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Effect of the 1998 Flood on Non-Engineered Structures

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Abstract

In 1998, Bangladesh experienced the worst ever floods in terms of severity, destructiveness and duration. The duration of the flood exceeded all previous records. Besides loss of human lives and livestock and damages to roads and bridges, there have been extensive damages to buildings in the flood-affected areas. The conditions of the majority of houses in the flood-affected areas are poor and therefore susceptible to damages. In this paper, an attempt has been made to have a quantitative estimation of the damages to houses caused by the 1998 flood. Study has also been made on the conventional techniques used in building the vitte and bera of houses by villagers and some conclusions have been drawn about the vulnerability of houses to flood damage. It appeared that the villagers do not use any special technique for the construction of flood-resistant houses. The tentative and preliminary estimates made in this study suggests that over Taka two thousand five hundred crore would be required for the reconstruction and rehabilitation of the flood-damaged non-engineered rural houses of Bnaglsdesh.

INTRODUCTION

In 1998, Bangladesh experienced the worst ever floods of the country. This flood exceeded all other floods in the living memory of the people of the country in terms of severity, destructiveness and duration. During the floods, apart from the heavy loss of human lives, livestock and standing crops, large-scale damage

of the roads, infrastructure and rural houses took place. The havoc of this flood that ran into several months can hardly be ever estimated. The housing condition of the majority of households of Bangladesh is simply poor and, thus, the losses to houses were of considerable magnitude. In this paper, an attempt has been made to have a quantitative estimation, albeit tentatively, of the damages caused by the floods of 1998 to rural houses. Here, efforts have been made to conduct a comprehensive study on the conventional techniques used by the villagers in preparing the Vitte (plinth) and Bera (wall) of the rural houses and houses that were seriously affected due to particular conventional technique used by the builders have been detected. Relevant information and data on flood 1998 have been collected from various available sources, as well as through a questionnaire survey carried out among 139 rural people, who were directly affected by the flood of 1998. A very approximate estimate has suggested that about 0.05 million families were most severely affected by the flood of 1998. The flood either washed away or severely damaged their houses and household belongings. From the study it has been found that to reconstruct all the affected houses (with an average size of 18 x 11 x 7 feet), about Tk. Twenty five hundred Crore (Tk. 2528,00,62,500) would have been required. Use of appropriate flood-resistant house building techniques by the villagers could have helped them to cope with this flood with lesser economic losses.

Usually when an area goes under water and remains under that condition for sometime it is called inundation. On the other hand, when this inundation causes damage to property and life, disrupts communication and causes harm to people as well as fauna and flora, it is called flood. Flood, apart from causing damages to economy and dislocation to public health, renders thousands of people homeless, causes damage to crops in the field, disrupts normal agricultural cycle, causes death to livestock, poses serious threats of nutrition, and may results into hunger and famines. The poor and downtrodden groups of any society usually suffer the most during and at the aftermath of any flood. The amount of damage from an event of flood usually depends on various factors. The location (urban/rural) of the area subjected to flooding as well as the depth, duration, and extent of flooding usually determines the potential amount of damage an incidence of flood may cause. Bangladesh experiences moderate to heavy flooding almost on a regular basis. Official statistics of last few decades indicate that each year on an average 20% of the land area of Bangladesh goes under floodwater. In some of the previous devastating floods, the effects on human life as well as on land were quite unbearable.

In reality, floods are natural phenomena in Bangladesh as it is a flood plain country. The floods in Bangladesh are mainly caused due to the fact that: (a) Bangladesh is a deltaic land situated just about fifteen feet above the sea level; (b) Bangladesh has a small geographical area; (c) Bangladesh accepts the huge

volume of the Himalayan ice-melt water flowing through the rivers up-stream in the neighboring countries; (d) The rivers of Bangladesh are not deep enough, (e) Tidal bore and, of course (6) Excessive rainfall.

The flood of 1998 made the people of Bangladesh to be faced with a disaster with catastrophic dimensions. This worst flood in the history of Bangladesh lasted from July to September 1998. During this flood, about 100,000 sq. km out of 148,393 sq. km, i.e., 69% of the total landmass of the country was literally inundated for about two and a half months. Floodwater engulfed about 52 out of 64 districts of the country directly affecting nearly 30.1 million people of the country. During the floods, more than one million people took refuge in about 3000 makeshift flood shelters (schools, colleges, community centers etc.) throughout the country. The timing, duration and magnitude of flood 1998 in Bangladesh have proven it to be unlike any other in the country's history. This flood was unique in the sense that the floodwaters receded at a much slower pace than the other floods that Bangladesh experienced prior to 1998.

During this flood, beside others, houses in the affected areas suffered heavy losses. Some houses were completely washed away by riverbank erosion and houses that were not washed away suffered extensive damages. However, the total losses in the housing sector have not been estimated so far. The havoc of this long flood can hardly be ever estimated. But its longer-term impact required a great deal of careful study.

Whereas complete prevention of flood is not possible, suitable measures can be adopted to alleviate the distress of the people. At the same time novel strategies concerning future planning and development may be formulated so that people learns to live with such devastating natural disasters with dignity and pride. The lessons learnt from the flood of 1998 may very well guide the decision-makers to plan a better future for Bangladeshi homeowners in the flood prone areas of the country. It is again very much important that suitable affordable techniques of building flood-resistant non-engineered rural (poor) housing are developed so that in the event of future floods losses to houses may be minimized as far as practically feasible.

Soon after the flood of 1998, various agencies carried out surveys on the people directly affected by it. A number of pockets, which were badly affected by the flood, in various parts of the country were identified. These vulnerable pockets have been given in Table 1 as well as shown in Fig. 1.

METHODOLOGY

Some of the households affected by the flood of 1998 were carefully selected so that they act as representative samples. Only those rural households that were directly affected by flood were chosen.

Whereas the flood of 1998 affected a total of 52 districts of Bangladesh, three districts out of these 52 were selected for conducting necessary surveys. The selected districts were, of course, identified as the most severely flood affected areas and were also easily accessible for the field survey. For each of the districts selected for flood survey, one *Thana* was selected randomly. From each *Thana*, one or two unions (depending on the degree of damage) was/were selected and from each union, one to three-village(s) were selected for the study. The study area is given in Table 2. During the field survey conducted across several villages, a questionnaire was prepared in Bengali and the survey was conducted among the flood affected peoples. The outputs of the survey were then processed in the computer. Again, relevant information available from various sources was gathered and efforts were made to tentatively determine the total number of affected households throughout the country due to this flood.

As the degree of damage sustained by the rural houses varied from house to house, as well as from village to village, an indicator was assumes to quantify the degree of damage. For the houses whose *Vitte* was completely damaged and *Bera* was also washed away, the indicator has been set at 100% damage of the house. Similarly for the houses whose *Vitte* was not washed away but fully damaged and *Bera* was also fully damaged, the indicator has been taken as 50-100% damage of the house. If either the *Vitte* or the *Bera* showed no significant damage, then the indicator has been reported as 0-50%. For other combinations, the extent of damage has been taken as 50% or has been left at the discretion of the surveyor.

Table 1: List of areas affected by the 1998 flood

District	Thana	Union	Villages
Kurigram	Kurigram	Pauch Gachhi	Char Shitaijhar
			Kadamtala
		Ghughudanga	Madhay Kusumpur
			Noabosh
			Char Vagabotipur
			Noanipara
			Char Zattrapur
		Nayerhat	Kawerchar
		Ashtimirchar	Fulerchar Kurichar
			Tapurchar
			Hakanda
			Jadurchar
	Ulipur	Jatia	Jatia

District	Thana	Union	Villages
Kurigram (contd.)	Rajibpur	All	
		Erandabari	Erandabari
		Fazlupur	Fazlupur
		Kanchipara	Kanchipara
		Gozaria	Gozaria
		Uria	Uria
	Shaghata	(Char Area)	(Char Area)
Gaibandha	Gaibandha	All	
	Shadullahpur	All	
		Idulpur	Idulpur
	Palashbari	Barisal	Rampur
Jamalpur	Dewanganj		Char Gelabari
	Motherganj		Char Nandanerpara
	Bakshiganj		Bir Nandanerpara
	Islampur	Chenadoli	Kutubullah Char
			Shingvana
	Dewanganj	Chenadoli	Char Gelabari
		Bahadurabad	Sardarpara
	Jamalpur	Ghoradhap	Ghoradhap
	Dewqanganj	Merur Char	Kolkihara
	Sarishbari	Satpowa	All
	Sarishbari	Jhagurara	All
		Tupkarchar	All
		Mahmudpur	All
		Chineytola	All
		Sudhibari	All
		Haripur	All
Mymensingh	Bhaluka	Berunia	Chandar Hat
	Nandail	Rajgati	Rajgati
	Kishoreganj	Latibabad	Durail
		Charpara	Latifabad
	Itna	Badla	Taleshwar
		Raituli	Pangdalang
Sherpur	Sherpur	Sherpur	Char Sherpur
Netrakona	Barhatta	Singba	Arshira
	Barhatt	Baushi	Sahipura

District	Thana	Union	Villages
Pabna	Shujanagar	Shujanagar	Tarabari
Bogra	Kahalu	Bir Kedar	Bholta
Barisal			Bobnadi
	Gaurnadi	Gaurnadi	Kolejdi
Pirojpur	Najirpur	Sriramkathi	Buichakathi
Gajipur	Kapashia	Shammania	Shammania
Narsingdi	Raipur	Moheshpur	Joynagar
Faridpur	Faridpur	Faridpur Pourashava	Charmadhabia
			Shovarampur
	Modhukhali	Baghat	Gamara
Shariatpur	Gosairhat		Marachfali
		Gosairhat	Lalbagan
Lakshmipur	Ramghar	Taraganj	Char Mathia
Natore	Natore Sadar	Khajura	Khajura

Table 2: Areas covered under this study

Zone	District	Thana	Union	Villages	Total No. of houses
Study area-1	**Kurigram**	Kurigram Sadar	Pauch Gachhi	Char Shitaijhar	200
				Kadamtala	100
			Zattrapur	Noabosh	40
				Char Vagabotipur	30
				Noanipara	50
				Char Zattrapur	150
Study area-2	**Jamalpur**	Islampur	Chenadoli	Shingvana	300
	Faridpur	Faridpur	Faridpur Pourashava	Charmadhabia	50
				Shovarampur	100

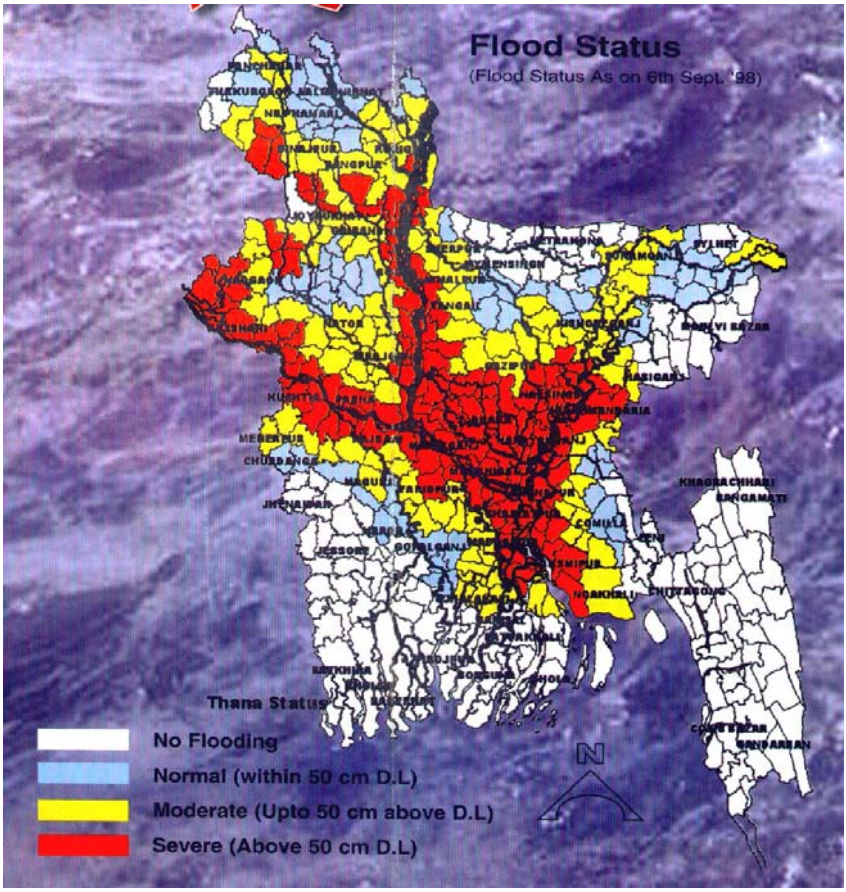

Figure 1: Extent of the 1998 flood

DESCRIPTION OF THE HOUSES

Various types of houses that exists in the study areas were critically inspected to quantify the state of the houses. In all study areas, most of the houses were *Kancha* (Figure 2*)*. Some semi-*Pacca* (Figure 3) and *Pacca* (Figure 4) houses were also found. *Kancha* is the type of house in which the building materials are mainly bamboo, G. I. sheet, wood, G. I. Wire, rope etc. The *Vitte* of the *Kancha* houses is made of compacted earth. The pillars are made of bamboo. Again, semi-*Pacca* is the type of house in which the building materials are mainly bamboo, G. I. sheet, wood, G. I. Wire, rope etc. The *Vitte* of this type of house is made of compacted earth or sand, with a 10 inch brick wall boundary around it.

This brick boundary of the plinth starts from a certain depth below the ground level and extends up to the floor level. *Pacca* is the type of house in which the building materials are steel rod, cement, sand, brick chips, bricks, G. I. sheet etc. The structure is built as RCC structure except the roof is made of G. I. Sheet. Again, *Chhawn* house is a type of *Kancha* house with the only difference that the roof is made of grass sticks (matured, dried rice, wheat trees etc.) instead of G. I. Sheet. The overall condition of the *Chhawn* house is, in general, not so good. It is made by the lowest income people just to take shelter. The full portion of this house is made of Catkin sticks including with bamboo sticks (sometimes, the roof may be made of G. I. Sheet). No established *Vitte* has been found for this type of house.

Figure 2: A *kancha* house

According to the present study, it has been found that about 68% of the houses of the study area *Kancha*, about 10% of the houses are semi-*Pacca*, only 4% of the houses are *Pacca* and 18% includes other types of houses such as *Chhawn*'s house, *Kancha* shed etc.

Questionnaire survey was conducted on a total of 139 people randomly selected from all the three study areas. About 57% of the people of the study area were farmers, 34% of the people were day labourers, 2% of the people were businessmen, 3% of the people were service holders, and 4% were engaged in other types of occupation such as boatman, fisherman, etc. Interview was also taken on females; all of them were day labours. The schematic representation of the occupation of the people is shown in Fig. 5. All the people interviewed were

permanent residents of the study area since birth and were present in the area during the 1998 flood. In 1988, average depth of inundation of floodwater was 4 feet for all the study areas. In contrast during 1998, average depth of inundation of floodwater was three feet from the ground level of the houses with an average period of inundation of about 76 days.

Figure 3: A semi-*pacca* house

Figure 4: A *pacca* house under flood water

EXTENT OF DAMAGE TO THE HOUSES

Extent of damage of the houses basically depends on the condition of the house, i.e. whether the house is *Kancha*, Semi *Pacca* or *Pacca*. The 1998 flood had caused serious damages to the houses of the affected area, especially the *Kancha* and Semi *Pacca* houses of the locality. However, all types of the houses were not affected by the same degree. Again in some houses, the Vitte was completely washed away but the *Bera* was not completely damaged pointing to the fact that different segments of the houses were affected by different degrees. Thus, an indicator for the extent of damage was developed to quantify the amount of damage due to flood. For the house whose Vitte was completely damaged and *Bera* was also washed away, the indicator has been taken as 100% damage of the house. Similarly for the house whose *Vitte* was not washed away but fully damaged and *Bera* was fully damaged, the indicator has been taken as 50-100% damage of the house. If either the *Vitte* or the *Bera* underwent no significant damage, then the indicator has been reported as 0-50%. For other combinations, the indicator for the extent of damage is taken as 50% and in some cases engineering judgement has been applied.

From the field data, it is found that about 16% of the houses of the study area was completely (100%) damaged, about 25% houses were 50-100% damaged, about 42% houses sustained 50% damage and only 17% houses were damaged by 0-50%. According to estimates published in the daily newspapers, the total houses damaged (assumed as 100% damaged) due to 1998 flood was 5,50,000 numbers, and using this information the total number of houses damaged under various categories have been estimated and as shown in Table-3. The schematic representations of the extent of damage of the houses of the study area and the total number of houses affected are shown in Figures 6 and 7, respectively.

Table 3: Number of houses affected by flood

Description of damage of houses (%)	Percentage of total damage (%)	Total number of houses affected (Nos.)
100	16	5,50,000
50-100	25	8,59,375
50	42	14,43,750
0-50	17	5,84,375
	Total	**34,37,500**

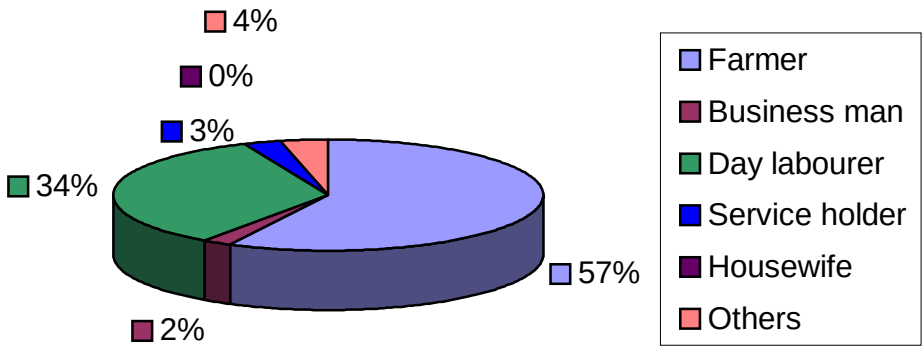

Figure 5: Description of the occupation of the people of the study area

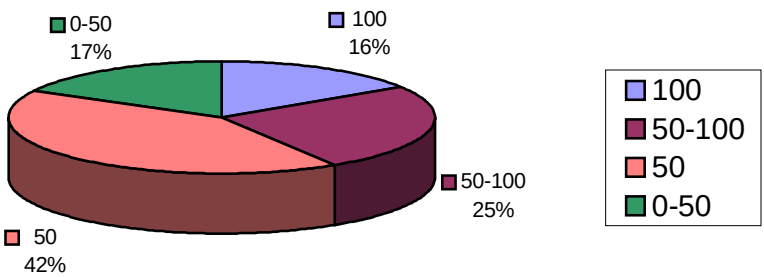

Figure 6: Extent of damages to houses of the study area

REPAIR COST OF HOUSES DAMAGED

Repair cost depends on the size of the house and the condition of the house. Field observation revealed that the average amount required to make a house of average quality (in between *Kancha* & Semi *Pacca*) and of average size (18 x 11 x 7) is Tk. 12,257. About 31% of the total cost is spent in preparing *Bera* and 69% of the total cost is spent in making *Vitte* of houses. Repair cost of such houses under various levels of damages was estimated and is given in Figure 8. The total repair and reconstruction cost of all the partialy and completely damaged houses has been tabulated in Table 4. From the table, it appears that the 1998 flood resulted in a total rural house reconstruction cost of about 25280 million Taka.

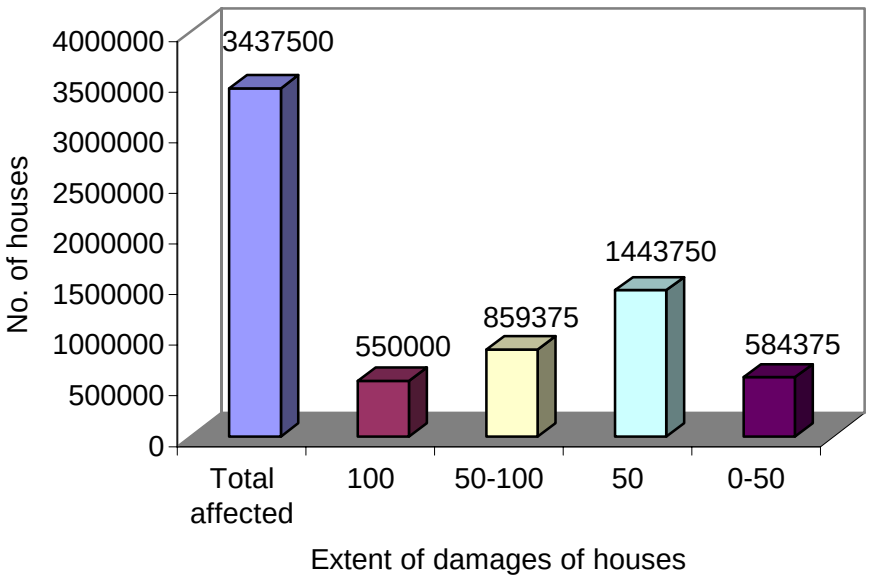

Figure 7: Number of houses affected by the flood

Table 4: Repair and reconstruction cost of damaged houses

Description of damage of houses (%)	Total amount required to make a house (Taka)	Total number of houses affected (Nos.)	Repair cost (Taka)
100	12,257	5,50,000	674,13,50,000
50-100 (75)		8,59,375	790,00,19,531
50		14,43,750	884,80,21,875
0-50 (25)		5,84,375	179,06,71,094
Total		**34,37,500**	**2528,00,62,500**

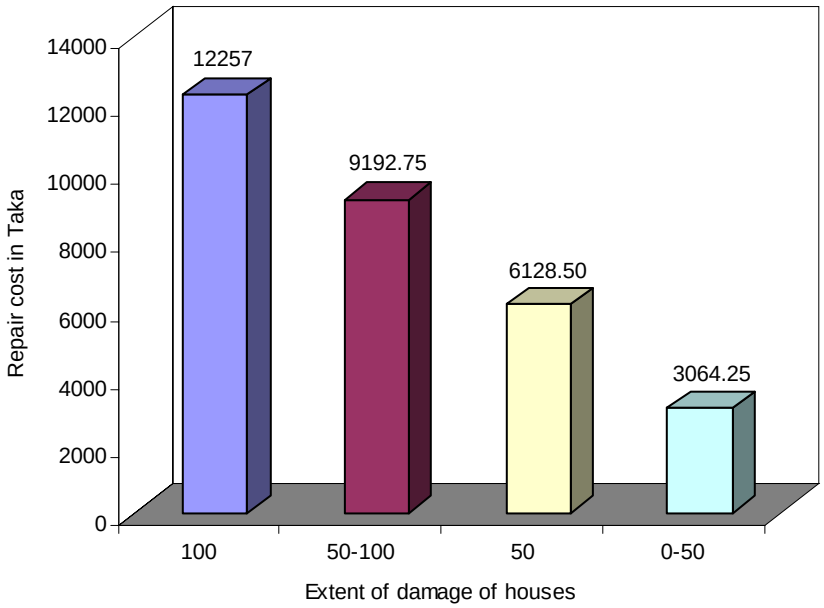

Figure 8: Repair cost of a house of average size 18 x 11 x 7 feet

RECONSTRUCTION TECHNIQUES OF THE HOUSES DAMAGED

Villagers usually use no special technique to build their houses. In making the *Vitte* of the house, most of them use only soil by filling it up to the desired height. The desired height of *Vitte* depends on the ground level of the area. On an average, height of *Vitte* is 3.36 feet. Some people plant trees around the *Vitte* as a preventive measure against natural forces. In making the *Vitte*, villagers use water to mix with soil, so that the filled soil can be compacted well. No other materials such as rice husk, rice husk ash etc. are generally used by them. They basically do not take any special care for protecting *Vitte* from flood damage. During reconstruction of Vitte, house builders first put a perimeter mud wall around the proposed Vitte, then put soil inside and compact it (Figure 9). Lateral support using bamboo and trees are sometimes used (Figure 10). Usually people do not take any measures for protecting *Bera* from damage. Only a small percentage of people use plastic, tar for this purpose (Figure 11). For strengthening the pole of the house, pole of cement is used by some solvent people. It has been gathered that about 19% people uses bamboo for giving lateral support to Vitte, 39% plants trees around Vitte and the rest 42% take no

special measures (Figure 12). Again, whereas both male and female workers are usually engaged in the reconstruction works, women workers are paid fewer wage than their male counterparts (Figure 13). Average time needed for getting into the house after making *Vitte* is about 14 days. It has been revealed that people would like to use high technology, as long as it is affordable.

Figure 9: Rebuilding of V*itte* washed away by flood

Figure 10: Mud-plinth (*Vitte*) protection using bamboo

Figure 11: Bera protection using polythene sheet

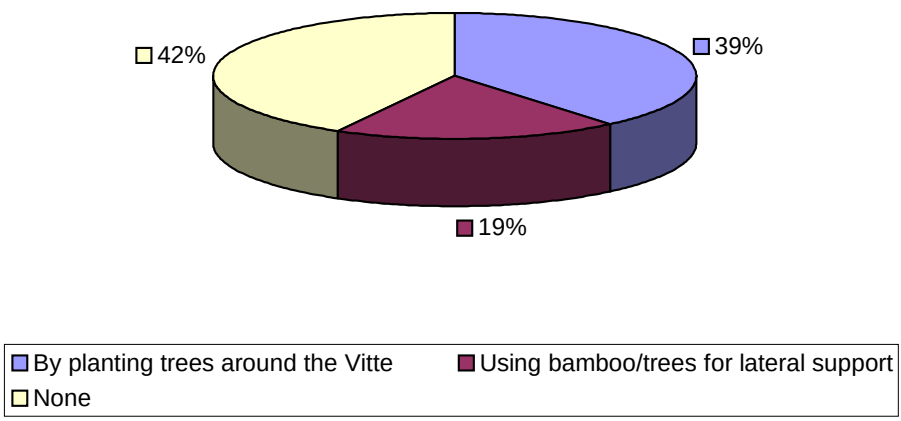

Figure 12: Special techniques used for protecting *Vitte* from damage

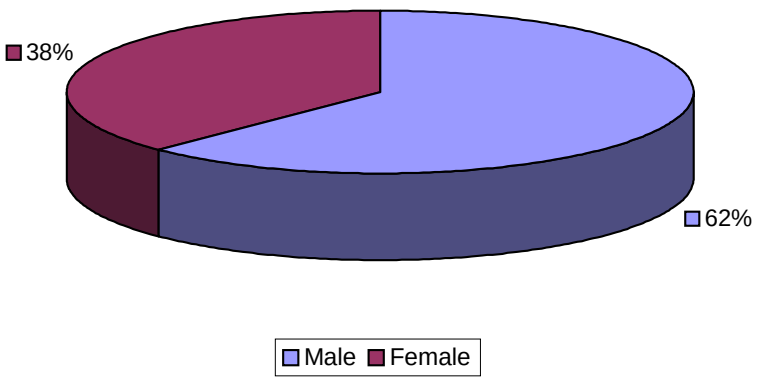

Figure 13: Average labour charge

In this regard, some recent works of Roy, et al. (2000) and Saha (2002) can be effectively used to minimize losses due to floodwater, which usually washes away the mud-plinth (*Vitte*) or mud-wall resulting in the total collapse of the poorly built rural houses. From these works it has been observed, quite conclusively, that by mixing 4%-6% cement by weight, depending upon soil type, with the soil of plinth towards the later stages of *Vitte* construction, mud-plinth can be made floodwater resistant. Figures 14 and 15 show mud-cement block casting and testing under submerged water, respectively.

Figure 14: Mud-cement block preparation

Figure 15: Mud-cement block testing under water

CONCLUSION

The present study is based on a limited survey conducted over a small fraction of the total area that went under water during the flood of 1998. The study relied on information that was available in the mass media as well. The following is the summary of the findings:

- It has been found that about 57% of the people of the study area (on whom observations were made) are farmers, 34% of the people are day laborer, 2% of the people are businessman, 3% of the people are service holder, and 4% includes other types occupation such as boatsman, fisherman etc.
- In most part of the country, the scale of severity in 1998 was much higher than that of the flood 1988 in terms of duration and overall damage to properties.
- About 68% of all the houses of the study area were *Kancha*, about 10% Semi *Pacca*, about 4% *Pacca*, and about 18% include other types of houses.
- Average depth of inundation of floodwater in 1988 was four feet in the study area. In contrast, in 1998, the floodwater remained three feet from the ground level, with an average period of inundation of about 76 days.
- Severe damage of the *Kancha* house of the people has been reported. About 16% of the houses of the study area were completely (100%) damaged, about 25% houses were 50-100% damaged, about 42% houses sustained 50% damage and only 17% houses were damaged by 0-50%. About 34,37,500 number houses over the whole country have been estimated as affected by the devastating flood of 1998.

- The total amount of money required to reconstruct all the affected houses of rural Bangladesh at the aftermath of 1998 flood is estimated to be about Taka two thousand five hundred Crores. This tentative estimate is, perhaps, on the higher side. However, this gives a clear indication of the large scale losses that took place in the non-engineered rural housing sector during 1998 flood.
- Currently, villagers do not adopt any special technological solution to make their houses floodwater resistant. Appropriate and affordable village building technologies may be adopted in the future to minimize losses. Again, further research, with the objective of being implemented immediately, may be initiated in an effort to build safer houses in rural Bangladesh. Such a study should look into alternative materials as well as construction techniques.

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