II M.Sc FOODS AND NUTRITION

NUTRITION IN EMERGENCIES

SUBJECT CODE: DEFN 34A

UNIT-1

Natural / manmade disasters resulting in emergency situations.

Famine, drought, flood, earthquake, cyclone, war, civil and political emergencies.

Factors giving rise to emergency situation in these disasters.

Illustration using case studies from Indian Subcontinent.

NATURAL/ MANMADE DISASTERS RESULTING IN EMERGENCY SITUATIONS

DEFINITION

A disaster is a serious disruption occurring over a relatively short time of the functioning of a community or a society involving widespread human,material,economic or environmental laws and impacts, which exceeds the ability of the affected community or society to cope using its own resources. A disaster is an event that causes damage, economic disruption, loss of human life and deterioration in health, and the health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area (WHO). Disaster help provide information and services related to the four pillars of all hazards.

In contemporary academia ,disasters are seen as the consequence of inappropriately managed risk. These risks are the product of a combination of both hazards and vulnerability. Hazards that strike in areas with low vulnerability will never become disasters,as in the case of uninhabitated regions .

Developing countries suffer the greatest costs when a disaster hits – more than 95 percent of all deaths caused by hazards occur in developing countries, and loses due to natural hazardsare twenty times greater [as a percentage of GDP] in developing countries than in industrialized countries .

TYPES OF DISASTER

There are two types of disasters manmade and natural.

Natural Disasters

Earthquakes, volcanoes, tidal waves (Tsunamis), cyclones, typhoons, hurricanes and tornadoes, floods, drought and famine, landslides and slip, avalanches, forest fires and ozone depletion are considered as natural disasters.

Manmade Disasters

Devastating fire accidents, explosions (Mumbai explosions, 1993), mining catastrophes

(Hundreds of mine workers will be buried when mines cave in), contamination of air, water and soil (Bhopal tragedy – 1984), large scale traffic accidents and traffic jams, nuclear accidents and wars.

FAMINE

The literal meaning of famine is “extreme inadequacy and the scarcity of food.” Famine is the phenomenon which occurs in a vast terrestrial area due to various environmental and biological reasons. Some of the prime reasons are population imbalance, scarcity of water or lack of rainfall, population imbalance, crop failure, government policies.

Famines in India

Famine in Indian sub-continent is a chronicle feature. Agriculture in India is heavily dependent on a suitable climate. Rains in summer are important for the irrigation of crops. Lack of rainfall and droughts had lead to several famines in India between the 11th and 17th centuries severely.

Notable Famines in India

- Bengal Famine of 1943
- Chalisa Famine of 1783
- Great Bengal Famine of 1770
- Skull Famine of 1791
- Orissa Famine of 1866
- Deccan Famine of 1630
- Bihar Famine of 1873
- Agra Famine of 1837

These famines caused a widespread scarcity of food and were responsible for numerous deaths across the country. The most significant famines in this list are the great Bengal famine of 1770 caused around 10 million deaths, skull famine or Doji bara famine caused 11 million deaths and Chalisa famine which also caused 11 million deaths approximately.

Causes of Famines

Natural Causes

- Floods, cyclone, storms
- Droughts
- Earthquake

Droughts cause extreme scarcity of water and thus results in crop failure. On the other hand, floods and earthquakes can destroy crops or food storage places. These all result in food scarcity and eventually famines.

Man-made Reasons

- Lack of food (due to no crop failure or no storage of food)

- No proper food distribution in certain regions
- Consumption of contaminated water and air. Crop irrigation impossible in such situations.

There were various famines that were man-made. Grabbing land, wars and improper administration were the main reasons for many of the famines in recent history.

Effects of Famines

Starvation is nothing but the biological consequences of a continuous scarcity of food. During the famine, starvation occurs on a mass scale.

Various diseases occur in the human body during famine-like cholera. It is caused by bacteria, *Vibrio cholerae*, which leads to an increased amount of water to be released from cells that line the intestines. Symptoms include watery diarrhoea, abdominal cramps, dry, mucous membranes, mouth, and skin, excessive thirst and lethargy.

Dropsy, which is now referred to as oedema is caused due to excessive fluid under the skin, the body swells. The affected area often retains a dimple after being pressed for a few seconds.

Dysentery is another bacterial disease which spreads through water, stool, and food. Poor sanitation, contaminated food and water and crowded living conditions lead to dysentery. Symptoms include blood in the stool, abdominal pain, diarrhoea, and fever.

Another notable condition is anaemia. There can be a lot more diseases that are caused due to famines. Apart from diseases, famines also cause lower fertility rates, poor living conditions, fewer income options, various socio-political issues, etc.

Prevention of Famine

Since famine is majorly caused due to natural reasons, it is difficult to prevent it. However, there are certain ways of controlling the effects of famine.

- There should be surplus agricultural production beyond the requirements of the rural population.
- The transportation system should be well-developed between rural and urban areas.
- There should be proper health care, clean drinking water and sanitation facilities to prevent any diseases.

Drought

Definition

Most people think of a drought as a period of unusually dry weather that persists long enough to cause problems such as crop damage and water supply shortages. But because dry conditions develop for different reasons, there is more than one definition of drought.
"Drought is caused by not only lack of precipitation and high temperatures but by overuse and overpopulation," said David Miskus, a drought expert and meteorologist at the National Oceanic and Atmospheric Administration's (NOAA) Climate Prediction Center.

In the 1980s, two researchers uncovered more than 150 published definitions of drought which they published in the journal Water International. In an effort to bring some order to measuring drought, the scientists grouped the definitions into four basic categories: meteorological, hydrological, agricultural and socioeconomic. The first three descriptions track drought as a physical phenomenon. The last category deals with drought as a supply-and-demand problem, through the impacts of water shortfalls.
These definitions usually specify the beginning, end and degree of severity of drought by comparing the precipitation over a certain time period to a historical average. Scientists include both rain and snow in precipitation measurements, because some U.S. regions, such as the mountainous West, rely on winter snow for much of their yearly water.
Here are descriptions of the four main categories of drought:

Meteorological drought is specific to different regions, depending on the amount of yearly precipitation that's average for that area. For example, the southwest portion of the United States averages less than 3 inches (7.6 centimeters) of precipitation per year, while the Northwest gets more than 150 inches (381 cm) per year, according to the U.S. Department of Interior. A decrease in precipitation compared to the historical average for that area would qualify as a meteorological drought.

Agricultural drought accounts for the water needs of crops during different growing stages. For instance, not enough moisture at planting time may hinder germination, leading to low plant populations and a reduction in yield.

Hydrological drought refers to persistently low water volumes in streams, rivers and reservoirs. Human activities, such as drawdown of reservoirs, can worsen hydrological droughts. Hydrological drought is often linked with meteorological droughts
.
Socioeconomic drought occurs when the demand for water exceeds the supply. Examples of this kind of drought include too much irrigation or when low river flow forces hydroelectric power plant operators to reduce energy production.

Tracking drought

In the United States, the Palmer Drought Severity Index (PDSI, weekly index from CPC shown), devised in 1965, was the first comprehensive drought indicator. It is considered most effective for unirrigated cropland. The PDSI combines temperature, precipitation, evaporation, transpiration, soil runoff and soil recharge data for a given region to produce a single negative number that indicates drought conditions.
This index serves as an estimate of soil moisture deficiency and roughly correlates with drought severity. The PDSI is the most commonly used index for drought monitoring and research. It has been widely used in tree-ring-based reconstructions of past droughts in North America and other regions.
In 1999, the U.S. Drought Monitor replaced the PDSI as the nation's drought indicator.
"One index can't cover the whole United States," Miskus said. "The Drought Monitor uses a lot of different tools to assess drought."

The nationwide Drought Monitor categorizes drought into five levels of severity:

- abnormally dry (category D0, corresponding to a PDSI between -1.0 and 1.9)
- moderate drought (D1, PDSI between -2.0 and -2.9)
- severe drought (D2, PDSI between -3.0 and -3.9)
- extreme drought (D3, PDSI between -4.0 and -4.9)
- exceptional drought (D4, PDSI between -5.0 and -5.9)

History of U.S. droughts

In the United States, the most devastating drought on record occurred in the 1930s during the so-called "Dust Bowl" years. According to the National Climatic Data Center, the drought affected almost the entire Plains region and covered more than 60 percent of the country at its peak in July 1934. It caused the migration of millions of people from the Plains to other parts of the country, especially the West Coast.

Researchers think a high-pressure ridge over the West Coast deflected moisture-bringing storms in 1934, causing the severe Dust Bowl droughts. This ridging pattern has been in place during some of the West's worst droughts, such as the 1976 and 2013 California droughts — two of the worst dry spells in the state's history.

Persistent high pressure in the atmosphere curbs cloud formation and leads to lower relative humidity and less precipitation. In the West, prolonged droughts occur when large-scale high-pressure patterns persist for months or more, blocking storms carrying winter rains and snow.

More recent U.S. droughts, such as those of the 1950s, 1988 and 2000, have also had serious economic and societal impacts. Between 1980 and 2014, 16 drought events cost a combined $210 billion in the United States, and thousands of people died due to the effects of drought, according to NOAA.

In June 2012, 55.8 percent of the land in the lower 48 U.S. states was in drought, the highest figure in the history of the U.S. Drought Monitor. As of July 2018, about 38 percent of the contiguous U.S. was categorized as in moderate to extreme drought, according to NOAA.

A dry future?

Drought can be devastating to an area’s economy and dangerous for human health. According to NOAA, droughts cost the United States around $9 billion a year. As the human population increases in arid regions as well as wet ones, so will the demand for water, and — with water supplies dropping at a faster rate — so will the likelihood of drought. In fact, population booms can trigger droughts almost by themselves.

Aside from the human population explosion, global warming also fuels the increased frequency and severity of droughts in many parts of the globe, now and in future. Climate change is a major factor in the western United States’ prolonged and more common droughts, according to NOAA. According to projections by the Intergovernmental Panel on Climate Change, droughts will especially increase in subtropical areas, such as the U.S. southwest, Australia and parts of Africa and Europe, as Earth's warming causes more evaporation and shifts weather patterns, pushing the paths of storms that bring thirst-quenching rains farther north. The Union of Concerned Scientists noted that climate change can also lead to more precipitation occurring as rain instead of snow. This can lead to flooding and quick runoff instead of slow absorption that is needed in dry areas.

Additional resources

- See the National Drought Summary for the current day.
- Get more drought information at the National Weather Service's Climate Prediction Center.
- Find out whether drought is affecting your area at the U.S. Drought Portal.
- UNICEF's list of counties currently affected by drought
- Reducing Poverty, Protecting Livelihoods and Building Assets in a Changing Climate Social Implications of Climate Change in Latin America and the Caribbean

Flood

Floods – Definition and Different Causes of Floods

Flood is a term used to denote an enormous amount of water. When there is an outflow of water in a place, it is said to be flooded. The situation caused when the water becomes uncontrollable is said to be flooded. The flood may take different forms such as in the form of heavy rainfall when there is a breaking of the dam. Furthermore, the melting of snow also leads to flooding. Floods lead to an overfull and huge spread of water but are not considered safe for the purpose of drinking. Thus floods bring with them a number of diseases such as typhoid, cholera and many others. Here, we shall discuss the various causes of floods.

Causes of Floods

Flood is usually a result of natural causes. It may also be caused by man-made factors. It causes huge damage to life and property. There are many different causes leading to flooding. Some prominent among them include:

Massive Rainfall

Drainage systems and the effective infrastructure design aid during heavy rains. They help the drainage of excess water into reservoirs in an easy way. But in cases of heavy rainfall, the systems stop working. Thus flood is caused.

Overflowing of the Rivers

The people living along the river always have a risk of life from the overflowing of the Rivers. To prevent such a situation, a string of dams are built. However, if these dams are not managed properly, they may cause flooding and huge damage.

Collapsed Dam

In the event of huge rainfall, the dams built begin to collapse. Thus, causing the flood situation to become even critical for the people living around.

Snowmelt

At the time of the high melting of snow due to heavy precipitation and other factors, the situation of flooding arises. Adopting sustainable measures for heavy precipitation can help in dealing with the flooding situation.

Deforestation

The cutting of trees in a reckless manner i.e. deforestation is also a major cause of man-made flooding. Trees prevent soil erosion and also the loss of crops. The vegetation is also enriched as a result of more and more trees. This also blocks the massive flow of rain, thus preventing flooding.

Climate change

The climatic changes caused due to human practices also add to the risk of flooding. Human beings cut trees in a large number, thus affecting the process of photosynthesis. Thus increased level of carbon-di-oxide in the atmosphere cause changes in climate posing threats of natural disasters like floods etc.

Emission of Greenhouse Gases

The burning of fossil fuels, the industrial influences, the pollution all is depleting the level of the ozone layer and increasing the level of greenhouse gases, becoming a major cause of man-made flooding.

Other Factors

The broken supply lines cause the outflow of water but lead to less damage. Also, there is water flow from the washing machines. Furthermore, overflow from dishwashers worsens the situation. Also, the lack of proper sewage systems adds to the destruction of this natural disaster.

Thus, a flood can be caused both due to natural causes as well as it can be a human-made flood.

Flood causes a huge loss of life and property. Waterborne diseases spread as a result of Floods causing health problems. Moreover, the destruction of roadways and infrastructure facilities, the disturbance of ecosystems, improper sewage systems all demand serious efforts of adopting sustainable measures.

Taking steps such as afforestation, decreased the emission of harmful gases into the atmosphere could help. Also, enrichment of vegetation, fewer deeds causing pollution and treatment of sewage could be useful ways to combat the situation.

Earthquakes

Earthquakes are caused by the movement of the Earth's plates. Discover how to measure the strength of an earthquake and the effects that major earthquakes have had.

Factors affecting the impact of an earthquake

- Distance from the epicentre - the effects of an earthquake are more severe at its centre.
- The higher on the Richter scale, the more severe the earthquake is.
- Level of development (MEDC or LEDC) - MEDCs are more likely to have the resources and technology for monitoring, prediction and response.
- Population density (rural or urban area). The more densely populated an area, the more likely there are to be deaths and casualties.
- Communication - accessibility for rescue teams.
- Time of day influences whether people are in their homes, at work or travelling. A severe earthquake at rush hour in a densely populated urban area could have devastating effects.
- The time of year and climate will influence survival rates and the rate at which disease can spread.

Earthquakes and volcanoes in LEDCs

LEDCs often suffer more from the effects of volcanoes and earthquakes than MEDCs.

The effects of an earthquake or a volcano in LEDCs

- Communication systems may be underdeveloped, so the population may not be well educated about what to do in the event of a volcanic eruption or an earthquake.
- Construction standards tend to be poor in LEDCs. Homes and other buildings may suffer serious damage when a disaster occurs.
- Buildings collapsing can cause high death tolls.
- Evacuation and other emergency plans can be difficult to put into action due to limited funds and resources.
- Clearing up can be difficult. There may not be enough money to rebuild homes quickly and safely. Many people could be forced to live in emergency housing or refugee camps.

Predicting earthquakes

Earthquakes are not as easy to predict as volcanic eruptions. However, there are still some ways of monitoring the chances of an earthquake:

- Laser beams can be used to detect **plate movement**.
- A seismometer is used to pick up the **vibrations** in the Earth's crust. An increase in vibrations may indicate a possible earthquake.

- **Radon gas** escapes from cracks in the Earth's crust. Levels of radon gas can be monitored - a sudden increase may suggest an earthquake.

Preparing for earthquakes

Many of the prediction techniques used to monitor earthquakes are not 100 per cent reliable. Planning and preparing for an earthquake is therefore very important.

- Preparing for an earthquake requires training for people, practising earthquake drills and paying attention to TV and radio
- Emergency kits, first-aid items, blankets and tin food are needed for the aftermath of an earthquake.

Cyclone

In meteorology, the term cyclone can be defined as the rapid inward circulation of air masses about a low-pressure centre which is circling counter-clockwise in the northern hemisphere and clockwise in the southern.

How does a cyclone form?

Cyclones are formed in the low-pressure area. The topography and the intensity as well as frequency of cyclones that could strike a coast decide the vulnerability of the place.

The temperature difference between the warm, rising and the cooler environment led to the rise of air to become buoyant and then moves to upward. Then the high-pressure area fills the air in the low-pressure area. This cycle continues as warm air rises and a low-pressure area filled with cool air. They build up over a period of time. The warm, moist air rises and cools the water in theair and forms clouds. The whole system of clouds and wind spins and grows, fed by the ocean's heat and water evaporating from the ocean surface.

There are six factors responsible for the formation of the cyclone: (1) Sufficient warm temperature at sea surface (2) atmospheric instability (3) impact area of Coriolis force so that low pressure can be developed (4) high humidity in the lower to middle levels of the troposphere
(5) a pre-existing low-level focus or disturbance (6) low vertical wind shear.

Types of Cyclone

1. Tropical Cyclone: It occurs over tropical ocean regions. it is two types- Hurricanes and typhoons. Hurricanes are found in the Atlantic and Northeast Pacific, whereas typhoons are found in the Northwest Pacific. On the basis of intensity and wind speed, this cyclone is classified into five categories- 1, 2, 3, 4 or 5. Category 5 has a wind speed of 155 mph or above.
2. Polar Cyclone: It occurs over Polar Regions of Greenland, Siberia and Antarctica. It is strong during the winter season.
3. Mesocyclone: It is a vortex of air within a convective storm. It is the air that rises and rotates around a vertical axis, usually in the same direction as low-pressure systems in a given hemisphere. These types of cyclones are accompanied by the rotating air within the thunderstorm.

Cyclone Prone area in India

India is highly vulnerable to natural hazards like earthquakes, floods, drought, cyclones and landslides. According to the meteorological department, there are 13 coastal states and Union Territories in India are Cyclone prone region. Four states like West Bengal, Andhra Pradesh, Odisha, Tamil Nadu-and one UT Puducherry on the east coast and Gujarat on the west coast are more vulnerable.

Cyclone Warning System in India

The India Meteorological Department is the nodal agency in India is responsible for meteorological observations, weather forecasting and seismology. A cyclone in the Bay of Bengal is predicted by the Area Cyclone Warning Centres (ACWC) and in the Arabian Sea is predicted by the Cyclone Warning Centre (CWC). Both ACWC and CWC sent their report to the coordinating centre, i.e., National Cyclone Warning Centre (NCWC).

ILLUSTRATION USING CASE STUDIES FROM INDIAN SUBCONTINENT

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. Roadtransport 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.

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 fullpreparedness 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, theother 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.

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 werefilled 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 throughеducation 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 DevelopmentCouncil (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. However, the health systems in India lack such disaster preparedness plans and training . In the present case, presence of the Indian Army that has standard disaster management plans and protocols for planning, training, and regular drills of thearmy 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.

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. In various studies, 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. 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. 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.
- Disaster management is a multidisciplinary activity involving a number of departments/agencies spanning across all sectors of development. The National Disaster Management Authority of India, set up under National Disaster Management Act 2005, 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. Being a mountainous region, the Ladakh district has difficult access to healthcare, with only nine Primary Health Centers and 31 Health Sub-Centers. 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.

- 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 standarddrills in all its establishments at regular intervals, which are periodically revised and updated. The civil administration and public health systems should regularly organize andconduct training of civil authorities and health professionals in order to be ready for action.
- 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.