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Flood Disaster Management in India – A Case Study on Chennai Floods

Shankar Neeraj[1], S. Balachandar[2] and B. Vivek Reddy[3]

[1]SRM University
[2]Aurora's Research and Technological Institute
[3]SVS Group of Institutions
E-mail: [1]sneeraj144@gmail.com, [2]soorabala@gmail.com, [3]vivekreddy043@gmail.com

Abstract—*A flood is a natural phenomenon which is caused due to factors such as heavy rainfall, high floods and high tides, etc., and it is very difficult to avoid especially in urban area. Floods result in losses of life and damage properties. Due to high cost of land in urban area as a result of increase in population, people are forced to build their residential places in the areas at risk induction. In India, flood disaster management activities are handled by government. Participation of nongovernmental agencies and private sectors are very limited. Proactive disaster management requires more participation from various governments, non-governmental and private agencies and public participation. A disaster management plan is necessary in order to avoid the great losses and fatality affected by flooding. This paper aims to study about the 2015 and 2016 floods and suggests the flood management plan for Chennai.*

1. INTRODUCTION

Due to high cost of land in urban area as a result of increase in population, people are forced to build their residential places in the areas at risk induction. A *disaster* is the occurrence of an extreme hazard event that impacts on vulnerable communities causing substantial damage, disruption and possible casualties, and leaving the affected communities unable to function normally without outside assistance (Benson & Twigg, 2007). Disasters and natural calamities demand a high degree of intervention under extreme conditions. Flood is the most destructive natural disaster which extensively damages the life and property in India; these are a result of heavy rainfall, high tides etc., which is very difficult to avoid in uban areas as because of overpopulation the costs of land in urban area are shooting high, There are basically three types of floods, they are flash, river and coastal. It accounts one-fifth ($1/5^{th}$) of global deaths due to floods and on an average 30 million people are evacuated every year. Some of the major effects of floods are: Millions of people are forced to be homeless as their houses are getting collapsed/settled. Agricultural land and top fertile soil are buried under water or washed away due to floods. Apart from these, the loss may be in the form of materials, damaged infrastructure, and job opportunities. Urban floods can be classified as floods due to local heavy rainfall, floods due to river overbank flow and flood due to high tides or storm surges. Floods due to local heavy rainfall are caused by insufficient or poor drainages. Floods due to river overbank flow occur when river level rises above river banks. Excessive river levels are normally caused by high runoff from upstream and backwater effect of high tides at river mouth. Construction of cities in floodplains reduces storage and block floodway in the flood plains causing flood damage even worse. India is the most flood affected nation in the world after Bangladesh. Most part of the Northern India is most frequently hit by severe flood, but recently some parts of southern India especially Chennai and Vishakhapatnam in the year 2015 and 2016. In urban area where population always grows and residential areas become more expensive, settlements started developing in flood risk area.

2. DESCRIPTION

Chennai, the capital of Tamil Nadu, was established in 1639 and is the fourth largest metropolitan city in India. Chennai is located on the eastern coast of India at 13.08270 N & 80.27070 E. The population of Chennai city as of 2011 Census of India, is 46,46,730 persons and covers an area of 426 sq.km. The city has an increased growth rate of 2% during the decades 1951-61 and 1961-71 which is greatly attributed to its industrial growth. The city is greatly affected by the rapid urbanization causing pressure on the outdated infrastructure. The major type of disasters that the city is susceptible to are cyclones (which has hit the coast 29 times in the past 50 years), tsunami in the Indian Ocean (2004), flooding due to rainfall and other such coastal disasters. Rainfall events from cyclones are likely to become more severe in the future as due to improper drainage system. In this context the city officials have started developing disaster management plans by starting with the installation of the early warning system. The combination of densely populated areas in Chennai and increasing risks of climate related hazards make the city especially vulnerable to disasters. Solving this issue from the neighborhood level will further help in the equitable and collective development of the whole city. For this purpose,

Chepauk area, with its heritage public buildings and a dense residential settlement have been selected as the detailed site for demonstrating the resilience framework strategies.

Fig. 1: Chennai during Floods

It has a decadal growth rate of 25% and is bursting at the seams. The topography of Chennai is divided into: a) small groups of hills on the western part b) middle part consisting of the built up area c) broad sandy beach on the coastal edge. Sand dunes are a part of the ecology of Chennai which helps to prevent sea water intrusion, but the unplanned urbanization today has altered this natural landscape greatly. The mean flood level from the previous cyclones and storm surges range from 6m –10m, see Fig. 1 for Chennai during floods.

The coastal front of Chennai is divided into three geomorphological types: a) Sheltered bay b) Seafront beach c) Coastal marshes. A sheltered bay type consists of breakwaters and a reinforced shoreline, whereas seafront beaches and the coastal marshes (river mouths) have a low elevation and fine sediment soil condition (prone to erosion). High dense residential settlements cover the major part of the coastal edge of the city with a population density of 1, 40,000 persons per sq.km. The average annual growth of traffic in Chennai during 1998- 2008 is in the range of 6% - 17%. This along with the lower percentage of four lane roads in the city is leading to a decreased vehicular speed in core areas. The pedestrian traffic in the CBD ranges from 4200- 1, 20,000 in the peak 12hr period. The lack of adequate facilities for a smooth flow of vehicular and pedestrian traffic in the core areas will make any future evacuation measures difficult in the time of a risk.

Some of the man made reasons for the adverse affect are lack of regulatory frameworks; unplanned cities and urbanization; old building stocks and at risk infrastructure; unauthorized structures; institutional arrangements; inadequate capacities of municipal councils; lack of funding; inadequacy of qualified human resources; and corruption and unlawful activities as major challenges for creating a disaster resilient built environment within Chennai.

In Chennai, there was no pre-existing policy or institutional framework or disaster management plan that could be readily adapted to deal with the aftermath of the 2004 tsunami. Coordination and communication issues arose and the demarcation of responsibilities was unclear. A buffer zone along the coast was at first established but without sufficient community participation so that alternative livelihoods were insufficiently considered for communities resettled further inland.

When exemptions to the buffer zone were subsequently granted to some commercial buildings, this raised suspicions of corruption, was widely criticized and eventually led to the reversal of the buffer zone policy. This U-turn resulted in the abandonment of some donor driven projects and underlined the insufficiency of skills for managing government-donor relations.

Reconstruction efforts for disaster prone victims can be hampered in the means of corruption, inadequate coordination, inexperience of construction management and pressures from government and humanitarian agencies for quick project.e up to the light, you can easily check your margins to see if your print area fits within the space allowed.

3. IMPACTS

The 2015 South Indian floods resulted from heavy rainfall generated by the annual northeast monsoon in November–December 2015. They affected the Coromandel Coast region of the South Indian states of Andhra Pradesh and Tamil Nadu, and parts of Puducherry, with Tamil Nadu and the city of Chennai particularly hard-hit. More than 500 people were killed. With estimates of damages and losses ranging from nearly □200 billion to over □1 trillion the floods were the costliest to have occurred in 2015, and were among the costliest natural disasters of the year in India.

Chennai Corporation officials reported at least 57,000 homes in the city had suffered structural damage, mostly those of working class. Many city neighborhoods, however, remained flooded with some lacking basic necessities due to the uncoordinated distribution of relief materials.

Supplies of basic necessities, including milk, water and vegetables, were affected due to logistical difficulties.

During the December floods in Chennai and the adjoining areas, milk packets sold for □100, five times more than their usual cost.

Water bottles and cans were sold at prices between □100 to □150.

Vegetables were sold at least □10 to □20 over and above their normal average cost at the wholesale level. Apart from basic necessities, fuel supplies and travel were greatly affected, especially in Chennai. Numerous accounts of price-gouging were reported; airfares to and from for most parts of South India peaked to almost 10 times over their normal price. In Chennai, over 1.5 lakh (150,000) street vendors sustained losses of over □300 crore. The persistent rainfall and flooding forced several major automakers in the region, including

Renault, Ford, Nissan and Daimler AG, to temporarily halt production. Industry analysts estimated total industrial losses as a result of the floods to be in the range of □10,000 to □15,000 crore.

4. RELIEF EFFORTS

Tamil Nadu Chief Minister of Tamilnadu announced an initial allocation of □500 crore rupees for relief and relocation, with □4 lakh rupees for each family who had lost relatives in the floods. 12 cyclone shelters were built in Nagapattinam district, while 11 teams of the National Disaster Response Force (NDRF) were dispatched to Tamil Nadu.

The Indian Coast Guard and the three other branches of the Indian Armed Forces conducted rescue operations across Tamil Nadu, Air-dropping 5000 kg of supplies and rescuing 25 stranded people, 40 medical camps and 121 special camps for cattle stock had been constructed and 70 relief camps had distributed 58,000 food packets. Upwards of 5,335 people living in low-lying areas had been evacuated and over 90,000 food packets distributed in 101 relief camps.

The NRDF had deployed 22 rescue teams to Tamil Nadu by the night of 2 December, and had rescued over 500 people. By the evening of 2 December, over 4,500 people had been evacuated to 24 relief camps in Chennai district; with a further 23,000 people in 99 relief camps in Kancheepuram district and nearly 2,000 others in 25 camps in Tiruvallur district. By the afternoon of 3 December, the NDRF said it had rescued over 5,000 people; 11 army columns were in position by the evening. Over 1,500 stranded passengers were evacuated from Chennai International by the evening of 2 December.

People in many localities began draining stagnant water, while government relief efforts were supplemented by thousands of Non Government Organisations (NGO) volunteers and individuals with food packets, drinking water, clothes, blankets and medicines.

In addition, Chief Minister of Tamil Nadu requested Prime Minister to develop a credit and soft loan programme through the Finance Ministry to aid families who had lost personal belongings and household appliances;

It was estimated that an average flood-affected person would require a minimum of □30,000 to be satisfactorily compensated for losses.

Three naval flood relief teams (See Fig. 2), comprising 86 trained swimmers and divers and three officers, were rushed to Tamil Nadu, along with several hundred food packets.

Rainfall gradually becoming less intense, the pace of relief efforts intensified by 5 December. By then, more than 11 lakh (1,100,000) people had been evacuated to safer places and thousands more temporarily housed in relief camps across the city and adjoining districts.

Fig. 2: Indian Navy Support

5. DISASTER MANAGEMENT PLAN

A disaster management plan for Chennai is in the works, following alarm over a series of earthquakes that have recently occurred in Nepal, and the tremors felt in various parts of the country, including here. Chennai is yet to have a comprehensive disaster management plan, which includes predefined roles and responsibilities with specific tasks for each official. The lack of a disaster management plan has previously led to a delay in relief and rescue work after major disasters such as tsunami and flood in the city in 2004. Chennai Corporation has 200 wards covering an area of 426 sq km. "Ward level mapping was done after the tsunami. Some of the earlier works pertaining to mapping for disaster preparedness are not relevant after the boundaries of wards and zones changed following expansion of the city".

Disaster Management plan which is partially implemented is as follows:

A Climate Disaster Resilience Index prepared for Chennai based on the data collected on five elements

- Physical
- Social
- Economic
- Institutional
- Natural

For ten old zones of the Corporation has to be revised for the 15 existing zones.

There is also a need for integrating other local bodies on the outskirts in the disaster management plan. According to a previous study, the coastline from Ennore to Kasimedu Fishing Harbour was found to be safer. The coastline from Cooum River to Kovalam creek was more vulnerable to disasters such as a tsunami.

The plan for disaster management will have a list of low lying areas, slums, persons with disability, senior citizens, pregnant

ladies, cooks, electricians, power cutting tools, ham radios, dilapidated buildings, hospitals and schools.

6. SUGGESTIONS

Flood Proofing: It is combination of structural change and emergency action without evacuation. It provides the raised platform for flood shelters for humans as well as cattle and raising the public utility installation above flood levels.

Flood Plain Management & Zoning: Flood plain zoning in order to restrict the damage occurred due to floods. This is done by determining the locations and the extent of areas which are affected by floods of different magnitudes or frequencies and then to develop such areas where the damage is minimum in case floods do occurs. It is relevant both for unprotected and protected areas.

6.1 Housing reconstruction programme experiences from the case study literature

From the cases of Japan, Gujarat and Bam, the importance of a suitable institutional framework is evident. A dedicated agency at national level with representation and units at state and local government levels should be set up to ensure central co-ordination of and support to the recovery and reconstruction effort. In these case studies, the institutional structures as well as overall guidelines for the planning and implementation of the housing reconstruction programmes were put into effect by legislative acts. Previous disaster experiences were built upon to establish base strategies for the housing reconstruction programmes (Ranghieri & Ishiwatari,2014; Barenstein, 2006; Gharaati & Davidson, 2008; Mahdi & Mahdi, 2011).

In Japan, community involvement in the housing reconstruction planning was emphasized and a zone for reconstruction was established. Reconstruction plans included clear reconstruction schedules with public milestones and specific budgetary provisions for reconstruction were made in a supplementary national budget to secure finance for reconstruction and recovery. State and local governments prepared regional and local recovery plans within the framework of the national plan (Ranghieri & Ishiwatari, 2014).

In the case of Bam, a well-planned reconstruction programme enabled technical and financial monitoring and control. A range of preferred disaster resilient housing models were offered with allowance for design choice. The reconstructed housing conformed with national building codes and implementation took place under rigorous supervision from both agency representatives and the beneficiaries themselves. The locals attained technical knowledge from inspectors due to their close working relationship during the reconstruction and this led to reduced overall housing reconstruction times, higher productivity and better work quality (Gharaati, 2006; Gharaati & Davidson, 2008; Mahdi & Mahdi, 2011).

In Gujarat, five alternative reconstruction approaches were adopted: the owner-driven approach, subsidiary approach, participatory approach, contractor-driven in-situ and contractor-driven ex nihilo approaches. Area authorities for reconstruction and redevelopment were formed in four affected areas to facilitate and monitor reconstruction works. In this case, in light of the limited local capacity, local, international and private donor organisations as well as the beneficiaries themselves were all part of the reconstruction efforts. The private sector was engaged in damage assessment and engineering analysis (Barenstein, 2006).

A new building code was established to ensure the construction of safe buildings. Construction guidelines and procedures for building permissions were established and engineers working for government were appointed for site supervision to ensure for quality control and enforcement of safety standards. These engineers also performed post construction validation and issued completion certificates. Particularly where the owner-driven approach was followed, beneficiaries were involved in the design, cost estimation and directly in the reconstruction works while material and financial support were provided to them. Their engagement was considered to create in them a sense of satisfaction and ownership in the process and in the product and this reportedly led to high levels of satisfaction and construction quality. Local capacities were strengthened through employment opportunities. Training programmes were provided to impart the skills needed for the reconstruction works and the vulnerable and poor were successfully included in the reconstruction initiative (Barenstein, 2006).

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