Causes, Effects and Remedies: A Case Study of Rural Flooding in District Charsadda, Pakistan

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Abstract

The paper deals with flood problems caused by Hissara drain, district Charsadda which is a typical example of rural flooding. The main purpose of this study is to evaluate effects and remedies for flash floods in District Charsadda and suggest recommendations for overcoming the problem. The study area is rural. Hence agriculture land-use is dominant in the area. There are two spells of rainy season in an year in the study area. The winter rainfall occurring due to western disturbances shows a high record during the months of March and April. The highest summer rainfall is in the month of August. The average winter rainfall is higher than that of summer rainfall. The study area faces the problem of flash floods. Heavy rainfalls and tortuous course of the drain are the major natural causes of flood whereas encroachment of drain boundaries, construction of weir structures and bridges on the drain are the major flood intensifying factors. Flood reduction programmes are poor in the area. Floods are the potential hazard of the area. They seriously affect the agriculture sector and physical infrastructure in the area. Flood hazard hinders the socio-economic development of the study area. Flood losses are mainly due to uncontrolled land-use. If land-use is controlled, not only would flood losses be minimised but flood intensity would also be reduced to a greater extent. The paper consists of nine sections. After a brief introduction of the study section two gives an introduction of the study area. Section three states research methodology. Section four describes flash floods situation whereas section five highlights causes of flash floods in the study area. Section six deals with impacts of flash floods and section seven evaluates flood hazard reduction measures in the study area. Section eight gives findings of the study whereas section nine suggests recommendations for mitigation of flood disasters in the study area.

Keywords: Rural Flooding, Disasters Management, Charsadda

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Introduction

This study attempts to assess the phenomenon of rural flooding in the Hissara Drain, Charsadda. In the study area flash floods during summer season is a recurrent environmental hazard. Consequently, it adversely affects life and property of the people of the area.

Today, there is great pressure on land particularly on agricultural land, as a result of the rapid expansion in the built up area. Due to this pressure even the active floodplains are occupied for dwelling purposes. Consequently, they are vulnerable to flood hazard. It is therefore, the need of the hour to safeguard land as well as settlements and infrastructure from flooding.

A number of rivers and drains flow through Charsadda district that often experience floods during rainy season and in effect cause tremendous losses. Charsadda district is characteristically the most thickly populated and fertile agricultural heart of Peshawar vale. The present study is an attempt to highlight the causes and damages of the floods as well as to evaluate flood protection measures in the area. This study mainly focuses on Hissara Drain, with the manageable catchment area. The drain flows from north to south in the eastern extremities of District Charsadda (see the Map).

Hissara Drain often experiences flash floods during summer season and in effect causes a lot of damages. The recurrence of floods is not at regular intervals. However, history of floods from Hissara drain reveals that floods occur roughly after each 3 to 4years. The study area is an elongated tract stretching along both sides of the Hissara Drain. Out of sixteen villages along Hissara Drain, four sample villages were selected for detailed study.

Environmental Set of the Study Area

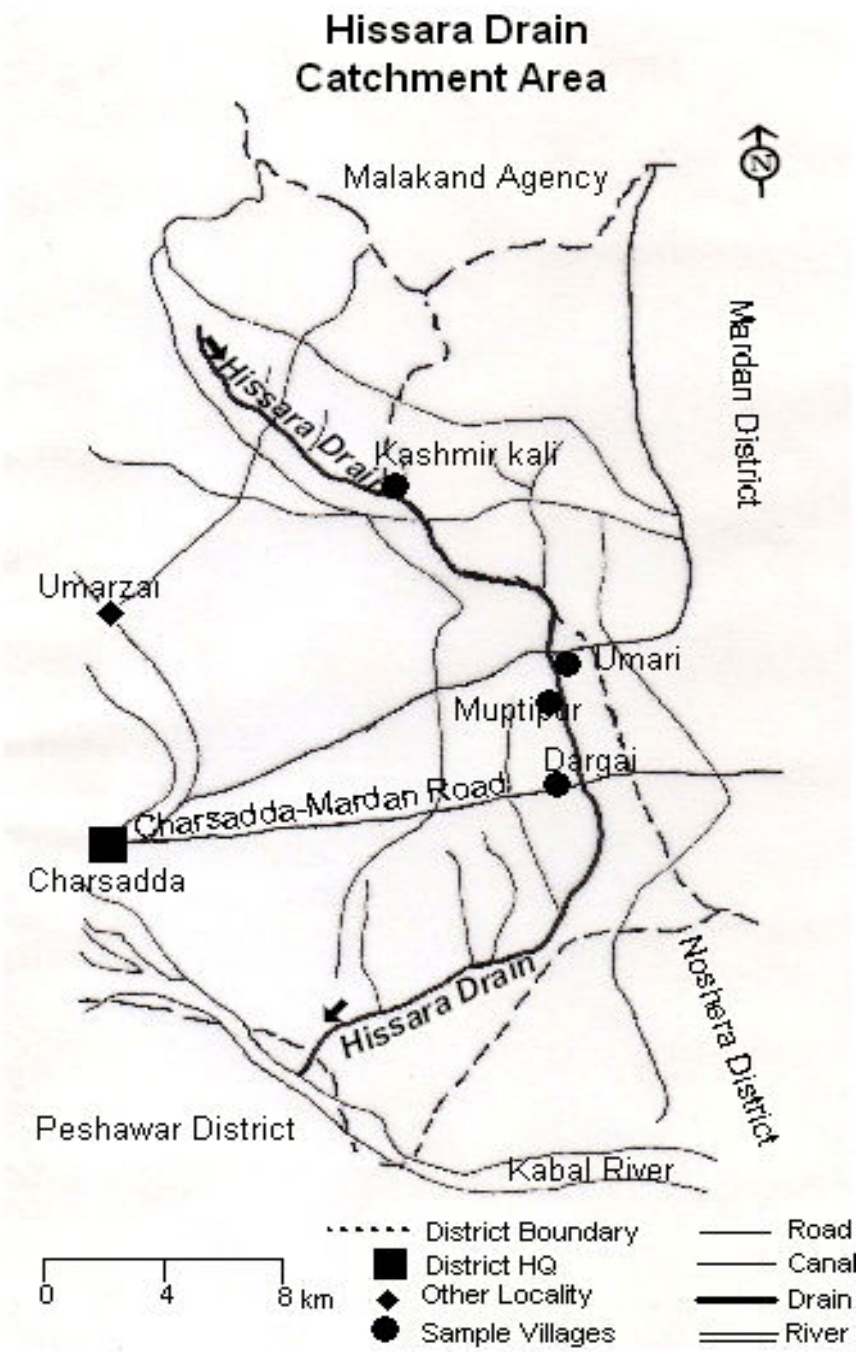
Charsadda district lies in the north-western part of Peshawar Vale. The Kabul River enters the district of Charsadda from the west. It flows along the southern boundary of the district and crosses it in the extreme south - eastern corner. The Swat River is the important tributary of the Kabul River. It enters the district near Abazai village and flows to Kabul in a south-easterly direction till it joins Kabul River.

Topography of district Charsadda comprises of a surrounding belt of high lying land which traverses down from the foot hills, and the central plains namely “Doaba” and “Hashtnagar” all under irrigation and richly cultivated. The plain area of the district includes: Doaba plains lying between Swat and Kabul rivers, Hashtnagar, in the central and south-eastern parts, Mohmand and Muhammad Zai plains in the north and north-east. The riverine area lies close to the river Swat and Kabul. The soil of district Charsadda is very fertile.

The head of Hissara Drain is in the Muza Shodag between the Amirabad Distributory and Baribandan Distributry of Upper Swat Canal System which is a plain area. The drain is narrow and shallow at its head whereas it gets wide and deep towards its tail. The drain plummets into River Kabul near Tulandai. Designed bed level at the tail is 937 ft. whereas it is approximately 1200 ft. at the head of the drain. The drain flows from north to south in the eastern portion of Charsadda district (see the Map). The catchment area of the drain comprises of nearly plain area. The catchment area as well as plains of the drain is very fertile and irrigated by Upper Swat Canal System and Lower Swat Canal System. Nearly all types of vegetation i.e. herbs, shrubs and trees exist but the agriculture practice is dominant in the area, hence agricultural crops and trees are the common vegetation in the area.

The climate of Charsadda District is of continental type. It can be divided into three periods, viz. winter season, from December to April; summer season from May to September out of which July to September is the monsoon period, whereas May-June and October-November is the transitional period. June is extremely hot and dry when the temperature rises to over $40^{o}C$. The months of July and August are hot and humid. The water vapour contents in the atmosphere show its maximum record during the month of August. The humidity record shows conformity with that of precipitation. The spring comes somewhere around the middle of March, which is the most pleasant season of the year (GOP, 1999).

There are two spells of rainy season in a year. The winter rainfall, due to western disturbances, shows a high record during the months of March and April. The highest summer rainfall is in the month of August. The average winter rainfall is higher than that of summer rainfall.


Hissara Drain
Catchment Area
Malakand Agency
N
Mardan District
Hissara Drain
Kashmir kali
Umarzai
Umari
Muptipur
Dargai
Charsadda-Mardan Road
Charsadda
Hissara Drain
Nosheara District
Peshawar District
Kabal River
District Boundary
District HQ
Other Locality
Sample Villages
Road
Canal
Drain
River
0
4
8 km

Methodology

To achieve the objectives of the study both primary and secondary sources were used.

Primary data were collected directly from the study area. The study area consists of about sixteen villages. For detailed and intensive study, four villages were selected as sample through random means. The selected sample villages are namely Kashmir Kalli, Umari, Muftipur and Dargai. A standard questionnaire was designed in order to collect baseline information regarding the flash floods in Hissara drain. The data were collected through interview survey procedure. In the study area about 250 questionnaires were filled by the respondents which included people from variety of professions such as farmers, educationists, labourers and businessmen etc. Secondary data was collected from various line agencies, maps, topographic sheets, research reports; data based searches, research papers and journals that provided information regarding flash floods particularly in the study area.

Both primary and secondary data were analysed by applying various cartographic as well as statistical techniques. Finally, the data was presented in the form of graphs, tables and description/ analysis.

Flash Floods in the Study Area

In recent years, flood hazard imposed serious problem to the socio-economic and physical environment. It is one of the most dramatic, dangerous and costly hazard in the physical environment that sweeps away the patent work of many years, carrying with it not only human lives but many human hopes and aspirations (UNDRO, 1991). In 1996 heavy flood came in local nallahs and drains which caused severe damages to the irrigation infrastructures, drains, settlements, land and crops in the districts of Mardan and Charsadda. Of these the flood in Hissara drain was much severe. The floodwater outflanked at different places and caused heavy damages. Similarly, flood of August, 1999 in Hissara drain caused damages to the settlements, weir structures, service roads and standing crops of the area. The heavy flash flood badly affected Hissara village, Shaheed Colony, Kashmir Killi, Shakh No. 6 and Mandani in Tangi Sub-Division, and Behlola, Topo Killi, Umari Killi, Mufti-Pur, Dargai and weir structure at RD: 78605 in Charsadda Sub-Division.

In the study area where agricultural occupancy is dominant, damages involve inundation of land accompanied by erosion and/or loss of crops. In direct category, damage to properties such as houses, roads, bridges, etc. and agriculture sector make the highest proportion.

The study area is traditionally dominated by agricultural activities. Flash flood is one of the most serious hazards for the Kharif harvest in the

area. The vast load of rushing flood water affects standing crops and damages them. If the flow of flood is strong it may uproot standing crops or make it too slanting to have normal life and growth. By damaging human habitations, crops, livestock and fields it affects agricultural operations indirectly. Hence, floods cause hindrance to the development of this area.

Causes of Flash Floods in the Study Area

In the study area flash floods occur when the water discharge exceeds the channel capacity. The low and heavy discharges result from an unfavourable combination of meteorological and physical condition of the drainage basin of Hissara drain. Rainfall often occurs in heavy downpours in the catchment's area of Hissara drain and shallow drains fail to accommodate the large volume of water. Consequently it results in flash floods within hours. The area has some typical conditions, meanders and unconsolidated materials which aggravate the flooding situations. All these factors of flooding in the area may be grouped into two main categories.

Climatological causes of Flash Floods in the study Area

Causes differ from flood to flood, keeping in view the nature and type of various floods. Hissara drain being local and seasonal drain experiences severe flash floods. The main source of water is monsoon rainfall. The major flow is in July and August, when heavy torrential rain falls occur during a short period of time. Due to heavy rainfall (5.5$^{//}$) in the chatchment area of Hissara and other local drains between the night 14-15/8/1996 heavy floods came in local drains. Of these, flood in Hissara drain was much severe. Similarly, due to unprecedented rain fall in the catchment area of Hissara drain, on the night between 9th and 10th of August 1999, the low lying areas on both sides of Hissara drain came under severe flood. Meanders greatly retarded the velocity of water. Hence, when there is heavy down pour in the catchment area of Hissara drain then there is heavy water discharge and the drain cannot accommodate it and ultimately water overflows the natural channel.

Table-1: Causes of Floods in the Study Area

Flood causes	No. of Respondents			
	Kashmir Killi	Umari	Mufti-pur	Dargai
Torrential rain falls	40	43	38	37
Tortuous course of drains	3	-	-	-
Both S. No. 1 & 2	10	-	-	-
Deforestation in catchment area	-	2	3	1
Bridges/structures on drain	5	15	19	22
Total	60	60	60	60

Sources: Field Survey, 2000

Anthropogenic Causes of Flash Floods in the Study Area

Anthropogenic causes are actually flood-intensifying factors which are responsible to exacerbate damages. There are several human factors, which contribute to the stream propensity for flood in the area. Firstly, intensive agriculture in the watershed of Hissara drain has resulted in great sediment load in the drain, which has got deposited at the bed of the drain and made the drain shallower. Thus, water carrying capacity of the drain has decreased and frequent overflow has been observed. Secondly, population pressure on land resources has resulted in encroachment towards the course of the drain. As a result, the waterway has become restricted and narrow with passage of time and the drain can not pass full discharge of the rural catchment area. Thirdly, construction of narrow bridges across the drain at various sites as also obstructed the easy flow of water.

The agricultural lands of Mufti-Pur and Manga etc. are irrigated from the Hissara drain at RD: 78605. During remodeling of Lower Swat Canal System, a weir structure, 24 ft-wide, was constructed by "Mardan SCARP Project" for feeding the 'Hissara Branch Channel' at RD: 78605 on Hissara drain. The weir structure at this RD: was designed to pass 1500 cusecs of floodwater. During the flood of 1999, more than 3500 cusecs of floodwater was observed. Due to insufficient waterway, the heavy floodwater was obstructed by the weir structure and out flanked both the banks causing heavy damages to banks, weir structure, houses and other property. The weir on Hissara drain at RD: 78605 had also been damaged by the flood of 1996 and had caused severe damages to Kashmir Killi (a section of Mufti-Pur). Similarly the bridge at RD: 77500 had also obstructed the floodwater. Due to this obstruction the floodwater over-flanked both the banks and caused damages to Mardan-Charsadda service road, village abadi and standing crops. Similarly, Kashmir Killi, which is located at the crossing of Lower Swat Canal on Hissara drain, was hit by floods of 1996 and 1999. The flood of 1999 washed away 161 houses and caused heavy financial loss to Kashmir Killi.

During field survey it was noticed that the drain's width close to Kashmir Killi was insufficient, having no protection against spilling. The problem has been further aggravated by a narrow bridge constructed in the past on a link road, which also obstructs the easy flow of floodwater. It was also observed that the course of the drain is very tortuous at Kashmir Killi and the floodwater over flanks the banks. It has also been noticed that bridges on Hissara drain throughout its length have narrow openings, which obstruct floodwater and cause flood in adjacent localities. During field survey, it was observed that the drain was not able to perform its function properly.

Impacts of Floods in the Study Area

Flash floods in Hisara drain have adverse effects both on living environment as well as physical infrastructure of the study area.

Impacts on Living Environment

Human Casualties: Human casualties have not been reported during flood of 1996 through out the study area. One person drowned in floodwater and died in Mufti-Pur village during flood of 1999 (table-2). Hence human casualties are few in the area.

Table–2: Flood Damages and compensation in the Study Villages for the Years 1996 and 1999

Name of Village	Loss of human lives		Fully Collapsed Houses		Partially Damaged House		Cattle Perished	Crop Affected Area (Acres)	Cost of Damages (Rs)	Compensation (Rs)
	Dead	Injured	Pacca	Kacha	Pacca	Kacha				
Year 1996										
Kashmir Killi (Akbar Abad)	-	-	-	10	-	14	-	30	8,00,000	50,000
Umari	-	-	-	8	-	22	-	40	6,60,000	35,000
Mufti-Pur	-	-	-	13	1	14	1	308	18,60,000	65,000
Dargai	-	-	1	51	13	87	5	120	32,00,000	2,62,000
Total	0	0	1	82	14	137	6	498	65,20,000	4,12,000
Year 1999										
Kashmir Killi (Akbar Abad)	-	-	-	161	-	11	8	40	51,00,000	7,90,000
Umari	-	-	-	4	-	2s	-	60	4,30,000	25,000
Mufti-Pur	01	-	-	-	-	12	-	211	11,50,000	30,000
Dargai	-	-	-	2	4	66	2	90	8.90.000	7,50,000
Total	01	0	0	167	4	91	10	401	75,70,000	9,95,000

Source: Revenue Department District Charsadda and Mardan and Field Survey 2000.

Livestock Losses: Being an agricultural based economy, people usually keep milch cattle like cows, buffaloes, sheep and goats etc. to meet the need of milk (GOP 1999). During the flood of 1996, a total of 6 cattle losses were reported in the area whereas livestock casualties were 10 during the flood of 1999. Hence, 16 cattle lost their lives during the floods of 1996 and 1999, (table-2).

Poultry Loss: Being a rural area, people keep poultry on subsistence basis. Poultry farming is also practised on commercial basis. Like other property losses poultry also suffered in flood condition. During the flood of 1996, the area under study suffered a lot and in effect 10,538 poultry heads were lost as compared to 1,026 in 1999. During the flood of 1996 a poultry farm having 10,000 poultry heads in Dargai village were completely washed away. Therefore, approximately 95% poultry loss was reported only in Dargai, (table-3).

Table– 3: Poultry Loss during Floods 1996 and 1999

Name of Village	Number of Poultry Lost During Flood		Total Number of Poultry	Cost of Damages (Rs.)
	1996	1999		
Kashmir Killi	90	830	920	27,600
Umari	84	22	106	3,180
Mufti-Pur	93	24	117	3,510
Dargai	10,281	150	10,431	3,12,930
Total	10,538	1,026	11,574	3,46,920

Source: Field Survey, 2000.

Impact on Physical Infrastructure

Physical infrastructure such as buildings, roads, bridges etc. also suffered during floods.

Damages to Houses: In the study area most of the houses are made of mud. During the flood of 1996, one Pucca and 82 Kacha houses completely collapsed in the area. Similarly, 13 Pucca and 87 Kacha houses were partially damaged during the same flood. During the flood of 1996, more than 60 percent damages to build up property were reported in Dargai village, (table-5-1). During the flood of 1999, 167 Kacha houses were demolished, whereas 4 Pucca and 91 Kacha houses were partially damaged in the study area. This time Kashmir Killi suffered more than 65 percent of the total losses to built-up property in the area, (table- 2).

Damages to Shops: In each village there are few shops of small-scale, which provide some basic services to the village people. During floods like houses, shops also suffer damages in the form of commodities loss or damages to building/structure. During the floods of 1996 and 1999, 25 shops were completely and/or partially damaged in the area. The total estimated cost of damages among the sample villages was around Rs. 315,000. Dargai was seriously disrupted and reported 50% of the total losses, (table - 4).

Table– 4: Damages to Shops during Floods 1996 & 1999

Name of Village	*Shops damaged During Flood 1996*		*Shops Damaged During Flood 1999*		*Total No.*	*Cost of Damages*
	Completely	*Partially*	*Completely*	*Partially*		
Kashmir Killi	0	2	2	1	5	75,000
Umari	0	1	0	1	2	10,000
Mufti-Pur	2	0	0	3	5	65,000
Dargai	5	2	0	6	13	1,65,000
Total	7	5	2	11	25	3,15,000

Source: Field Survey, 2000.

Damages to Mosques: Floods also damaged partially or completely the buildings of mosques. During floods of 1996 and 1999 two mosques in Kashmir Killi, one in Umari, three in Mufti Pur and eight mosques in Dargai villages were either completely or partially damaged. The fully collapsed mosques were mostly Kacha and could not withstand the rushing water of floods. The total cost of damages in respect to mosques was 170,000 rupees @ 5000 rupees for partially damaged and 25000 for fully damaged mosques (table- 5).

Table– 5: Damages to Mosques During Floods 1996, 1999

Name of Village	Damages to Mosques			Cost of Damages (Rs.)
	Fully	Partially	Total	
Kashmir Killi	1	1	2	30,000
Umari	-	1	1	5,000
Mufti-Pur	1	2	3	35,000
Dargai	3	5	8	10,0000
Total	5	9	14	170,000

Source: Field Survey, 2000.

Damages to Bridges: Bridges on water channels also incur damages during flood conditions. Characteristically a rural and agricultural area most of the bridges are Kacha which are constructed across irrigation water channels or seasonal water channels. These bridges are very important because they are used to link various market roads. Kacha bridges cannot withstand the rushing floodwater due to insufficient waterway. During floods of 1996 and 1999, 26 bridges were either completely washed away or partially damaged through out the sample area. The total cost of damage was 25,500 rupees @ 1000 rupees for completely damaged Kacha bridge, 1500 rupees for partially damaged Pacca bridge, and 500 rupees for partially damaged Kacha bridge according to government rates (table-6). Most of the washed away bridges were Kacha. Pacca bridges suffered only partial damages.

Table– 6: Damages to Bridges during Floods 1996, 1999

Name of Village	Fully Collapsed Bridge		Partially Damaged Bridge		Total No. of Damaged Bridges	Cost of Damages (Rs)
	Pacca	Kacha	Pacca	Kacha		
Kashmir Killi	-	1	2	2	5	5,000
Umari	-	1	1	2	4	35,00
Mufti-Pur	-	4	1	3	8	7,000
Dargai	-	5	3	1	9	10,000
Total	0	11	7	8	26	25,500

Source: Field Survey, 2000.

Impact on Agriculture

The economy of the study area is agrarian and is dominated by agricultural activities. Floods have affected the agricultural land of the area from different aspects. Flood either eroded the top fertile soil or damaged the standing crops. Acreage of Kharif crop is greater than Rabi crop in the area. Flood season coincides with Kharif crop in the area and that is the reason only Kharif crop suffered greater loss. Acreage of maize crop is about 50 percent in Kharif crop. Maize crop is most susceptible to rushing as well as stagnant floodwater and that is another factor of great loss to Kharif crop. During the flood of 1996, almost 498 acres of cropland was affected in the sample study area. Similarly, 401 acres of Kharif crop was badly affected in the area during the flood of 1999. In respect to affected cropland, Mufti Pur leads with 30 to 43 percent followed by Dargai with 12 to 15 percent (table- 7). Kashmir Killi is least affected in terms of crop damages, because the drain is passing through a small portion of the agriculture land of Kashmir Killi.

Table– 7: Crop Affected Area during Flood 1996 and 1999

Flood 1996							
Name of Village	*Total Area (Acres)*	*Kharif Crop*		*Rabi Crop*		*Total Affected Area (Acres)*	*Cost of Damages (Rs)*
		Area (Acres)	%age	Area (Acres)	%age		
Kashmir Killi	1553	30	1.9	-	-	30	1,50,000
Umari	805	40	5.0	-	-	40	2,00,000
Mufti-Pur	711	308	43.3	-	-	308	15,40,000
Dargai	779	120	15.4	-	-	120	6,00,000
Total	3848	498	12.9	-	-	498	24,90,000
Flood 1999							
Kashmir Killi	1553	40	2.6	-	-	40	2,00,000
Umari	805	60	7.5	-	-	60	3,00,000
Mufti-Pur	711	211	29.7	-	-	211	10,55 ,000
Dargai	779	90	11.6	-	-	90	4,50,000
Total	3848	401	10.4	-	-	401	20,05,000

Source: Field Survey, 2000.

Impact on Overall Economy

In the study area where agricultural occupancy is dominant, damages involve inundation of land accompanied by erosion and/or loss of crops. During floods of 1996 and 1999 about 900 acres of cropland was affected and the total cost of damages was approximately 5 million rupees (table- 7). Loss of 5 million rupees to a poor agrarian economy is

a huge loss and poor farmers can not afford even a small loss. Damages to built-up property such as houses, mosques, shops, roads and bridges etc. also make the highest proportion. The total cost of damages in the physical infrastructure sector is 2.2 million rupees. Again a loss of 2.2 million rupees to the physical infrastructure sector of a poor economy is a big loss and affects the poor economy badly. Hence, flood hazard is a hurdle in the way of economic development of the area.

Flood Hazard Reduction Measures in the Study Area

The term flood control does not mean the complete elimination of floods. At best, it can provide only a certain amount of protection against the overflow of water. If the problem of flood is viewed as a problem of flood control we can never win. On the other hand, if the problem is seen as one of adopting any measures which will reduce damage, whether we control floods or not, there is the possibility open to us that eventually damages will be reduced (Alexander, 1993). During field survey both administrative as well as engineering measures against flood hazard were observed in the area and were found as following:

Structural Measures

The structural measures against flooding include construction of retention reservoirs and embankments for towns and village protection and drainage schemes (Khan, and Atta-ur-Rehaman, 2005). During field survey it was observed that various measures in combination are adopted to protect flood prone areas from floods. But during field survey it was found that government had not paid due attention to flood problems in this area. In 1994, section RD: 00-123000 of Hissara drain was re-modeled by "Mardan SCARP Project" to control the problem of water logging and flooding in the area. The drain was channelized and widened. During re-modeling few, weir structures and a number of bridges were constructed on the drain. Similarly during re-modeling of 'Lower Swat Canal System' a weir structure 24 ft. wide was constructed on Hissara drain at RD: 78605 for feeding 'Hissara Branch Channel'. Hence re-modeling and channelization of the drain controlled water-logging to a greater extent and flood problem to some extent, but construction of weirs and bridges on the drain has further intensified flood problem in the area.

Tree plantation on banks of the drain and deposition of sediments at the bed of the drain in the portion north of Lower Swat Canal has resulted in water-logging and flood problems. National Drainage Programme (NDP) conducted a survey in the area to control water-logging and flood problems in the area and resultantly

recommended desiltation of the drain so as to get the drain deep and wide and enhance its discharge capacity but it is still awaited.

Non-Structural Measures

Administrative measures aim at reducing damage potentialities by timely evacuation of people and movable property liable to damage and also to manage human activities in flood prone areas. These include flood forecasting, flood warning and flood plain zoning, etc.

Flood Forecasting and Warning: In many parts of the world where damaging floods occur, forecasts are made for determining magnitude of impending storms. Forecasts may simply be a warning of danger (Bolt et al., 1995). The aim of flood forecasting and warning services is to give timely warning to the concerned people, line agencies and organizations for flood fighting and evacuating people from flood prone area (Atta-ur-Rahman, 2003). Hissara drain experiences flash floods. Warming for flash floods associated with heavy thunderstorms are often very uncertain. Flash floods normally occur within 6 to 8 hours of the beginning of heavy rainfall. This requires rapid localized warning system and immediate response from the administration as well as from the affected community to mitigate the damaging effects. Floods usually occur in the monsoon season in Charsadda. Hence, a high level meeting is held in the month of June before the arrival of the monsoon season in order to frame guidelines for combating floods and natural disasters. At such meetings all line agencies and departments such as revenue department, irrigation department, health department, public health engineering department, education department, etc. are directed to be alert. A flood control room is installed at the District Headquarter to collect and get prior information about floods. But during field survey, it was observed that government agencies did not warn the respective localities about floods in time, hence, upstream localities did not receive any prior flood warning. Down stream people were warned by local people little before flood occurrence (table – 8).

Table– 8: Flood Warning

Name of Village	Flood Warning Agency and Number of Respondents							
	Govt. Agency		N.G.O		Politicians		Local people	
	Yes	No	Yes	No	Yes	No	Yes	No
Kashmir Killi	–	60	–	60	–	60	–	60
Umari	–	60	–	60	–	60	45	15
Muftipur	–	60	–	60	–	60	50	10
Dargai	–	60	–	60	–	60	60	–

Source: Field Survey 2000

Emergency Evacuation: In flood situation people and movable property are required to be shifted to safe places so as to reduce flood damages. Governmental and non-governmental agencies and local people equally participate in the evacuation process. During field survey, it was found that local people to some extent evacuated the troubled people from the flooded area. Most of the people leave the flooded area by themselves. Government agencies could not reach in time to evacuate the people (table- 9).

Table- 9: Evacuation of Flood Affectees

Name of Village	Name of Rescue Agency and Number of Respondents			
	Govt.	N.G.O.	Local People	Themselves
Kashmir Killi	–	–	–	60
Umari	–	–	5	55
Mufti Pur	–	–	14	46
Dargai	–	–	11	49

Source: Field Survey 2000

Rehabilitation of Flood Affectees: After evacuating people from the flooded area, the very next phase is rehabilitation of the flood victims (Khan, 1993). The displaced people require food, shelter and rehabilitation for normal life. Floods displace the people, disrupt their socio-economic activities and damage their movable and immovable properties. They need rehabilitation on emergency basis (Lockyer, 1996). During field survey, it was observed that government, non-government agencies and local people equally participated in rehabilitation process of flood victims. Food, medicine, tents and cash were distributed among the flood affectees to help them in rehabilitation (table-10). It was also observed in the field that people were not satisfied with over all flood protective measures in the area (table- 11).

Table– 10: Relief and Compensation During and after Floods 1996, 1999

Flood Year 1996							
Name of Village	*Relief During Flood*					*Relief After Flood*	
	Tents	*Food*	*Medicine*	*Clothes*	*Any other*	*Cash (Rs.)*	*Any other*
Kashmir Killi	Yes	Yes	Yes	No	No	50,000	No
Umari	Yes	Yes	Yes	No	No	35,000	No
Mufti-Pur	Yes	Yes	Yes	No	No	65,000	No
Dargai	Yes	Yes	Yes	No	No	2,62,000	No
Flood Year 1999							
Kashmir Killi	Yes	Yes	Yes	No	No	7,90,000	1,22,000 (Bricks)
Umari	Yes	Yes	Yes	No	No	25,000	No
Mufti-Pur	No	Yes	Yes	No	No	30,000	No
Dargai	Yes	Yes	Yes	No	No	1,50,000	No

Source: Revenue Department, Distt. Charsadda and Mardan & Field Survey 2000

Table–11: Satisfaction of People from Flood Protective Measures

Response	Number of Respondents			
	Kashmir Killi	Umari	Muftipur	Dargai
Yes	0	3	7	5
No.	60	57	53	55

Source: Field Survey 2000

Flood Plain Regulations and Management: Floodplain regulations and management play a very important role to control and manage the land-use, minimize flood losses and intensity, and reduce danger to life and property when the inevitable in-undations occur (Khan, 1993, Atta-ur-Rahman, 2003). But unfortunately there is lack of floodplain regulation and management in this area, and the area is open for any land-use whether is compatible or not.

The site of Kashmir Killi is not suitable for settlement at all, because it is situated on the low-lying side of Hissara drain and many times subjected to floods of even low magnitude yet people still live there. The site of this village was previously a low price agricultural land. After 1980 low-income people from other places got owner-ship of plots of land there on which they constructed their houses. Actually it is a low-lying site which is the reason why floods during 1996 and 1999 hit this village severely and washed away 161 houses completely. Similarly Kashmiriano Killi (a section of Mufti-Pur) was established just near the weir structure at RD: 78605 which is a risky place and that was the reason why floods of 1995-1996 and 1999 hit this village. If there were flood plain regulations and management in this area, there would have been compatible land-use, and hence there would have been no such heavy flood damages.

Findings

The following are the main findings of the study area:

- The study has revealed that Hissara being a local and seasonal drain experiences flash floods which normally occur within few hours of the beginning of heavy rainfall in the catchment area.
- The major natural causes of flooding in the area are heavy downpours during the monsoon season and tortuous course of the drain.
- Encroachment of channel of the drain, sedimentation at bed, weir structures and bridges constructed on the drain are the major flood its intensifying factors and anthropogenic causes of the several floods in the area.

- Agriculture sector claims the highest proportion of flood losses due to the dominance of agricultural activities in the area.
- Built-up properties particularly houses incurred great damages due to highest proportion of mud houses.
- Human casualties and live stock losses in the area are very few.
- Flood protection measures are not satisfactory in the area. As far as flood warning system is concerned, it is present in the area but not effectively used.
- There is lack of floodplain regulations and management in the area.
- The people who lives in the area need proper flood protection measures

Recommendations

The study area is suffering from flood hazard. In such a situation, the most important task at this stage is to suggest remedial measures to minimise the flood damages. With proper planning and consistent efforts towards implementation, flood damages can be checked and the needs of the area can be satisfied to the best possible extent. The following remedial measures are suggested against rural floods in the study area.

Channelization

The study area characteristically a very fertile agricultural land requires channelization of the drain. Flood intensity and resultant flood damages may be reduced to some extent by allowing easy flow of floodwater in the drain. Meanders of the drain which increase intensity of the flood may be removed through channelisation of the drain so as to check the flood intensity and inundation. Boundaries of the drain may be demarcated and encroachment towards the drain should be prohibited. The course of the channel may be widened and deepened so that floodwater may flow easily. Bridges across the drain that lead to the overflow of floodwater may be designed at the highest level of rural flash floods. Hence, rest of the drain (portion north of Lower Swat Canal System or beyond RD: 123000) which has not been widened during Mardan SCARP Project may be deepened & evidenced.

Village Protection

To reduce losses to villages and most vulnerable agricultural fields, some specific measures should be adopted to give an effective solution to this acute problem. These measures include embankment and raising of village site through land filling.

Embankment

This is generally the most costly and popular method of flood control. Embankments are only suggested for some critical localities such as Muftipur and Dargai village sections, where overflow is most often during flood condition.

Flood Proofing of Buildings

It is not desirable to shift buildings from the flood prone areas as the study area is very densely populated with intensive agricultural activity. Hence, it is recommended that flood proof buildings should be built in order to resist flood water. This strategy is most applicable for Muftipur, Umari and Dargai villages.

Relocation

In case of Kashmir Killi one of the sample villages, relocation is the answer. Kashmir Killi is located on low land at the confluence of two drains. The low land extends inland not more than a quarter of a mile away. Levees and walls are neither technically sound nor economically justified for this locality. Firstly, because the course of the drain is tortuous and secondly because the course of the drain is directed to the settlements and levees and walls can not withstand floodwater due to high flood intensity here.

Hence, Kashmir Killi may be relocated at least a quarter mile inland at a flood free site. Site of razed buildings may be cleared of debris and used as open area or agricultural land.

Flood Plain Regulations, Management and Control

Flood plain regulation seeks the optimum use of flood prone areas while minimising losses to lives and property. If at all these is a situation where this cannot be more economically accomplished then flood hazard reduction cannot be achieved by engineering works for flood control.

Flood losses are mainly due to uncontrolled land-use. If the land-use is controlled, not only will flood losses be minimised but flood intensity will also decrease. In general terms, the purpose of land-use regulation is to maintain an adequate management policy. Land-use regulation should present a strong base for land management and control. Land management is the introduction of improved agricultural practices on fields, which involves the conservation of the soil resource, the mitigation of erosion and the increase of agricultural field. The purpose of control is to implement patterns of land-use which reduce danger to life and property when the inevitable inundation occurs. Land-use control can be employed to adjust existing uses to the recognised risk in areas where there is less drastic change in over-all land-use or physical hazard.

For land-use regulation, proper management and for control of unauthorised land-use in future, it is necessary to apply zoning law in the flood plain.

The aim of flood plain zoning is to demarcate the areas that are liable to be affected by floods of different magnitude and frequencies. This facilitates the organisation of developmental activities in different zones in such a manner that the inconvenience and danger due to floods are minimised. If flood plain zoning is implemented properly, it can be a very useful and effective flood control measure in the area. The flood plain of Hissara drain are closely occupied and settled and pressure on flood plains for settlements as well as agriculture land is increasing rapidly with the passage of time. Hence, in the study area flood plain regulation, management and control are the need of the hour in order to minimise flood damages.

Flood Forecasting and Warning

Forecast about the flood situation may also be an important measure to provide some relief to the concerned population. Flood forecasting takes place from 24 to 48 hours in advance of the actual occurrence of floods, but Hissara drain is a local and seasonal stream that experiences flash flood within few hours after heavy downpour in the up-stream and 3 to 4 hours in the down stream. The gap between down pour and flood occurrence is very narrow and gives time for flood forecasting and timely dissemination of flood forecasting information little lead time. In such a situation flood warning is needed to be very efficient.

Such a flood warning essentially consists of quick communication and dissemination of the news about the approaching floods, its magnitude and consequent damage that are likely to occur to the threatened areas in time so that both the civil authorities as well as people likely to be affected can take necessary precautionary measures. A flood warning centre may be installed up-stream in Hissara drain system so as to warn the down-stream people at least an hour or two before the approaching flood by telephone or loud speaker etc.

Tree Plantation

Dense vegetation plays a very important role in checking runoff as well as soil erosion. Hence farmers of the catchment area of Hissara drain may be advised to grow more and more trees so as to check runoff and provide maximum time lag between rainfall and flood occurrence.

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