Vulnerability and Coping Strategies of Floods in Bangladesh Agriculture

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Abstract

Bangladesh is a disaster prone country. Flood is the most frequent form of disaster that ravage millions of life, thousand acres of crops and ultimately breakdown the economic backbone of the country. Therefore, the paper aims to describe coping strategies usually practiced by the farmers against flood. The data contained in this paper were collected from secondary sources like books, journals and internet etc. Among various coping strategies only the coping strategies of crop, livestock and poultry and fisheries are stated in this paper. 'Storing all types of seed' and 'sale excess livestock and poultry before flood' were mainly practiced in pre -flood period. 'Collect quick growing vegetable seeds' and 'use of hay for cattle feed were mostly practiced during flood period. 'Sowing quick growing leafy vegetables', 'completing vaccination after flood' and 'releasing preciously stored fingerling' were mainly practiced in post flood period. Overall coping strategies practiced by the farmer satisfactorily during flood period while second in post flood period followed by pre-flood period.

Keywords: Flood, Vulnerability and Coping Strategies

Introduction

General background

The natural disaster and environmental degradation arising from the world wide climate change is the most critical and time befitting issue all over the world. A low lying country with more than 230 rivers and waterways, Bangladesh is widely regarded as being one of the most vulnerable countries due to its disaster prone and odd geographic location, socio-eco-environmental condition and over population (Hamid, 2009). Bangladesh is the part of world's most dynamic hydrological system. In fact, the country is a tender landmass framed by three major rivers and a fluid landscape. Bangladesh is frequently hit by different natural disasters such as flood, drought, riverbank erosion, cyclone and storm surge etc. Each of these has impact on the livelihood of major population to a great extent.

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Land of the country may broadly be categorized into (i) hills (12%); (ii) terraces (8%); and (iii) floodplain (80%). Agriculture is the dominant land use in the country covering about 59% of the total land mass. Rivers and other water bodies comprise about 9% of the total land area (GOB, 2008).

The country has an average rainfall of about 2300 mm; the range can be 1500 mm to 5000 mm. Bangladesh has also a unique coast line, conical in shape, which causes a higher sea level during monsoon period. Due to the unique topography, river system and rainfall pattern, flood occurs in Bangladesh, almost every year and devastating ones in every 5 to 10 years interval (GOB, 2008). Bangladesh has always experienced some degree of flooding. According to WHO 4 million people are affected every year due to flood and up to 5.6 million people are physically exposed periodically and 15 coastal districts are cyclone prone (Azad, 2009). Displacement due to flood and drought and erosion along with inadequate facilities/supports during and after major disasters create hardships and life-threatening problems to the population specially the poor, women and children. According to Islam, 2009, when major forms of disasters occur due to flood, river bank erosion, drought, extreme temperature, wind storms, drought and earthquakes, water born diseases and mass internal displacement are inevitable consequence.From1904 to 2007 about 63,923,520 people were affected by natural disasters (EM-DAT: The OFDA/CRED International database Jan: 2007). On an average, 15 percent of land floods each year but in 2004 that figure reached 34 percent and the super cyclone 'Sidr' and the two consecutive floods of 2007 together killed more than 4000 people, 1778507 livestock and damaged 2473637 acres of crops, 1522080 households, 8075 km roads fully or partially (BBS, 2007,a).

The 1988 flood caused over 1650 deaths and damage variously estimated at about US$ 1200 million. The 1998 flood forced over a million people out of their homes, damaged 16,000 km of roads and 4500km. of embankment, and destroyed crops over 5000,000 hectares of land. The July, 2007 flood a total of 46 districts was affected to varying degrees during both flood waves. The flood inundated about 32,000 sq km including the char areas of 6,000 sq km affecting almost 16 million people in around 3 million households (GOB, 2007,a).

Justification of the study

Floods are normal events in the deltaic plains of Bangladesh. It is natural that the disruption caused by flood affected the economic activities and GDP. A country like Bangladesh cannot afford to withstand the burden of such recurring colossal damages and immense suffering of the people for long. Although the lifestyle of the people in Bangladesh is well adopted to flood phenomena, the damages due to inundation, riverbank erosion or breach of river structures, etc. still occur in various regions in every monsoon season. They often have disastrous consequences: major damage to infrastructure, great loss of property, human suffering and impoverishment of the poor. As the majority of the people live in the countryside, their livelihoods are directly or indirectly dependent on the land (BBS, 2003). Therefore, flooding jeopardizes the lives and livelihoods of people. Major losses were incurred in crops, livestock and poultry, fisheries and forestry. The usual flood free area i.e. South-western part of Bangladesh was affected by sudden flash flood in 2000 and caused damage of the earthen houses, households lost their livestock and

poultry and other durable assets. Standing crops like Amon paddy, vegetables, and tree resources were lost. Thereby, the affected people cope with by applying some local strategies based on their previous experiences whenever they faced severe flood. Slowly but steadily they reached self-sufficiency by using coping strategies against various damaging aspects of flood. So, it is important to know the cultural coping strategies followed by the farmers for their survival and resilience.

Objectives of the study

From the above view points, the present study takes an attempt to depict the following objectives:

- To get an overall idea about flood situation of Bangladesh; and
- To describe the coping strategies practiced by the farmers.

Scope and importance of the study

In view of the above objectives, the paper has the following scopes:

- It will sketch an overview of the flood situation of Bangladesh.
- It will illustrate the coping strategies followed by the farmers against flood in Bangladesh.

Limitations of the study

The limitations of the paper are noted below:

- All the data used in the seminar paper was collected from secondary sources.
- The present seminar paper is concerned with only few coping strategies although a lot of coping strategies are practiced by the farmers.

Results and Discussion

In this chapter, the findings of the study and their logical interpretation have been presented according to the objectives of the study in two sections. The first section describes the overview of flood situation in south Asia. The second section describes the farmers' practices of coping strategies against flood.

An Overview of flood in South Asia

The South Asian country Bangladesh is prone to flooding due to being situated on the Ganges Delta and the many tributaries flowing into the Bay of Bengal. The coastal flooding twinned with the bursting of Bangladesh's river banks is common and severely affects the landscape and society of Bangladesh. 75% of Bangladesh is less than 10m above sea level and 80% is flood plain, therefore rendering Bangladesh a nation very much at risk of further widespread damage despite its development. There are several types of floods that have recently occurred regularly, affecting different areas in their own distinct way. These flood types include flash floods in hilly areas, monsoon floods during monsoon season, normal bank floods from major rivers (Brahmaputra, Ganges, Meghna) and rain-fed floods (Bhattacharya, Amartya).

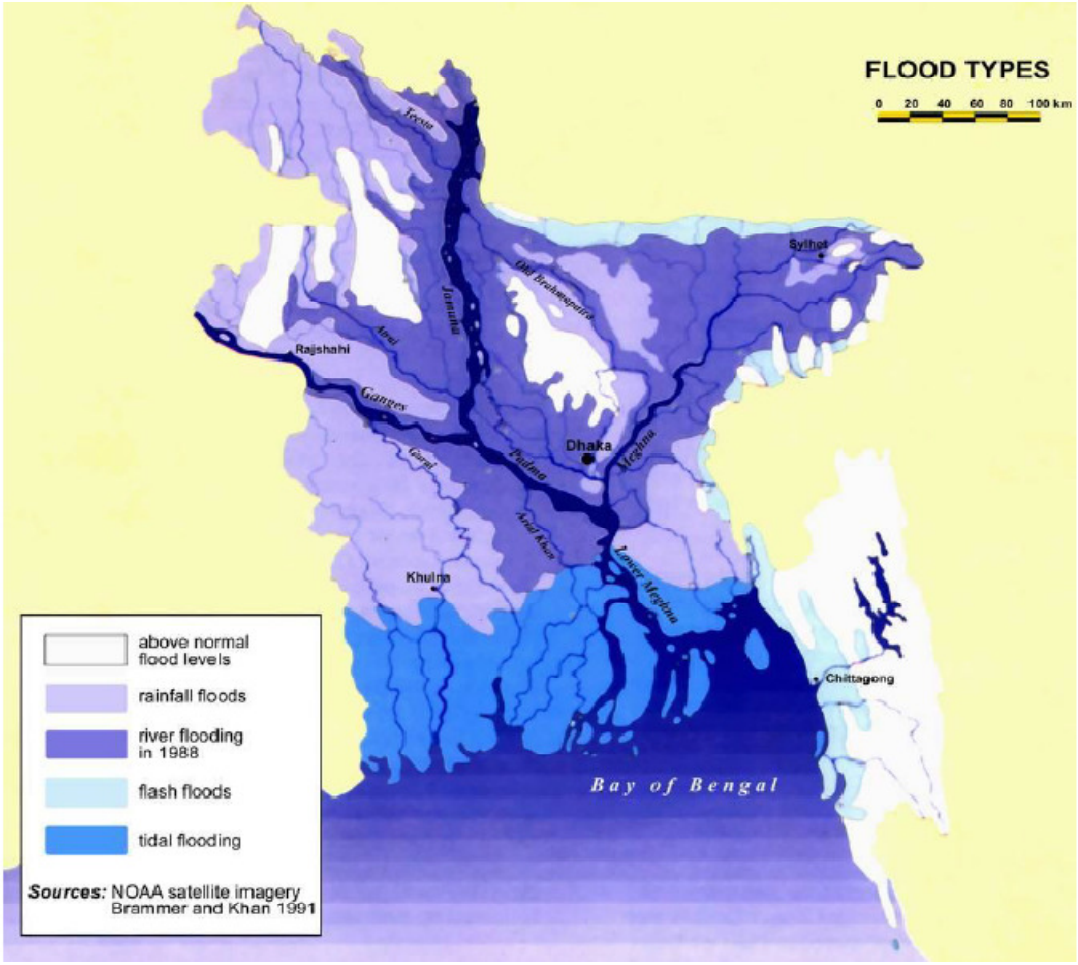

Fig. 1. Types of flood in Bangladesh (Source: FFWC)

While floods have been endemic to the climate and hydrological systems in South Asia, their increasing magnitude and frequency in recent times is a matter for serious concern. An analysis carried out based on CRED/EMDAT data highlights that (i) flood occupies 35% of all natural disasters in South Asia (Figure 2)

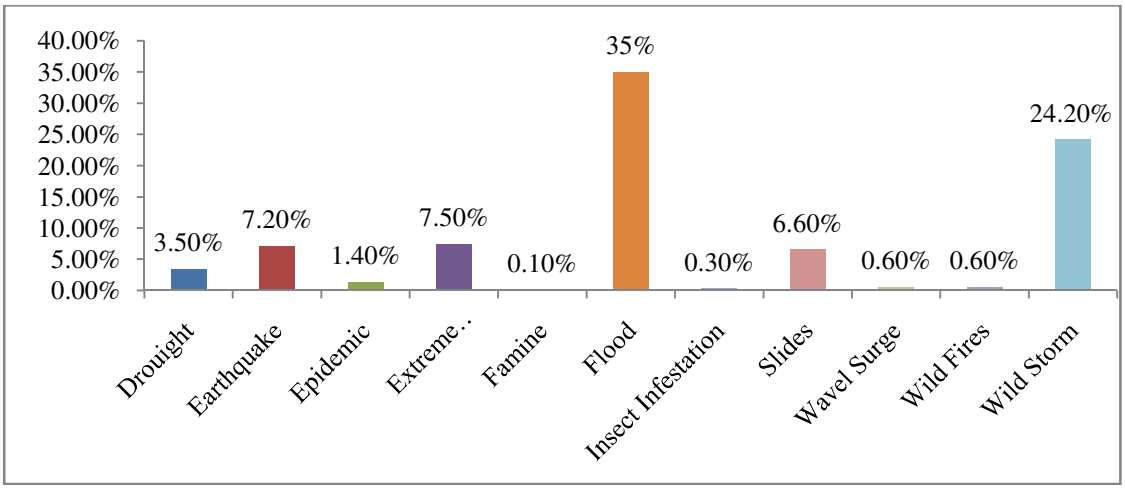

Fig. 2. Natural disaster in South Asia (1975-2005)
Source: Relief Web News, April 1, 2007 (http://www.reliefweb.int).

The number of flood events and related casualties are on the rise (Figure 3). In the past 20 years, EMDAT recorded data also reveal that the floods in 1988, 1995, 1998 and 2007 were among the worst the region has seen in terms of overall impacts.1 Some of the flood events in South Asia provide the extent of vulnerability the region is characterized with. For example, as recorded data in EMDAT reveals, more than 28,000 human casualties in Bangladesh (July 1974) has been the highest ever casualties by flood. Similarly, the 1993 flood in India was reported as the 5th greatest flood in the world, affecting more than 128 million people.

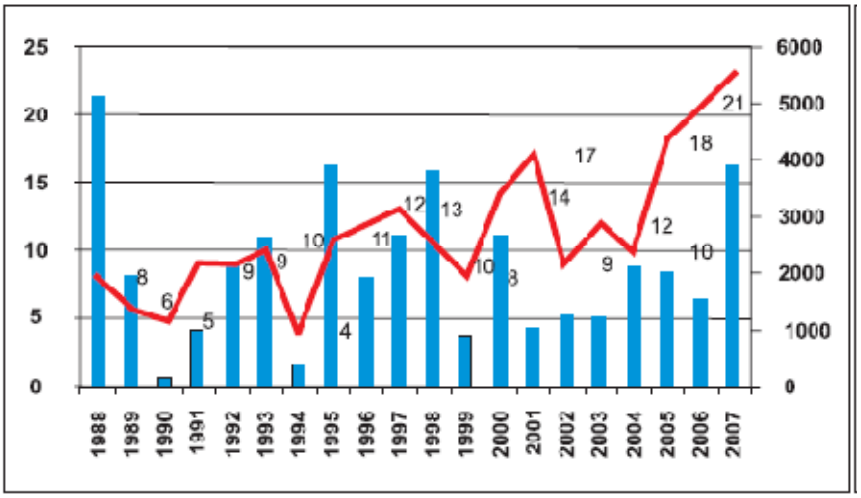

Fig. 3. Flood Trend in South Asia - Number of people killed (bar), Number of events (line)
Source: CRED Data (www.emdat.be).

To be precise, natural disasters in 2007 killed 9718 people in South Asia. 58% of them belonged to Bangladesh, followed by India (26%), Pakistan (9%), Afghanistan and Nepal (3% each), and Sri Lanka (1%). Two cyclones (Sidr & Yemyin) and different flood waves contributed largely to these casualties (Fig. 4).

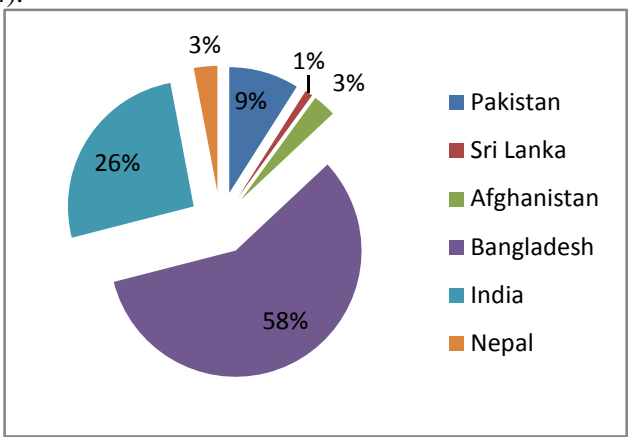

Fig. 4. Country-wise numbers of people killed by natural disasters in 2007 in South Asia
Source: Emergency Data (EM-DAT) base of Centre for Epidemiology of Disasters, Leuven, Belgium, 2008

In 2007, EMDAT had classified countries in terms of two categories. One was a set of those countries that were the worst affected in terms of the number of people killed. The second was a set of other countries in terms of number of people affected due to the natural disasters. Among the top five countries worst affected in terms of number of people killed, Bangladesh and India occupied first two positions, while Pakistan was on fourth position (Table 1).

Table 1. Most affected countries by flood in different Asian countries

Country	No of people killed	Country	No of people affected (million)
Bangladesh	5635	China PR	12011
India	2236	India	3814
China PR	1161	Bangladesh	2293
Pakistan	911	Zimbabwe	212
Korea DPR	610	Philippines	2.2

Source: Emergency Data (EM-DAT) base of Centre for Epidemiology of Disasters, Leuven, Belgium, 2008

Other two were China PR and Korea DPR. On the other hand, China PR was ranked one in terms of number of people affected due to the natural disasters followed by India and Bangladesh.

Damages due to flood in Bangladesh

It is reported that from 1904 to 2007, Bangladesh faced a total number of 287 natural disasters which together affected 415071861 people.

Table 2: Natural disasters in Bangladesh: 1904-2007

Disaster	No of Events	Killed	Injured	Homeless	Affected	Total affected
Drought	6	19000018	0	0	25002000	25002000
Earthquake	6	34	625	15000	3500	19125
Epidemic	28	403102	0	0	2757519	2757519
Extreme temperature	28	2171	2200	0	185000	187200
Flood	69	50103	102220	32703724	290376548	323182492
Wind storm	150	614293	874631	9972843	53076046	63923520

Source: EM-DAT: The OFDA/CRED International Database Jun: 2007

Among the natural disasters, flood occupies 2nd position after wind storm in case of no of people affected, number of total people affected, number of homeless people and number of people injured.

From 1986 to 2007 there were 22 events of flood which together affected 236.26 million people, killed 4636340 livestocks and damaged 36556.99 thousand acre crops fully or partially (GOB, 2010).

Cultural coping strategies practiced by the farmers against flood in Bangladesh

Awareness about occurrences of flood

A list of items about awareness about the occurrences of flood that help them to select coping strategies to be practiced is given in Figure 5 analysis of the data reveals that majority of the respondents assumed that farmers of the flood affected areas were aware about the occurrence of flood from mass media (radio, television, news paper) due to ranked first (19.55) followed by excess rainfall, rapid raising water level of the river and flood in upstream countries were ranked second (19.51), third (16.40) and fourth (14.57) respectively. Rest of the items i.e. idea of old and experienced person, gap between floods, miking of local administration, early and excessive fog, rapid fluctuation of temperature and frequent earthquake ranked fifth (9.55), sixth (8.26), seventh (8.08), eighth (7.68), ninth (5.42) and tenth (4.310) respectively.

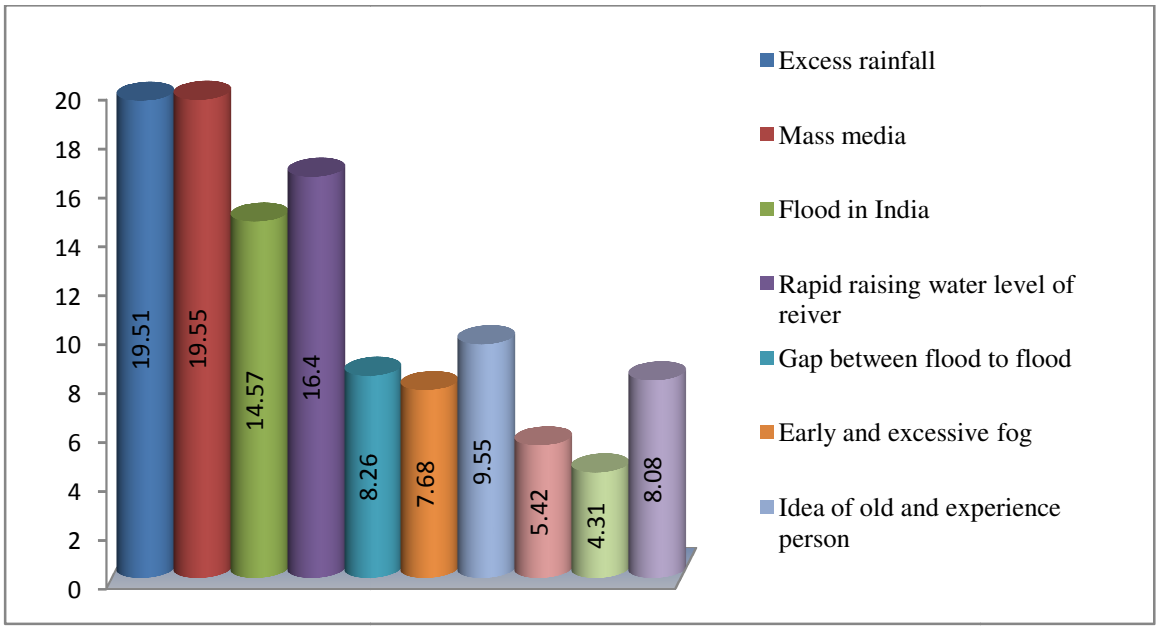

Fig. 5. Extent of practice of awareness about occurrences of flood
Source: Farhad, 2008

Distribution of the respondents based on awareness about the occurrence of flood, data in table 3 indicates that 37 percent of the respondents were highly aware about the flood while 32 percent of the farmers were medium aware about the occurrence of flood and 31 percent were under low category about the occurrence of flood.

Table 3. Distribution of respondents on the basis of awareness about the occurrences of flood

Category	Frequency	Percent
Low (<10)	47	31.0
Medium (15)	48	32.3
High (>15)	55	36.7
Total	150	100

Source: Farhad, 2008

Findings also indicate that majority (69 percent) of the respondents were high to medium award about the occurrence of flood. Awareness enhances the farmers to take decision about the practices of coping strategies.

Crop production

Crop productions are seriously hampered in every flood occurrence in Bangladesh. From their previous experiences farmers are to practice a lot of coping strategies.

Pre- flood period

Some of the coping strategies followed during the pre-flood period are listed in table 4. Findings indicate that coping strategy like 'storing all types of seeds' ranked first and 'storing excess seeds for emergency make up' ranked second followed by 'storing and placing agricultural equipments in a secured place', 'maintaining gap in cropping pattern during flood' and 'cultivation of Kanaf jute based on flood information' ranked third fourth and fifth respectively.

Table 4. Extent of practice of coping strategies related to crop production at pre-flood period

Coping strategies of crop production	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Storing all types of seeds	32	82	22	14	0	19.20	1st
2. Storing excess seeds for emergency make up	20	67	45	15	3	17.15	2nd
3. Storing and placing agricultural equipments in a secured place	21	32	45	35	17	13.55	3rd
4. Cultivation of Kanaf jute based on flood information	13	16		37	43	9.43	5th
5. Maintain gap in cropping pattern during flood	14	19	41	38	39	10.26	4th
Mean						13.97	
Range						4-40	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0
CI= Composite Index
Source: Farhad, 2008

The average index value of all the five coping strategies was 13.97, which was not found satisfactory. Therefore, it can be concluded that farmers of the flood affected areas may be used previously stored excess and all type of seeds to make up their emergency.

During flood period

Onrush of flood creates problem in crop production and thinking farmers future cultivation. In this regard farmers of flood affected areas utilize some of the coping strategies against crop production during the flood period. Data in table 5 indicate that coping strategy like 'collecting quick growing vegetables' ranked first and 'storing all types seed of in a secured places' ranked second followed by 'harvesting flood affected submerged crop', 'producing seedling/ sapling by Dapok method/ poly bag/earthen pot' and 'growing seed bed neighboring flood free area by land exchange system' ranked third fourth and fifth respectively.

Table 5. Extent of practice of coping strategies related to crop production during flood period

Coping strategies of crop production	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Collect quick growing vegetables	37	67	37	8	1	19.15	1st
2.Produce seedling/ sapling by Dapok method/ poly bag/earthen pot	21	38	42	27	22	13.73	4th
3. All types of seed stored in a secured places	30	77	20	20	3	18.26	2nd
4. Harvest flood affected submerged crop	21	34	45	36	14	13.86	3rd
5. Growing seed bed neighboring flood free area by land exchange system	17	17	63	34	1	12.40	5th
Mean						15.53	
Range						4-37	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0 CI= Composite Index

Source: Farhad, 2008

The average index value of all the five coping strategies was 15.53 and with the range from 4 to 37, which prevails that better practiced of coping strategies against crop production during the flood period.

Post-flood period

Crop productions are to be of crucial importance in post flood period. The people face problems due to inadequacy of seeds, seedlings, saplings, fertilizer etc. Some of the coping strategies followed during the pre-flood period are listed in table 6. Findings indicate that coping strategy like 'sowing quick growing leafy vegetables' ranked first and 'preparing seed bed and sowing seeds in a high place' ranked second followed by 'pit preparation for vegetable cultivation', 'cultivating late variety of rice like Naizershail, Poranga, BR-22/23' and 'cultivation of maize, potato, mustard without tillage' ranked third fourth and fifth respectively. The average index value of all the five coping strategies was 15.53 which were found satisfactory with the range from 3 to 34.

Table 6. Extent of practice of coping strategies of related to crop production at post flood period

Coping strategies of crop production	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Sowing quick growing leafy vegetables	40	61	36	11	2	18.93	1st
2.Prepare seed bed and sowing seeds in a high place	29	64	42	14	1	18.04	2nd
3. Cultivate maize, potato, mustard without tillage	19	25	48	37	21	12.62	5th
4. Prepare pit for vegetable cultivation	17	47	43	25	18	14.22	3rd
5. Cultivate late variety of rice like Naizershail, Poranga, BR-22/23	22	33	48	29	18	13.86	4th
Mean						15.53	
Range						3-34	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0 CI= Composite Index

Source: Farhad, 2008

Comparative scenario of coping against crop in different flood situation

Analysis the results contained in figure 6 reveals that there was no remarkable difference among the three flood period. The relative percentage of coping strategies practiced against pre-flood period was 30 percent which was slightly below than during (35%) and post (35%) flood period.

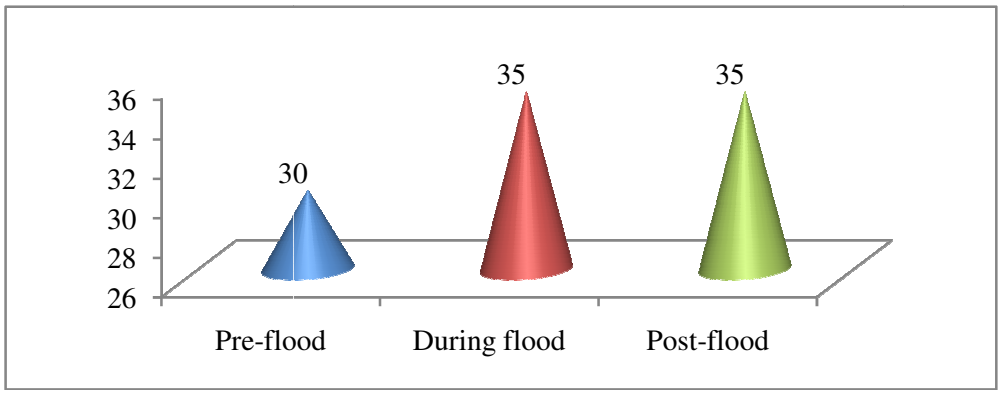

Fig 6. Relative percentage of the coping strategies practiced related to crop production
Source: Farhad, 2008

Findings also indicate that coping strategies practiced against crop production may be immense importance during all period of flood.

Livestock and poultry

Losses of livestock and poultry are another vital issue in the flood affected areas of Bangladesh. Their impacts are visualized in the socio-economic development of flood affected farmers.

Pre- flood period

To save livestock and poultry from flood during the pre flood period the farmers usually take the measures listed in the table 7. Findings indicate that coping strategy like 'Sale excess livestock and poultry before flood' ranked first and 'Make temporary shade for livestock and poultry in a high place or in embankment' ranked second, although there was no significant difference between them. Other practices like 'Vaccination livestock and poultry before flood', 'Preserve hay (dried straw) heap in a high place' and 'Cultivate maize and other fodder crop in a high place' ranked third, fourth and fifth respectively.

Table 7. Extent of practice of coping strategies related to livestock and poultry at pre-flood period

Coping strategies of livestock and poultry	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Sale excess livestock and poultry before flood	27	38	49	25	11	15.33	1st
2.Make temporary shade for livestock and poultry in a high place or in embankment	20	42	47	25	16	14.44	2nd
3. Vaccination livestock and poultry before flood	8	29	54	32	2	11.51	3rd
4. Cultivate maize and other fodder crop in a high place	10	22	33	43	42	9.55	5th
5. Preserve hay (dried straw) heap in a high place	10	18	39	49	34	9.82	4th
Mean						12.13	
Range						0-36	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0 CI= Composite Index

Source: Farhad, 2008

The average index value of all the five coping strategies was 15.53 which were found unsatisfactory with the range from 0 to 36.The findings reveal that the farmers are to practice more coping strategies to save their livestock and poultry.

During flood period

Feeding and rearing are the main problems during flood. To save the livestock and poultry from the catastrophe of the floods the usual measures taken by the flood affected farmers are mentioned in table 8. Findings indicate that coping strategy like 'Use hay (dried straw) for cattle feed' ranked first and 'Transfer livestock to high place/neighbors/relatives house/shed in embankment' ranked second. Other practices like 'Consult with veterinary surgeon for flood related diseases', 'Complete vaccination of livestock and poultry' and 'Rearing poultry on the roof or high place' ranked third, fourth and fifth respectively. The average index value of all the five coping strategies was 14.88, which indicate that all the strategies were practiced satisfactorily.

Table 8. Extent of practice of coping strategies related to livestock and poultry during flood period

Coping strategies of livestock and poultry	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Use hay (dried straw) for cattle feed	35	85	20	6	4	19.60	1st
2.Transfer livestock to high place/neighbors/relatives house/shed in embankment	17	46	50	22	15	14.54	2nd
3. Consult with veterinary surgeon for flood related diseases	12	50	50	24	14	14.31	3rd
4. Complete vaccination of livestock and poultry	10	54	54	28	14	14.13	4th
5. Rearing poultry on the roof or high place	10	34	34	36	26	11.82	5th
Mean						14.88	
Range						0-40	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0 CI= Composite Index

Source: Farhad, 2008

Post-flood period

Gushing waters during onrush of flood engulf lot of lives as well as livestock and poultry. Data highlighted in table 9 indicate that coping strategy like 'Complete vaccination immediately after flood' ranked 1st and 'Use hard-cash to re-start their livestock and poultry farm' ranked 2nd.

Table 9. Extent of practice of coping strategies related to livestock and poultry at post flood period

Coping strategies of livestock and poultry	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Complete vaccination immediately after flood	22	59	42	19	8	16.35	1st
2.Use hard-cash to re-start their livestock and poultry farm	23	38	50	24	15	14.6	2nd
3. Cultivate maize and quick growing fodder crop for livestock	16	27	61	23	23	12.44	4th
4. Repairing the livestock and poultry shade	14	41	43	34	18	13.28	3rd
5. Take loan from bank/relatives to purchase essential livestock	11	14	12	47	36	9.64	5th

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0 CI= Composite Index

Source: Farhad et, al., 2009

Other practices like 'Repairing the livestock and poultry shade', 'Cultivate maize and quick growing fodder crop for livestock' and 'Take loan from bank/relatives to purchase essential livestock' ranked third, fourth and fifth respectively. The average index value of all the five coping strategies was 13.27, which indicate that all the strategies were practiced satisfactorily.

Comparative scenario of coping against livestock and poultry in different flood situation

Livestock and poultry livestock faced a serious problem during on rush of flood hit i.e. at the time of during flood. Livestock and poultry suffered lot in shortage of feeding, resting, water related diseases, and some time washed away and lost huge of livestock and poultry by on rush of flood hit. From those points of views, findings contained in the figure 7 depicted that the relative percentage of the coping strategies practiced against livestock and poultry practiced greater 37 percent during flood period as compare to pre and post flood period. Results further indicate that the rate of practices between pre and post flood period were 30 percent and 33 percent.

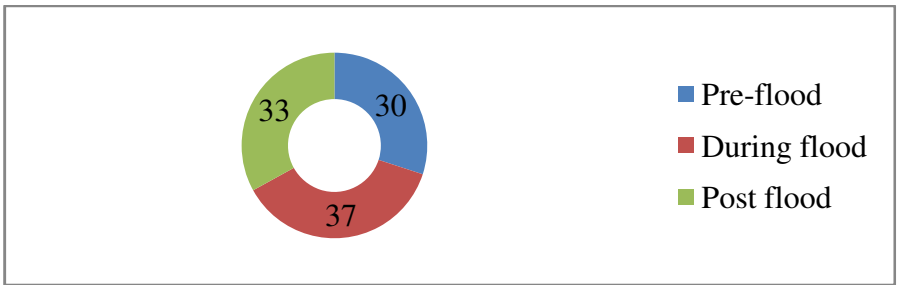

Fig. 7. Relative percentage of the coping strategies practiced related to livestock and poultry
Source: Farhad, 2008

Fisheries

This is also another vulnerable issue in flood affected areas. In almost every flood occurrence some of the fisheries farm holders were completely ruined due to heavy economic losses.

Pre- flood period

Some of the coping strategies applied by the farmers based on the gathered experience are depicted in Table 10. Findings indicate that coping strategy like 'Raising the embankment of fish farm by extra earthling up to protect the entrance of flood water' ranked first, 'Netting the surrounding of the fish farm to save the fish from flood' ranked second and' Harvest and sale comparatively bigger fish before flood' ranked third, although there was no significant difference among them. Other practices like 'Preserve fingerling for future cultivation' and 'Stock fish feed before flood occurrence' ranked fourth and fifth respectively.

Table 10. Extent of practice of coping strategies related to fisheries at pre-flood period

Coping strategies related to fisheries	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Raising the embankment of fish farm by extra earthling up to protect the entrance of flood water	25	51	43	15	16	15.73	1st
2.Netting the surrounding of the fish farm to save the fish from flood	25	41	44	23	17	14.84	2nd
3. Harvest and sale comparatively bigger fish before flood	15	45	54	15	21	14.13	3rd
4. Preserve fingerling for future cultivation	13	32	37	35	33	11.42	4th
5. Stock fish feed before flood occurrence	7	28	41	38	36	10.31	5th
Mean						13.28	
Range						0-40	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0
Source: Farhad, 2008

The average index value of all the five coping strategies was 13.28, which indicate that all the strategies were practiced satisfactorily.

During flood period

During flood period most of the fish farm are damaged and washed away by onrush of flood. Analysis of the data contained in the Table 11 shows that among the coping strategies practiced 'Protect the fisheries farm from the entrance flood water by raising embankment' ranked first, 'Harvest and sale bigger fish from the risky farm' ranked second and' Preserve fingerling for immediate fish culture' ranked third, 'Cleaning the surrounding of net of the farm' ranked fourth and 'Use branches of trees and bamboo sticks for shelter of fish' ranked and fifth respectively.

Table 11. Extent of practice of coping strategies related to fisheries during flood period

Coping strategies related to fisheries	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Harvest and sale bigger fish from the risky farm	21	44	59	11	5	15.33	2nd
2.Protect the fisheries farm from the entrance flood water by raising embankment	15	48	55	18	14	16.97	1st
3. Preserve fingerling for immediate fish culture	8	41	50	23	28	12.35	3rd
4. Use branches of trees and bamboo sticks for shelter of fish	8	36	41	44	21	11.82	5th
5. Cleaning the surrounding of net of the farm	16	34	31	43	26	12.04	4th
Mean						13.07	
Range						0-34	

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0
Source: Farhad, 2008

The average index value of all the five coping strategies was 13.70, which indicate that all the strategies were not useful in practicing during flood condition.

Post-flood period

To restart the farming business the victims of the flood practice some own strategies. Analysis of the data presented in the Table 12 shows that among the coping strategies practiced 'Release previously stored fingerling t' ranked first, 'Cleaning flood affected fisheries farm/ponds' ranked second. Rest of the strategies like 'Take help from relatives/friends if possible' ranked third, 'Cleaning Liming flood affected fish farm' and 'Take loan from bank, NGOs and private organization' ranked fourth and fifth respectively.

Table 12. Extent of practice of coping strategies related to fisheries at post flood period

Coping strategies related to fisheries	Extent of practices					CI	Rank
	Re	Fre	Oc	Ra	N		
1.Release previously stored fingerling	20	58	32	16	24	14.84	1st
2.Take help from relatives/friends if possible	9	30	64	20	27	12.17	3rd
3. Cleaning flood affected fisheries farm/ponds	10	46	47	27	20	13.28	2nd
4. Liming flood affected fish farm	9	34	43	39	25	11.68	4th
5. Take loan from bank, NGOs and private organization	9	16	30	43	52	8.31	5th

Re = Regularly =4, Fre = Frequently =3, Oc = Occasionally = 2, Ra = Rarely = 1 and N = Never =0
Source: Farhad et, al., 2009

The average index value of all the five coping strategies was 12.05, which was unsatisfactory regarding practices.

Comparative scenario of coping related to fisheries in different flood situation

Findings presented in the Figure 8 highlights that the relative percentage of the coping strategies against fisheries was (35%), (34%) and (31%) for during, pre and post flood period.

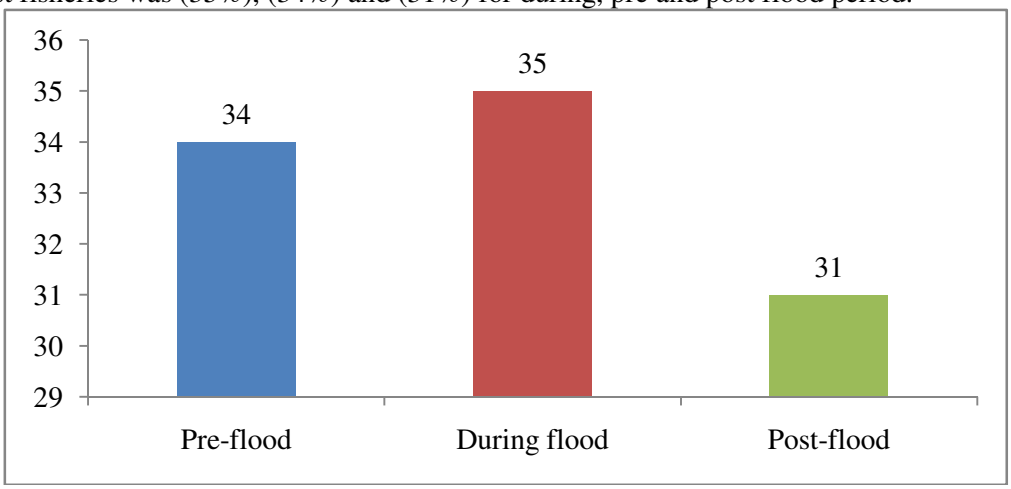

Fig. 8. Relative percentage of the coping strategies practiced related to fisheries
Source: Farhad, 2008

The rate of intensity of practices was more or less same. It implies that every coping strategies are immense important for fish culture that's why coping strategies against fisheries were more or less equal important in all flood period.

Structural Measures

Considering the issues of securing peoples' life and property, livelihood, food etc. the Govt. put emphasis on protecting Medium High and Medium Low Lands from floods through construction of embankments. Since 1960s Bangladesh has implemented about 628 nos. of large, medium and small scale FCDI projects. Total investment was to the tune of US$ 4.0 billion. It provided flood protection to 5.37 million ha of land, which is about 35% of area. A picture flooded, non-flooded and flood protected area is shown in figure 9. A picture structural measures works are given in table 13.

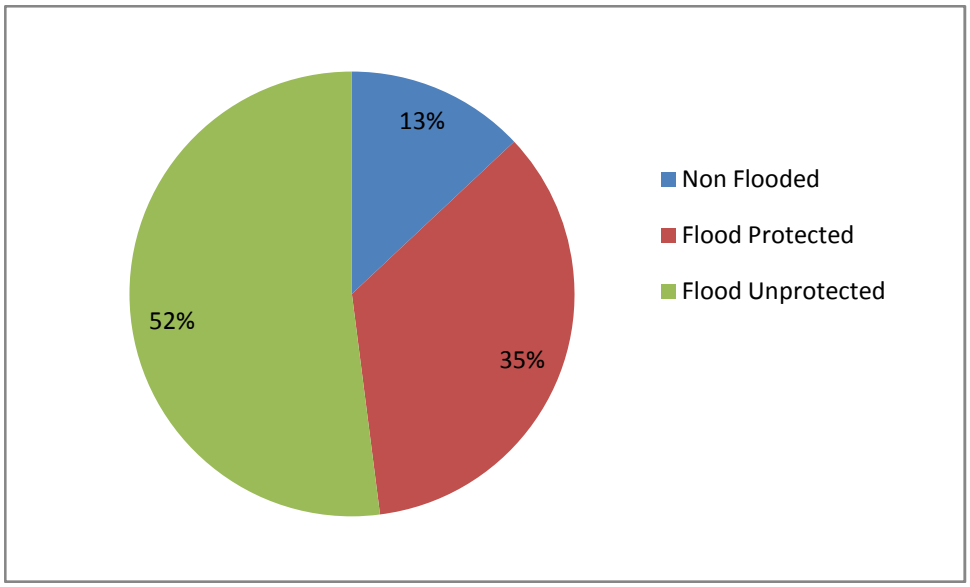

Fig. 9. Present flood status
Source: World meteorological organization, 2003

Table 13. Structural Measures for Flood Management

Item	Quantity
Embankment	10,000 km
Drainage Channel Imp.	3500 km
Drainage Structure	5000 nos.
Dam	1 no.
Barrage	4 no.
Pump House	100 nos.
River Closure	1250 nos.

Source: World meteorological organization, 2003

Mitigation and recovery efforts of Bangladesh

Bangladesh has a very effective system for dissemination of early warning against floods. The Flood Forecasting and Warning Centre (FFWC) issued warnings to flood-prone areas of rising river flows. The Bangladesh Red Crescent Society (BDRCS) initiated a community-based disaster preparedness program to extend beyond cyclones to cover flash floods and river erosion as well. The arrangements worked well while responding to the 2007 floods.

Some of the major highlights about the Bangladesh floods in 2007, reported by GoB are summarized below:

Damage caused by the flooding made considerable impacts on the household levels, and adversely affected health and food security. About 70-75% of the total damages and losses was reported in the crop, livestock, fisheries and forestry sectors. While the people in general were aware of the floods, they were caught unaware due to the sudden embankment breaching, which claimed more lives (human and animal) and damages. It was found that regular and routine maintenance activities of the embankments not addressed for a long period led the breaching of embankments. Critical infrastructures and means of communication were disrupted, which led the people 30 to lose access to food grains; domestic animals' losing access to fodder; and paralyzed the options for all the alternate livelihoods. The Jamuna river widened about 8 km to 12 km, and other rivers showed the same tendency without stopping. Bangladesh has lost more than 1,000 km^2 of land along the major rivers during the last 30 years. The land would have provided living space for about 1million people. Many food surplus districts could not achieve the target because of the devastating flood. Less water outlet of small rivers and canals and poor drainage system was another cause of disrupting water flow, which ultimately caused more extensive flooding. Improper water management caused river erosion, which increased the vulnerability of the community; especially for those residing near the Brahmaputra, Meghna and Jamuna basins.

Many of the roads, buildings (schools, health centre and others) were designed and constructed without complying with building codes; similarly, many of the construction works were not completed prior to the floods, which suggested that the planning of construction should take into account the weather risk emanating from the monsoon.

The roles and responsibilities outlined in the Standing Orders on Disasters (SOD) were not fully followed by concerned officials and lack of coordination among stakeholders and within the departments in the field level were observed. Despite this, District Disaster Management Committees (DDMC) or Upazila DMC had many meetings/stakeholders consultations, which enhanced the effectiveness of early warning and relief management operations. The post-disaster recovery experiences of floods in 2007(b) include the following highlights:

With the damage and need assessment of floods in 2007, relief and recovery efforts were taken up on a large scale. The efforts under Vulnerability Group Development (VGD) targeted for relief and early recovery by providing cash and cereals directly to the affected population were attached high priority at all levels;

Recovery targets in terms of (i) increasing output of agricultural, manufacturing and service sectors, (ii) maintaining/increasing capital stock, (iii) maintaining GDP growth rate, (iv) maintaining exports, (v) maintaining imports, (vi) maintaining current account balance, (vi) managing inflation, and (vii) maintaining poverty levels were listed out and the efforts were started towards meeting them;

Among the recovery efforts taken up in the country, the major highlights were sector-wise targets as well as achievements. In the arena of shelter, the facts and figures pertaining to partially and fully damaged houses vis-à-vis the physical and financial targets showed a positive balance;

On the livelihood recovery front, besides the number of families and the people affected, the various programs such as Vulnerability Group Development (VGD), the Test Relief (TR), Rural

Maintenance, Food for Work (FFW), Risk Reduction and special program for the poorest districts leading to the recovery were placed on high prioritizes for the Government;

The need for infrastructure recovery was identified taking into account the extent of fully as well as partially damaged roads, educational institutions, embankments, bridge/culverts, etc. and the various programs, viz. re-location and revision of budgetary supports for Flood 31 South Asia Disaster Report 2007 rebuilding and also the taking up of austerity measures in public revenue expenditures, special procedures for approving rehabilitation and reconstruction projects as well as fast track implementation projects were embarked upon;

Governmental and institutional arrangements for the recovery were focused in terms of functioning, recasting and reorganization of disaster management committees, Government and NGO collaboration, participation of the armed forces, early recovery coordination and monitoring mechanisms, rapid emergency and need assessment procedures, loss and damage assessment procedures, and information management;

On the lessons based on Bangladesh's experiences of floods in 2007, the following aspects could be highlighted;

Early recovery assistance not to be too early; Risk reduction to be an integral part of recovery; Integration of poverty alleviation and disaster risk reduction (DRR); Govt. (GO)-NGO Collaboration; Need for improved early warning.

On the key influences on resilient recovery and sustainable development, the following issues could be highlighted:

Information management, production of site traps, media campaign on flood Management, emergency response coordination and monitoring mechanism, rapid emergency and needs assessment procedure, loss and damage assessment procedure, partnership building and mainstreaming DRR in development planning.

With the lessons learnt from the 2007 floods, GoB had made the following key observations to be pursues in order to reduce the risk of future flood events in the country:

Priority reconstruction to be focused on addressing the direct impact areas such as embankments, roads and culverts, and essentially the work to be undertaken before the onset of the 2008 monsoon to reduce subsequent vulnerability.

Work-based safety-net programs to be used to establish/construct the embankment and also linked with employment opportunities of the flood affected people.

Risk analysis and risk mitigation to be a mandatory element of any new construction or replacement program design involving both single sector and cross-sector risk analysis to ensure that reconstruction work should survive the next wave of flooding.

Efforts to be pursued on standardization of damage and loss assessment format along with the guidelines and capacity building to improve efficiencies and coordination between agencies, district administration, UN Agencies and NGOs.

Severely affected districts (by households, area and croplands) to be given immediate attention for risk reduction and Contingency planning and capacity building to be focused at the field level to strengthen early warning, evacuation, rescue, relief management and damage assessment capabilities and interagency coordination.

Conclusions

Flood is the most prevalent natural disaster here in South Asia followed by wild storm, disease epidemic and extreme temperature. Among the south Asian countries Bangladesh is affected much by flood. She ranked first in terms of number and percent of people killed and third in case of total people affected. All most one third of the farmers have low contact with information media. People get aware about flood from mass media and excess rainfall mainly. The farmers practiced coping strategies against crop production satisfactorily during flood period and post flood period but it was not up to the mark at pre-flood period. All the coping strategies practiced against livestock and poultry at pre-flood, during flood period and post flood period were found satisfactory. Use of the coping strategies against fisheries was found satisfactory at the pre-flood period but in case of during flood and post flood period all the strategies were not useful in practice. In the pre-flood period coping strategies mainly practiced against fisheries (34%) followed by crop production (30%) and livestock and fisheries (30%). Coping strategies against livestock and poultry (40%) are mainly practiced during the flood period by crop production (35%) and fisheries (35%). Farmers practice of coping strategies are higher against crop production (35%) followed by fisheries (31%) and livestock and poultry (30%) in the post flood period. The practices of coping strategies were comparatively higher during flood period followed by post flood period and pre-flood period.

Recommendations

Based on the findings, interpretation and conclusion of the study, the following recommendations were drawn:

- Expansion of media facilities should be taken urgently for smooth application of coping strategies against flood.
- Steps should be taken by the concerned organization to increase the practices of coping strategies through massive motivation, which could help them reduce the losses.
- The coping strategies, which were found as ranked first and second in each parameter, should be disseminated throughout the flood prone areas as and when necessary.
- More facilities should be provided for the better utilization of resources, that could help protect their family from damage and loss during on rush flood hit.

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