

Disaster Management in Flash Floods in Leh (Ladakh): A Case Study

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ABSTRACT

Background: On August 6, 2010, in the dark of the midnight, there were flash floods due to cloud burst in Leh in Ladakh region of North India. It rained 14 inches in 2 hours, causing loss of human life and destruction. The civil hospital of Leh was badly damaged and rendered dysfunctional. Search and rescue operations were launched by the Indian Army immediately after the disaster. The injured and the dead were shifted to Army Hospital, Leh, and mass casualty management was started by the army doctors while relief work was mounted by the army and civil administration. **Objective:** The present study was done to document disaster management strategies and approaches and to assess the impact of flash floods on human lives, health hazards, and future implications of a natural disaster. **Materials and Methods:** The approach used was both quantitative as well as qualitative. It included data collection from the primary sources of the district collectorate, interviews with the district civil administration, health officials, and army officials who organized rescue operations, restoration of communication and transport, mass casualty management, and informal discussions with local residents. **Results:** 234 persons died and over 800 were reported missing. Almost half of the people who died were local residents (49.6%) and foreigners (10.2%). Age-wise analysis of the deaths shows that the majority of deaths were reported in the age group of 25–50 years, accounting for 44.4% of deaths, followed by the 11–25-year age group with 22.2% deaths. The gender analysis showed that 61.5% were males and 38.5% were females. A further analysis showed that more females died in the age groups <10 years and ≥50 years. **Conclusions:** Disaster preparedness is critical, particularly in natural disasters. The Army's immediate search, rescue, and relief operations and mass casualty management effectively and efficiently mitigated the impact of flash floods, and restored normal life.

Keywords: Disaster management, humanitarian assistance, mass casualty management

Introduction

In the midnight of August 6, 2010, Leh in Ladakh region of North India received a heavy downpour. The cloud burst occurred all of a sudden that caught everyone unawares. Within a short span of about 2 h, it recorded a rainfall of 14 inches. There were flash floods, and the Indus River and its tributaries and waterways were

overflowing. As many as 234 people were killed, 800 were injured, and many went missing, perhaps washed away with the gorging rivers and waterways. There was vast destruction all around. Over 1000 houses collapsed. Men, women, and children were buried under the debris. The local communication networks and transport services were severely affected. The main telephone exchange and mobile network system (BSNL), which was the lifeline in the far-flung parts of the region, was completely destroyed. Leh airport was flooded and the runway was covered with debris, making it non-functional. Road transport was badly disrupted as roads were washed away and blocked with debris at many places. The civil medical and health facilities were also severely affected, as the lone district civil hospital was flooded and filled with debris.

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Materials and Methods

The present case study is based on the authors' own experience of managing a natural disaster caused by the flash floods. The paper presents a firsthand description of a disaster and its prompt management. The data was collected from the records of the district civil administration, the civil hospital, and the Army Hospital, Leh. The approach used was both quantitative as well as qualitative. It included data collection from the primary sources of the district collectorate, interviews with the district civil administration and army officials who organized rescue operations, restoration of communication, and transport, mass casualty management, and informal discussions with local residents.

Disaster management strategies

Three core disaster management strategies were adopted to manage the crisis. These strategies included: i) Response, rescue, and relief operations, ii) Mass casualty management, and iii) Rehabilitation.

Response, rescue, and relief operations

The initial response was carried out immediately by the Government of India. The rescue and relief work was led by the Indian Army, along with the State Government of Jammu and Kashmir, Central Reserve Police Force (CRPF), and Indo-Tibetan Border Police (ITBP). The Indian Army activated the disaster management system immediately, which is always kept in full preparedness as per the standard army protocols and procedures.

There were just two hospitals in the area: the government civil hospital (SNM Hospital) and Army Hospital. During the flash floods, the government civil hospital was flooded and rendered dysfunctional. Although the National Disaster Management Act⁽¹⁾ was in place, with the government civil hospital being under strain, the applicability of the act was hampered. The Army Hospital quickly responded through rescue and relief operations and mass casualty management. By dawn, massive search operations were started with the help of civil authorities and local people. The patients admitted in the civil hospital were evacuated to the Army Hospital, Leh in army helicopters.

The runway of Leh airport was cleared up within a few hours after the disaster so that speedy inflow of supplies could be carried out along with the evacuation of the casualties requiring tertiary level healthcare to the Army Command Hospital in Chandigarh. The work to make the roads operational was started soon after the disaster. The army engineers had started rebuilding the collapsed bridges by the second day. Though the

main mobile network was dysfunctional, the other mobile network (Airtel) still worked with limited connectivity in the far-flung areas of the mountains. The army communication system was the main and the only channel of communication for managing and coordinating the rescue and relief operations.

Mass casualty management

All casualties were taken to the Army Hospital, Leh. Severely injured people were evacuated from distant locations by helicopters, directly landing on the helipad of the Army Hospital. In order to reinforce the medical staff, nurses were flown in from the Super Specialty Army Hospital (Research and Referral), New Delhi, to handle the flow of casualties by the third day following the disaster. National Disaster Cell kept medical teams ready in Chandigarh in case they were required. The mortuary of the government civil hospital was still functional where all the dead bodies were taken, while the injured were handled by Army Hospital, Leh.

Army Hospital, Leh converted its auditorium into a crisis expansion ward. The injured started coming in around 0200 hrs on August 6, 2010. They were given first aid and were provided with dry clothes. A majority of the patients had multiple injuries. Those who sustained fractures were evacuated to Army Command Hospital, Chandigarh, by the Army's helicopters, after first aid. Healthcare staff from the government civil hospital joined the Army Hospital, Leh to assist them. In the meanwhile, medical equipment and drugs were transferred from the flooded and damaged government civil hospital to one of the nearby buildings where they could receive the casualties. By the third day following the disaster, the operation theatre of the government civil hospital was made functional. Table 1 gives the details of the patients admitted at the Army Hospital.

The analysis of the data showed that majority of the people who lost their lives were mainly local residents (49.6%). Among the dead, there were 10.3% foreign nationals as well [Table 2]. The age-wise analysis of the deaths showed that the majority of deaths were reported in the age group 26–50 years, accounting for 44.4% of deaths, followed by 11–25 year group with 22.2% deaths.

The gender analysis showed that 61.5% were males among the dead, and 38.5% were females. A further analysis showed that more females died in <10 years and ≥50 years age group, being 62.5% and 57.1%, respectively [Table 3].

Victims who survived the disaster were admitted to the Army Hospital, Leh. Over 90% of them suffered traumatic injuries, with nearly half of them being major traumatic injuries. About 3% suffered from cold injuries and 6.7% as medical emergencies [Table 4].

Table 1: Admissions in the Army Hospital, Leh

Items	Army personnel		Paramilitary	Civilian	Total
	Self	Dependents			
No. of casualty reported	11	7	2	529	549
No. of patients treated	11	7	2	529	549
No. of admissions	11	7	2	108*	128
No. of major surgeries	0	0	0	16	16
No. of minor surgeries	0	0	0	138	138

*Includes 4 pregnant women who delivered

Table 2: Number of deaths according to status of residence

Status of residence	Frequency	Percent
Foreign nationals	24	10.3
Local residents	116	49.6
Non locals/tourists	76	32.5
Unidentified	18	7.7
Total	234	100.0

Table 3: Age and sex distribution of deaths

Age (Years)	Gender				Total	
	Female		Male		No.	Percent
	No.	Percent	No.	Percent		
<10	20	62.5	12	37.5	32	13.7
11–25f	19	36.5	33	63.5	52	22.2
26–50	29	27.9	75	72.1	104	44.4
51+	16	57.1	12	42.9	28	11.9
Age not ascertained	6	33.3	12	66.7	18	7.7
Total	90	38.5	144	61.5	234	100.0

Table 4: Distribution according to nature of casualty among the hospitalized victims

Nature of casualty	Frequency	Percentage
Traumatic injuries		
Major	45	43.3
Minor	49	47.1
Total	94	90.4
Cold injuries	03	2.9
Medical emergencies	07	6.7
Total	104*	100.0

*Does not include 4 pregnant women who were admitted after flash floods

Rehabilitation

Shelter and relief

Due to flash floods, several houses were destroyed. The families were transferred to tents provided by the Indian Army and government and non-government agencies. The need for permanent shelter for these people emerged as a major task. The Prime Minister of India announced Rs. 100,000 as an ex-gratia to the next of kin of each of those killed, and relief to the injured. Another Rs. 100,000 each would be paid to the next of kin of the deceased from the Chief Minister's Relief Fund of the State Government.

Supply of essential items

The Army maintains an inventory of essential medicines

and supplies in readiness as a part of routing emergency preparedness. The essential non-food items were airlifted to the affected areas. These included blankets, tents, gum boots, and clothes. Gloves and masks were provided for the persons who were working to clear the debris from the roads and near the affected buildings.

Water, sanitation, and hygiene

Public Health is seriously threatened in disasters, especially due to lack of water supply and sanitation. People having lost their homes and living in temporary shelters (tents) puts a great strain on water and sanitation facilities. The pumping station was washed away, thus disrupting water supply in the Leh Township. A large number of toilets became non-functional as they were filled with silt, as houses were built at the foothills of the Himalayan Mountains. Temporary arrangements of deep trench latrines were made while the army engineers made field flush latrines for use by the troops.

Water was stagnant and there was the risk of contamination by mud or dead bodies buried in the debris, thus making the quality of drinking water questionable. Therefore, water purification units were installed and established. The National Disaster Response Force (NDRF) airlifted a water storage system (Emergency Rescue Unit), which could provide 11,000 L of pure water. Further, super-chlorination was done at all the water points in the army establishments. To deal with fly menace in the entire area, anti-fly measures were taken up actively and intensely.

Food and nutrition

There was an impending high risk of food shortage and crisis of hunger and malnutrition. The majority of food supply came from the plains and low-lying areas in North India through the major transport routes Leh–Srinagar and Leh–Manali national highways. These routes are non-functional for most part of the winter. The local agricultural and vegetable cultivation has always been scanty due to extreme cold weather. The food supplies took a further setback due to the unpredicted heavy downpour. Food storage facilities were also flooded and washed away. Government agencies, nongovernmental organizations, and the Indian Army immediately established food supply and

distribution system in the affected areas from their food stores and airlifting food supplies from other parts of the country.

Health

There was a high risk of water-borne diseases following the disaster. Many human bodies were washed away and suspected to have contaminated water bodies. There was an increased fly menace. There was an urgent need to prevent disease transmission due to contaminated drinking water sources and flies. There was also a need to rehabilitate people who suffered from crush injuries sustained during the disaster. The public health facilities, especially, the primary health centers and sub-health centers, were not adequately equipped and were poorly connected by roads to the main city of Leh. Due to difficult accessibility, it took many hours to move casualties from the far-flung areas, worsening the crisis and rescue and relief operations. The population would have a higher risk of mental health problems like post-traumatic stress disorder, deprivation, and depression. Therefore, relief and rehabilitation would include increased awareness of the symptoms of post-traumatic stress disorder and its alleviation through education on developing coping mechanisms.

Economic impact

Although it would be too early to estimate the impact on economy, the economy of the region would be severely affected due to the disaster. The scanty local vegetable and grain cultivation was destroyed by the heavy rains. Many houses were destroyed where people had invested all their savings. Tourism was the main source of income for the local people in the region. The summer season is the peak tourist season in Ladakh and that is when the natural disaster took place. A large number of people came from within India and other countries for trekking in the region. Because of the disaster, tourism was adversely affected. The disaster would have a long-term economic impact as it would take a long time to rebuild the infrastructure and also to build the confidence of the tourists.

The floods put an immense pressure and an economic burden on the local people and would also influence their health-seeking behavior and health expenditure.

Political context

The disaster became a security threat. The area has a high strategic importance, being at the line of control with China and Pakistan. The Indian Army is present in the region to defend the country's borders. The civil administration is with the Leh Autonomous Hill Development Council (LAHDC) under the state government of Jammu and Kashmir.

Conclusions

It is impossible to anticipate natural disasters such as flash floods. However, disaster preparedness plans and protocols in the civil administration and public health systems could be very helpful in rescue and relief and in reducing casualties and adverse impact on the human life and socio economic conditions.⁽²⁾ However, the health systems in India lack such disaster preparedness plans and training.⁽³⁾ In the present case, presence of the Indian Army that has standard disaster management plans and protocols for planning, training, and regular drills of the army personnel, logistics and supply, transport, and communication made it possible to immediately mount search, rescue, and relief operations and mass casualty management. Not only the disaster management plans were in readiness, but continuous and regular training and drills of the army personnel in rescue and relief operations, and logistics and communication, could effectively facilitate the disaster management operations.

Effective communication was crucial for effective coordination of rescue and relief operations. The Army's communication system served as an alternative communication channel as the public communication and mobile network was destroyed, and that enabled effective coordination of the disaster operations.

Emergency medical services and healthcare within few hours of the disaster was critical to minimize deaths and disabilities. Preparedness of the Army personnel, especially the medical corps, readiness of inventory of essential medicines and medical supplies, logistics and supply chain, and evacuation of patients as a part of disaster management protocols effectively launched the search, rescue, and relief operations and mass casualty reduction. Continuous and regular training and drills of army personnel, health professionals, and the community in emergency rescue and relief operations are important measures. Emergency drill is a usual practice in the army, which maintains the competence levels of the army personnel. Similar training and drill in civil administration and public health systems in emergency protocols for rescue, relief, mass casualty management, and communication would prove very useful in effective disaster management to save lives and restore health of the people.⁽²⁻⁴⁾

Lessons learnt and recommendations

Natural disasters not only cause a large-scale displacement of population and loss of life, but also result in loss of property and agricultural crops leading to severe economic burden.⁽³⁻⁶⁾ In various studies,^(3,4,7,8) several shortcomings have been observed in disaster response, such as, delayed response, absence of early warning systems, lack of resources for mass

evacuation, inadequate coordination among government departments, lack of standard operating procedures for rescue and relief, and lack of storage of essential medicines and supplies.

The disaster management operations by the Indian Army in the natural disaster offered several lessons to learn. The key lessons were:

- Response time is a critical attribute in effective disaster management. There was no delay in disaster response by the Indian Army. The rescue and relief operations could be started within 1 h of disaster. This was made possible as the Army had disaster and emergency preparedness plans and protocols in place; stocks of relief supplies and medicines as per standard lists were available; and periodic training and drill of the army personnel and medical corps was undertaken as a routine. The disaster response could be immediately activated.
- There is an important lesson to be learned by the civil administration and the public health system to have disaster preparedness plans in readiness with material and designated rescue officers and workers.
- Prompt activation of disaster management plan with proper command and coordination structure is critical. The Indian Army could effectively manage the disaster as it had standard disaster preparedness plans and training, and activated the system without any time lag. These included standard protocols for search, rescue, and evacuation and relief and rehabilitation. There are standard protocols for mass casualty management, inventory of essential medicines and medical supplies, and training of the army personnel.
- Hospitals have always been an important link in the chain of disaster response and are assuming greater importance as advanced pre-hospital care capabilities lead to improved survival-to-hospital rate.⁽⁹⁾ Role of hospitals in disaster preparedness, especially in mass casualty management, is important. Army Hospital, Leh emergency preparedness played a major role in casualty management and saving human lives while the civil district hospital had become dysfunctional due to damage caused by floods. The hospital was fully equipped with essential medicines and supplies, rescue and evacuation equipments, and command and communication systems.
- Standard protocols and disaster preparedness plans need to be prepared for the civil administration and the health systems with focus on Quick Response Teams inclusive of healthcare professionals, rescue personnel, fire-fighting squads, police detachments, ambulances, emergency care drugs, and equipments.⁽¹⁰⁾ These teams should be trained in a manner so that they can be activated and deployed within an hour following the disaster. "TRIAGE" has to be the basic working principle for such teams.
- Effective communication system is of paramount importance in coordination of rescue and relief operations. In the present case study, although the main network with the widest connectivity was extensively damaged and severely disrupted, the army's communication system along with the other private mobile network tided over the crisis. It took over 10 days for reactivation of the main mobile network through satellite communication system. Thus, it is crucial to establish the alternative communication system to handle such emergencies efficiently and effectively.^(2,11)
- Disaster management is a multidisciplinary activity involving a number of departments/agencies spanning across all sectors of development.⁽²⁾ The National Disaster Management Authority of India, set up under National Disaster Management Act 2005,⁽¹⁾ has developed disaster preparedness and emergency protocols. It would be imperative for the civil administration at the state and district levels in India to develop their disaster management plans using these protocols and guidelines.
- Health system's readiness plays important role in prompt and effective mass casualty management.⁽²⁾ Being a mountainous region, the Ladakh district has difficult access to healthcare, with only nine Primary Health Centers and 31 Health Sub-Centers.⁽¹²⁾ There is a need for strengthening health systems with focus on health services and health facility network and capacity building. More than that, primary healthcare needs to be augmented to provide emergency healthcare so that more and more lives can be saved.⁽⁷⁾
- Training is an integral part of capacity building, as trained personnel respond much better to different disasters and appreciate the need for preventive measures. Training of healthcare professionals in disaster management holds the key in successful activation and implementation of any disaster management plan. The Army has always had standard drills in all its establishments at regular intervals, which are periodically revised and updated. The civil administration and public health systems should regularly organize and conduct training of civil authorities and health professionals in order to be ready for action.⁽¹⁻⁴⁾
- Building confidence of the public to avoid panic situation is critical. Community involvement and awareness generation, particularly that of the vulnerable segments of population and women, needs to be emphasized as necessary for sustainable disaster risk reduction. Increased public awareness is necessary to ensure an organized and calm approach to disaster management. Periodic mock drills and exercise in disaster management protocols in the general population can be very useful.^(1,3,4)

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