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The Flood Event of July 2010: Socioeconomic Disruptions in Lower Dir District

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Abstract

Pakistan experienced a devastating flood in the summer of 2010. Almost all the major rivers of the country as well as the streams and seasonal torrents in the mountainous areas were in flood. This is attributed to heavy rainfall and snowmelt. The flood destroyed agricultural land, standing crops and infrastructure throughout the country. The number of affected districts was 78, with 2,000 human casualties, 0.55 million housing units destroyed and 6 million people displaced. The present study is focused on the lower Dir district in the Khyber Pakhtunkhwa province of Northern Pakistan. The whole district is drained by Panjkora River. Data for this study were collected from the official sources. To cross check the official data field survey was also conducted in the affected areas. The floodplain of river Panjkora is very fertile and suitable for the cultivation of different crops. Findings of this study reveal that maximum losses were in agriculture sector followed by infrastructure and communication network. Almost all the bridges over the Panjkora River were destroyed by this flood.

Keywords: Socioeconomic disruptions; Dir Lower; 2010 Floods;

Introduction

Hazards may be in the form of earthquakes, tsunamis, landslides, drought and floods etc. Flood is one of the most frequent natural hazards (Verworn 2002; White et al. 2010), often cited as being the most lethal of all natural disasters (Alexander 1993; Wheater 2006). Flood catastrophes have increased almost three

times from 1980 to 2009 (Munich RE 2010). The impacts of floods on a global scale are enormous (Coates 1999; Jonkman et al. 2008; Chang et al. 2009; Te Linde et al. 2010; Lehner et al. 2006). In the past few years many rivers flooded all over the world, such as the Jamuna River in Bangladesh, the Yangtze in China, the Oder and the Vistula in Poland, the Moldau in the Czech Republic and the Elbe in Germany (Vuren et al. 2005). During twentieth century, floods killed 8 million people (Jonkman, 2005). From 1980 to 2010, 13393 fatalities and 149600 million US dollars losses were recorded in 10 costliest floods (Munich RE 2010). In Asia alone floods annually destroy about 10 million acres of crops and affect the life of more than 17 million people (Atta-ur-Rahman 2003). According to Mirza et al. 2001, almost one fourth of the land of Bangladesh is annually flooded. The hazardous flood of 2004 affected 70 million people in Bangladesh (Ali 2007). In 1993, River Mississippi flooded causing 19 billion US dollars losses (Changnon 2004), while in Netherlands, the 1995 flood event in the Rhine caused 250,000 people to be evacuated (Vuren et al. 2005). Similarly, according to Teng et al. 2006, in Taiwan, floods have caused 518 million US dollars losses in the last 25 years. The increasing intensity and severity of flood events may be a result of global warming and potential changing climate worldwide (Milly et al. 2002; Ulbrich et al. 1996; Katz et al. 1992; Karl et al. 1993; Jones 1999; Kohler et al. 2010). However, there are a number of anthropogenic factors as well, (Hofer 1993; Nirupama et al. 2007; Mitchell 2003; Dong. et al 2009; Changnon 2003; Wheater et al. 2009) which turn the floods more destructive.

Like the rest of the world (Compana et al. 2001; Travis 2005; Mohapatra et al. 2003; Fuller 2005; Faisal et al. 1999), floods recurrently occur in Pakistan. In the history of Pakistan, huge floods have occurred in 1955, 1959, 1976, 1988, 1996, and 2007 (GOP 2000; Khan et al. 2004). It is estimated that during the last fifty years, in Pakistan, the total losses due to floods are about US $ 10 billion, while more than 5,800 people lost their lives (Khan et al. 2001-02). On 1st July 1977, flooding in the Malir and Layari river courses (Karachi), killed 280 people, rendered 18,000 houses and destroyed 5000 dwellings (Jhonson 1979, Pp.90). Similarly in August, 2009, floods devastated large areas of Mardan and Swabi districts, killing at least 13 people and sweeping away hundreds of houses (Daily Dawn 2009).

The heavy floods of July, 2010 were the most devastating floods in the history of Pakistan. Unprecedented heavy monsoon rainfall is blamed to have caused this historical flood. The entire country right from Chitral, the northernmost end up to Karachi, the southernmost end, including northern areas and Jamu Kashmir, was

flooded. The gushing water in Indus system and other rivers hit a total of 78 districts (NDMA 2010). At one time, almost one fifth of Pakistan's total area was under water. About 2,000 people lost their lives and about 20 million affected in these floods (NDMA 2010). A total of 2946 people received injuries, 557226 houses were destroyed, over 6 million people were displaced and 1744471 households were affected (Wunder blog 2010; Ahmadani 2010). The number of individuals affected by these floods exceeded the combined total of individuals affected by 2004 India's Tsunami, 2005 Kashmir earthquake and 2010 Haiti earthquake (BBC 2010; Gulf News 2010).

A huge volume of standing crops and agriculture lands were washed by these devastating floods, as most of the agriculture activities are practiced in the floodplains of Indus River and its major tributaries. Floods destroyed 2244644 acres of crops, which include 700,000 acres of cotton, 2,000 acres each of rice and cane, 330,000 acres of wheat and 300,000 acres of fodder (Bloomberg 2010; NDMA 2010). Pakistan exported 4.6 million tonnes rice last year, which may face a 24% decrease due to the damages caused by recent floods to the paddy crops (Reuters 2010). The GDP growth rate of 4% prior to floods may turn negative with the estimates ranging from -2% to -5% of GDP (Jehangir 2010).

The right bank tributaries of River Indus i.e. river Panjkora and river Swat etc also experienced heavy floods. District Dir Lower and Upper are drained by river Panjkora. Panjkora River is very important because of the fertile alluvial flood plain it has developed (Dichter 1967 Pp.60). The recent flood was the heaviest among all flood events occurred in river Panjkora in the past, which affected both the lower and upper Dir districts. Dir lower is one of the most severely affected districts of the province, which received a lot of damages as a result of this flood. The flood took the lives of many people and washed away standing crops and fertile agriculture floodplain. Communication lines and infrastructure was destroyed and a number of markets were flushed. The main objective of this study is to assess the damages caused by the flood of 2010 in Lower Dir district Northern Pakistan.

The Study Area

This study has been carried out in lower Dir district, which lies in the northern part of Khyber Pakhtunkhwa. River Panjkora flows through the middle of the district with a number of large tributaries from the surrounding mountains. The name Panjkora is a combination of two words, "Panj" and "Kora" which means five streams. This name is given to the river because it is a combination of five major

streams namely, Kohistan River, Gwaldai River, Sherengal River, Dir River and Barawal River. Besides these five main tributaries, river Panjkora is joined by a number of other tributaries as well.

River Panjkora has a large catchment area in the mountains with snowy heights reaching up to above 5,000 meters. These mountains receive heavy snowfall in winter, which melts in the summer months resulting into floods. One of the causes of the recent heavy floods was melting of the snow received in the last winter. Rugged topography and steep slope of the catchment area intensifies the speed of flood water along with some other natural and anthropogenic factors.

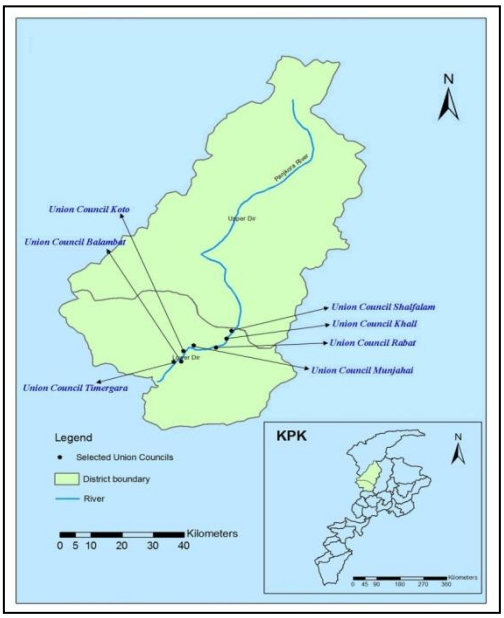

Fig. 1: Location Map of the Study Area

(The figure has been constructed in ArcMap software, using raster map of Dir Lower and Upper; and topographic sheet no. 38.N/13)

The whole of Dir district is vulnerable to flood risk. Mostly the agriculture activities are practiced in the floodplain of Panjkora River and its tributaries. Similarly the markets almost all over the district are located close to river Panjkora increasing flood risk vulnerability (Changnon 2005; Pielke 2001). Almost the whole area of lower Dir district all along the course of Panjkora River was affected by the recent flood. The intensity of damages however varies from sector to sector and place to

place. Seven worst affected union councils of lower Dir district namely UC Shalfalam, UC Khall, UC Rabat, UC Munjahai, UC Koto, UC Balambat and UC Timergara (fig. 1) were selected for this study. Most of the villages of these union councils are located in the hilly areas away from the river, therefore the destruction of residential dwellings and human casualties are low. The major problem was the destruction of communication lines, roads and bridges which disconnected the villages from markets and the main road. Agriculture, being a land based industry, vulnerable to both surface and ground water flooding (Moriis et al. 2007; Posthmus et al. 2009) is the most severely affected sector in the area. The cultivated land and standing crops of all the selected union councils have been washed away.

Methods and Materials

The variables taken into consideration for this study are; damages to agriculture sector in terms of crops, cultivated land and orchards; human casualties; damages to houses, infrastructure like roads and bridges; damages to shops and markets, including sale items and commercial land. Most of the information for this study was collected from secondary sources; however field survey was also carried out in order to get some basic information about the flooded areas. During field visits the people of the affected areas were asked about flood damages, and factors which were involved in intensifying these damages. Interviews were taken from the officials of the concerned line agencies such as District Revenue Office (DRO), Irrigation Department, Agriculture department, Tehsildars, Communication and Works department (C&W) in order to know the efforts of these agencies for the reduction of flood risk and damages, and future planning for flood risk reduction.

The damages data was collected from DRO, C&W, agriculture and irrigation departments of lower Dir district. For a detailed review of literature about flood hazards' global and regional perspectives and the past history of floods, a number of published articles in different journals like the Natural Hazards, Disasters, Flood Risk Management and Pakistan Journal of Geography; books; online news and websites; media reports and statistical reports were reviewed. ArcGIS was used for the purpose of map making like the study area map, and the statistical data was treated in other software like MS Office.

Loss Estimation

Estimates of the financial losses were based on estimates of physical damages and unit prices (Morris et al. 1988). This method is applied to almost all types of

damages. Losses of damaged infrastructure like roads, bridges, poles, towers and other physical infrastructure were estimated through the information and figures recorded from the contractors and builders about the cost of construction of these units and the required amount of money for the reconstruction of these units. These figures were then compared to the data provided by C&W department in order to remove the ambiguities. Losses of markets damages were estimated through calculating the cost of shops' structures with local trends and the cost of items damaged in the markets according to the current prices.

Losses to cultivated land were calculated according to the prices of land, and losses to crops were estimated by calculating the per acre production capacity and then per tone prices of that particular crop. The production capacity of land was based on the figures provided by agriculture department and farmers' estimates as Posthmus et al. 2009 has applied. The owners of orchards were asked about the costs of orchards and their annual production, in order to calculate the losses to this sector.

Results and Discussion

Characteristics of the Floods

As a result of intensive monsoon rainfall, heavy floods were observed in almost all rivers of the country during the last week of July, 2010, which prolonged up to the end of August, 2010 particularly in the lower stage of river Indus. Heavy rainfalls along with snowmelt in the mountains and catchments areas of rivers are considered to have caused these historical destructive floods. Panjkora River is one of the right hand tributaries of river Indus. During the early months of 2010, the mountains and catchments areas of river Panjkora received the heaviest snowfall of the past 80 years. This snow melted with the rainfall in July, resulting in the most disastrous floods, ever occurred in Panjkora River.

In river Panjkora, the flood was at its peak during the night between 28th and 29th July, 2010 (DRO 2010). These two days and one night were the most crucial hours in the time of flooding. Flood water inundated the areas, never been flooded in the past. Standing crops in the floodplain all along the river were washed away, along with some human casualties. A total of 17 bridges and many roads were destroyed. Agriculture, commercial and residential land were washed away (DRO 2010; C&W 2010). Due to steep slope of the river bed, the flood water was flowing at a very high speed, carrying heavy boulders and sediments load along. Similarly, due to thick forests in the catchments areas of Panjkora River and its

tributaries, flood water eroded and transported big trees in a large number. These trees and boulders turned the flood into a more destructive one, destroying suspension bridges along the way.

Causes and intensifying factors of the recent floods

The main cause of the recent floods was the heavy monsoon rainfall, which prolonged up to six days. Snowmelt in the catchments areas of all the tributaries of Panjkora River increased the volume of water in the river, resulting into heavy floods in the low lying areas. Similarly the steep slope of the catchments area is another factor, which increased the speed of water and its capacity to erode and transport heavy load of boulders and sediments, enhancing the destructiveness of floods. River Panjkora is joined by a large number of large and small tributaries from the surrounding mountains of snowy heights. These tributaries discharge more and more water into the main river increasing the volume of water during floods.

Besides these natural causes, there are some anthropogenic factors as well, which increase the intensity of damages. Clearing of forest cover from the catchments areas, is a major intensifying factor of floods. Forest land can effectively control runoff, as trees absorb rainwater into soils. Once deforested, the lands act as less permeable surface, potentially causing downstream flooding (Chang et al., 2009). Poor floodplain management is another factor in intensifying the damages of floods. Agriculture is practiced in the active floodplain all along the course of Panjkora River. Similarly most of the human casualties in the lower and upper Dir districts were caused due to the ignorance of people who lost their lives during attempt to catch wood and trees brought by floodwater.

Damages in the Study Area

Agriculture sector

Floodplains provide very good locations for agricultural activities (Simonovic, 1999). Unfortunately, the same rivers and streams that attract development periodically overflow their banks causing damages to cultivated land and crops. Agriculture activities are practiced in the floodplain (*sholgara*) of river Panjkora. A number of crops and vegetables are grown in this floodplain. Narrow irrigation channels and water courses are constructed by the people of the area. In the recent flood events, water has inundated almost the whole cultivated land all along the banks of the river (fig. 2). Most part of the cultivated floodplain has been washed away completely, while sediments have been deposited on the remaining narrow tracks (fig. 3). In the

selected union councils, a total of 75,500 kannals irrigated land (*sholgara*), and 693 kannals rain-fed (*lalma*) lands have completely been washed away, costing about 15030.2 million rupees (table no1). The people of the study area had constructed some embankments and retaining walls for the protection of agriculture land. However, due to small landholding per household and low production of the cultivated land, the protective measures deemed insufficiently cost-beneficial (Johnson et al. 2007). These measures were neither enough nor able to survive in such devastating floods and have completely been washed away.

Table 1: Damage to cultivated lands and estimated losses

UC	Affected land (kannals)		Total estimated loss
	Sholgara	*Lalma*	(Rs. million)
Shalfalam	1173	0	586
Khall	2484	0	1987.2
Rabat	4227	243	1869
Munjahai	3701	0	2456
Koto	6210	13	4978
Balambat	1130	0	2249.6
Timergara	2375	437	904
Total	**75500**	**693**	**15030.2**

Source: DOR Lower Dir

Fig. 2: Flood water flowing over cultivated land
Photograph taken on 29th of July, 2010

Table 2: Damage to crops and estimated losses

UC	Total volume of crops damaged (tonnes)	Paddy (tonnes)	Maize (tonnes)	Total estimated loss (Rs. million)
Shalfalam	197.9	173.5	24.4	2.04
Khall	549.1	258.4	290.7	16.5
Rabat	172.5	120.5	52	10.2
Munjahai	616.3	600	16.3	17
Koto	1245.2	1242	3.2	97.67
Balambat	592.7	431.2	161.5	16.3
Timergara	226	226	-	33.5
Total	**3599.7**	**3051.6**	**548.1**	**97.67**

SOURCE: DOR Dir lower and field survey

Besides agriculture land, the flood destroyed a huge volume of standing crops as well (Fig. 5). A total of 3599.7 tons of crops were washed away with a total estimated loss of 97.67 million rupees. Paddy crops suffered most serious damages to the tune of 3051.6 tons (Table 2.)

Fig. 3 Flow of floodwater over standing crops (paddies)
Photograph taken on 29th of July, 2010

Damage to orchards and trees

The people of the area use to cultivate trees on the banks of the river and on the sides of the fields, along with cultivation of crops and vegetables. Mostly poplar trees are grown for fuel and construction purposes, while in some areas these trees are grown all over large pieces of cultivated land for commercial purpose. Similarly fruit orchards particularly orange orchards are widely found in the study area. The orange of Rabat, Khall and Koto areas are very popular. Almost all those fruit orchards and trees in the floodplain have completely been flushed by the recent floods (fig. 4). A total of 1262 kannals orchards and 2280 trees have been damaged in the study area with a total estimated loss of 94.55 million rupees (table no 3).

Fig. 4: Damage to Orchards and trees
Photograph taken on 29th of July, 2010

Table 3: Damage to fruit orchards and other trees in the study area

UC	Fruit orchards (kannals)	Trees (number)	Estimated loss (Rs. million)
Shalfalam	0	300	0.3
Khall	29	460	4.1
Rabat	23	220	2.5
Munjahai	569	700	86.05
Koto	0	150	0.15
Balambat	10	200	1.2
Timergara	0	250	0.25
Total	**1262**	**2280**	**94.55**

Source: DOR Dir lower and field survey

Damage to human lives and settlements

As already mentioned people interact with floodplain for agriculture practices, while the residential settlements are away from the banks of river. Therefore fewer damages have occurred to residential houses and less number of human casualties is reported. However in some areas, there are dwelling units constructed in vulnerable areas, most of which have been damaged by the flood. In terms of human casualties and houses destruction, UC Khall is the most seriously affected union council in the study area, where 14 houses are completely destroyed while 9 are partially damaged (table 4), whereas a total of 16 vehicles have also been damaged by floods among which 6 were in UC Khall (Table 4).

Table 4: Damage to human settlements and vehicles in the study area

UC	Damaged Houses (number)		Estimated loss	Vehicles damaged (number)
	Partially	Fully	(Rs. Million)	
Shalfalam	0	0	0	0
Khall	9	14	19	6
Rabat	0	0	0	0
Munjahai	0	0	0	0
Koto	0	0	0	0
Balambat	6	3	4.8	3
Timergara	7	12	16	7
Total	**22**	**29**	**39.8**	**16**

Source: DOR Dir lower and field survey

Table 5: Human casualties in the study area

UC	Death toll	Injuries
Shalfalam	0	0
Khall	4	7
Rabat	0	3
Munjahai	0	0
Koto	0	0
Balambat	1	9
Timergara	1	11
Total	**6**	**30**

Source: DOR Dir lower

A total of 6 life losses and 30 injuries are reported from the study area (table 5). Most of human casualties have occurred in UC Khall, where four persons of a single family were drowned by the flood (table 5). These people lost their lives when they were trying to catch the trees and wood slippers brought by floodwater (Fig 4 above).

Damages to bridges and roads

The recent floods washed away all the suspension bridges in district lower and upper Dir with a number of RCC bridges as well. Flood water rose very high and drowned the bridges either completely or washed away the approaches and parts of some RCC bridges. A total of 9 suspension bridges and 3 RCC bridges were destroyed in the study area (table 6). According to C&W department this was a loss of almost Rs. 257 million. The RCC Bridge in UC Khall, known as Japani *Pul* remained standing, even water was flowing over it for a long time, but the approaching roads to both the ends of the bridge were destroyed. A large population living in the villages to the right bank of river Panjkora depends upon Khall Bazaar for livelihood commodities. As a result of the destruction of all connecting bridges, the people of these villages were not having access to the bazaar for almost four weeks. After the decline of floodwater, the people themselves connected the Japani Bridge to the road through filling the eroded depression and opened it for pedestrians and later on the approaches were reconstructed by the people and opened for traffic. Now a day all the villages to the right bank of the river depend on this bridge for transportation as all other suspension bridges are destroyed. At many points, chair lifts are used to cross the river (fig 5). Some of these lifts are run through generators or vehicle engines while some through handles.

Fig. 5: Chair lift, an alternative means for crossing the river
Photograph taken in December, 2010

Table 6: Damages to bridges, roads and estimated losses of these damages

UC name	Type of bridge		Nature of damage		Est. Loss	Roads	Est. Loss
	Suspension	RCC	Full	Partial	Rs Million	(km)	Rs Million
Shalfalam	2	0	2	0	30	2	1
Khall	3	1	3	1	60	32	4
Rabat	1	0	1	0	15	0	0
Munjahai	1	0	0	0	15	0	0
Koto	1	0	1	0	2	0	0
Balambat	0	2	2	0	120	8	1
Timergara	1	0	1	0	15	21	8
Total	**9**	**3**	**10**	**1**	**257**	**63**	**14**

Source: C&W, DRO, Dir lower and field survey

Flood water also washed away a total of 63 km roads in the study area causing an estimated loss of Rs. 14 million (Table 6), disrupting transport for quite a long time.

Damage to commercial land and markets

Located close to the riverbanks in both the districts, four markets were completely washed away while others were partially damaged. A total of 287 shops were affected in the study area with 222 completely destroyed causing a total estimated loss of 226.5 million rupees (Table 7). Khall is the most severely affected UC in terms of market destruction, where 221 shops have been damaged costing 166.3 million rupees. For example, the main market in UC Khall, lying on each side of the river has been severely affected, the right bank market completely washed away while the left-bank one has been damaged up to 60 percent (Fig 6). A total of 26 kanals commercial land has also been destroyed; costing Rs. 35.5 million (Table 7).

Fig. 6 Shops destroyed be the recent flood
Photograph taken in December, 2010

Table 7 Damage to shops and commercial lands in the study area

Name of UC	Damaged shops	Nature of damage		Estimated loss	Commercial land damaged	Estimated loss
	Total number	Partial	Full	RS. Million	(kanals)	RS. Million
Shalfalam	0	0	0	0	2	2.2
Khall	221	51	170	166.3	5	5.1
Rabat	0	0	0	0	0	0
Munjahai	0	0	0	0	0	0
Koto	0	0	0	0	0	0
Balambat	39	12	27	31.2	3	4.2
Timergara	27	2	25	29	16	24
Total	**287**	**65**	**222**	**226.5**	**26**	**35.5**

Source: DRO Dir lower and field survey

The Aftermath

The study area is a part of district lower Dir. Dir is connected to the rest of the country through Chikdara Bridge. This bridge was destroyed by the recent floods and the district was disconnected from the lower areas. As a result the supply of livelihood items and transportation was suspended resulting into food shortage and price crises. An alternative way through Bajauar Agency was to be used for transportation, which was very long and in bad conditions. The food commodities brought through this way were not enough for the population of the area and due to long mileage and fuel shortage the prices of these commodities increased by four and five times.

In the same way, the villages were disconnected from the markets and main roads due to the destruction of transportation lines and bridges all over the study area. On one hand, the access to market was very difficult, and on the other hand, the shortage of food items, high prices and the transportation of these items to the villages was another problem. In most areas the people worked on community basis to restore transportation lines and establish alternative means e.g. chair lifts, for crossing over the river to overcome the problem at their own.

The eroded lands are now under the process of reconstruction. The people are again converting the flooded areas into agriculture land by filling the eroded areas and removing the deposited load from the cultivated land. During the process of reconstruction, a number of conflicts are arising among the people who claim shares in these flooded areas. Re-demarcation of fields' and property's boundaries is a difficult and conflictive process. Some people claim larger shares than they were having before the flood. As land settlement is not established in Dir district, therefore there is no record of land and property; hence the possession of larger area by one person engulfs the land of another person, resulting into conflicts and suspension of the reconstruction process.

Fig. 7: Reconstruction of damaged cultivated lands
Photograph taken in December, 2010

Fig. 8: Temporary wooden bridges constructed by the community
Photograph taken in December, 2010

Conclusion

The floodplain all along the banks of river Panjkora is extensively used for growing crops, trees, orchards and vegetables; therefore, agriculture sector has faced most serious damages as compared to other property. The destruction of cultivated land and standing crops, particularly paddies, is a great loss to the study area as many people were engaged in agriculture activities and a large number of families depended upon the crops grown in these lands. Reclamation and reconstruction of these flooded lands is a difficult, time consuming and expensive process. Similarly, due to the erosion of fertile surface soil and destruction of narrow water courses which were supplying water for irrigation, production per acre will be much lower than before for many years to come.

The main road to Dir runs close along the river and hence the markets are also located along the road close to the river. This factor increases the vulnerability of commercial centres to flood risk. Large number of shops full of sale items and stocks were drowned by water in the recent flood event.

A number of suspension bridges (formed of wood) and RCC bridges were destroyed resulting into the disconnection of many villages from markets and the main road. No doubt, these floods were caused by nature but the damages were mainly due to anthropogenic factors, like mismanagement of the floodplain, insufficient protective measures, unawareness of people and impoverishment in technical and financial resources. The existing political, economic and physical constraints in a community determine one's vulnerability to floods and other hazards. Lack of structural measurements and weakness of the existing structures increased the intensity of damages caused by the floods.

Certain structural and non-structural measures can reduce the intensity of damages to a much greater extent. Involvement of local people and community in awareness raising tasks about floodplain management, flood risk and interruption in river channel may have promising results in flood risk reduction. However, the joint efforts of the government and the local line agencies are necessary in flood prevention and disaster mitigation. The community, therefore, should have some monitoring groups that should push the concerned officials to undertake their institutional duties and responsibilities. Local volunteer emergency rescue teams are helpful in reducing human casualties. Similarly, the line agencies should pinpoint the most vulnerable flooded sites and settlements, and the construction of dwellings or commercial units should be prohibited in those vulnerable areas.

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