American Journal of Theoretical and Applied Business
2015; 1(1): 41-47
Published online July 23, 2015 (http://www.sciencepublishinggroup.com/j/ajtab)
doi: 10.11648/j.ajtab.20150101.17

Investigating People's Role in Flood Control and Management in West Bengal-A Case Study

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To cite this article:
Suvankar Chakraborty. Investigating People's Role in Flood Control and Management in West Bengal-A Case Study. *American Journal of Theoretical and Applied Business*. Vol. 1, No. 1, 2015, pp. 41-47. doi: 10.11648/j.ajtab.20150101.17

Abstract: Purpose of the study: The present study investigates the disaster affected people as well as the role of people in flood control and management in West Bengal. Background: A holistic and integrated approach in the direction of flood management is crucial both for pre-disaster preventive, mitigation and preparedness along with usual post disaster response. Methodology: This study is based on primary data collected through structured questionnaires and secondary data has been collected from government records and the records of the study area. In the course of analysis, descriptive statistics and regression analysis have been used. Results: Empirical results indicate that major areas of the study block are frequently affected by flood and most of the people are affected by flood almost every year but people's role regarding flood management is reasonably not bad for flood control and management.

Keywords: Flood Management, People's Role, West Bengal, Udaynarayanpur Block, Descriptive Statistics, Two-Way ANOVA

1. Introduction

Flood refers to the phenomenon influx of water beyond its normal, confines in an area resulting in disruption of normal human activities, destruction of properties, loss of animal & human lives and environmental damage. Major contributing factors for flood are- accumulation of water due to localized heavy rainfall, accumulation of run-off after heavy rainfall, discharge from upper basin areas, distinctive features and drainage condition of river/ canals/ dykes, shape of the catchment's area and shape and strength of river/coastal embankments. Though natural calamities like flood cannot be avoided, its impact in terms of loss of lives and damage to properties can be minimized by undertaking appropriate management practices for preparedness, prevention and mitigation measures. This constitutes a holistic approach towards management of flood with emphasis not only on the traditional post disaster response; but also on pre-disaster preventive, mitigation and preparedness as well, thereby, laying down the Standard Operating Procedure (SOP) for flood management. SOP for proper management of flood comprises of three phases: (i) pre-flood phase, (ii) during flood phase and (iii) post-flood phase.

Throughout the world, governments and civil society are faced with the challenge of identifying the areas that are at risk of extreme disaster events. Catastrophes such as flood which is a common phenomenon in Udaynarayanpur Block are reminders for Government and Civil Society to be prepared by reducing the impact of risk of disaster, although extent of risk may not be reduced and therein lies the importance of good flood management. While the center of attention is on flood control and management initiatives, mainly in case of non-structural measures, public awareness is extremely pertinent. In fact, non-structural measures more often than not necessitate people's approval of living with floods and fighting to find some solutions to flood problems. On the other hand structural initiatives may be also important to reduce the impact of flood. An impudence on the structural initiatives concert in reducing flood incidences may discriminate the decision making process and ultimately lead to an increase in flooding possible impacts in case of structural breakdowns (Mal and Mondal, 2013). Keeping in view of this, the present paper aims to examine the people's role and awareness on account of flood control and management in Udaynarayanpur Block, Howrah District, West Bengal.

2. Review of Related Literature

There are various studies, technical papers and articles covenanting various aspects that influence flood control and

management such as:

Goel (2006) critically analysed the impact of natural and man-made disaster and come out with concrete suggestions to overcome the problem of disaster management. Mal and Mondal (2013) described the people's perception about flood control and management in Daspur Block of West Midnapore District based on the data for the year 2011. They illustrated that floods present a serious threat in the eyes of the inhabitants, and that the perception of threat, to a certain degree depends on the place of residence. More than 90% people of the area emphasis on the repair and strengthening of the mounds of the rivers to prevent flood. The surveys also highlighted, among the other measures, solidarity and the importance of insurance against floods. Coppola (2010) claimed that the ideal combination of practical and academic experience is highly needed for disaster preparedness, mitigation, response, recovery and communications. Extensive case studies cover the latest disasters, offering ample opportunity for current students and practitioners to build their critical thinking skills. Mahul and HYPERLINK http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=383760andaaHYPERLINK "http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=383760"HYPERLINK "http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=383760"Ghesquiere (2007) suggested that countries should ignore uncertainty for public investment and behave as if indifferent to risk because they can pool risks to a much greater extent than private investors can. They identified several cases where the government's risk-neutral assumption does not hold, thus making rational the use of ex ante risk. They argued that because sovereign insurance is usually more expensive than post-disaster Financing**,** it should mainly cover immediate needs, while long-term expenditures should be financed through post-disaster Financing (including ex post borrowing and tax increases). In other words, sovereign insurance should not aim at financing the long-term resource gap, but only the short-term liquidity need. Weeks (2006) illustrate that disaster planning for health care providers following the September 11, 2001, terrorist attacks and more recently Hurricane Katrina focuses on preparing hospitals and other emergency services to respond to victims' medical needs. But little attention has been paid to the challenges that providers would face resuming normal operations after responding to the catastrophe. Alexander (2002) claimed that flood management is a long term as well as sustainable stroke. For an assimilation that includes space, time and policy activities, it should be also including all actions: the inhabitants, local and divisional authorities, the government and other management authorities. In the flood emergency planning and implementation process, it is also important to take account existing public experience on living with floods or how local organizations usually working directly within floods. Actually flood emergency plans must be complementary rather than substitute to existing experience on flood management. Choudhury et al (2010) tried to highlight the issue concerning the need for integration of management of river basin in West Bengal. The first integrated river basin plan of India in Damodar, resulted the formation of Damodar Valley Corporation (DVC). Examination of actual inflow and outflow data for the two terminal dams of DVC at Maithon and Panchet show that significant flood moderation has been achieved during the past years due to the construction of the dams, reservoirs, barrage in Damodar- Baraka river system. It has been noticed from the available data that the performance of these reservoirs in terms of flood moderation has been achieved to the extent of 53 % to 80% in the high flood years. Jha and Bairagya(2011) assessed the environmental impact of flood and their characteristics which include different measures like flood elevation, discharge, volume and duration. The physical and socio-economic condition of the study-area has also been analyzed. An attempt has also been made to suggest some measures for the development of the study-area and to find out the Environmental Problems related to flood in the study-area. The present study is based on the flood data of 35 years of the region. The quantitative-statistical method i.e. Gumbel's method has been adopted to analyse the flood frequency.

2.1. Research Gap

The conclusive sum of this retrospective review of relevant literature produced till date on the offered subject reveals wide room for the soundness and instigates of this work and replicates a few crucial supports that emphasize its feasibility. The continuation of people's role in flood control and management in West Bengal, especially in Howrah are scarcely available. As a result, the present study seeks to examine the people's role in case of flood control and management in Udaynarayanpur Block.

The decisive quantity of this traditional review of related literature produced till date on the offered subject divulges wide room for the validity. Nor has any previous research assessed the effectiveness of the disaster management department and the role and responsibilities of disaster management department in addition to disaster management strategies in West Bengal. Disaster management analysis in the perspective of Udaynaryanpur Block of Howrah District of West Bengal has also not been made in any of the papers reviewed above. In almost all the papers there is further scope for more empirical research.

2.2. Objective of Study

The objective of the present study is:

(a) To assess the people's awareness about flood risks in Udaynarayanpur Block;
(b) To observe the people's awareness and role regarding flood control and management;
(c) The relevance of pre and post disaster management so as to face crisis situation.

3. Methodology of the Study

3.1. Data Source

This study is based on primary as well as secondary data. The secondary data has been collected from Sechpatra of various years, Government Flood Relief offices, statistical hand book of the districts, Economic Review, Human Resource Development Report, District Census Book etc. The primary data has been collected mainly from the basin dwellers with structured questionnaires. Generally the inquiring was performed in the one month flood period. Table 1 signifies the description of the study area.

Table 1. *Description of Udaynarayanpur, Howrah.*

Overall View:	**Geographical Area**	**No. of Gram Panchayats**	**No. of revenue villages**
Howrah	138719 Hectares	157	766 (inhabited villages-727)
Udaynarayanpur	12480 Hectares	11	75
Land Area:	**Land use**	**Non-Agricultural Land**	**Cultivable area**
Howrah	138676 Hectares	49478 Hectares	89192 Hectares
Udaynarayanpur	11049 Hectares	2517 Hectares	8532 Hectares
Soil information	**Sandy Loam**	**Loam**	**Clay Loam**
Howrah	8460 Hectares	8645 Hectares	23365 Hectares
Udaynarayanpur	3350 Hectares	570 Hectares	2480 Hectares
Cultivation	**Important Agricultural Produce**	**Produce- wise quantity handled (annual)**	**No. of farm families covered**
Udaynarayanpur	Potato, Jute, Til, Ground Nut, Vegetables, Rice, Groundnut and Arum	Potato – 7,500 MT Jute – 3500 MT Til – 375 MT Ground Nut – 1800 MT Vegetables – 1,500 MT	25% - 30% of Farmers of the Block

Source: Census Reports, 2001.

3.2. Sample Design

We have selected Udaynarayanpur Block, a flood prone area of Howrah District. Almost all the Gram Panchayats as well as all villages of the Block are the flood prone area, so all the Gram Panchayats have been taken as sample for the present study. Then we have selected 100 each respondents from 9 severely flood prone Gram Panchayats and 100 each respondents from 2 less flood prone Gram Panchayats, that is, overall 1100 respondents were taken as sample.

Table 2 characterizes the sample design of the Udaynarayanpur block. Udaynarayanpur Block experienced flood almost every alternative year however the impact of flood was very severe in 2013 after 1978.

Table 2. *Flood Affected Gram Panchayats of Udaynarayanpur, Howrah.*

Name of Gram Panchayats	**Population**	**Sample taken**
Severely Flood affected Gram Panchayats:		
Bhabanipur Bidhichandrapur	13862	100
Harali Udaynarayanpur	13474	100
Rampur–Dihibhursut Asanda	13986	100
Kurchi Shibpur	14023	100
Debipur	14117	100
Garbhabanipur–Sonatala	13176	100
Kanupat Mansuka	13482	100
Pancharul	12340	100
Singti	12146	100
Less Flood affected Gram Panchayats:		
Khila	13028	100
Harishpur Raghunathpur	12456	100

3.3. Tools Used

In the course of analysis in this study, median, correlation and multiple regression have been performed by using SPSS-17 software.

3.4. Variables Used

The following flood control and management indicators have been used for the present study which are discussed below.

(A)Flood Control Indicators - The flood plan indicators can be obtained through application of air-photo interpretation techniques. These parameters are helpful for flood hazard zoning and estimation of inundated areas.

1. Flood inundation mapping - Surface water bodies can be mapped by adopting the unique recognition characteristics of near infrared spectral bands. Accordingly, the extent of the area inundated by flood can be obtained relatively easily from satellite-based observation. In this case one can adopt both digital and optical data processing techniques as they are helpful in delineating the flooded areas. Based on the information the planning and decision-making authorities of flood control can take decisions with a fair degree of reliability on such aspects as extent of flood damage, structural measures, areas requiring post-flood alleviate measures and providing relief to the affected people.
2. Flood plain land use information – The land use information of the flood-prone rivers is very important, which is required for planning measures for flood alleviation. This also helps in the assessment of flood damage. On a long-term basis such information is also of help in the development of (i) necessary measures to control man's encroachment on the flood plain and (ii) flood hazard zoning giving due weightage on the varying degrees of flood hazard.
3. Flood susceptibility – The natural flood susceptibility indicators are:

(a) Characteristics of drainage basin, i.e., drainage

density, shape,

(b) Channel configuration and geomorphological characteristics,

(c) Soil moisture availability and differences in soil type,

(d) Upland physiography and agricultural development,

(e) Land use boundaries,

(f) Flood alleviation measures and degree of abandonment levees.

4. Flood warning – The satellite can be fitted with Data Collection System. These systems gather data from ground-based remotely located automated Data Collection Platforms (DCP). The DCPs are equipped with transducers fitted by the concerned user organization or department. These data are then transmitted to the ground receiving stations or central computing facilities of the department.

(B) Flood Management Indicators-

(1) Flood plains - A floodplain is an area near a river or a stream which floods when the water level reaches flood stage. A flood plain is a strip of flat and dry land alongside a stream, river or lake and ends up covered by water during a flood. This happens when there is heavy rainfall.

(2) Flood proofing - Any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

(3) Flood forecasting-It is the use of real time precipitation and stream flow data in rainfall –runoff and stream flow routine models to forecast flow rates and water levels for periods ranging from a few hours to days ahead , depending on the size of the watershed or river basin. Flood forecasting can also make use of forecasts of precipitation in an attempt to extend the lead-time available.

(4) Disaster preparedness – It is a process of ensuring that an organization:

(a) has taken all the preventive measures,

(b) is in a state of readiness to contain the effects of a forecasted disastrous event to minimize loss of life, injury, and damage to property,

(c) can provide rescue, relief, rehabilitation, and other services in the aftermath of the disaster, and

(d) has the capability and resources to continue to sustain its essential functions without being overwhelmed by the demand placed on them. Preparedness for the first and immediate response is called emergency preparedness.

(5) Response planning - Disaster management is the discipline of dealing with and avoiding both natural and manmade disasters. It involves preparedness, response and recovery in order to reduce the impact of disasters.

(6) Flood fighting - An effort made to prevent or mitigate the effects of flood waters. Numerous potential hazards exist during flood events. These hazards are manageable if identification and communication occur on an ongoing basis. Personal safety requires a conscious effort that every flood fighter must consider in their various duties and activities in terms of providing boat, patrolling, construction equipments, contaminations, vegetation, insect and animal exposure, swift water etc.

(7) Flood insurance - Flood insurance denotes the specific insurance coverage against property loss from flooding. To determine risk factors for specific properties, insurers will often refer to topographical maps that denote lowlands, floodplains and floodways that are susceptible to flooding.

4. Empirical Results and Analysis

The National Commission on Floods (1980) assessed the flood prone area in India as 40 million ha (12% of the total area). Out of the total area liable to floods, about 80% (32 million ha) could be provided with reasonable protection, and about half of this surface has so far been provided with a reasonable protection through various means of flood management measures. One of these areas is the Damodar River basin. The maximum flood in the Damodar River recorded in the pre-dam period was in August 1913 with a peak flow of 18,406 m3/s (before the implementation of the Damodar Valley Scheme). The all-time high combined inflow to the dam system observed in the valley occurred in September 1978 with a peak flow of 21,900 m3/s. It is entirely situated in the two states of Jharkhand and West Bengal of India. The basin experiences seasonal rain due to the South-Western Monsoon every year and floods occur depending on the intensity of the storms. The catchment area is about 22,000 Sq.km, of which about 19,000 Sq km are in uplands and 3,000 Sq.km of very fertile irrigated plains. The normal track of the monsoon depression from Bay of Bengal towards the West Bengal lies to the south of the Damodar valley. During the monsoon season, the rainfall in the area is mainly due to either the passage of depressions over and near the area or active monsoon conditions. A heavy storm proceeded by another storm normally causes flooding in the West Bengal area. The disaster caused by a flood in 1943 which led to the preparation of a project, primarily for the control of floods and secondly for the development of water resources for various other uses, e.g. power, irrigation, navigation, and water supply for industrial and municipal uses. This project was approved in 1947, to be implemented through the Damodar Valley Corporation (DVC) under the leadership of the first Prime Minister, Pandit Jawaharlal Nehru who thought that large dams would be the temple of development of our country (Chandra, 2003, P4, Rudra 2010, P. 64), which came into existence in 1948. It was implemented in two phases. It was decided that the scheme had to be implemented through eight large dams at eight sites viz. Tilaiya, Maithon and Balpahari on the river Barakar, Bokaro on Bokaro river, Konar on the Konar river and

Panchet , Aiyer and Bermo. But in the first phase only four dams viz. Tilaiya(1953), Konar(1955), Maithon (1957), and Panchet(1959) were constructed by DVC. Then one more reservoir, Tenughat (1978) under the control of Jharkhand and Durgapur Barrage (1955) under the control of West Bengal were constructed (Chandra, 2003, p4). Besides flood protection, the whole system was expected to provide committed annual irrigation of 364,000 ha water for industrial and domestic uses. My area of study is a flood affected zone of Udaynarayan Block of lower Damodar Basin. The total population of this Block (2001 census) is 1,72,022 out of which total population , total number of male is 88,390 and number of female is 83,632 and the density being 1,569 per square kilometer, with the sex ratio of 946. About 80% of total population is affected by flood. More than 60% of total land in this block is agricultural land and out of that 90% is affected by flood. Total available land is 11,049 Hectares and out of which land not used for cultivation is 2517 Hectares. Total number of Gram Panchayat in this block is 11 which are –(1) Bhabanipur - Bidhichandrapur (2) Debipur (3)Garbhabanipur-Sonatala (4) Harali-Udaynarayanpur (5) Harishpur (6) Kanupat-Monsuka (7)Khila (8) Kurchi-Shibpur (9) Pancharul (10) Rampur-Dihbhursut Asanda (11) Singti.

Out of the above 11 Gram-Panchayats, 9 Gram Panchayats are affected by flood and 2 Gram-Panchayats i.e. Khila and Harishpur are not much affected by flood because these two Gram Panchayats is situated in the left side of Damodor river and the height of embankment is higher than right bank of the Damodor river.

Table 3 Signifies the size of flood effects of the Udaynarayanpur Block. In the flood period, government as well as many non government organization took a crucial job by organizing the vulnerability situation and gives a lots of relief goods.

Table 3. *Land, population, house affected in 2013 in Udaynarayanpur, Howrah.*

Sl. No.	Details	
1	No. of population affected	146090
2	No. of families affected	24000 (approx)
3	No. of house damaged	14348 (approx)
4	Total crop land affected (in hectare)	8532 (approx)
5	Crops damaged in Rupees	5 Crore (approx)
6	No. of loss of human lives	17
7	Road damaged	Almost all Muddy Roads
8	Water level rises due to flood above the agricultural field	About 8-10 ft.

Source: Author's Survey and Udaynarayanpur Block Development Office.

Table 4. discloses the flood relief uniqueness of the Udaynarayanpur Block during 2013 flood. The awareness about the reasons, peripheral gifts and management choices is conflicting from harsh flood prone areas and less affected areas.

Table 4. *Flood Reliefs Uniqueness of Udaynarayanpur Block During 2013.*

Flood Reliefs Uniqueness	Relief Materials
Tripals distributed	24,000 piece
Drinking water supply	4,50,000 liter per day
Dry food supply	Chire-10000kg,Gur-3000kg & Muri–200kg
Biscuits	20000 pkts
Rice	25000 qtls
No. of boats engaged for transportation	30
No of NGOs involved	3

Source: Author's Survey and Udaynarayanpur Block Development Office.

Table 5. *Public Perception about the Causes of Flood of Udaynarayanpur Block during 2013.*

Areas	Options	Percentage of Respondents	
		Yes	No
Severely Flood affected Gram Panchayats	Natural (Heavy Rain)	54	46
	Artificial (Man-made)	46	54
Less Flood affected Gram Panchayats	Natural (Heavy Rain)	38	62
	Artificial (Man-made)	62	38

Source: Author's Survey

Table 5. illustrates the result of public awareness about the reasons of the flood of Udaynarayanpur Block. In both cases, the differences are statistically significant. The multiple regression analysis disclosed that at least 53.72 per cent of variability of the respond could be enlightened by the panic of floods. This flood is moderately correlated (r = 0.4658) in the midst of the disaster preparedness to carry out protective along with additional contradict computes. Two-way ANOVA divulged that the residential area has a huge impact on awareness in the direction of obtain contradicts outcomes than fears on flood. While flood cannot be avoided, its shock in case of loss of human lives and properties damages can be reduced through proper flood management performance through awareness, prevention and alleviation measures. Vulnerability evaluation in the course of flood inundation mapping, plain land use information, proofing, warning, forecasting, planning and insurance are the entire pre-disaster and post-disaster phases at flood control and management. About 79.45 percent people claimed that they have no ideas about flood control and management selected indicators.

Tables 6. and 7. illustrate that the public perception of flood control and management options in keeping with the respondent's opinion in the pre-disaster and post-disaster phases. About 92.82 per cent of the respondents did not know concerning the significance of insurance against flood in the pre-disaster and during disaster phase. In addition to this, the respondents claimed that they have no knowledge (more than 85 per cent) about the selected indicators except flood fighting. In case of flood fighting, they get full support from the local government, state government and NGOs. Furthermore, almost all the respondents agreed that they are not satisfied about local administration, places of shelter, dry foods and other foods but satisfied only about drinking water in the post-disaster phase. As per dwellers of the area the diverse causes of flood in this area are affirmed at this point

extremely in brief – somewhat flat and basin shaped landscape, no such channel to flow away the gathered surplus water, defective land use follow, massive sedimentation on river couch as well as decrease of water holding capability, no foremost flood control channels, enormous amount of water release from Mython and Panchet reservoirs are some of the reasons for flood in the area under study.

Table 6. *Public Perception about Flood Control and Management of Udaynarayanpur Block in 2013 in Pre-disaster Phase.*

	5 point Likert Scale				
Flood Control and Management Initiatives	**Strongly**	**Fully**	**Fairly**	**Hardly**	**Not at all**
Flood inundation mapping	0	0	0	267	833
Flood plain land use information	0	0	202	898	0
Flood susceptibility	0	0	0	871	229
Flood warning	0	120	106	783	91
Flood plains	0	0	195	898	7
Flood proofing	0	0	157	0	943
Flood forecasting	0	0	105	911	84
Disaster preparedness	0	0	0	989	111
Response planning	0	0	536	564	0
Flood fighting	0	1100	0	0	0
Flood insurance including crop	0	0	79	575	446
Median	0	0	106	783	91
Range	0	1100	536	989	943

Table 7. *Public Perception about Flood Control and Management of Udaynarayanpur Block in 2013 in Post-disaster Phase.*

Flood Control and Management Initiatives	**5 point Likert Scale**				
	Strongly	**Fully**	**Fairly**	**Hardly**	**Not at all**
Local administration (Panchayat/B.D.O.) appropriately involved in the disaster management	0	0	1100	0	0
Need to move to other place to take shelter	0	0	1100	0	0
Satisfied with the dry foods/other foods provided during hazard	80	0	900	120	0
Drinking water is provided by local authorities (in pouch)	160	800	100	40	0
Aware how to protect yourself if there is a snake-bite	0	0		1100	0
Initiative taken by administration /NGO to save livestock	0	0	900	160	40

Source: Author's Survey

5. Conclusion and Recommendations

It is evident that with the onset of monsoon and heavy downpours there is every possibility that water will be released from Maithon and Panchet Dams and Durgapur Barrage and as a result the areas like Udaynaryanpur Block lying in the lower Damodar basis is likely to be flooded almost every year. In Howrah District out of 14 Blocks mainly 4 Blocks namely, Udaynarayanpur, Amta-1, Amta II and Bagnan II Blocks are flood prone. The approximate flood prone area under these 4 Blocks are 4000 ha, 6000 ha, 1000 ha and 700 ha respectively. Flood generally occurs in this district in two phases :

(1) Early flood – during end of July to middle of August and
(2) Late flood during middle of September to middle of October

Early flood: Early flood occurs due to excessive rainfall causing water logging of farm lands and mounting pressure due to overflow of water also results into damaging Hooghly, Rupnarayan and the Damodar river embankments. For this a considerable damage takes place to crops like rice, jute, vegetables and pulses. Following measures may be taken to cope with this early flood situation after receding of flood water:

Farmers may be advised to make additional seedbeds by staggering method for re-transplanting. Community nurseries may be organized for the same purpose. Direct seeding of short duration varieties by using drum seeder in lieu of transplanting may save cost. Nitrogenous fertilizers may be used for top dressing @ 25 kg per ha for quick recovery of damaged plants , and for this fertilizer may be supplied for distribution among farmers and local fertilizer dealers may be instructed to stock at least 25% extra to their usual stock during the time of occurrence of early flood.

Late flood: In case of late flood most of the crops ,mainly rice goes to maturity stage and damage is irreparable hence recovery or re-transplanting is not possible and farmers may have to sacrifice returns from kharif crop. In this case following measures may be taken:

1. Arrangement for sowing of pulses and oilseeds covering areas in addition to the normal one.
2. Growing wheat, boro paddy and rabi crops in larger areas to make over the crop loss.
3. To save animals from starving dry straws as cattle feed should be stocked and distributed among villagers having large number of cattle.
4. Sufficient loan facilities for rabi crops may be arranged by the local administration.

For both early and late flood situation following general recommendations may be made:

(i) The State Government should pay more attention towards increasing the capacity of channel through improvement of drainage of lower Damodar. At

Panchayat level 100 days' work may do a commendable job in this regard. Thus, in order to derive the maximum benefits of flood moderation there is the need for an immediate solution of the problem of drainage congestion of lower reaches.

(ii) Structural measures alone should not be the strategy. It must be realized that embankment and dykes will be necessary but more emphasis should be given on non-structural measures through community based preparedness for facing the flood in the lower basin of Damodar which will help in minimizing losses of property and life of human beings and livestock and also in reducing the recurring expenditure on flood relief.

Due to time constraints the study is restricted to 11 panchayats of only 1 Block out of 14 Blocks of Howrah District. There is further scope for carrying out research work based on a comparative study of all the 4 mostly flood affected blocks (Amta I, Amta II, Bagnan and Udaynarayanpur) of Howrah District. Research work may also be taken up to investigate the long-term impact of flood on the crops production in the Howrah District.

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