0.77 percentage point. Although statistically significant, the coefficients were generally small and economically insignificant. The dummy for a traditional leader status was insignificant and had a negative coefficient, which could be interpreted as absence of clear evidence of elite capture.

Flood damage captured by the fitted residuals showed an interesting contrast between damage to houses and other types of damage. Households whose houses were more damaged were more likely to receive aid, especially from the government. If the house damage due to floods had been larger by PKR 100,000 (this figure is close to the mean), the probability of that household receiving government emergency aid would have been higher by 4.9 percentage points and the probability of it receiving government rehabilitation aid would have been higher by 9.1 points. Thus house damage was moderately associated with damage-based targeting. On the other hand, flood damage to land, crops, and other assets was associated with a lower probability of receiving aid. Regarding damage to other assets, the households that experienced such damage were engaged in modern agro businesses and were better off than other people in the village. This could be the reason that even when their assets were

Table 11 *Aid recipient status, flood damage, and initial assets*

	Dependent variable: Dummy for the aid receipt (×100)			
	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 household head	−0.983	0.552	−1.054	−1.165
	(0.645)	(0.781)	(0.802)	(0.780)
Village leader dummy of household 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 (PKR 100,000)	−0.089***	−0.121***	−0.077**	−0.012
	(0.031)	(0.034)	(0.034)	(0.017)
Livestock asset value (PKR 1,000)	−0.029	0.013	−0.007	0.003
	(0.023)	(0.015)	(0.019)	(0.016)
Flood damage in PKR 100,000 (fitted residual from Table 8)				
House damage	4.488*	1.607	9.139**	2.710
	(2.697)	(2.457)	(3.874)	(1.810)
Land damage	−0.142	−0.037	−1.806	−0.013
	(0.655)	(0.859)	(1.391)	(0.359)
Crop damage	−0.942*	0.042	−0.243	0.010
	(0.522)	(0.401)	(0.697)	(0.197)
Livestock damage	2.969	−19.838	20.654	1.712
	(23.205)	(25.849)	(16.430)	(18.156)
Other assets damage	−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 parentheses. 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 per cent (***), 5 per cent (**), and 10 per cent (*) levels.
Source: Calculated from the 2011 pilot survey.

damaged by floods, they were not given relief. A similar interpretation is possible for crop losses, since larger crop losses were experienced by the more prosperous, capitalist farmers than by other farmers. This last, however, is only a conjecture. Our results could also suggest a serious failure in targeting, in that households whose standing crops were seriously damaged were not given priority in receiving aid.

To summarise this section, the extent of aid duplication observed in our data-set is 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 houses were destroyed). In this sense, we were not able to find evidence for obvious mis-targeting. However, the response of aid receipt probability to these household-level indicators is weak, and the response to other indicators, especially crop loss, is 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 affected persons complained of unfair distribution of government aid – for example, of *Watan* cards.

Level of Recovery

Given the distribution of flood relief described above, to what extent had the survey households recovered from flood damage at the time of our survey?[6] Table 12 shows the average recovery status in percentage points. The extent of overall recovery, on average, was 69 per cent. That is a self-assessment, taking one of the 11 percentage point categories from 0 (no recovery) to 100 (complete recovery). Overall recovery was decomposed into recovery with respect to houses, land, the two cropping seasons of rabi 2010–11 and kharif 2011,[7] and livestock.[8] Recovery percentage figures are applicable only to households that suffered damage in each category. The table indicates that crop damage had already recovered at the time of our survey. The

Table 12 *Average percentage recovery rate, survey households, Khyber Pakhtunkhwa, Pakistan, 2010*

	Average	(Standard deviation)
House (n=87)	60.1	(27.8)
Land (n=19)	55.8	(43.8)
Crop-2010–11, rabi (n=75)	84.9	(28.8)
Crop-2011, kharif (n=75)	96.0	(15.2)
Livestock (n=28)	46.4	(48.5)
Overall (n=99)	69.0	(25.3)

Source: Calculated from the 2011 pilot survey. The unit is percentage points.

[6] The extent of recovery also depends on risk-coping and self-insurance within a village. The use of such measures was not frequent in our survey villages (see Kurosaki *et al.* 2011).

[7] The kharif crop is the monsoon or autumn crop for which harvests come in September–November; rice, cotton, and maize are the major kharif crops. The rabi crop is the spring or dry season crop for which harvests come in March–June; wheat and gram pulse are the major rabi crops. The 2010 Pakistan floods destroyed the 2010 kharif crop.

[8] These recovery percentages are self-assessments by respondents, verified by the investigator team on the spot. Recovery with respect to houses, land, and livestock was measured in terms of the reacquisition or reconstruction of equivalent assets, or rehabilitation to the pre-flood level. With respect to crops, the recovery percentage corresponds to how close the cropping patterns in rabi 2010–11 or kharif 2011 were to pre-flood patterns.

Table 13 *Bivariate comparison of recovery and aid*

	Difference between recovery 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)
Difference between those receiving aid and others[#]						
Emergency, govt	−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, govt	−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

Notes: [#] The numbers show the difference of recovery status between households with aid and households without aid. For instance, −2.74 in the first cell means that the average overall recovery rate among those who received government emergency aid was lower by 2.74 points than 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 per cent (***), 5 per cent (**), and 10 per cent (*) levels. For the land damage, since there is only one household with aid, the t test is not applicable (shown as "n.a.").
Source: Calculated from the 2011 pilot survey.

sample households expected their 2011 kharif harvest to be back to normal (the average recovery rate was close to 100 per cent). On the other hand, livestock damage did not recover much; the average recovery rate was around 50 per cent. House and land recovery was in between, at around 60 per cent on average. However, as shown by the relevant standard deviations in Table 13, variations across households were also substantial.

We examined, in two steps, which factor is associated with variations in recovery across households. First, we simply compared the average recovery rates between two types of households: those who received aid and those who did not. If this difference was positive and statistically significant, we may conclude that aid was effective in helping households recover from flood damage. Secondly, we used multiple regression analyses.

The results of the first step are shown in Table 13. All four aid recipient dummies were associated negatively with overall recovery, although not statistically significant. The negative correlation between aid receipt and house recovery was statistically significant, and there was no statistically significant difference across the four types of aid (from government or NGOs, emergency or recovery aid) as far as the recovery from house damage is concerned. This implies that the average recovery rate from damage to houses was lower among those who received aid from outside than among those who did not, and this pattern was shared regardless of the aid donors. We observed a significantly positive difference among aid recipients only with respect to recovery from damage to land, crops, and livestock. These results can be interpreted as either the real absence of any impact of aid on recovery or the endogenous placement bias. By the latter we mean that the direct impact of aid or

coping on recovery was positive, but cancelled out by the negative selection effect due to the tendency that priority in aid or informal help was given to households for whom recovery was relatively difficult. Owing to the small size of our sample, it was not possible to identify the two effects econometrically and test the difference in aid effectiveness among different donors (using the instrumental variables, for example).

As side evidence of the priority in respect of aid given to households who had difficulty in recovery, we estimated a more reduced-form regression model. The dependent variable is, as before, the recovery percentage. The explanatory variables are now those used in explaining the distribution of aid in Table 11, that is, village fixed effects, initial assets of households, and flood damage (not the observed values but the residuals, after controlling for village fixed effects and initial assets).

The regression results are reported in Table 14. Household size had positive and significant coefficients with respect to 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 labour force availability within a household helped the household recover from flood damage. The education of household heads had a positive effect on 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 helped households recover from flood damage. The village leader dummy had a positive coefficient that is statistically significant (though the significance level was low). Thus, if a household head was a traditional village leader, the overall recovery percentage would have been 11.5 percentage points higher. This may be a sign of elite capture or of the superior ability of such households in mobilising resources for recovery. Initial livestock assets contributed to recovery in respect of livestock. This is natural, because compensating for the loss of one animal is easier for households with a large initial endowment of livestock than for households with a smaller such endowment.

Most of the flood damage variables have negative coefficients as expected, indicating that households who suffered greater damage than the damage predicted by their initial assets and village fixed effects found recovery more difficult than others. Two of the negative coefficients were statistically significant – if the damage to a house were PKR 100,000 greater, the household's house recovery percentage would have been lower by 5.2 percentage points; if the damage to crops were PKR 100,000 larger, the household's rabi crop recovery percentage would have been lower by 1 percentage point.

The regression results in Table 14 thus confirm that households whose initial asset endowments were better than others were quicker than others in recovery, while those that suffered larger flood damage lagged behind others in recovery. This supports the interpretation that since aid was targeted towards households with greater damage

Table 14 *Recovery from floods, size of flood damage, and household's initial capital*

	Dependent variable: Recovery status in percentage points		
	Overall	House	Land
Household's initial capital			
Number of household members	1.014**	1.005	5.080**
	(0.452)	(0.604)	(1.862)
Years of education of household head	0.814**	0.524	1.263
	(0.395)	(0.584)	(1.766)
Village leader dummy of household head	11.494*	14.339	9.859
	(6.689)	(9.032)	(17.330)
Number of house buildings owned	−12.000	−8.972	9.727
	(8.042)	(12.135)	(23.789)
Owned land value (PKR 100,000)	0.039	0.027	0.017
	(0.028)	(0.026)	(0.028)
Livestock asset value (PKR 1,000)	0.017	0.004	−0.013
	(0.013)	(0.017)	(0.019)
Flood damage in PKR 100,000 (fitted residual from Table 8)			
House damage	−2.102	−5.171*	
	(1.907)	(3.009)	
Land damage	−0.748		−0.577
	(0.651)		(1.161)
Crop damage	0.023		
	(0.323)		
Livestock damage	7.758		
	(10.048)		
Other assets damage	−5.818		
	(4.451)		
Village fixed effects	Full	Full	Village 3,5
R-squared	0.370	0.321	0.837
F-statistics for zero slopes	4.54***	3.04***	17.81***
F-statistics for zero village fixed effects	4.69***	1.26	4.24*
Number of observations	99	87	19

	Dependent variable: Recovery status in percentage points		
	Crop 2010–11, rabi	Crop 2011, kharif	Livestock
Household's initial capital			
Number of household members	−0.192	1.313**	0.130
	(1.157)	(0.655)	(2.753)
Years of education of household head	−0.382	0.213	3.353
	(0.660)	(0.310)	(2.525)

Table 14 *Recovery from floods, size of flood damage, and household's initial capital (Continued)*

	Dependent variable: Recovery status in percentage points		
	Crop 2010–11, rabi	Crop 2011, kharif	Livestock
Village leader dummy of household head	−7.181	2.300	−43.533
	(7.750)	(2.925)	(31.511)
Number of house buildings owned	−2.199	−1.113	23.161
	(7.023)	(3.799)	(27.709)
Owned land value (PKR 100,000)	0.003	−0.006	−0.439
	(0.031)	(0.009)	(0.382)
Livestock asset value (PKR 1,000)	−0.015	0.020	0.149*
	(0.027)	(0.015)	(0.077)
Flood damage in PKR 100,000 (fitted residual from Table 8)			
House damage			
Land damage			
Crop damage	−1.003**	−0.296	
	(0.397)	(0.189)	
Livestock damage			11.609
			(38.832)
Other assets damage			
Village fixed effects	Full	Full	Village 5,7
R-squared	0.443	0.255	0.414
F-statistics for zero slopes	4.74***	0.56	4.10***
F-statistics for zero village fixed effects	3.10***	0.71***	1.50
Number of observations	75	75	28

Notes: Huber-White robust standard errors are shown in parentheses. 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 per cent (***), 5 per cent (**), and 10 per cent (*) levels.
Source: Calculated from the 2011 pilot survey.

to houses and with smaller initial assets (households for whom recovering from flood damage was inherently difficult), the positive correlation between aid and recovery is not readily observable in Table 13.

Conclusion

This article analyses the damage caused by floods in Pakistan in 2010, the distribution of aid, and the extent of recovery at the household level. The study is based on a pilot survey of 100 households in Khyber Pakhtunkhwa. With regard to the nature of flood damage, we found that damage to houses, land (crops), livestock, and other business assets were not highly correlated. This suggests the possibility of within-

village coping measures to function against flood shocks. In the distribution of aid from outside, different types of aid (government or NGOs, emergency or recovery aid) overlapped. Within villages, aid was targeted towards households with greater damage to houses, while households that suffered greater damage than others to land, crops, or other assets were not given priority in aid distribution. We found evidence (though not very strong) that within-village, across-household aid was targeted towards 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 that it discriminated politically between recipients.

With regard to recovery from flood damage, we found that the recovery percentage was higher with respect to crops than with respect to houses, land, or livestock. Aid recipients, particularly those who suffered damage to their houses, did not show higher recovery than non-recipients of aid. This could be because of a mix of recovery-promoting aid and selective aid directed towards households for whom recovery was inherently more difficult than for others. We found that households that had lower assets initially and were hit by larger flood damage had more difficulty in recovering from that damage than others. This suggests that such households need to be supported over a longer term.

The overall results suggest that the short-run impact of the floods on the agrarian economy and on the livelihoods of the people was to maintain the socioeconomic characteristics that had prevailed prior to the floods. The potentially inequality-increasing impact of disuniform flood damage was partially mitigated by aid allocation, and recovery in cropping was already high at the time of our pilot survey.

Because of the small sample size and non-representative nature of the household data-set, however, we cannot claim general applicability for our findings. Furthermore, we cannot rule out the possibility of the beginning of a long-run change triggered by the disastrous floods. Nevertheless, the empirical patterns presented in this paper are suggestive in understanding the impact of natural disasters and its relation with relief allocation. We plan to conduct new rounds of household surveys in order to explore further the findings in this paper and to analyse the dynamics of the recovery process in more detail.

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Appendix Tables

Table A1 *Damage 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	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).

Table A2 *Flood damage and the distribution of* Watan *cards in Khyber Pakhtunkhwa, Pakistan*

Name of 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: Websites of Provincial Disaster Management Authority, Government of Khyber Pakhtunkhwa (http://www.pdma.gov.pk/), viewed on 30 June 2011.

Table A3 *Characteristics of sample villages*

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

Source: 2011 pilot survey data.