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CONTENTS

PREFACE

"Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, which results in substantial loss of life or human suffering or damage to, and destruction of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. "

– ***Definition of disaster as per the National Disaster Management Act 2005***

Consciousness about safety is a state of mind and as a society we are not very safety conscious – this attitude is evident in approach to managing disasters too. India is a country that is extremely vulnerable to disasters and the situation is exacerbated by climate change factors, increasing human activity in the fragile eco-systems of the Himalayas and the Western Ghats. In addition, the rapid urbanization is rendering large sections of population vulnerable to industrial disasters.

Given the Hazard Risk Vulnerability profile of the country, sensitization and capacity building of the society at large and that of the government, especially the civil services in particular is a must. And this awareness and sensitization has to come at every level from the political to permanent executive- and from general administration to the line departments.

Disaster Management is slowly emerging as an academic discipline in its own right with institutions like the Tata Institute of Social Sciences awarding a post graduate diploma in Disaster Management, and in the process creating pool of resource persons who can be drawn upon by the states to provide the requisite intellectual capital in this area. These developments notwithstanding, Disaster Management is and will remain an experiential discipline and the best way to learn and to prepare is to draw upon the experiences in handling and managing disasters world over. With the

complexity in governance and the higher vulnerability of populations owing to their concentration on account of urbanization the focus of Disaster Management has shifted from the earlier focus primarily on response and relief to mitigation, prevention and preparedness. Equally important is the Mainstreaming of Disaster Management into the development process and creating a culture & ethos of Preparedness & Prevention across the country. Disaster Management can thus be broadly sub-divided into the following:

- Prevention: Disaster Risk Reduction
- Mitigation
- Response
- Relief and Rehabilitation

From an administrator's standpoint the first two points merit maximum intervention and involvement. In fact, due diligence if carried out in the planning and development stages of the various schemes as far as disaster risks are concerned, can reduce the loss of lives and damages to assets considerably. Even in case of extreme natural calamity like earthquake, cyclone adequate safeguards in planning and construction stage can prevent damages and loss of lives. Best case in point being the Haitian earthquake in 2008 which was 7 in Richter scale caused 160000 casualties whereas Japan routinely experiences shocks and tremors of such magnitude with hardly any damage and destruction. There is a popular saying "earthquakes don't kill people, buildings do". Latur quake of 1993 was not that severe in intensity (5.8 in Richter scale) but killed over 20000 people, most of whom were asleep in their stone houses that abounded in that region. Thus embedding Disaster Risk Reduction in administration is something that should receive a high priority in general administration and line departments.

It is however the response part that gets maximum attention whether one is in the business of disaster management or when is generally looking at the subject. Response is the end result of a prolonged preparation that ideally should go into overall Disaster Management plan. The promptness and effectiveness of response is, quite naturally, a function of training, capacity building and the capability of the responders, especially the state. Therefore a concerted program of the government in this field, from creating

a strong institutional edifice to rendering that edifice capable, has been the need of the hour.

Best Disaster Management is one that we do not hear or read about because in media good news is no news and bad news is good news, and perhaps this is what takes the sheen off Disaster Management: it just does not elicit good PR: how many of us know cyclone Nilam or Thane being as severe in intensity as the 1999 super cyclone of Orissa? But because of advance warnings and preparations Nilam and Thane caused far less casualties and destruction and that is probably why media did not cover it as extensively as it did in case of Orissa.

Disaster Management, though an important function of state, is not a very popular discipline or an important department, as is evident from lack of interest of the higher bureaucracy. Normally, the Secretary in-charge is a reluctant fellow, who has the charge virtually thrust upon him. This is quite ironical because India has one of the most comprehensive legislation in Disaster Management anywhere in the world. The National Disaster Management Act 2005 addresses the issues of scope, definition, institutional chain of command and accountability quite unequivocally and exhaustively. The institutional edifice that the act provides- the three tier structure- fits in seamlessly with India's administrative structure. Yet growth and capacity building in this area have been haphazard. Our response and preparedness, in most states (with the exception of Gujarat, Tamil Nadu, Andhra Pradesh and a few North Eastern states) has been tardy. There is delay in response and more importantly inadequacy in prevention and mitigation. Most of these lacunae stem from a lack of understanding and capacity and are exacerbated by lack of coordination between departments and organization and the inability to integrate technology. Disaster Management is an emerging discipline and the best way to impart training and awareness is through the medium of live examples and case studies. This is what this journal proposes to attempt: the endeavour has been to pick up case studies from the recent past from different parts of the country. These studies are based on extensive fieldwork and primary data. The range of coverage is vast in its geographical spread: Uttarakhand, Sikkim, Assam and Andaman and Nicobar islands. The disasters covered include floods, cloudburst and flash floods, earthquake and Tsunami. The treatment of post-disaster Relief and Rehab in Nicobar is

a first-hand account of a young administrator, currently working in the capacity of Private Secretary to a Union minister, and holds invaluable lesson for the field officers.

Uttarkashi has witnessed major cloudburst and flash floods year after year. The incident referred to in this journal is the flash flood of 2012. Although conclusive evidence is yet to be clinched, the rapid climate change is said to be a major cause in the aberrations in precipitation in the Himalayas and this has been compounded by uncontrolled human activity in the region necessitating urgent interventions by the state.

The case study of North Sikkim, prepared jointly by Assistant Professor CDM Dr Indrajit Pal and the then District Magistrate North Sikkim Sh Aunjaneya Kumar Singh highlight the practical issues in the initial post-disastert reponse and underscores the invaluable need for a viable District Disaster Management Plan (DDMP) and safety drills especially in remote areas.

Brahmaputra valley is one of the chronic flood prone areas in the world. The annual frequency of floods over so many years has resulted in a rich institutional memory of flood management by the administration; with the result that the state machinery with the help of remote sensing technology, is able to plan for the contingencies better. But then is recurrence is so widespread the issue warrants a more in depth look at long term planning and resettlement of the population.

In this effort of CDM an attempt has been to compile a practical reference journal with inputs from the members of CDM and significantly the young administrators in the field. It should be a guide and an enabler for the young Officer Trainees to get a feel of what a disaster is like. Thus a deliberate effort has been to avoid making it too academic and pedantic.

Learnings from each of the cases reinforces the need for greater sensitization and capacity building of the field level officers and the need for integration of plans with the aim of bringing all stakeholders on the same page as far as managing/mitigating disasters is concerned.

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Earthquake & Tsunami Relief Work in Nicobars District of the UT of Andaman & Nicobar Island; How an Officer at Senior Position is Expected to Function – A Case Study

A. Anbarasu*

Introduction

The Andaman and Nicobar Islands (A & N Islands) are a group of islands at the juncture of the Bay of Bengal and Andaman Sea, and are a Union Territory of India. It comprises two island groups, the Andaman Islands and the Nicobar Islands, separated by the 10° N parallel, with the Andamans to the north of this latitude, and the Nicobars to the south. The Andaman Sea lies to the east and the Bay of Bengal to the west. The territory's capital is the Andamanese town of Port Blair. There are 572 islands in the territory and of these, about 34 are permanently inhabited. The total land area of the territory is approximately 7,950 km^2 (3,070 sq mile). There are three Districts, namely, North Andaman, South Andaman and Nicobar. The capital of Nicobar District is Car Nicobar (Fig 1).

As per 2011 Census of India, the population of the Union Territory of Andaman and Nicobar Islands was 379,944, of which 202,330 (53.25%) were male and 177,614 (46.75%) were female. Only 10% of the population lives in Nicobar islands.

The major languages spoken in the Andamans in numerical order are Bengali (32.6%), Tamil (27.61%), Hindi (22.95%), and Telugu (14.84%). Andaman Creole Hindi is widely used as a trade language in the Andamans. Presently

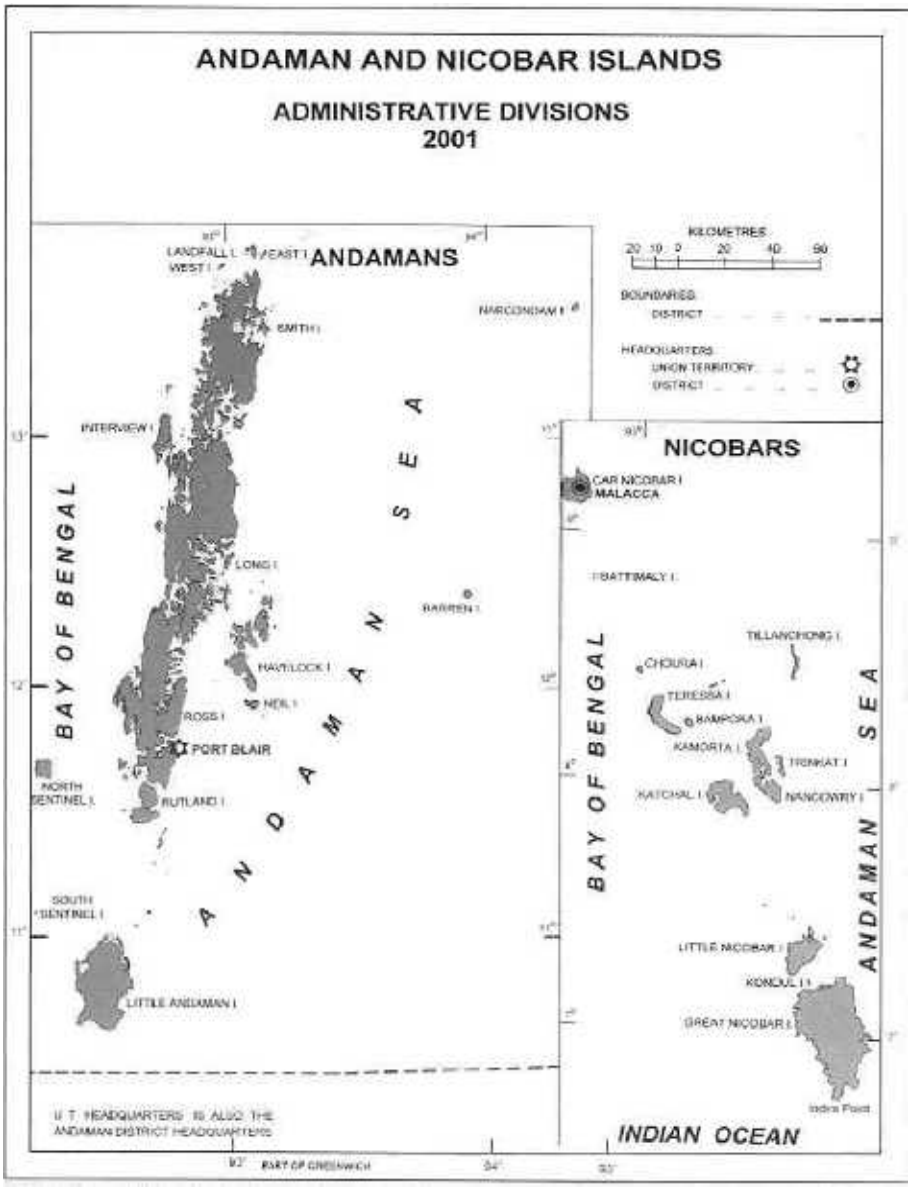

Fig 1: Schematic map of Andaman and Nicobar

there remain only approximately 400-450 indigenous Andamanese in the Andaman islands, including the Great Andaman, Onges, Jarawa and Sentinelese with Sentineles maintaining a steadfast independence. In the Nicobar islands, the indigenous people are the Nicobarese, or *Nicobari,* living throughout many of the islands; and the Shompen, restricted to the hinterland of Great Nicobar Islands.

Nicobars District is a tribal district and is governed by the Provisions of Protection of Aboriginal Tribes (Regulation) 1956. Entry in to the District is restricted and permission to enter the Districts granted under the Regulation provisions.

History of A&N Islands

The islands have been inhabited for several thousand years, at the very least. Genetic and cultural studies suggest that the indigenous Andamanese people may have been isolated from other populations since the Middle Paleolithic. In that time, the Andamanese have diversified into distinct linguistic, cultural and territorial groups.

The Nicobar Islands appear to have been populated by people of various backgrounds. At the time of the European contact, the indigenous inhabitants were the Nicobarese people, speaking a Mon-Khmer language; and the Shompen, whose language is of uncertain affiliation. Both are unrelated to the Andamanese.

In the pre-colonial era Rajendra Chola I, one of the Tamil Chola dynasty kings, occupied the Andaman and Nicobar Islands to use them as a strategic naval base to launch a naval expedition against the Sriwijaya Empire (a Hindu-Malay empire based on the island of Sumatra, Indonesia). They called the islands Tinmaittivu ("impure islands" in Tamil). The islands provided a temporary maritime base for ships of the Marathas in the 17th century. The legendary admiral Kanhoji Angre established naval supremacy with a base in the islands and is credited with attaching those islands to India.

Looking at the Colonial period, the history of organized European colonization on the islands began when the Danish settlers of the Danish East India Company arrived in the Nicobar Islands in 1755. On January 1, 1756, the Nicobar Islands were made a Danish colony, first named New Denmark, and later (December 1756) Frederick's Islands.

From 1778 to 1784, Austria mistakenly assumed that Denmark had abandoned its claims to the Nicobar Islands and attempted to establish a colony on them renaming them Theresia Islands. In 1789 the British set up a naval base and penal colony on Chatham Island next to Great Andaman, where now lies the town of Port Blair. Denmark's presence in the territory ended formally on 16 October 1868 when it sold the rights to the Nicobar Islands to Britain, which made them part of British India in 1869. In 1858 the British again established a colony at Port Blair, which proved to be more permanent. The primary purpose was to set up a penal colony for dissenters and independence fighters from the Indian subcontinent. In 1872 the Andaman and Nicobar islands were united under a single chief commissioner at Port Blair.

During World War II, the islands were practically under Japanese control, only nominally under the authority of the Arzi Hukumate Azad Hind of Netaji Subhas Chandra Bose. Bose visited the islands during the war, and renamed them as "Shaheed-dweep" (Martyr Island) and "Swaraj-dweep" (Self-rule Island). The islands were re-occupied by British on 7 October 1945, to whom the remaining Japanese garrison surrendered.

At the independence of both India (1947) and Burma (1948), the departing British announced their intention to resettle all Anglo-Indians and Anglo-Burmese on the islands to form their own nation, although this never materialized. It became part of the Indian union in 1950 and was declared a union territory in 1956.

An insight into Earthquake and Tsunami- 2004's Twin Tragedy and its Impacts

"Most terrifying natural hazard", as Tsunamis are often referred to, have impacted the socio-economic and cultural life of humans wherever they struck. The earth is made up of bigger and smaller plates and movement of Plates is a part of the dynamics of earth which is called "Plate Tectonics". Along the compression Zones of Plates, over a period of years, due to movement of Plates, large amount of energy is accumulated and, beyond a point, sudden displacement of Plates occur resulting in Earthquake and resultant Tsunami if the epicenter is below sea. The 9.3 magnitude earthquake occurred in the vicinity of seismically active Indo-Burma plate close to Sunda Trench relatively at a depth of 1400 meters in the morning of

26th December, 2004 caused catastrophe in the Indian Ocean rim zone cutting across National and Geographical boundaries in the form of a killer Tsunami. More than 2,76,000 people lost their lives in the tragedy. Though more than 13 Tsunamis have been recorded in the last three hundred years in the Indian Ocean region, out of these, three had occurred closer to Andaman Nicobar region prior to 26 December, 2004; the first one being on 31.12.1881 having Car Nicobar Islands as source location having a magnitude of 7.9 in Richter Scale. The second seaquake generating Tsunami had occurred on 26.6.1991 in Andaman Sea (7.7 in Ritcher Scale). The third one is under discussion in the present write-up. The most destructive Tsunami in Indian Ocean prior to the one occurred on 26.12.2004, is believed to have occurred in August, 1883 resulting in 100 ft. Tsunami killing roughly about 36000 people living in and around Java and Sumatra.

On 26 December 2004 the coasts of the Andaman and Nicobar Islands were devastated by a 10 m (33 ft) high tsunami following the 2004 Indian Ocean Earthquake. The high intensity earthquake rattled the buildings to such a great extent that many buildings either collapsed or got cracks in the process. The high intensity Tsunami following the earthquack further brought down the weak structures. More than 2,000 people were confirmed dead, more than 4,000 children were orphaned or suffered the loss of one parent, and a minimum of 40,000 people were rendered homeless. At the Southern most tip of Nicobar District, the Indira Point, subsided 4.25 m and was partially submerged in the ocean. The territory lost a large amount of area which is now submerged. The territory which was at 8,249 km2 (3,185 sq miles) is now merely at 7,950 km2 (3,070 sq miles), a reduction of 299 sq. km. While newer settlers of the islands suffered the greatest casualties from the tsunami, most of the aboriginal people survived because oral traditions passed down from generations ago warned them to evacuate from large waves that follow large earthquakes.

Studies have releaved that the killer seaquake of 26th December, 2004 had its epicenter at the interface of Burma Plate(inclusive of Andaman and Nicobarridge) and India Plate and in the process Indian Plate sub-ducted under the Burma Plate. Studies further revealed that Tsunami waves generating out of earthquake propagate comparatively more in strength in

east-west direction than the north-south direction. Since Nicobars District was closer to epicenter as compared to the Andaman District, the Tsunami waves struck Nicobars District within a few minutes after the earthquake at 06.29 Hrs on 26th December, 2004, whereas the first water level rise in South Andaman was reported only at 06.50 Hrs.

The impact of Tsunami on Andaman group of islands was less as compared to Nicobars District due to less intensity of Tsunami waves and due to longer distance from the epicenter. Though very few losses of lives were reported in the Andaman District damages to fishing vessels and port infrastructure was significant. Nicobars District bore the brunt of the seaquake and Tsunami resulting in loss of life. The smaller size of islands also contributed to wide-spread damage. Most of the villages in Great Nicobar, Little Nicobar, Kondul, Pillomilo, Trinket, Bambooka, Chowra and Car Nicobar islands have been almost wiped out of the map as bulk of the settlements were located closer to the shore. Public infrastructure of these islands had got severely damaged. However, repairs could be made to the jetties of Car Nicobar and Kamorta which enabled commencement of shipping services and berthing of vessels in connection with relief and rehabilitation works. Had there been large scale damages to the above two jetties, probably the entire post Tsunami operations in the Nicobar District would have come to a standstill. Campbell Bay jetty was operated with a pontoon bridge in spite of collapse of the jetty in the middle portion.

Problems before the Administration:

Extent of damage to infrastructure of all the Islands in the Nicobar District was very high. Since most of the islands were located far off and the telephonic link totally cut off, it was feared, initially, that the number of dead and missing would be very high. Since, most of the public fled to forest areas to escape the fury of Tsunami, it took some time for them to approach the Government authority and vice-versa. Power Supply system was damaged heavily and wide spread damage was caused to power houses, transformers, DG sets, T&D system etc. Roads located adjacent to coastal areas bore the brunt of the attack. In Car Nicobar the circular ring road was damaged extensively. Important bridges such as Austin Creek Bridge developed major cracks. In Car Nicobar, bridges located at Passa and Kimous were completely washed away by Tsunami waves. In Nicobar District, extensive damages to water supply network had occurred (Fig 2). Most of the wells located in the

Fig 2: Glimpses of damages at Andaman and Nicobar

erstwhile villages were flooded with sea water, thus making them unfit for consumption.

Out of the total 49 Jettys, 21 had been damaged severely. Malacca Jetty and Tee top Jetty of Car Nicobar were totally damaged and rendered useless. Approach to the Mus Jetty was damaged. In Islands such as Chowra, Teresa and Katchal there was complete collapse of Jetty infrastructure. Due to subsidence of Land mass to roughly about 150 CMs, Jettys at Kamorta and Nancowry had been inundated at many places during high tide time. Damages had been reported to many ships which had been anchored in the Jetty area.

The economy of the Islands was completely crippled and wide spread damages had been caused to the business community. Commercial buildings, mostly located closer to the sea especially in places like Malacca, Big Lapathi etc of Car Nicobar had been razed to ground. In Nicobars District agriculture was mostly coconut based and most of the Coconut trees had been uprooted by killer waves. More than 70% plantation crops had been either permanently or partially damaged. Large scale damages to Fisheries infrastructure and Live Stock in Nicobars District was reported. Further, most of the school buildings and public health centres were damaged due to Tsunami.

Since most of the villages in Nicobars District covering island such as Car Nicxobar, Chowra, Terssa, Katchal, Kondul, Bompooka, Trinket, Pillomillow etc were located within 500 mtrs from shore line, almost all the houses in such locations had been completely damaged and flattened forcing the locals to move to higher elevations.

Inundation of sea water due to subsidence of low mass also posed grave challenges to administration.

Immediate Challenges before the Administration:

The biggest challenge to the Administration in the initial days was the rescue and treatment of the affected persons and to extend immediate relief to the needy.

Immediate Action by the A&N Administration:

Immediately after Tsunami on 26th December, 2004, meetings took place at the level of Lieutenant Governor, Commander-in-Chief of Defence Forces and Chief Secretary in order to coordinate relief and rehabilitation measures

in far away islands such as Car Nicobar, Little Andaman etc., An apex coordination cell was also constituted with senior officers of A&N Administration and A&N Command, which initially functioned from the office of Deputy Commissioner, Andamans. Ships were sailed to various group of southern islands on 27th December, 2004. Marooned Tribals from the islands of Kondul, Pillomillow, Pillopanja, Pillohabhi, Macachav, Peyond and Pilpohuva were taken to the Head Quarters of the Great Nicobar, i.e., Campbell Bay through M.V. Katchal. Stranded locals of Trinket islands were taken to Kamorta, as was the case with the locals of Chowra and Bompooka islands, who moved to Teressa islands.

While Defence Aircraft (IL- 76 and AN-32) and Helicopters (MI-8) had been deployed for relief work, they also airlifted stranded locals and Tsunami affected persons. While Helicopters facilitated movement of relief materials and affected persons between Head Quarters and various islands, the Aircrafts airlifted people between mainland and islands and between Car Nicobar, Campbell bay and Port Blair remarkably. During post Tsunami immediate relief operation, about 1,500 sorties of Aircraft were undertaken.

In addition to the A & N Command Defence personnel, more than 2000 personnel of A&N Police, Central Para Military Forces and Indian Reserve Battalion had been deployed for rescue and relief works. They were made into several teams and dispatched to various places, particularly to Southern group of islands where loss of life and damage to infrastructure was the maximum.

There was anxiety among tourists and passengers at the Port Blair Airport, which was understandable due to the trauma faced by the tourists who had come to the islands for a pleasure trip but had to face one of the severest earth quake and Tsunami that mankind had ever anticipated. However, with the limited staff available with Airport authorities and further deployment of personnel by Tourism Department of A&N Administration, the situation was somehow managed but not before seeing the disgruntled protest of stranded passengers. A special Indian Airlines flight was sent to Port Blair from Chennai at 04.30 AM on 27th December, 2004 which reached Port Blair at 06.30 AM. Hundreds of passengers were lined up at the Airport counter to know about the arrangements made for special sorties of Indian airlines. Since, there were flights both from Chennai and Kolkata, separate

arrangements were made for dealing with passengers, destination-wise. Special flights of Alliance Airlines were operated both from Chennai and Kolkata. During their onward journey these special flights carried various types of relief materials and, on their return, took back the stranded tourists and Tsunami affected locals. Within a span of 4 days all the stranded passengers were evacuated.

Response of an IAS officer to the Situation

The officer, an AGMUT Cadre officer of 1996 batch was working in Andaman & Nicobar Island since September, 2003. He, along with his wife and daughter was to catch the morning flight from Chennai to Port Blair on 27th December, 2004 after completing his official tour to Tamil Nadu. He reached Chennai in the early morning of 26th December, 2004 en route to Port Blair. But at about 7.00 AM on 26th December, the Deputy Resident Commissioner of A&N Administration stationed at Chennai knocked at the door of the officer and informed him about a possible earthquake and subsequent ingress of water in the low lying areas of Port Blair and the rest of A & N Island such as Junglighat, Sippighat. etc. He had further stated that there could be some causalities which were yet to be confirmed.

The young IAS officer immediately tried to contact few senior officers in Port Blair and, after repeated attempts, could contact Secretary to Lieutenant Governor who had informed that A &N Islands were rocked by a severe earthquake which shook buildings for a few minutes continuously followed by surging of seawaters. He further stated that there were possibilities of large scale damage to life and property considering the magnitude of the earthquake. The officer sent his wife and child back to his native place and immediately contacted the Chief Secretary assuring him that he would be reaching Port Blair in the first available aircraft so as to be a part of relief and rehabilitation measures. He told his wife that probably he would be deputed to one of the affected areas to tide over the crisis. By the morning of 27th December, 2004, the devastation of Tsunami was visibly felt through the media reports highlighting the death toll in various countries touching hundreds and thousands.

Concern shown by the Officer for others:

On reaching Port Blair on 27th December, the young IAS officer was informed by the Chief Secretary that it had been decided to send him to

Nicobar as Special Relief Commissioner. The Chief Secretary advised him that he should carry drinking water, candles, mosquito coils, mug, torch light etc along with him. The officer had no idea about the availability of accommodation and, as per his statement; he was least bothered about it. He was however, worried about convincing his family about his going to Car Nicobar as Special Relief Commissioner, as the fears were obvious. The officer thought of breaking this news to his family members only at the time of boarding the Special Aircraft to Car Nicobar so that there was no request from the family members to stay back. It could have given real shock to his wife and other family members as going to Car Nicobar at this crucial juncture would have been seen as an adventure and risk from their point of view. In fact, a lot of after-shocks were getting reported from Nicobar District and the situation in Car Nicobar was unclear. Probably the news of his going to Car Nicobar would have shocked everyone at home. The officer had only thing in mind at that point of time and that was when thousands of families were wallowing, there was no point in his thinking about his own family who were hale and healthy. So, he neither thought about his family members nor about his likely central deputation (which was expected at any moment as he had already applied for it) but only for the people having tears in their eyes. The officer travelled by AN-32 Air Force flight which does not have normal seating facilities and a linear bench type structure remains inbuilt with a provision to accommodate 30 persons each side. Having travelled in normal passenger aircrafts in the normal course, the system and facilities available in AN-32 was an eye opener to the officer to learn about how things are managed in difficult circumstances. He thought of the defence personnel who travel in such aircrafts frequently and at time on daily basis. The landing of the aircraft at Car Nicobar Air Force Station at night was also a big challenge when there was no power supply and the airbase area bad been completely devastated by the Tsunami. The officer saw that the Defence personnel had kept kerosene lamps all along the air strip, at regular intervals, on both sides. It was completely dark en route from airbase to open maidan of Car Nicobar Headquarters where thousands of Nicobare refugees were stationed. The officer was moved by the extent of hardship and devastation faced by the island.

For food, the officer, along with all other, also stood in a queue at the Car Nicobar Maidan where a make-shift kitchen was established. Though the

dinner was a simple kichdi (a mix of rice and dal) it gave satisfaction that people were able to have food in the hour of calamity and ration articles had reached the far off island. Then came the problem of accommodation. Since the Government Guest House located in Malacca village, adjacent to sea had been severely damaged, they had to look for accommodation elsewhere. The officer found an abandoned room in the District Hospital at Car Nicobar and stayed there to assist the District Administration. The mosquito menace was very high at that point of time and the officer had neither mosquito net nor coil. At this juncture also the officer kept thinking about affected persons who were sleeping in open places and in make-shift tents.

Initiatives Taken by the Officer while working as Special Relief Commissioner and thereafter as Deputy Commissioner of Nicobar District:

A few instances from his journal are reproduced:

Establishment of Control Room

'Next day, we thought we should prioritize various issues for intervention in Nicobar district and immediately established a Control Room in Car Nicobar which was not in existence. Non- functioning of a Control Room in the office of the Deputy Commissioner was greatly hampering the immediate relief work. There was also a reason for the non-functioning of DC's Office and Control Room. The sea quake preceding the Tsunami had developed major cracks in the office of DC and it was advised that using such a building for office work, when repeatedly there were after-shocks, was not prudent from security point of view. However, when we inspected the building, we found it structurally sound (my graduation as an architect became handy) and decided to establish the control room in the ground floor of the conference hall of the building. We immediately arranged for some tables and chairs and started operating from the make shift control room. Initially, only two officers, including me, mustered courage and started sitting in the control room, whereas most of the Government servants, due to fear of after-shocks, were reluctant to come and sit. This was more due to psychological fear, as they had undergone mental trauma on the fateful day of 26th December, 2004. As the time passed by and considering the brave front put-up by me, officers started coming to the Control Room one by one.'

Allowing Limited Phone Facilities to Everyone

'In addition to the Inmarsat and Iridium satellite phones of Administration, few Inmarsat Phones were mobilized from BSNL and arranged for the public convenience. We had also issued instruction to the effect that Government Phones could also be used for contacting their family members outside and others, but strictly in the late evenings, as the phones would be very busy in the morning on account of official work.'

Making of abandoned vehicles operational

'Arranging transport had become a problem with vehicles either damaged totally or abandoned. However, vehicle was a pre-requisite to move around and monitor relief and rehabilitation work. On 30th morning, I had noticed a Tata Sumo lying abandoned in front of the office of the Deputy Commissioner. When I enquired about the vehicle from the local officers, it was informed that the vehicle belonged to District Rural Development Agency, Car Nicobar and that the key of the vehicle might be available in the office. I had put an official on duty to locate the key immediately so that the vehicle could be put into some productive use. Very few vehicles of local public had escaped the wrath of Tsunami waves and they had been deployed by them for their personal and community requirements. I was so fortunate that the key of the vehicle was located within few hours. Since I know driving very well, I thought it fit not to locate for a driver at that point of time as having a driver would have been considered a luxury. Perhaps had I even located a driver, I would have put him in some constructive use then employing him to drive the Tata Sumo. Self- management, as far as possible, in the hours of crisis is the most needed. We also made efforts to identify abandoned vehicles and after making due entries in the police records, they had been put on the roads to meet the transport requirements.

Bringing back the Transport System in Operation

'There was shortage of vehicles in the islands, both for public and Government transport. Out of the five buses in Car Nicobar two had been completely damaged. Within a few days the remaining three were repaired and made road worthy. Adequate diesel was supplied as part of relief efforts and the same had been used for the plying of buses also. The apex Tribal Cooperative Society of Car Nicobar i.e. Ellon Hinengo Ltd. (EHL) was running

the only petrol pump at Car Nicobar. Immediately after Tsunami, the employees of petrol pump had fled the islands and the unit was kept closed. This necessitated supply of diesel and petrol through the relief supply. Repeated instruction to EHL to open the petrol pump, immediately, couldn't yield any result. Thereafter, it was decided to take over the petrol pump under the provisions of Essential Commodities Act and when Government was about to take over the EHL brought their men and reopened the petrol pump. When Government buses became operative, it was locally decided that they would run free of cost for the benefit of public for a period of a month or so. In addition, clear cut instructions were also issued to the officials who were using Government vehicles to make them available for the public also as and when they were not in use for governmental purpose. Even, during inspections, it was advised to them that they might take public en route, so as to mitigate the problems of public as far as possible. The community also uses bicycles to commute between the places. As Tsunami had greatly damaged many bicycles in most of the villages, the matter was taken up with the Port Blair Centre with a request to dispatch as many bicycles as possible to the Nicobar Group of islands to make the community mobile and independent.

Circulation of Cash restored

The community was further encouraged to retrieve as many items as possible from the erstwhile settlement areas for their needs, for which payment was made out of the funds of District Rural Development Agency (DRDA) of Nicobar District. Though there were no explicit provisions in the schemes for clearance of debris, it was discussed with the community in details that they could no longer reside closer to the sea and that in future they had to stay away from shore area at a relatively higher elevation. In such a scenario, their old settlement areas could be effectively used for establishing shore protection belt and coconut plantations. Since there are provisions in DRDA schemes for clearing of land for plantations, the clearing of debris was shown as clearance of land for coconut plantation and accordingly workers were paid @ Rs.107/-per day fixed for un-skilled labour in Nicobar District. Large number of people from each village had cleaned up the erstwhile damaged villages, as far as possible, and was paid accordingly. This important initiative of Administration in ensuring flow of money into the

system in the initial days had infused much confidence to the tribal leaders and local villagers. The Muster Roll for such works also were maintained by the captains, there by the Administration inculcated a sense of ownership in the minds of public. Extensive tours were undertaken inside the villages mostly on foot and by bikes to enquire from the locals about the reaching out of relief materials as first hand information.

Giving a Fillip to the Craftsmanship of the Local Community

Traditional Nicobarese houses are made of wood and other local materials and the locals excel in wood carpentry. Though they have been housed in tents and make-ship structures, it was thought fit to equip them with tools so that they may retrieve wood from the uprooted trees (particularly Coconut Trees) and build their temporary wooden structure for stay. Carpentry tools and hand held machines were mobilized and provided to them. This move of the administration made them to look forward and resilient. They retrieved wood and logs and started making their own temporary structures to live. For this work, they were also compensated with daily wages under the Rural Development Schemes. After four weeks, the District Administration established a saw mill to process the logs and woods towards community needs.

Introduction of Flexibility in Working Hours

Flexibility was granted to the community in the working hours. Since almost all the locals had been affected by the Tsunami, it was practically impossible to expect them to work from morning till evening routinely as they had to attend their domestic affairs also which was equally important. As such, before the commencement of the work, based on the tentative number of man days, the lump sum amount of money payable for the work was arrived at and depending on the convenience of the locals, they were allowed to carry out the work. But in the process, it was ensured that the total number of eight hours per person, as required for a single day wage, was put in by each individual. The village captains were entrusted with the responsibility of maintaining the muster roll for each work with the support of DRDA personnel. As and when the money was required by the community, the same was released to meet their requirements.

Payment of Cash Relief at the Door-Steps

A & N Administration announced immediate cash relief @ Rs. 2000/- per family. Instead of calling the families to the administrative office of each island, arrangements were made to distribute the same at the door-steps of each family in coordination with the local tribal community. For this, officer from Port Blair were also drawn to coordinate with the Nicobar Administration. Also it was planned to open a branch of the local cooperative bank to handle the work and to enable people to save money, if they so wished.

Meeting with Tribal Council Leaders

For synergizing the relief related efforts, it was decided that a meeting of Tribal Council Leaders might be convened so that details of action taken and proposed to be taken could be discussed with them. This was in addition to village level meetings held by the Deputy Commissioner and other second level officers. Shri Aberdeed Blair, Chief Captain of Tribal Council, Car Nicobar was staying in Sawai camp, deep inside the forest away from the main head quarter. It was felt by the Administration that meeting with Shri Aberdeen Blair would be helpful in sending a strong signal to the community that Administration was very sensitive to the needs of the Tribal Leadership. Considering the fact that Shri Ibrahim Ali Hussien, Vice Chief captain of Tribal Council, Car Nicobar was recovering from his illness in Chennai, it was thought fit to initiate dialogue process with the Chief Captain.

Even though, officer had met Shri Aberdeen Blair in his Sawai village camp, Shri Aberdeen Blair wanted to visit the head quarters for not only meeting various village captains but also to meet the Deputy Commissioners and other officers to discuss about issues of common importance. Shri Aberdeen Blair was very old and unable to walk longer distances, he was taken in a make shift Palanquin and brought to the head quarter covering more than 15 Kms. The first meeting with Shri Aberdeen Blair took place in the park in front of the Deputy Commissioners office. He was gracious enough to appreciate the responses of Administration and desired that the tempo should be kept up.

After collecting ration articles meant for his camp, he had left head quarter immediately so as to reach his Sawai village before sunset. He was also given

basic medicines water, purifying tablets among others for the use of community. It was also felt at that point of time to arrange for accommodation facilities for Shri Aberdeen Blair in the head quarters itself so that he was enabled to meet community leaders as and when he desired to do so. In addition it would also help the District Administration to approach and consult him on important issues and help Shri Aberdeen Blair to attend his medical needs as he was said to be suffering from low blood pressure. So Shri Aberdeen Blair was provided with an unoccupied Government House which enabled him to devote more time to plan for his intervention. This move also helped to reach out to him as and when required for the consultancy process.

Involvement of Villagers in Relief Operations

'In order to streamline the relief and rehabilitation measures and to involve the local villagers, it was decided that relief will ordinarily be handled over to the respective village captain who will, in turn, distribute it as per scale to all the villagers in coordination with the Government officials. There were reasons for this decentralization measures, e.g., (i) The captains commanded respect from the villagers and they were held in high esteem (ii) Inculcating in them a sense of involvement in the relief work (ii) Making Government official free to do some other works. (iv) To ward off any grudge/disagreement from any quarter in respect of relief supplies. One interesting feature about various relief camps was that the erstwhile inhabitants of each village had established intermediate shelters based on their 'Tuhet' joint family system and, accordingly, there were many camps representing each village. The details of men, women and children staying in each camp were displayed prominently and the quantity of ration required for each camp was worked out. A check list covering various aspects such as health, water supply, power, ration articles and other relief materials was worked out and camp-wise availability of the same was verified from time to time. This move of the administration had given more time to plan for other interventions.

Decentralization of Administration

In order to ensure better administration and better management of information systems, Relief Officers were posted in all the inhabited islands

of Nicobar District and their corresponding sector officers positioned at Port Blair to ascertain the types of intervention required for the islands. In any homogenous District connected well with roads and supplies the entire coordination was done by the office of Collector. However, looking at the geographical spread, comprising many islands, logistic constraints, non-availability of required men machine and materials, it was a good idea to decentralize the relief management systems so that each island becomes a self contained unit with direct access to authority concerned to place demands and get it arranged. Had Nicobars Administration centralized the management of information flow, there would have been utter confusion and intended timely benefit would not have become possible. It did not mean that through decentralization the District Administration had washed off its hands from its legitimate role of coordination. The District Administration was fully aware of the happenings in all the islands and never shrilled away from interventions whenever it was needed. The operative freedom of the officers in charge of relief work in all the islands had given good results and wherever the problems were identified, remedial measures were taken on the spot. In addition to materials sent from Port Blair to the entire island whatever items could be sent from Car Nicobar was also arranged, initially through MI-8 helicopters which had a capacity to take 2.4 tons. Thus, sorties were made to islands such as Teressa, Katchal, Kamorta etc. Since, Campbell Bay has a small air strip AN-32, planes took relief materials from both Port Blair and Car Nicobar.

Establishing of Make-Shift Helipads for Food Dropping

Though in the initial week most of the camps were covered in the Car Nicobar, few camps located in interior areas of Sawai, Arong etc. couldn't be reached ordinarily by road. Several hours of trekking was required to reach such camps. Since, taking relief materials through head loads was becoming extremely difficult, it was decided that dropping of ration articles by choppers may be tried. In the first attempt, materials so dropped got damaged and it was decided that with the cooperation of the villagers, make shift helipad can be made and helicopter landing can be attempted. A&N Command took its MI-8 Helicopter and made landing in the make shift helipad with the relief materials. It was such a welcome sign for the Sawai villagers who had seen, at last materials reaching their camps without the

ordeal of long walks with head loads of materials. Thereafter also materials were supplied to Sawai villages through helicopters. The tribal captain of each village (equivalent to Panchayat President) was given responsibilities to manage the relief materials approved for them.

Medical Facilities & Hygiene Factors

Since the affected families had moved to elevated areas in make-shift structures and tents we had focused in the initial days on medical needs and hygiene factors. Apart from mobile health teams, para medical staff was deployed at such make-shift tent locations to extend medical facilities and counseling. Since Nicobar group of Island is mosquito endemic region, attempts were made to provide mosquito nets to the population. Water purification compounds were also supplied to the public. The support of multi lateral agencies, NGO's was also taken towards extending health facilities. The medicine facilities at the Districrt hospital were also restored for medical consultancy, whenever required.

Restoration of Mobile Service in Car Nicobar by BSNL

Within 10 days of Tsunami, the BSNL Authorities had successfully restored the mobile services in Car Nicobar. In order to ensure better monitoring and uninterrupted relief intervention, it was decided that mobile phones could be given to important officers. Ordinarily sanction of Government is required for extending mobile phone facility to any officer of Administration. However, considering the immediate necessity, it was decided to procure at least 10 mobile phones.

Handling of panic situation

In the hour of crisis, information management has to be carried out very cautiously and effectively. In view of repeated aftershocks, there was a news item in All India Radio about possible Tsunami attack and advice to people to stay away from shore area. The news item was broadcasted in local Nicobar language also, which created panic among the community. Those who were staying in the head quarters Maidan area which was closer to sea started running in the opposite direction hoping to reach safer places in the eventuality of another tsunami attacking the islands. After having the news, I proceeded from the Airport towards head quarter area self driving the Tata Sumo. Mid-way I saw hundreds of people running in the opposite

direction. A PWD truck coming in the opposite direction signaled me to stop the vehicle and the driver of the vehicle cautioned me not to proceed further to the head quarters as a Tsunami was likely to strike the islands. The people who were running, including older people were very desperate to move to interior areas as quickly as possible. I immediately understood that people had become unduly confused because of the overfeeding of the information and proceeded straight to head quarter and arranged for vehicles to inform public not to panic.

Making Provision of Ration for Group 'C' and 'D' Employees

Initially, relief materials were provided only to the locals excluding the group 'C' and group 'D' Government Servants. The main reason given for not providing ration to the Government Servants was that they were getting Government salaries. However, the irony was that there were no shops available in the Nicobars Districts since the commercial infrastructure had completely collapsed. Even if one had money, it had no value in Car Nicobar at that point of time as nothing could have been bought with that money. Therefore, the requirement of the Government of Employees at the cutting edge level had to be taken care of. As soon as the matter was brought to our notice by the employees union, it was decided that ration articles would be made available to the Group 'C' and Group 'D employees also. Instead of giving ration articles individually, Head of the Departments were asked to give requirements in respect of their departments under the condition that articles in one lot would be stored appropriately and common cooking for Government Servants would be ensured. In addition to the ration articles, other relief materials such as candles, blankets etc. were also provided to the employees.

Prior to extending ration to the Government Servants, they were barely managing their food requirements without having any avenue for the purchase of articles. As soon as the facility was extended, they had started preparing food collectively and were able to put long hours of work which was beneficial to Government at that point of time. It was quite evident in the functioning of the Public Works Department as most of the workers were engaged in clearing of roads from headquarters to Mus Jetty which was one of our priority item.'

Use of Old Japanese Tracks for sending Relief Supplies and Creation of Storage Facilities

Once the Jetties were repaired, materials started arriving in ships as well. However, due to non-cleaning of roads laden with debris, sand deposits, relief materials were taken by head loads to many make-shift villages. Jungle roads which were not put into regular use were cleared on priority to facilitate movement of trucks with relief materials. Opening up of the erstwhile Japanese Tracks (Kutcha Jungle roads) had facilitated to bring ration articles to the villages located closer to the Head Quarter. Since, these Katcha Roads were opened up after nearly sixty years, the conditions of the roads were very bad with a log of ups and downs. The road had also to cross small nuallah and had steep gradient making it very difficult for trucks loaded with relief materials to negotiate the road curves and to reach the head quarter areas. Though the passenger hall and the guest house of Andaman & Lakshdweep harbor Works (ALHW) at the jetty were converted into the make shift godowns, for operational reasons, the District stadium and the indoor games hall located closer to the head quarter were also converted into godowns. In addition, the ground floor conference hall of the office of the Dy. Commissioner (Nicobars) was also transformed into a godown to keep important articles meant for relief. Since telephone connectivity to the jetty area could not be made operational in the initial fifteen days, a police wireless system was installed in the jetty area for effective communication. The port department was also requested to install a port wireless system in the office of Deputy Commissioner (Nicobars) for effective coordination in the movement, loading and unloading of the relief materials in the jetty area. Suitable teams of officers were designated to each godown points along with sufficient police personnel for security. The local able bodied youth were mobilized on daily wage basis to help administration in the loading and unloading of materials in the jetty. Youth were selected from those villages which had suffered the most. In Tsunami affected areas, it sent a strong signal that the administration is sensitive enough to prioritize as to where and how immediate assistance should go.'

Instance of immense sacrifice

The officer had been facing the toughest time of his life. However, he was more concerned about the sufferings of others. While working as Special

Relief Commissioner, he got an call from one of the Union Ministers who had visited the A&N Island to oversee relief measures, inquiring about the various initiatives taken by the Administration. While the talks were going on, the Hon'ble Minister told him that her Private Secretary (an IAS officer of the rank of Director in the Government of India) was likely to go back to his native State and that whether he would like to work as her Private Secretary. The young officer had a very good opportunity to drag his hands from the posting as Relief Commissioner, but his inner conscience did not allow him to do so. He, politely informed the Hon'ble Minister that he would let her know. Finally the officer decided to remain in the service of the needy people in Nicobar District. He did not allow the self-interest to come in the way of the country interest.

Officer's Attitude towards Relief

When the Officer was posted as regular Deputy Commissioner to Car Nicobar from the position of Special Relief Commissioner, his first address to the Officers/Staff was as reproduced below:

> 'It is emphasized that in spite of having less number of government servants, as against the demand, we all government servants should work with team spirit with an accommodative nature. In a government system, on occasions, individual brilliance and wisdom may lead to collective failure and disappointment. I want all the government servants present here to disprove that notions and come out with flying colours. Every government servant is supposed to perform multifarious tasks, voluntarily, and come out of the web of compartmentalized thinking. They should implement the decisions taken at the regular evening coordination meetings and they should not expect directions always in writing to initiate work as is the custom of government functioning everywhere. They should sympathize with the affected people and be genuine to their needs. The Deputy Commissioner is the first member of the team; the team will take credit for good works done and the Deputy Commissioner will take the responsibility for anything that goes wrong. All the government servants may contribute to the best of their abilities in the hours of crisis.'

Other Important Decisions

Several important decisions, as enumerated below, were also taken and guidelines given to the officers for the overall betterment of the relief and rehabilitation measures;

(i) It was informed to all Departmental Heads of Car Nicobar that they should believe in team work and the oral instructions given in the evening coordination meeting should be meticulously carried out. However, directions involving financial implications and spending of a large sum of money would be given in writing.

(ii) The evening coordination meetings may be attended by all those agencies, including NGOs connected with relief work to get sorted out their problems, if any, then and there itself.

(iii) The main door of Deputy Commissioner's chamber would be kept open throughout the day. This would enable the locals and others to move freely into the chamber of Deputy Commissioner for redressed of grievances, if any. Considering the simple and reluctant nature of the Tribals, keeping the doors open made their approach to DC's office easy, as and when required. The District Administration could develop a good rapport with the local community.

(iv) Considering the large scale devastation that occurred outside and the plight of locals who had been staying in tents, it was decided not to have the luxury of air conditioning in the chamber of Deputy Commissioner. Accordingly, two AC machines installed in the chamber of Deputy Commissioner were deactivated temporarily.

(v) The Telephone, Fax and Xerox facilities installed in the office of Deputy Commissioner were thrown open to NGOs, Central Para Military Forces and other needy public before and after the office hours.

(vi) Hotline telephonic connections, both ways, between Car Nicobar and other islands, viz., Teressa, Katchal, Kamorta, Campbell Bay were established so as to ensure proper relief and rehabilitation interventions by the Assistant Commissioners and Special Relief Officers attached with each islands. This facilitated easy contact of

Deputy Commissioner by the second level officers, as and when required.

(vii) After few weeks, evening meetings were conducted in various villages with all the officers so as to bring the administration more close to affected people.

(viii) The officer permitted two rooms of his Bungalow to be converted into Guest House. Formal order to this effect was also issued. He also accommodated two more officers junior to him in his own bungalow and also in his office.

(ix) He got intermediate shelters erected for all the needy before the start of monsoon season, i.e., by May 2004. Designs, details of pucca structures were got approved during his tenure as DC.

Thus an officer is expected to think out-of-the-box while dealing with difficult circumstances and grim situations.

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Cloudburstsand Flash Floods at Uttarkashi, Uttarakhand – A Case Study of 2012

Dr. Indrajit Pal *

Introduction

Uttarkashi district (Garhwal Himalaya) situated at 78o 26'E and 30o 44' N at an elevation of 1150 Mts. above sea level on the bank of Bhagirathi rivercovering an area of about 8016.00 Sq.Km. has a total population of about 3,29,686 approx (2011 census) (Fig 1).

It has its headquarters at Uttarkashi city and comprises six Tehsil: Barkot, Bhatwari, Chiniyalisaud, Dunda, Purola and Mori.The district is located in seismically themost sensitive zone 5 of the Himalaya. The main central thrust and the main boundary thrust lines are passing through the district. It was main focal point of the earthquake disaster in 1991 (6.4 in Richter scale). The district also faced the heavy flood in 1978, 1997 and 1998, mass landslide in Varunawat hill in 2003, 2007 and 2007, in Bhatwari village in 2011. Thus the possibility of earthquake, flood and land slides are always there. The District Disaster Management Plan (DDMP) address the district responses to disaster situation such as land slides, earthquake, forest fire, flash flood, cloud bursting and road accidents.It is an important stopover for pilgrims visiting Gangotri. Uttarkashi has also emerged as an important centre for adventure sports.Home to pilgrim spots Gangotri, Yamonotri, Uttarkashi is also strategically important as it borders Indo-Tibet border.

Geology of Uttarkashi

Uttarkashi town is in Garhwal Lesser Himalaya and is situated south of the Main Central Thrust (MCT), which passes near Sainj. The area lies in the high seismo- tectonically active zone (seismic zone V). The MCT zone has witnessed two major earthquakes since 1991. The epicenter of the 1991 Uttarkashi earthquake was in the Agoda village of Uttarkashi town. The area was subjected to tectonicmovements due to which several faults and weak planes have developed in the region. The Uttarkashi formation includes Netala Quartzite, Lower Uttarkashi Limestone, Pokhri slate, Upper Uttarkashi Limestone and Bareti Quartzite (Jain, 1971). The rocks found in the Varunavat Parvat comprise mainly quartzite and phyllites of Damta Group, which are highly shattered, fragmented and fractured and thinly jointed. These are covered with 20-25 m thick slided material. The beds are dipping at 30-350 towards N3500 inside the hill slope. There are three sets of major joints while, the soils in this region are almost new, generally thin and porous in nature. The two major rivers Ganges and Yamuna have origin from the Himalayan region of this state and therefore the water resources are important assets of the state.

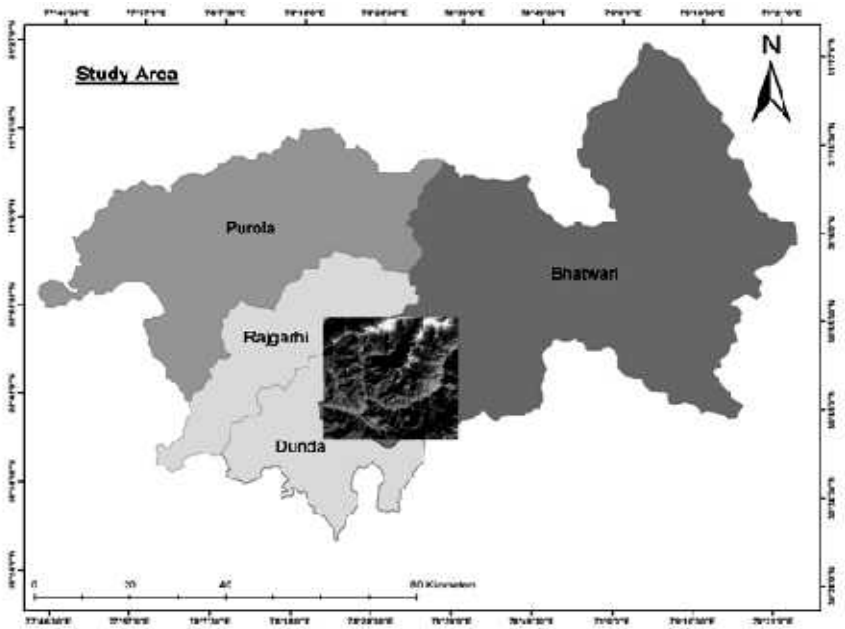

Fig 1: Schematic map of Uttarkashi District

Uttarkashi Forest Division at a glance

Total Geographical area of the District	:	8016.00 Sq.Km.
Total Forest cover area	:	7216.61 Sq.Km
Total area of Uttarkashi Forest Division	:	2243.06 Sq.Km.
Sub Forest Division	:	Bhatwari, Dharasu
Ranges in Forest Division	:	1. Gangotri, Taknor, Barahat
		2. Mukhem, Dunda, Dharasu

Concepts of Cloud Burst and Flash flood

A cloudburst is an extreme amount of precipitation, sometimes with hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions. Colloquially, the term cloudburst may be used to describe any sudden heavy, brief, and usually unforecast rainfall. Technically speaking the precipitation rate equal to or greater than 100 mm (3.94 inches) per hour is a cloudburst. The associated convective cloud can extend up to a height of 15 km above the ground. During a cloudburst, more than 20 mm of rain may fall in a few minutes. When there are instances of cloudbursts, the results can be disastrous. Cloud burst also responsible for Flash flood creation.

Flash floods are characterized by sudden rise and recession of flow of small volume and high discharge, which causes damages because of suddenness. They generally take place in hilly region where the bed slope is very steep. Flash flooding occurs when precipitation falls too quickly on saturated soil or dry soil that has poor absorption ability. The runoff collects in low-lying areas and rapidly flows downhill. Flash floods most often occur in normally dry areas that have recently received precipitation, but may be seen anywhere downstream from the source of the precipitation, even many miles from the source. Among all other factors cloudburst is one of the causes of flash floods in hilly areas.

Background of the Uttarkashi Incident

In the Year 2012 the monsoon was relatively weak throughout the state and high rainfall was received only in the first week of August, especially in Uttarkashi district. Rainfall data from India Meteorological Department, Dehradun are clearly indicates the abnormal precipitation at tehsils.

On 3rd and 4th August, 2012 localized heavy rains in the catchment of the Asi Ganga and Swari Gad, tributaries of Bhagirathi river, caused the waters of Bhagirathi to rise about 4 meters above the danger level (Fig 2) at Uttarkashi led to catastrophic flash floods and landslides in the Asi Ganga and the Bhagirathi River Valley of Uttarkashi District (Fig 3).

The devastation due to heavy precipitation and flash flood in the districtresulted in washing off of a number of vehicular and pedestrian bridges.The destruction of motor bridge at Gangori on the Rishikesh – Gangotri National Highway caused entire area ahead of Gangori physically cut off from the rest of the state. In the Asi Ganga valley many stretches of Gangori – Sangam Chatti motor road were washed off. A number of stretches of the Rishikesh – Gangotri National Highway and other connecting roads were also washed off in the incident. Hundreds of pilgrims were stranded at various stretches of Uttarkashi –Gangotri and Uttarkashi–Yamunotri road due to blockage at several places.

The challenges of management of vehicular traffic compounded manifold due to the coincidence of peak pilgrim season and monsoon season of the State. A large number of people from various parts of the country were stranded at various places between Rishikesh – Gangotri National Highway because of the washing off of the bridge at Gangori. As the blockage

Fig 2: Glimpse of catastrophic water level rise in the Asi Ganga river
(Source: DM Office, Uttarkashi).

continues for a loner period the situation became serious for the stranded tourist and pilgrims. Resuming the vehicular traffic to Gangotri was taken up on high priority and with the instruction form district administration the Boarder Road Organization mobilized material for construction of a Bailey bridge. The temporary bridge was in place on 26thAugust, 2012 and traffic resumed on the Gangotri route on 3rdSeptember, 2012.

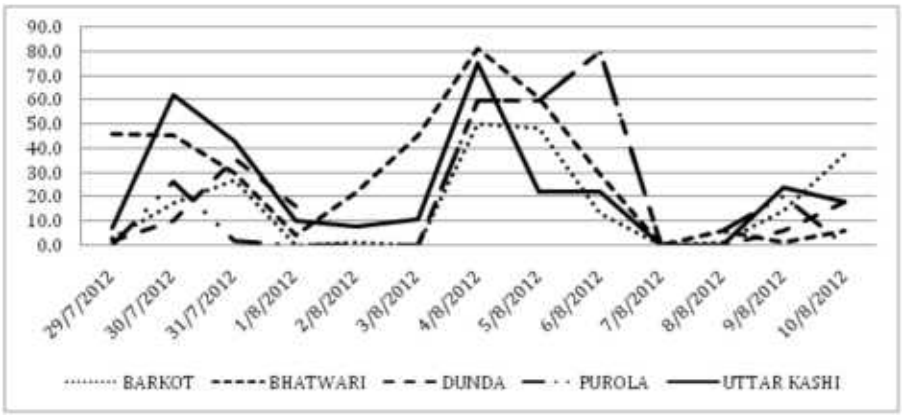

Fig 3: Block wise Rainfall distribution at Uttarkashi District
(Source: IMD, Dehradun).

Impact of the Incident

About 1053 families in the 85 villages of Uttarkashi district were affected by the incident. The villages were marooned due to the disruption of pathways, roads, small bridges etc. and at the same time mobile and other

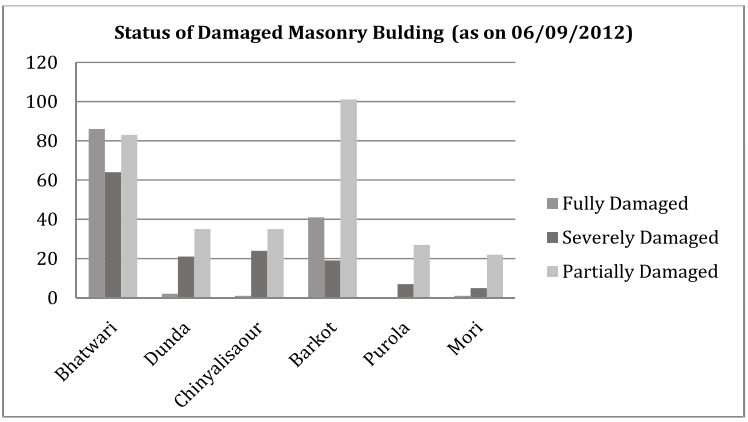

Fig 4: Block wise damage status of the Masonry Building
(Source: DM Office, Uttarkashi)

communication network was also shattered. The severe flash floods and landslides killed 35 people and left more than 20 injured.Besides the human loss the incident also claimed 426 animals lives (Fig 4).

The disaster fully damaged 131 pucca buildings and 9 kuchcha house whereas 140 pucca buildings had been severely damaged and 303 pucca buildings had been damaged partially. Heavy losses were also incurred to the public infrastructure and other properties.The flash flood and landslides damaged approximately 61.787 hectares of agricultural land, which affected about 1304 families had been affected. Water supply lines in the area had been damaged and hence the affected area in the district faced acute shortage of drinking water. 14 bridges had been damaged and 2 bridges were partially affected. 6 power lines were also damaged causing electricity problems in the area. More than 500 people were stranded at various stretches of the Rishikesh - Gangotri National Highway in Uttarkashi-Bhatwari-Gangotri route. The worst affected areas were Gangori, Sangamchatti and Bhatwari (Fig 5).

Fig 5: Damaged road near Uttarkashi
(Source: DM Office, Uttarkashi).

Since the major part of the district is forest covered and about 28% of the area of the district is comes under the jurisdiction of Uttarkashi forest division, the catastrophe had also damaged the large part of the physical infrastructure and biodiversity of the region. Specially the Dodital -Samgamchatti area had been affected severely. Pictorial representation of the affected area of the forest is as follows (Fig 6a & 6b).

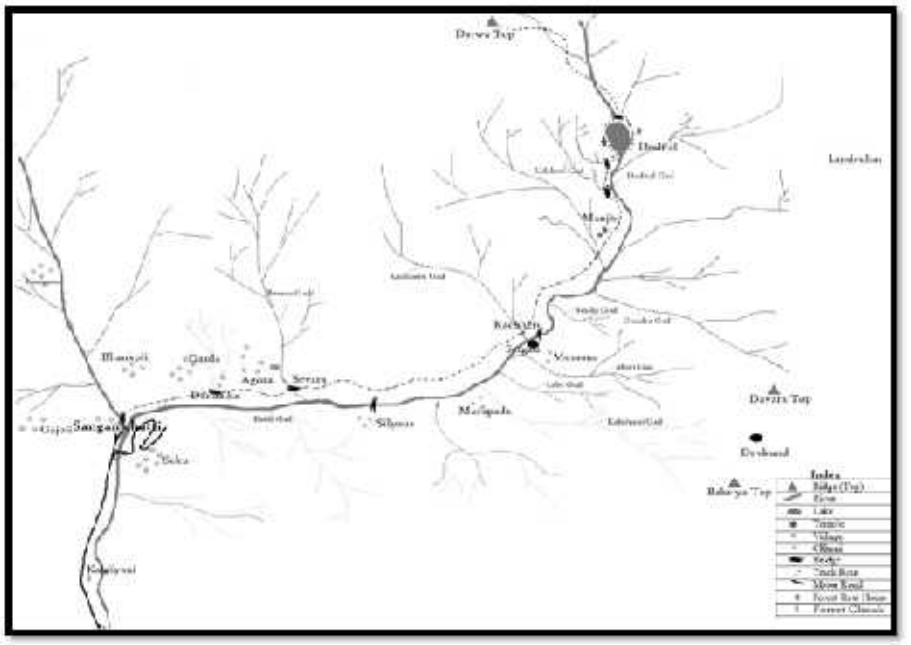

Fig 6a: Dodital –Sangamchatti Area: Before Disaster
(Source: DFO, Uttarkashi).

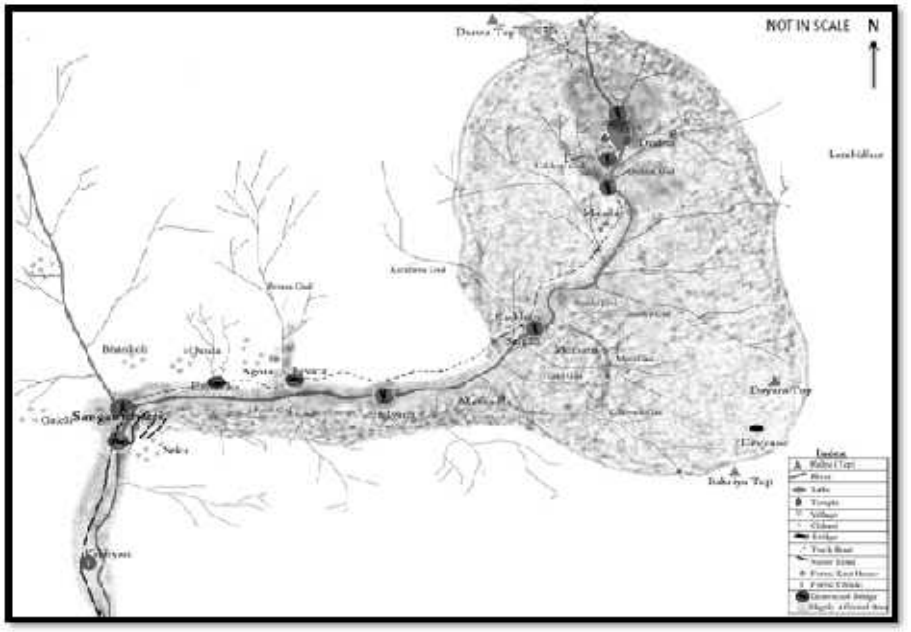

Fig 6b: Dodital –Sangamchatti Area: After Disaster
(Source: DFO, Uttarkashi).

Immediate response by the District Administration

District administration was on high alert in the aftermath of the flash flood and landslides in the area around Uttarkashi. The district administration responded to the disaster situation with support from Indo-Tibetan Police Force, Border Roads Organization, National Disaster Response Force, Army, Air Force, National Institute of Mountaineering and NGOs etc.

Initiatives had also been taken to air-lift the stranded pilgrims and injured victims from the cut-off / affected areas to Uttarkashi, Chinyalisaur and Dehradun. Immediate relief in terms of cash and items has been provided to the victims as state disaster response fund norms. The control room in the district headquarters was working 24x7. The victims had been provided temporary shelters in 7 educational institutes and hostel buildings. Food items had been air dropped in inaccessible areas.

Government of Uttarakhand deployed all its resources and all possible measures were taken to manage the situation. Leave of all the government officials was immediately cancelled and all educational institutions of the district wereclosed. Additional Revenue officials (4 SDMs and 5 Tehsildars) were sent to the district to assist the local administration. The situation was extremely serious on Rishikesh - Gangotri National Highway, which was blocked continuously for a long period due to the washing off of the vehicular bridge at Gangori. High priority was given to resume the vehicular traffic from Uttarkashi to Gangotri and material for construction of a Baileybridge was mobilized and on 3rd of September, 2012 the traffic up to Gangotri was resumed. Every effort was made to ensure the supply of essential commodities and medicines. Medical teams were air dropped at remote locations.

Damage Estimation

Department wise estimate of Fund for repair /Restoration of damaged Infrastructure (Table 1),

Table 1: Department wise damage estimation (Source: DM Office, Uttarkashi)

S.No.	Department	No of Scheme	Total Money Required for Restoration (in Lacs)
1	Uttarakhand Jal Vidyut Nigam Ltd.	8	14939.70
2	Uttarakhand Lok Nirman Vibhag (6th Circle P.W.D. Uttarkashi)	160	9650.96
3	Border Road Organisation	15	9000.00
4	Irrigation Department Uttarkashi	327	8980.77
5	Uttarakhand Jal Sansthan	285	4468.50
6	Nagar Palika Parishad Uttarkashi	32	3910.85
7	Forest Department Uttarkashi	270	3763.08
8	Rural Development	432	1365.51
9	Zila Panchyat	433	1352.77
10	Construction Division, Uttarakhand Peyajal Nigam, Uttarkashi	127	982.00
11	Uttaranchal Power Corporation Uttarkashi	13	740.80
12	Revenue Department Tehsil Bhatwari, Uttarkashi	1	500.00
13	Construction And Maintenance Unit (Ganga) Uttarakhand Peyjal Nigam Uttarkashi	5	425.00
14	Minor Irrigation	302	401.87
15	Fisheries Departments Uttarkashi	2	255.00
16	Tourism Department Uttarkashi	6	202.00
17	Education Department Uttarkashi	42	150.97
18	Fire Service Gangori Uttarkashi	1	116.57
19	Nagar Panchyat Gangotri	1	15.85
20	Bharat Shanchar Nigam Ltd Uttarkashi	1	10.96
21	Uttarakhand Renewable Energy Development Authority Uttarkashi	6	6.85
22	Animal Husbandry	2	3.56
23	Health Department	1	0.55
	Total	**2472**	**61244.12**

Relief and Rehabilitation

Honbl'e Chief Minister Vijay Bahuguna announced ex gratia of Rs 3 lakh for the Uttarkashi cloudburst victims and Rs 1 lakh as compensation for fully destroyed houses. For shops and other business establishments, the Chief

Minister announced that compensation through his discretionary fund would be provided. The district authorities assured the availability of 99 metric tons of sugar, 307 metric tons of wheat, 387 metric tons of rice and 13 kilolitres of kerosene. Water supply was ensured through the help of tankers. Army, ITBP, NDRF and IAF was also called in for rescue, evacuation and distribution of relief. State Government ensured that the pilgrims and tourists are evacuated at the earliest. IAF helicopters were also requisitioned to evacuate the stranded pilgrims especially for those requiring immediate medical attention.

Difficulties faced by the administration

Keeping in mind the vulnerability profile of the district, the district administration ensured the emergency stock of food grains in Uttarkashi. The food grains stocked in the district were of great help during the emergency situation when road connectivity was completely dysfunctional.The damages and losses due to the incidents were aggravated manifold because of the hilly topography and fragile nature of the terrain. Torrential precipitation in the upper reaches of the catchment of Asi Ganga resulted in flash flood like situations in the downstream areas.The blockade of the course of Asi Ganga at many places and their subsequent breach added to the fury of flash floods. Sudden and unexpected rise in the water levels certainly overwhelmed the administration. Air evacuation of the injured persons could not be carried out because of the poor visibility and bad weather conditions. The supply of essential commodities to the far flung remote areas were hampered due to the blockade of traffic along the link roads, and administration had to put an extra effort to ensure the availability of essential supplies to the affected masses. Administration had arranged for manual or animal transportation of essential supplies to ensure the availability of materials in remote areas.

Lessons Learnt and recommendations

The district is receiving large number of pilgrims and tourists during the month of August-September every year and overwhelmed vehicular traffic to Char Dham Yatra route is another challenge for the local and district administrations. Frequent landslides and blockage of the route very often put the pilgrims and tourists stranded.

Learning 1 (Emergency Operation Center): District level control room or Emergency Operation Centre should be activated for the regular monitoring of the vehicular traffic during the Char Dham Yatra. It should be manned by personnel from all the line departments and be under overall supervision of the District Magistrate or his nominee or Superintendent of Police.

Learning 2 (Implementation of Policy and Law): The Uttaranchal River Valley (Development and Management) Act, 2005 was in place since January, 2005 in the state of Uttarakhand. It was enacted for the sustainable development and proper management of river valley with special reference to the Bhagirathi river valley up and down stream of Tehri Dam including its catchment and command areas in the state of Uttarakhand. Implementation of the laws and regulations through out the district should be followed strictly.

Learning 3 (Emergency Stock of Food Grains and Essential Supplies): Experience from past disasters helped district administration to ensure the emergency stock of food grains in Uttarkashi. Apart form the food grains essential supplies for two weeks should also be ensured by the district administration. The emergency stock of food grains and other essential supplies should be placed strategically through out the district for immediate access during emergency.

Learning 4 (Use of Geo-Informatics in Disaster Management): Though the Control room / Emergency Operation Centre for District was in place but widespread Wireless communication network and Geo-informatics should be adopted in the District Control room or Emergency Operation Centre for planning and fast decision making during emergency. Learning 5 (Proactive steps towards Construction): As the Geology and Geomorphology of the district is fragile, Geomorphological Hazards like Landslides, cloudburst and flashfloods are prevalent in the region. The administration should take additional precautions during construction and restoration of the roads and buildings. Geological Survey of India and Forest Department should taken into consideration for identification of landslide prone areas and weak areas vulnerable to disasters. National Building Code needs serious consideration to be implemented for earthquake resistant buildingsat Seismic zone 5 and "Eco-Sensitive zone" between Gaumukh and Uttarkashi need attention during development planning.

Learning 6 (Quick Response Team): District Level and Block Level Quick Response Team or Civil Defense Team should be formed either though community based disaster management preparedness programs. If manpower permits deputation post for the District and Block Level Quick Response Team would be an option for the better coordination and control by the government machinery.District / Block should do drill and Community Based Disaster Preparedness activities regularly.

Learning 7 (Land use Planning): Under Section 8 (1) (a) of The Uttaranchal River Valley (Development and Management) Act, 2005 the Authority could be oversee the formulation and execution of development plan to achieve optimum utilization of natural resources for integrated and sustainable development of the basin. The development plan shall include water resources, land use and development of agriculture, sector development and related matters. Large number of damages on the riverbanks of Bhagirathi River in the aftermath of Uttarkashi Cloud burst incidents depicts the scope of improvement in the implementation of land use plan for development aspects. Natural calamity could not be stopped but the preparedness and implementation of relevant laws could reduce the losses.

ADDITIONAL INFORMATION

Ganga Action Plan

The Ganga Action Plan or GAP was a program launched by Rajiv Gandhi in April 1986 in order to reduce the pollution load on the river. But the efforts to decrease the pollution level in the river became more after spending Rs. 901.71 Crore (~190 million USD adjusting to inflation).Therefore, this plan was withdrawn on 31 March 2000. The steering Committee of the National River Conservation Authority reviewed the progress of the GAP and necessary correction on the basis of lessons learned and experiences gained from the GAP phase; 2 schemes have been completed under this plan. A million liters of sewage is targeted to be intercepted, diverted and treated. Phase-II of the program was approved in stages from 1993 onwards, and included the following tributaries of the Ganges: Yamuna, Gomti, Damodar and Mahananda. As of 2011, it is currently under implementation.

National River Ganga Basin Authority (NRGBA)

NRGBA was established by the Central Government of India, on 20 February 2009 under Section 3(3) of the Environment Protection Act, 1986. It also

declared Ganges as the "National River" of India. The chair includes the Prime Minister of India and Chief Ministers of states through which the Ganges flows.

Supreme Court of India

The Supreme Court has been working on the closure and relocation of many of the industrial plants along the Ganges and in 2010 the government declared the stretch of river between Gaumukh and Uttarkashi an "eco-sensitive zone".

Highlights of facts and figures from Districts (Source: DM office, Uttarkashi)**: Distribution of relief amount in Disaster affected families / persons at Uttarkashi District (dated 06/09/2012)**

Relief to the families for the damage of Utensils, Domestic appliances, food and cloths etc.						
Sl. No.	**Name of the Tehasil**	**No. of affected families**		**No. of beneficiary**		**Total disbursed amount (in Rs.)**
		As on 20/08/12	**As on 06/09/12**	**As on 20/08/12**	**As on 06/09/12**	
1.	Bhatwari	814	914	814	914	4508800
2.	Dunda	12	23	12	23	124200
3.	Chinyalisaour	0	4	0	4	17600
4.	Barkot	77	82	77	82	442800
5.	Purola	1	1	1	1	5400
6.	Mori	5	29	5	29	140400
	Total	**909**	**1053**	**909**	**1053**	**52,39,200**

Losses of Land Agriculture / Crops					
Sl. No.	**Name of the Tehasil**	**Total area (in Hector)**	**No. of affected families**	**No. of beneficiary**	**Total disbursed amount (In Rs.)**
1.	Bhatwari	27.686	324	324	672243
2.	Dunda	13.652	285	285	378801
3.	Chinyalisaour	0.23	1	1	3722
4.	Barkot	11.857	409	409	196703
5.	Purola	0	0	0	0
6.	Mori	8.362	285	285	220575
	Total	**61.787**	**1304**	**1304**	**14,72,044**

Details of Casualties / Injured							
Sl. No.	**Name of the Tehasil**	**No. of person dead**	**Severe injured**	**Minor injured**	**No. of beneficiary**		**Total disbursed amount (In Rs.)**
					Total No.		
1.	Bhatwari	33	3	14	33	17 dead, 3	5290000
2.	Dunda	2	0	2	2	severely	20000
3.	Chinyalisaour	0	0	0	0	injured, 16	0
4.	Barkot	0	0	0	0	minor	0
5.	Purola	0	0	0	0	injured	0
6.	Mori	0	0	1	1		10000
	Total	**35**	**3**	**17**	**36**		**53,20,000**

Details of affected cattle						
Sl. No.	**Name of the Tehasil**	**No. of animals**		**No. of affected families**	**No. of beneficiary**	**Total disbursed amount (In Rs.)**
		Large cattle	**Small cattle**			
1.	Bhatwari	35	0	33	23	368000
2.	Dunda	2	0	2	2	31400
3.	Chinyalisaour	1	0	1	1	16400
4.	Barkot	24	0	22	22	346600
5.	Purola	6	0	6	6	90200
6.	Mori	20	338	86	86	641400
	Total	**88**	**338**	**140**	**140**	**14,94,000**

Description of relief distribution for damaged building / house														
Sl. No.	**Name of the Tehasil**	Damaged masonry building						Damaged kachha house				**Total no. of affected families**	**Total no. of benefi ciary**	**Total disbursed amount (In Rs.)**
		Fully	**Beneficia**	**Severely**	**Beneficia**	**Partially**	**Beneficia**	**Fully**	**Beneficia**	**Severely**	**Beneficia**			
1.	Bhatwari	86	84	64	64	83	83	9	9	0	0	242	240	9095900
2.	Dunda	2	2	21	21	35	35	0	0	0	0	58	58	398800
3.	Chinyalisaour	1	1	24	24	35	35	0	0	0	0	60	60	317700
4.	Barkot	41	41	19	19	101	101	0	0	0	0	161	161	4411600
5.	Purola	0	0	7	7	27	27	0	0	0	0	34	34	95400
6.	Mori	1	1	5	5	22	22	0	0	0	0	28	28	173300
	Total	**131**	**129**	**140**	**140**	**303**	**303**	**9**	**9**	**0**	**0**	**583**	**583**	**1,44,92,700**

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Assam Floods 2012 (June–October): A Case Study of District Barpeta

Analyses, Assessments, Lessons Learnt

Abhinav Walia, Dr. Indrajit Pal, Dr. Siddharth Singh

Barpeta District (Assam) at a Glance

Barpeta district in the State of Assam was created and started functioning since 1983. The district is spread across 3245 sq.kms. It is surrounded by Bhutan Hills in the north, Nalbari and Baksa districts in the east, Goalpara and Kamrup districts in the south and Bongaigaon and Chirang districts in the west. Total population of the district is 16,93,190 (2011 census) with a population density of 632 per sq.km. and sex ratio of 1000:951. The major rivers flowing through the district are Brahmaputra,

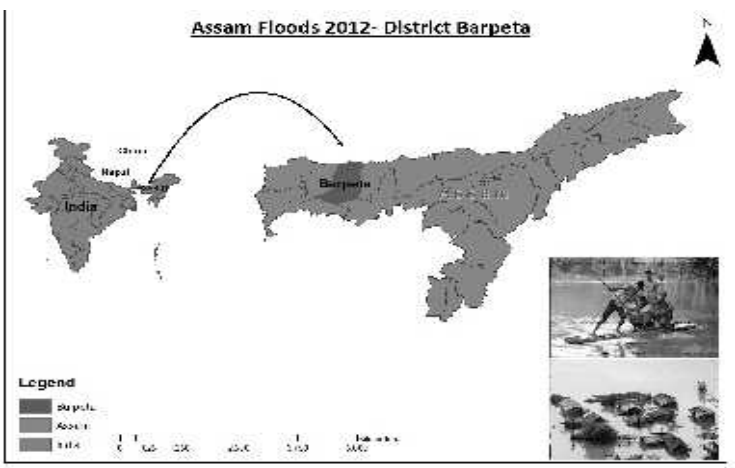

Fig 1: Geographical location of District Barpeta

Beki, Manas, Pahumara, Kaldia, Palla, Bhelengi and Chaulkhowa. The rivers flowing through the district are also causes annual floods and riverbank erosion particularly in the char areas (flood plane), leading to a considerable loss of life and property. Barpeta district has overall flat topography with gentle slope towards south. The northern part of the district is slightly elevated, while the southern part close to the northern bank of the river Brahmaputra is low lying and flood prone.

Administrative setup: The district at present comprises of 9 Revenue Circles (viz. Barpeta, Barnagar, Kalgachia, Chenga, Sarupeta, Bajali, Sarthebari, Baghbor and Jalah), 12 Development Blocks (viz. Barpeta, Sarukhetri, Chenga, Gobardhana, Bhawanipur, Chakchaka, Pakabetbari, Mandia, Rupshi, Bajali, Jalah and Gumafulbari), 12 APs, 149 GPs, 26 Mouzas, and 1086 Revenue Villages. It has 7 Police Stations (viz. Baghbar, Barpeta, Barpeta Road, Patacharkuchi, Sorbhog, Sarthebari and Tarabari), 2 Municipal Boards (viz. Barpeta and Barpeta Road) and 4 Town Committees (viz. Sorbhog, Sarthebari, Pathsala and Howly).

Major Rivers : Beki, Manah, Pohumara, Kaldia, Palla, Nakhanda, Marachaulkhowa, Bhelengi

Background of the Incident

Three waves of devastating floods in Assam in 2012 affected nearly 16,12,999 population of 686 villages. The extent of the floods spread across 1,83,322 hectares of landmass of the district. Entire north-eastern states faced the worst floods in 2012 floods ever since 1998 (Fig 2). In Barpeta district the death toll rose to 36 and number of people affected and traumatized.

Fig 2: Flood affected area of Barpeta (Source: DM Office, Barpeta)

An active monsoon in the year 2012 has given Barpeta an above average rainfall. Water level in the majority of rivers approached fast the danger mark and inundated most of the district areas.Since flood puts the health of people, economy, agriculture etc. at risk, this hazard is a prime concern for the Barpeta District Disaster Management Authority.

Floods in the Berpeta district and surrounding areas triggered by various factors, primarily due to heavy seasonal rain in the catchment area of Brahmaputra, other rivers and tributaries. Barpeta and nearby districts seen powerful swells of rain this year which triggered three waves of severe flood. The degree of flooding is said to be almost unprecedented. Total 8 circles in the district suffered the damage, some of them seriously affected and some less. Heavy seasonal rain during June-October caused the Bharamputra and other rivers passing by the district to overflow. Approximately 686 villages were flooded and some have water stood very high. Limited access to safe water and inadequate sanitation also resulted from flooding.

Berpeta district experienced three waves of flood during the year 2012 (Table 1). This was one of the most severe floods in the Barpeta history. The river Bharamputra touched the highest flood level of 43.62 m in the history of last nine years.

Table 1: The brief about the three flood waves.

	Duration of the flood	**Rivers Responsible for Flooding**	**Major Revenue Circles affected**
First Wave	7th to 24th June, 2012,	Pahumara, Kaldia, Bhellengi and Tihu	• Sarthebari (in continuation) • Bajali • Sarupeta • Barpeta (small part)
Second Wave	25th June to 14th August, 2012	Brahmaputra, Nakhanda, Mora Chaulkhowa and Bhellengi	• Barpeta • Sarthebari • Baghbar • Chenga • Kalgachia • Barnagar
Third wave	21st Septo 15th Oct, 2012	Pohumara, Kaldia, Bharamputra, Nakhanda and Mora chaulkhowa.	• Barpeta • Chenga • Kalgachia • Sarthebari • Baghbar • Bajali

Impacts of the Incident

Impacts on Human and Livestock : 2012 floods of Assam had caused severe economic, human and livestock losses. A total number of 686 villages were affected by the floods. Death toll of Human was raised to 36 out of which 23 were males and 13females. A high number of livestock and poultry had also been affected i.e., 425732, below mentioned is the breakup for the same:

i.	Poultry affected	:	230344 nos
ii.	Livestock affected	:	195267 nos
iii.	Animals lost	:	71 nos
iv.	Poultry lost	:	50 nos

There was hardly any circle in the district,which was not affected during the flood period (June-Oct, 2012). Barpeta,Chenga and Baghbarcircles were affected entirely and only Barnagar circle was affected least where 5 out of 97 villages were affected. Below graph shows the circle village wise flood affected areas (Fig 3).

Impacts on Agriculture and Infrastructure

The agricultural land was the worst affected by the flood and a total of 1,56,480 hectares of agricultural land was inundated. Since the district grossly depends on agriculture the livelihood of the local communities

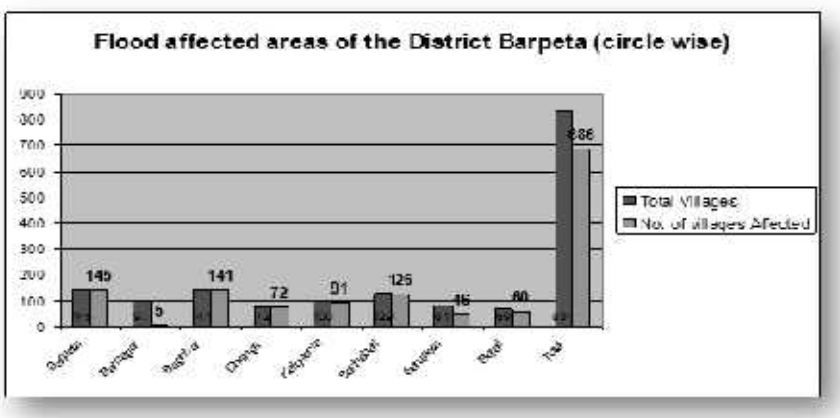

Fig 3: Circle wise Flood affected areas of the Barpeta District
(Source: DM Office, Barpeta)

shattered by the impact. A significant amount of infrastructural damage was also recorded, which includescompletely damaged houses (12508), severely damaged houses (3521).

Impacts on infrastructure

Large number of roads, bridges, culvert had been damaged along with the losses in other sectors i.e fishery, water resource etc. Most of the State Highway, PWD roads have been affected by the incessant rains either being inundated or waterlogged causing communication disruption and obstruction in relief and rescue operations (Table 2).

Table 2: Sector wise damage and losses of infrastructure occurred by the floods (Source: DM Office, Barpeta)

Sl No	Name of Department	Nature of Damage	Unit/ Area	Approx. Value/cost
1	Agriculture	Crop land	67711.57 Ha.	25146 L
2.	Water Resource	Breach gap	13 nos	Temporary- 524 L Permanent- 1360 L
3	PWD Rural Road	Breach gap & RCC/ SPT bridge /culvert damage	775 nos Road	Temporary 895.61 L Permanent 29000 L
5	PWD State Roads	Breach gap & RCC/ SPT bridge /culvert damage	(24 nos Road)	Temporary74 .L Permanent500 L
6	DRDA	MG NREGA Schemes IAY houses	Partially 189 nos Fully - 3 nos Partially-135 nos	1500.L
7	Fishery	Infrastructure/Loss of fish/fish seed	2800 Ha.	53.70 Cr + 36.40 L
8	Under Rev.Circles	Houses	Fully-12508 nos Severely-3521 nos Partially- 28891 nos	F - 2281.L S - 113.L P- 5489.L

Mitigation measures by the District

District Administration was regularly monitoring the early sign of impending flood and rising water levels in the rivers on day-to-day basis. Since flood is the regular phenomenon in the district so it is essential to monitor the situation in advance for better preparedness. According to the rainfall in the catchment area and prediction of IMD, there was high possibility of the flood hitting the district this year, a number of necessary arrangements/exercises had been carried out i.e. identification of potentially weak areas along embankments and river banks, capacity building, quick response, early

warning etc. All the potentially weak embankments were identified as vulnerable sites and mapped by the Water Resource Department. After identification of such sites, repair works in advance has been completed especially for the most vulnerable sites like Pazarbhanga, Manikpuretc (Fig 4).

As a next step for effective flood management the District administration did the assessment of available resources in hand and the resources required for worst case. Immediately after the warning for severe rainfall at the catchment areas and speculation of flooding of the district, a 24x7 Emergency Control Room was established at the district head quarter with adequate number of resource persons.

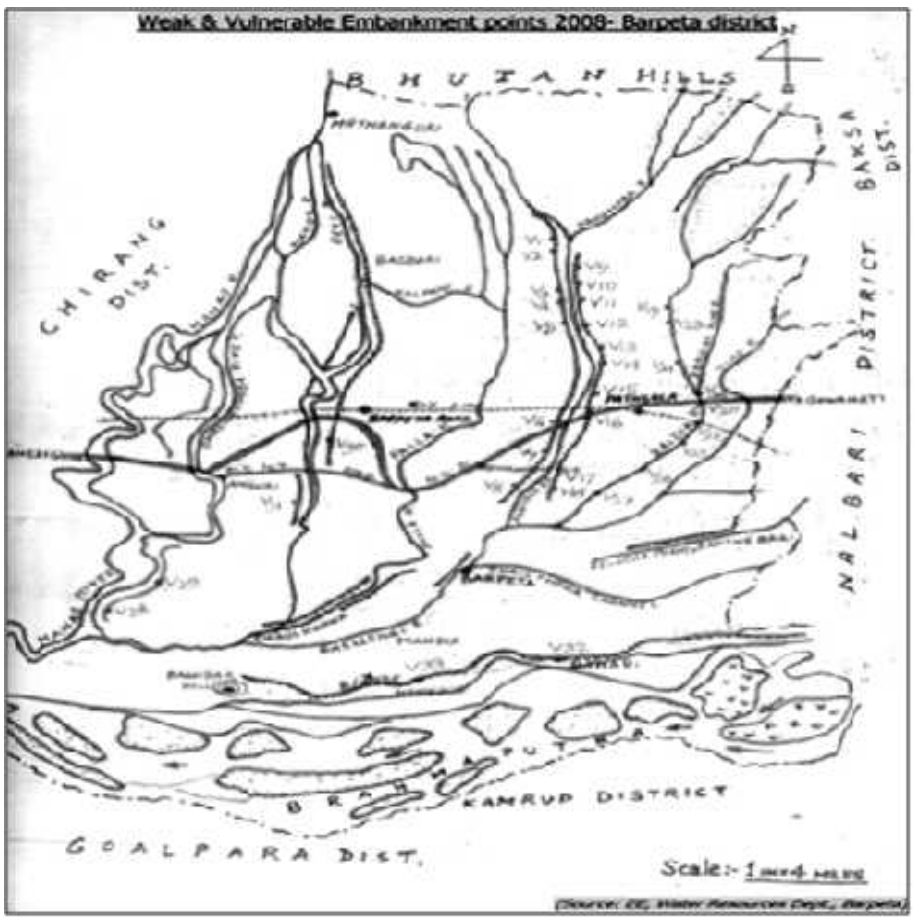

Fig 4: Schematic vulnerability map of Barpeta district
(Source: Water resources Department, Barpeta)

FLOOD MANAGEMENT BY DISTRICT ADMINISTRATION

Early warning

Early warning dissemination was very effective in the district to connect the last mile. First early warning for flood was released by the Central Water Commission (CWC), agency responsible for monitoring of all the rivers in the state and releasing early warning. In case of rise in water level or any probability from the catchments area, CWC issues the warning to the SDMA/DDMA for further dissemination through Early Warning System (EWS) established by the DDMA. For each village State Government has appointed a resource person (village head man), who is responsible for the dissemination of early warning in his/her villages during flood situation. In all the three wave of flood early warning has been disseminated on time for the quick response and evacuation.

Rescue and Response

Since flood is a regular phenomena in the district, all the concerned departments including the District Administration was prepared in advance to manage the flood situation. District Disaster Management Authority/Administration had planned to deal with the floods and other disasters in advance. As soon as department received the early warning from the CWC, the information was quickly disseminated to each village in a well planned manner for the evacuation of the people and cattleliving in the places have probability of inundation. The major key departments involved in the relief and rescue works were, District Administration Officials, other line department officials, army, SDRF, NDRF(Stationed at Barpeta for any Emergency).

As the 2012 floods were severe as compare to the previous years, the requirement of the boats were comparatively high. A total of 292 boats were deployed with the rescue teams to evacuate the people and cattle. Approximately 83,731 people were evacuated safely and a total of 105 relief camps were established with all the necessary arrangements and as many as thousands of others have taken shelter on roadsides, embankments, highlands etc. About 40 medical teams had been formed to provide medical assistance to the affected people.

Step by step Rescue and Response

- On receipt of warning of the impending flood for all the three waves, part of the immediate response an early warning has been disseminated in each village to warn the people.
- Emergency Operation Centre (EOC) activated in the District on 24 x7 basis.
- District Administrationhas been disseminated early warningin the likely affected areas especially to those people who have no access to mass media.
- Immediately after inundation evacuation activities has been started from the worst affected circles on the priority basis.
- Adequate number of Disaster Management staff, rescue swimmers, boats, and equipment had been deployed to all the affected villages for quick rescue and relief operations.
- Flood affected people had been shifted to pre-identified safe places at higher elevations i.e. schools, PanchayatGhar, embankments.
- As a key responsibility, food, safe drinking water, hygiene and sanitation facilities etc. has been provided to all the affected people by the District Administration.
- Search and Rescue activities were also carried out through out the district along with the relief work. All the injured and people needed medical attention had been administered by the medical care unit.
- Damage assessment has also been carried out for the assessment of loss due to flooding for private and public infrastructures and crops etc.
- Cost of damages has also been sent to the State Govt. for release of funds from the "Calamity Relief Fund" as per the prescribed norms.

Relief distribution - challenges and strategy employed

As per the requirement of the affected population, large quantity of food items and ration has been distributed to the communities. As a Gratuity Relief following items have been distributed,

Rice	**:**	**14,306.41 quintals**
Dal	:	2,655.83 quintals
Salt	:	742.77 quintals
Tarpaulin & Plastic Sheets	:	11,500 pieces
Baby Food:	:	500 pkts

Repair, Restoration works

Large number of infrastructure losses including the Water, Sanitation and Hygiene (WASH) happened due to the floods. District administration installed number of tubewells for the water supply, numbers of temporary latrines/ bathrooms has also been constructed. Below is the list of the repair, restoration and distribution works has been carried out after the flood:

- Hand tubewells installed: 697 nos
- Temporary latrines constructed: 158 nos
- Temporary Bathrooms installed: 53 nos
- Total no of spot sources disinfected: 11536
- Candles distributed:500 bundles
- Cattle feed: 500 Qntl. and 3 trucks of green fodder
- Phenyl: 2500 ltrs
- Bleaching Powder: 6.00 Ton

Major causes of Flooding and Casualties

Barpeta is regularly affected by floods due to high discharge in the Brahmaputra and other river system of the district. The main causes of floods are widespread heavy rainfall in the catchment areas and inadequate capacity of the river channel to contain the flood flow within the banks of the river. There are several other causes associated with the flooding in the district which are mentioned below:

Meteorological conditions

The precipitation here is mainly due to the South-West monsoon. Heavy rainfall occurs from June to September. Average annual rainfall in the region is very high and ranges from 1750mm in the plains to about 6400 mm in the hills, this huge volume of water rushes through the narrow bowl shaped valley of Assam to the Bay of Bengal ravaging the area through floods and land erosion. The recurring floods on an average devastate about 20% of the total area of the plain districts of the state of Assam and in the high floods years the devastation has been recorded to be as high as 67 % (Fig 5).

River erosion and Breaching of embankments

Breaching of embankments is one of the other major problem in the district and a major cause for the rapid inundation. Roads and embankments have

been breached or overtopped at various places, with the worst breaches developed at:

- Pazarbhanga under Barpeta circle on Bahari-Baghbar embankment.
- DRDA Embankment at 4 No.BordoloniSatrakanara under Baghbar Circle.
- Embankments of Tihu and Kaldiarivers underSarthebari Circle.
- Bundh of Deojarariver at Deojara.
- Pahumara L/B embankment at Gahinpara

Fig 5: Breach and river erosion on the bank of river Bharamputra
(Source: DM Office, Barpeta)

Satellite Monitoring of floods by NRSA

ISRO/DOS is playing a vital role in supporting the flood management activities, by providing space as well as aerial remote sensing based services

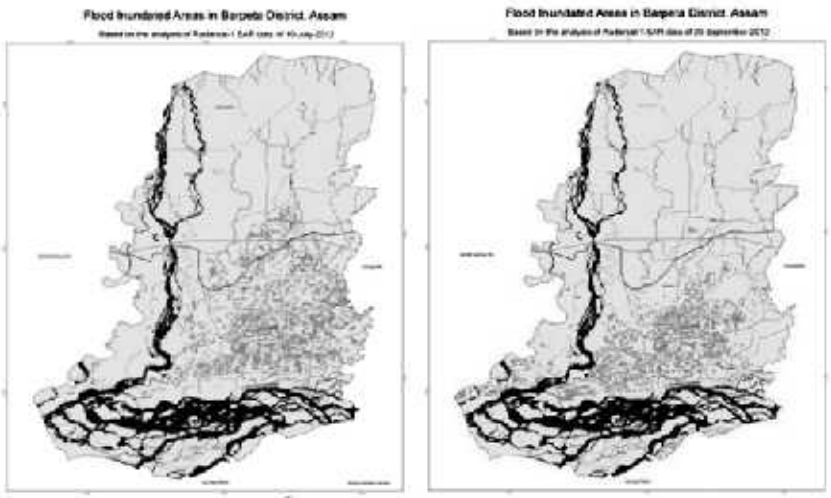

Fig 6: Flood inundation map of Barpeta district
(Source: ISRODocument)

and products. Using satellite data from Indian Remote Sensing Satellite (IRS) System and from foreign satellites, the impact of floods in the country is being assessed for the past one decade (Fig 6).

ISRO developed the flood inundation map for the 2012 floods in the Barpeta district. As per the Radarsat-1 SAR data, Barpeta district was the most flood affected district on July 19th, 2012 and on July 24th, 2012 it was one of the major affected district. Below figures shows the flood inundation in the Barpeta District during July and September.

Post Flood issues and challenges

Overall flood management in the district was significantaccording tothe severity of the 2012 floods but still there are some challenges to reach the final goal of zero casualties. During the entire flood management (June-October 2012), number of issues had been identified which need to be addressedon the priority basis to deal the future floods in a better manner. Some major issues and challenges identified by the District Administration are discussed below,

Problems concerned with people's return to home

Since the embankments are on higher elevation than flood plains, people had taken immediate shelter during the floods. The flood affected victims, who had lost their homes stayed back on the embankment for a long time andsome stayed back permanently. Though the people on the embankment are protected physically but on the other side there was high vulnerability of erosion and in case of breaches there was a greater chance of loss of life and property. In first two waves of the flood it has been observed that majority of people are not returning their home from the temporary shelters established on the embankments. After breaching on some sites, embankments have been developed to stop breaching. Development of temporary embankments created another problem with the decreasing water level, the floodwater on the other side of the embankments trapped on the agriculture. District Administration took necessary action to shift the displaced people to their home back and made the way for water to go back to the river from the agriculture fields (Fig 7).

Fig 7: Glimpse of the displaced people living on high embankments.
(Source Pic1: http://www.reuters.com/article/2012/07/16/us-india-floods-idUSBRE86F0GV20120716)

Disease surveillance and control

During the entire flood period (June-Oct, 2012), therewas no disease outbreak reported.District Administration, Medical and Public Health Departmentwere prepared in advance to deal with any disease outbreak situation. A total number of 40 medical teams have been deployed to the various sites for the surveillance and monitoring purpose.

Management of VIP visits

VIPs visits during and after flooding have been identified as one of the major challenges. During the flood situation it is very difficult to manage the necessary arrangements i.e., security, logistics etc. for the VIPs as most of the resources are deployed in the rescue, relief and other important work related to flood management.

Coordination among the Agencies

Coordination among the NGOs is one of the other important issue need to be addressed. In normal practice majority of the NGOs are trying to reach the worst affected sites with the same type of relief material. Hence, a good coordination mechanism among the NGOs is high priority need.

Damaged Roads

Most of the roads were severely damaged including the State Highways, PWD roads due to the inundation and waterlogging caused serious communication disruption in relief and rescue operations. The district administration planned alternative solution to combat with these situations

through the deployment of adequate number of boats for the relief and rescue operations. But restoration of road connectivity is the challenge to pursue quick relief and rescue operations.

Inundation of agricultural land

District administration faced huge challenge to drain out the trapped floodwater in the agricultural lands. In many cases, the temporary small embankments were made to stop the high flow of water inside the town. After the flood is over the same small embankments were acted as barrier to stop the backflow of trapped water. Finally the administration removed the small temporary embankments.

Rumor Control

Controlling of rumor is one of the major challenges in the district. Number of rumors like high discharge of floodwater from major breach site, tiger in the village etc. had been in spread created complex situation. District Administration acted upon the information received from various reliable sources deployed in each village. Team from DDMA/ District Administration has been reached on the site and quickly analyzed the situation and conveyed locals about the fake rumors.

Lessons learnt& Recommendations

Common features of such disruptions include issues such as the interruption of community functions and response roles.

1. Flood hazard and potential flood risk from all sources should be identified and considered at the earliest stage in the planning process.Reconnaissance combined with repair during dry period (convergence of WR, DRDA, Dist. Admin, PWD required). Development should preferentially be located in areas with little or no flood hazard thereby avoiding or minimising the risk. Identification and mapping of all the resources, alternative routes is required in advance in view to the worst flood scenarios along with the capacity building exercises for all the stakeholders including the community.
2. Measures identified for actual flood period
    a. Establishment of 24 x 7 flood control room with advance equipment

b. A dedicated officer for inter departmental/ NGO coordination

c. System for ensuring the flood warning reach the last mile i.e. people of the area

3. During the flood period there was lack in adequate number of boats for the relief and rescue work.Boat Management – It is essential to arrange adequate availability of the boats in advance, ensuring use by flood affected person, control etc. All the resources i.e. boats men, rescue swimmers etc. need to put in loop in terms of regular meetings and exercises especiallyduring the non-flood period.

4. Relief Camp Management- Common problems associated and solutions. Each year is has been observed that relief camp management is a major challenge for the department especially distribution of ration, hygiene and sanitation.Even each relief camp context presents different unique challenges which require improvisation and quick problem solving techniques. Simulation exercises on variety of camp scenarios required including hands-on activities, complemented with Camp Management theory through which relief/rescue workers and volunteers will learn about the camp management techniques.

5. Identification of the unplanned and unauthorized construction in the riverbed areas needs to be identified and mapped through GIS for planning. Resettlement of such communities needs to address in priority basis by District Administration.

6. Flood awareness among the communities need improvement along with the concept of community based disaster risk management. Casualty rate can be reduced through such programmes. Launching public awareness campaigns on flood safety and risk reduction and sensitizing all stakeholders to flood problems and mitigation in flood prone areas is essential.

7. Geographical Information System (GIS) based database need be prepared to map,analyze, plan and manage all the hazards and resources for the better management of future floods. Flooding becomes a major hazard to life and property only when people live on the floodplain. Flood hazard maps will be showing flood boundary

based on different magnitudes of flood with specific return periods. These maps can be used to regulate developmental activities within the floodplain, so that damages could be minimized. Some of the data required for hazard mapping is difficult to obtain from ground measurements and its time consuming; in such cases remote sensing plays an important role. Satellites provide synoptic and frequent coverage of flood affected areas and thus become valuable for monitoring flood disaster. Thus satellite data can be directly used for deriving the flood inundation limits. If satellite data sets during flood times are available over a period of time for a floodplain, they can be conveniently used for hazard zone mapping.

A GIS based detailed mapping and modeling will be useful for flood hazard. Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. The basic concept of flood plain zoning is to regulate land use in the flood plains in order to restrict the damage due to floods, while deriving maximum benefits from the same. Below example depicts the flood zone mapping (Fig 8).

Fig 8: Schematic outline of flood zone map

8. Coordination among the agencies is one of the common issue often faced during any disaster situation, the same has been faced by the district administration. Coordination mechanism especially during the flood time needs improvements. District Administration is working to establish proper mechanism for the coordination among the various agencies.

9. Water Management is another major identified issue by the District Administration. Presently administration is working on the planning phase of this issue. Since the area is too big, so instead of making embankments, Administration and PWD planning to do the proper channelization of the rivers and tributary system. During the flood time, instead of creating flooding excess water will be distributed in different channels to avoid inundation. Proper channelization of water is an effective and long-term solution for the flood management. In case of embankment development, the concern is the regular increase in riverbed height, as much as big embankments we develop, it will be shorter each year due to the high quantity of sedimentation in the river bed. So development of embankments is not the long term solution for the problem.

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WHO-EHA, SEARO Publications

ICIMOD Publications

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Disaster Management in Namchi (Head Quarter, South District) on 18th Sept, 2011 Sikkim Earthquake

Dr. Indrajit Pal, Aunjaneya Kumar Singh

Overview of the district

Sikkim is a small state and has been divided into four districts viz- East, West, North and South. South Sikkim, with its district HQ as Namchi is gifted with tremendous natural beauty. South District of Sikkim lies at an altitude of 400 mtr to 2000 mtr with unique and countryside escape of endless waves of agricultural fields and the terraced slopes, intercepted by spring patched forests and encompasses a total area of around 75000 hectares. Area wise, it is the smallest district of Sikkim and population-wise, second one. Namchi is nestled among the hills having elevation of 5500 ft and which commands panoramic view of snowcapped mountains and vast stretches of valley. South Sikkim has variety of climatic conditions and average annual rainfall of 162.5 cms. Maximum temperature recorded so far on the average is 17-27 Degree Celsius and minimum 02-21 Degree Celsius. Namchi and Ravangla are sub-divisions of the district and Namchi, Jorethang, Melli and Ravangla are important towns. South district has 8 Assembly Constituencies, 1 Municipal Council, 1 Nagar Panchayat, 7 Municipal Wards, 45 Gram Panchayat Units and 225 Wards.

Namchi is around 78 km away from the capital Gangtok and around 85 km from Siliguri, which is the gateway to enter in Sikkim from West Bengal. The nearest railway station is New Jalpaiguri (NJP) (around 105 km) and nearest

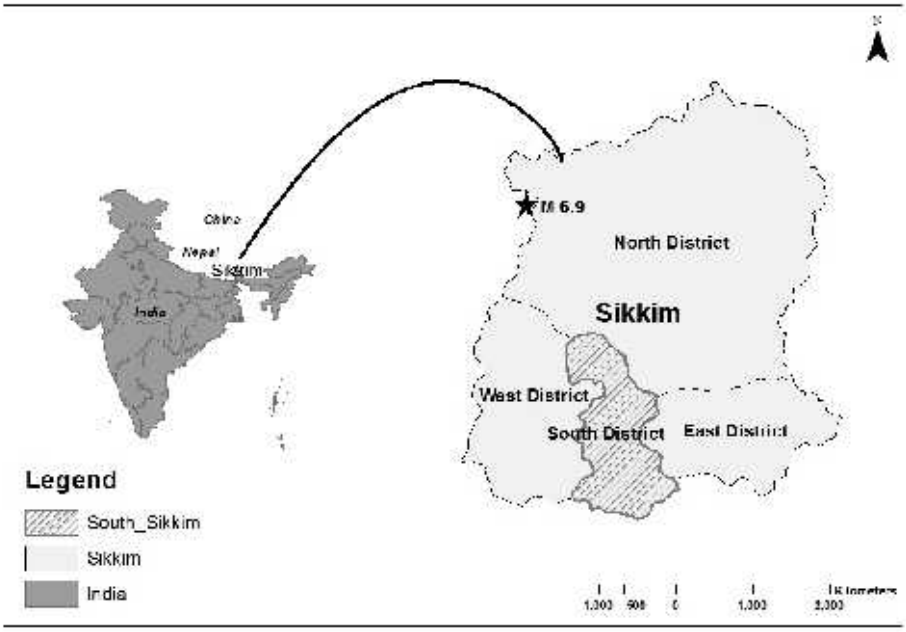

Fig 1: Location map Namchi, Sikkim (Source: Namchi District Office)

Airport is Bagdogra (around 110 km) from Namchi. The Melli check post is the entry point to South District from West Bengal (Fig 1).

Earthquake and its Seismological setting

The M6.9 Sikkim earthquake of September 18, 2011struck at 18:10:48 IST lasted to about 30 to 40 secondswith its epicenter located at 27.72°N, 88.06°E nearIndia-Nepal border region, about 68 km NW ofGangtok at a focal depth of 19.7 km. Threeaftershocks of magnitude 5.7, 5.1 and 4.6 were alsofelt in Sikkim within 30 minutes of the initialearthquake. This region has experienced relativelymoderate seismicity, with 18 earthquakes of M5 orgreater over the past 35 years within 100 km of theepicenter of the September 18, 2011 event. Theaffected region lies in the high risk seismic zones ofIV of Indian seismic code IS: 1893 with the expectedshaking intensity of VIII (on MSK scale).

Background

A devastating Earthquake of magnitude M 6.8 on Richter scale shattered Sikkim on September 18, 2011 (18:11 hrs IST). Epicenter reported near Mangan about 68 km Northwest of Gangtok, the capital of Sikkim. Tremors

were widely felt in all the North Eastern states of India, West Bengal, Bihar, Uttar Pradesh, Haryana, Rajasthan, including capital city Delhi, Nepal as well as China. Several aftershocks accompanied with incessant rainfall were causing further distress in the relief and rescue operations. More than 100 people lost their lives, several injured and rendered homeless. Namchi, the South District Head Quarter and adjacent areas were less affected by the incident. National Highways, State Highways including the rural connectivity in the Chungthang, Lachung and Lachen area have been snapped. A high-pressure situation emerged as a calamity of such magnitude.

- Earthquake measuring M 6.8 on Richter scale occurred on September 18, 2011 (18:11 hrs IST) in the Sikkim-Nepal border region (27.723oN, 88.064oE).
- Duration of the earthquake was about 45 seconds.
- Epicenter reported near Mangan about 68 km Northwest of Gangtok, the capital of Sikkim.
- Tremors were widely felt in all the North Eastern states of India, West Bengal, Bihar, Uttar Pradesh, Haryana, Rajasthan, including capital city Delhi, Nepal as well as China.
- National Highways, State Highways including the rural connectivity in the Chungthang, Lachung and Lachen area have been snapped.
- Several aftershocks accompanied with incessant rainfall were causing further distress in the relief and rescue operations.
- More than 100 people lost their lives, several injured and rendered homeless.
- Namchi, the South District Head Quarter and adjacent areas were less affected by the incident.
- The area plunged into darkness and mobile phone lines were jammed.
- A high pressure situation emerged as a calamity of such magnitude.

Immediate orders and instructions(Response to Crisis on 18th September, 2011)

- Immediately after the earthquake DC/ South managed to contact District Project Officer (DPO)/ Land Revenue & Disaster Management

Department (LR&DMD)/ Southand called an emergency meeting at his residence within 2 hours.

- SP/South discussed the situation with DC/ South.
- It was decided that SP/South will immediately take stock of the situation through Wireless Telecommunication (WT) from Police Stations/Outposts and Check posts and report the same to DC/South.
- Instructions were also given to all police stations/outposts and check postsfor immediatestart of rescue operation in their areas with the help of locally available resources.
- Connection to the Head Office and Relief Commissioner could not be established.
- 6:30 p.m.DC/ South and team reached Namchi Bazaar to take stock of the situation as it is densely populated.
- Two buildings were found severely damaged at Namchi Bazaar near the Fountain Park.
- 6:40 pm - SDM/HQ was directed to inspect the District Hospital and issue instructions to get ready for an emergency situation.

Immediate Orders / Instructions given:

- Rescue operations to be carried out in all the areas by local administration, police and panchayats.
- Since high intensity aftershocks were still expected, evacuation from unsafe buildings were put on priority.
- Liquor shops to shut down and no liquor to be sold until further orders.
- Those having emergency power to keep them on, to enable rescue operations.
- Public advised not to spread rumors.
- DC/ South visited the Fire Office and instructed the personnel to be prepared for rescue operations.

Establishment of CONTROL ROOM

- 6:50 p.m. - DC/ South visited the District Collectorate to set up an Emergency Control Room.
- The building was declared unsafe for Control Room after seeing wide cracks on the beams and pillars.

- There was no functional wireless system, no power supply and no telecommunication in the Collectorate.
- 7:00 p.m -No officers could be telephonically contacted the DC/ South called for an Emergency District Level meeting through WT message.
- The only functional communication system was the Wireless Telecommunication in the hands of the Police. The SP/South took charge of it. All communication directed through it and reported to the DC/South over WT regularly.
- Two control rooms were set up. One at DC/South's residence and the other at SDM/HQ's Office in the District Collectorate.
- Around 7:30 p.m - Collapse of one building at Mazhigaon, Jorethang was reported. Around five people were reported to be trapped. DC/ South directed the concerned police station to carry out the rescue operation with the help of local gentry.
- Envisaging the need for an Incident Command System / Incident Response System the DC/ South setup the Command Center at his residence itself. It was functional by 8:00 p.m.

Govt. intervention

- Hon'ble Home Minister Shri P. Chidambaram held a meeting with Shri Pawan Chamling, Hon'ble Chief Minister of Sikkim, at Gangtok and also did an aerial survey to see the most damaged areas in the north district.
- Hon'ble Home Minister announced Rs. 50 crore assistance to Sikkim Govt. and assured every kind of help they needed to restore normalcy.
- Hon'ble Prime Minister of India visited Sikkim on 29thSeptember 2011 and announced Rs 1000 cr package for immediate restoration of damaged infrastructure like road, buildings, schools, water supply and power lines.
- At the district level, respective District collector was the incident commander and Secretaries of the State Government have been designated in each district to coordinate the relief efforts.

Some agencies present at disaster site are:

- National Disaster Response Force (NDRF)
- Indian Air Force (IAF)
- Indian Territorial Army

- Indo-Tibetan Border Police (ITBP)
- Border Roads Organisation (BRO)
- Border Security Force (BSF)
- Air force Intelligence Surveillance & Reconnaissance Agency (AFISR)
- SPHERE, CASA, Caritus, State IIG-West Bengal, World Vision, Delhi School of Social Works.
- Expert team formed by PMO, MoUD, MHA, NDMA and others
- TISS-Mumbai, IIRS-Dehradun, IIT-Roorkee and others

Difficulties faced by the District Administration:

1. LACK OF EQUIPMENTS

- Supply of the equipment for relief & rescue had been sent to the Head Office (i.e., Gangtok)
- Since 2009 adequate and proper equipmentwas not provided to District Control Room.
- The Head Office managed the supply of equipment.
- Hence availability of equipment during emergency was an issue.

2. INSUFFICIENT FUNDS

- Absence of fund for maintenance ofexisting equipment.
- Setting up of EOC was difficult.
- No emergency power was available.

3. NO COMMUNICATION SYSTEM IN THE COLLECTORATE

- Absence of Wireless Set for the BDOs and DM Team increased the dependency on WT lines under police control.
- Absence of HAM at the District / Blocks.
- Satellite phonein the Collectorate was also not functional.

4. NO DISASTER MANAGEMENT TEAM

- Quick Response Force for disaster management was ill equipped, untrained and inadequate in numbers.

5. LACK OF FULL FLEDGED CONTROL ROOM

- The Emergency Operation Centre stationed below the Annex building was not in a condition to function as required both in terms of manpower and location.

- Staffs appointed for Emergency Operation Centre are appointed on Temporary basis.
- Wages of the staffs at the EOC were not appropriate comparing with the service rendered. (EOC staffs are working round the clock and their work demands high skill.)

6. LACK OF COMMUNITY COMMUNICATION SYSTEM:

- Lack of a communication system in the local community other than telephonic network, made it very difficult to make contact.

7. LACK OF MOCK DRILLS EXERCISES

- Few numbers of Drills exercised in the District during the last two years.
- Need for regular drills involving Govt. Officers, Schools, Hospital Staffs, PRIs etc.

Recommendations / Suggestions

1. A fully equipped Control room/Emergency Operation Centre (EOC) need to be set up in a centrally located area where efficient management of crisis situation with the presence of all government agencies can be undertaken.
2. Sensitization of Government officials on disaster and emergency management aspects need to be addressed for proper functioning of EOC and quick decision-making.
3. Number of QRT personnel need to be increased. At least 10 -12 QRT members may be deputed for each block. Presently the total strength of QRT in the State is 44 available exclusively for disaster management.
4. Cadre from existing services could be deputed for EOC and QRT with adequate training and proper equipment.
5. Regular training for QRTs on rescue operations, relief distributions and shelter management could be arranged through the experienced and expertise institutes like,"Sikkim Amateur Mountaineering Association (SAMA)", Himalayan Mountaineering Institute, Darjeeling; Training wing of Sikkim Police department, National Civil Defence College, Nagpur; National Industrial Security Academy (NISA), Hyderabad etc.
6. Formation of Incident Response Team (IRT) in the State is need of the hour. Various officials/staff from existing cadres can be selected to

form the IRT.

7. District and State level sensitizationon Incident Response System (IRS) is also necessary for the efficient functioning of IRT.
8. NGOs and volunteers also need to be inducted as a part of the IRT.
9. Periodic trainings and involvement in disaster management in other states could be given to the IRT members for better exposure to practical real life situations.
10. Modern equipment and latest techniques for disaster management system need consideration.
11. Since Sikkim is prone to earthquake, conduct of regular sensitization programme on dealing with earthquake crisis should be done at all levels –Govt. employees, public,students, private companies, NGOs etc.
12. District Disaster Management Plan (DDMP) shall be prepared and updated with the active participations from line departments.
13. District Disaster Management Authority (DDMA) should convene in a regular interval for advance planning, policy development and modifications in the DDMP.
14. MOCK DRILLS must be conducted at least once in a year in every residential locality, school, office and bazaar area.
15. Community or HAM radio services can be set up in Sikkim for seamless communication during crisis situations.
16. Single point proactive information dissemination through IPR and media need consideration.
17. Earthquake proof norms/standards to be made compulsory for all constructions.

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