Natural disaster management in India with focus on floods and cyclones

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Abstract. Disasters are of two major kinds, natural and manmade, and affect the community. Natural disasters are caused by natural earth processes like floods, droughts, cyclones, tsunamis, earthquakes and epidemics. Manmade disasters occur due to chemical spills, accidents, terrorism activities etc. India is prone to almost all the major natural disasters. The high population density combined with poor preparedness, planning and management, and rescue and relief measures inevitably lead to huge losses of lives and property every year in the country. This paper analyses the disaster management policy of India and its implementation using two recent case studies – one where a relative degree of success has been achieved (cyclones) and the other where we are still struggling to have even a basic preparedness system in place (floods).

1. Introduction

The Disaster Management Act, 2005 defines disaster as “a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area”.[1] In this paper, two case studies – cyclones and floods – are taken up for comparison of disaster management strategies adopted in the country and the areas that need improvement are highlighted.

2. Natural disasters

Disasters are of two major types – natural and manmade. As the names imply, natural disasters are caused by the earth’s natural processes that occur on a regular basis whereas manmade disasters are due to human actions. From a larger perspective, no natural process can be a disaster by itself; it just occurs as a result of the causal effects. For example, the movement of plates gives rise to earthquakes and tsunamis; climate processes give rise to cyclones, floods and droughts. These have been occurring and will keep occurring through time. When such a resultant process interacts with the human populations and their belongings so as to cause a widespread loss of lives and property, we call that a disaster. If an earthquake or tsunami occurs in the middle of an ocean and we are not affected by it, we don’t consider that a disaster. Hence, disaster is purely from an anthropogenic point of view, and thus all disasters are “manmade” to a certain extent, as it is we who decide to settle down in the path of a natural process. Apart from that, by our sheer mismanagement of the natural resources, what ought to be a normal event with little consequence sometimes ends up as a disaster, e.g. the floods that recur in...
our cities. Thus, disaster management, in addition to planning, preparedness and mitigation of disasters, should also include proper management of natural resources as a preventive measure including consideration of the consequences of the (mis)management of such resources. Figure 1 shows the natural disasters and their classification (adapted from ASDR 2013 [2]).

Figure 1. Natural disasters and the subgroups (adapted from ASDR 2013).

2.1. Natural disasters in India
As per India’s National Policy on Disaster Management [3], the natural disasters that India is prone to are earthquakes, floods, droughts, cyclones, tsunamis, landslips and avalanches. Almost 59% of India’s landmass is prone to earthquakes; over 12% of land is prone to floods; about 76% of the coastline is prone to cyclones and tsunamis; 68% of the cultivable area is drought-prone; and hilly areas are subjected to wet and dry landslides and avalanches. Around 2% of the GDP is lost due to disasters [4]. Figure 2 shows the relative position of India among the top ten disaster-prone countries in 2013 (adapted from ASDR 2013 [2]). India ranks fifth in the number of incidences (12), but what we should focus is on the importance of the nature of the disaster. Except for countries more prone to earthquakes, most of the disasters are caused by hydrological and meteorological factors, i.e., floods and storms/cyclones.
Figure 2. Percentage distribution of disasters among the top ten countries in 2013 (adapted from ASDR 2013).

Table 1 gives some details of major disasters in India in recent years. Again, we can see that in the last nine years, hydrometeorological factors have caused the worst damage.

| YEAR | PLACE                           | TYPE      |
|------|---------------------------------|-----------|
| 1993 | Latur, Maharashtra              | Earthquake|
| 1999 | Odisha                          | Cyclone   |
| 2001 | Gujarat                         | Earthquake|
| 2003 | India (mainly Andhra Pradesh)   | Heat wave |
| 2004 | Southeast coast                 | Tsunami   |
| 2005 | Kashmir                         | Earthquake|
| 2005 | Maharashtra                     | Flood     |
| 2008 | Bihar                           | Flood     |
| 2009 | 10 states                       | Drought   |
| 2010 | Jammu & Kashmir (J&K)           | Flood     |
| 2013 | Uttarakhand                     | Flood     |
| 2013 | Maharashtra                     | Drought   |
| 2014 | J&K                             | Flood     |
| Every year | Major cities         | Floods    |

Earthquakes of course create huge losses when they occur with high magnitude but they are far fewer in occurrence. Floods, droughts and cyclones, however, occur year after year and cause insidious damage just by the sheer frequency and geographical spread. Climate change is enhancing the risk and unpredictability now. Hence it is very important to focus on implementing preventive and relief measures for these events on a war footing.
3. Disaster management in India

During the British era and post-Independence years, disaster management was largely limited to post-disaster relief works, food-for-work programmes etc., under a Central Relief Commissioner who headed the State Relief Commissioners. A disaster management cell was set up in the 1990s following the declaration of the International Decade for Natural Disaster Reduction by the United Nations. This was later moved to the Ministry of Home Affairs [4].

The National Disaster Management Authority (NDMA) is currently the nodal government agency dealing with disaster management in India. It was created by the Government of India by enacting the Disaster Management Act on 23 December 2005. It is headed by the Prime Minister and oversees the State Disaster Management Authorities (SDMAs) headed by the respective Chief Ministers. The National Institute of Disaster Management (NIDM) for capacity building and National Disaster Response Force (NDRF) for response were also set up subsequently. The primary aim of the NDMA is to lead and implement a holistic and integrated approach to disaster management.

Following the setting up of the NDMA, measures for prevention and mitigation were formulated for the major disasters. The following paragraphs focus on cyclones and floods.

3.1. Cyclones

The almost 8000 km-long Indian coastline is exposed to about 10% of the world’s tropical cyclones. Of these, the majority originate over the Bay of Bengal and strike the east coast. The cyclones bring heavy rains and storm surges into the coastal regions. The major destructive force, however, is the wind that accompanies the cyclone. It causes huge damage. States affected by tropical cyclones in India are Gujarat, AP, Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu.

Mitigation Project was launched by the Ministry of Home Affairs (MHA) covering Odisha and AP to upgrade cyclone forecasting, to track cyclones and provide warning systems. The project also aimed to build capacity and construct cyclone shelters and embankments. The total cost of the project was Rs. 1496.71 crores with 80% assistance from the World Bank and the rest from the two states.

The India Meteorological Department (IMD) is the nodal agency for early warning of cyclones.

Floods

India experiences flood havoc every year due to natural and manmade causes. The total flood affected area is 456.40 lakh ha and an average of 72.75 lakh ha is affected annually [5]. Apart from flooding of river banks during monsoon rains and cloudbursts, the urban cities in the country are increasingly witnessing flooding events leading to huge losses. As per a report in the magazine Down to Earth, 10, 22, 35, 37 and 17+ cities in India bore the brunt of flooding in 2005, 2006, 2007, 2010 and 2014, respectively [6].

The National Flood Risk Mitigation Project was started to mitigate risk, severity and effects of floods.

The Ministry of Water Resources launched the Flood Management Programme (FMP) at a total cost of Rs.8000 crores for the 11th Plan period (2007–12). It aimed to monetarily assist the state governments for undertaking flood management works in critical areas. As of 31 March, 2010, 117 works for 10 states were reportedly complete; 1.33 billion hectares restored and protected, and about 12.89 million people would be rendered safe, according to the report [4]. 42 new flood management schemes were included under the FMP from Assam, Bihar, Goa, Gujarat, J&K, Kerala, Manipur, Odisha, Pondicherry, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal for 2010–11.

The Central Water Commission (CWC) is the nodal agency for flood forecasting and warning. On average, 6000 forecasts are issued during monsoon every year.

4. Case studies

The pre- and post-disaster management strategies adopted for two annually recurrent disasters in India are explained below with case studies.
4.1. Cyclones
Due to more awareness and monitoring of cyclones in the last several years, the track and magnitude are known beforehand and evacuation and relief measures are taken up on a large scale whenever a cyclone is set for landfall along the Indian coast. The deaths due to cyclones have decreased as a result. Cyclone Hudhud that made landfall near Visakhapatnam in Andhra Pradesh (AP) in October 2014 was a very severe cyclonic storm. It impacted AP, Odisha and Chattisgarh. Around 7 lakh people were evacuated prior to landfall and this minimized the death toll to around 100 [7]. The NDRF was massively deployed for rescue and relief operations. The cyclone caused extensive damage to Visakhapatnam city and the neighbouring districts and the total damage is estimated at Rs. 70,000 crore, the highest till date in India. After Cyclone Phailin hit Odisha in 2013, there were reports of looting of relief materials and absence of relief measures. Thus, even though human fatalities have been reduced because of advance information and the steps taken by the government and the people, the destruction of infrastructure in the aftermath of a cyclone has still not been reduced. This leads to the weaker sections of society suffering in the post-disaster scenario.

One of the shocks for India in 2016, especially Chennai, was the Vardah Cyclone [8]. A low pressure area created in Malay Peninsula and the Sumatra region moved towards southeast Bay of Bengal and created the tropical disturbance and then evolved into a cyclone with a maximum wind speed of 192 kmph and impacted AP and TN. Chennai was in the eye of the cyclone. Due to the warning given by the Cyclone Warning Division of India Meteorological Department, over 15 teams of NDRF had been already deployed to the coastal areas of Tamil Nadu and Andhra Pradesh. The cyclone uprooted more than 12,000 trees and disrupted telecommunication in TN and made a landfall in Chennai. Around 20,000 people were evacuated and this minimized the death toll to around 16. The total damage was estimated at Rs. 6,749 crores to the state [9]. The people who were affected by Vardah were also helped by the Indian Armed Forces. The losses were huge but people helped each other to bring up the situation to a normal state.

4.2. Floods
In the first week of September 2014, the Srinagar weather station in J&K recorded more than 500 mm of rainfall [6] leading to disastrous floods, which killed more than 215 people and displaced tens of thousands more in the state. The state emergency forces were ineffectve and people in responsible positions were prominent by their absence. Around 2.5 lakh people were rescued by 30,000 troops of armed forces, the NDRF and the locals. The Central Water Commission (CWC) had no flood forecasts for the state. Infrastructure losses are pegged at Rs. 6,000 crores. Deforestation in the catchment areas of rivers – especially Jhelum, Chenab and Indus – and streams is a big problem in the Kashmir valley. The loss of trees has caused more erosion from catchment areas and raised the riverbeds; consequently the water carrying capacity of the streams and rivers is much reduced leading to breaching of river banks and inundation. Illegal and unplanned construction in the floodplains has altered the natural flow as the existing contour drainage is cutoff. Unplanned road construction in the Himalayas destabilises the upstream slope and chokes the river bed with debris. More importantly, failure to preserve wetlands and lakes has played a major role in ecological degradation as their sponge action is cut off. Wularlake, which was 20,200 ha has been reduced to 2,400 ha and the Dal lake in Srinagar has been shrunk to almost half its size. Almost half of Srinagar’s lakes, ponds and wetlands have been encroached over the years and untreated sewage and sullage are being discharged into it. This has led to eutrophication of water bodies leading to further reduction in storage capacity. Excessive usage of chemical fertilisers in the fruit orchards throughout Kashmir has compounded this problem. Relief measures have been implemented slowly and there is now a fear that the problems will only increase because of the harsh winter. The imminent danger to Srinagar was highlighted in 2010 itself [10] but no action was taken.
The Nov-Dec 2015 floods of Chennai is described as the worst in a century [11]. According to Skymet data, Chennai recorded a whopping rainfall of about 1218.6mm in November 2015. The ensuing flood affected the Coromandel coast of TN and the Union Territory of Puducherry, with the city of Chennai and surroundings particularly hard hit. Urban development that cares little for natural processes has led to many wetlands being built over. In addition, old, underdeveloped civic infrastructure and drainage systems have led to increased flooding in major cities. Earlier, numerous lakes and tanks were built by the rulers, which ensured that excess water from one lake entered the next lake and so on, thus ensuring a good distribution of the excess water and minimum wastage of precious rainwater. As per a CSE report, there were over 600 lakes in Chennai the 1980s, but by 2008 only a few were still in good condition. More than 500 people lost their lives and over 1.8 million people were evacuated with the help of NDRF and Indian Armed Forces during the Chennai floods. The total damage was estimated in the range of Rs. 200 billion to over Rs. 1 trillion [12]. The insurance losses due to the floods were the maximum encountered so far in Chennai.

5. Lapses
The Comptroller and Auditor General’s report [5] on the audit of disaster management found several shortcomings. As can also be seen from the case studies above, the management of disasters has to be thoroughly strengthened from all angles. The following are the major lapses:

SDMAs not fully functional; state disaster response funds mismanaged in many states; state disaster response forces raised only in seven states.

Interference among agencies leading to duplication of same works.

No actionable plan for flood management in the Ministry of Water Resources.

Emergency action plans for only 25% of dams; inflow data for only 0.006% of barrages and reservoirs as of Sep 2011.

No data till date for many rivers; no information on water bodies; no proper monitoring mechanisms in place.

FMP not properly implemented; more than 50% of flood prone areas not protected.

No cyclone-related programs initiated by Ministry of Earth Sciences even though it was identified as the nodal ministry.

Management and mitigation plans not prepared for cyclones.

6. Suggestions for improvement
While it is true that whatever preparation we undertake will not be enough in a catastrophe, we cannot take that as an excuse and not have basic protection measures in place. The majority of India’s natural disasters are annual occurrences – floods, droughts and cyclones – for which, even after so many years after Independence, we donot haveenough planning, protection and relief and rehabilitation. In Chennai, for example, there was excess water in 2015, which not only incapacitated the city but also emptied into the sea. Whereas in 2016, even Cyclone Vardah was not enough to make up for the deficit in the northeast monsoon and the city is staring at one of the worst droughts even before summer has started. The agencies that deal with disaster are found wanting in implementing their responsibilities; there is no coordination among various sectors and agencies; there is no proper control structure; there is lack of communication and information at critical moments. All these and more need to be addressed and steps taken so that when any part of the country encounters a disaster, the suffering of the people is minimised through a strong infrastructure and timely relief and rehabilitation. While there are calls for the Railway Minister to step down owning responsibility for a single accident, no one is held responsible in the aftermath of a disaster. What can we do to change this?

Technically capable people with a set term should be allowed to head NDMA and implement its policies.

The hazards database of the country should be updated as soon as possible with inputs from district and state levels and from field experts and civil society organisations (CSOs).

A chain of command during disasters should exist with powers of implementation.
The agencies at the district and state levels should be trained for effective response measures. The projects undertaken should be finished within deadlines and with strict quality. A nationwide and statewide database of CSOs and individuals experienced with handling disasters should be maintained and their help sought during crises. Private sector should be roped in for implementing pre- and post-disaster measures. Reputed CSOs must be involved from the planning stage itself and provided with necessary wherewithal for their involvement during and after a disaster.

Specific to cyclones and floods:
- Data on river discharges should be collected for all major rivers and should be freely available. Similar data should be provided for all hazards so that more research will be conducted across the country.
- Where long term data is not available, discharges for all rivers should be empirically estimated and probable flood levels in highly populated areas should be identified.
- The existing flood zone maps should be modified to include areas of repeated urban flooding.
- Urbanisation should be planned so that existing water bodies are not destroyed. If possible, restoration of damaged wetlands and water bodies should be taken up on a war footing.
- Desilting of ponds, tanks and other water bodies should be done periodically with the support of CSOs, local people and other stakeholders to maintain their maximum storage capacity.
- In urban areas, choked storm water drains should be cleaned before monsoon starts so that inundation can be avoided.
- Afforestation in the catchment areas should be promoted to prevent siltation of water bodies due to excessive soil erosion.
- Drainage in urban areas should be improved drastically without affecting the existing natural drainage system.
- Stocks of relief materials should be made available in adequate supply and in working condition; looting should be prevented.
- Efforts should be undertaken to minimise infrastructure damage due to cyclones and floods.
- The effects of climate change on the country’s hydrometeorology and coastal processes need to be researched and measures taken accordingly.

7. Conclusions
With the second highest population, increasing urbanisation and added high risk for extreme events, India is in a vulnerable situation of facing disasters year after year. The unplanned and substandard infrastructure combined with poor implementation of planning, relief and rehabilitation measures increases the human, physical and economic losses sustained during and after a disaster. It is high time that we wake up to reality and enforce strict measures to reduce losses on all fronts. Accountability at all levels is the need of the hour. While the economically stronger sections of society will have more resilience in bouncing back to near normalcy from a disaster as a community, it is the economically weaker and vulnerable (elderly people, women, children, and the differently abled) sections that are hit the most during and even many years after a disaster occurs. Care should be taken to see that the weaker sections are also able to recover fast from disasters.

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