



A Study on Flash Floods and Landslides Disaster on 3rd August 2012 along Bhagirathi Valley in Uttarkashi District, Uttarakhand



Towards a disaster free India.....

World Centre of Excellence on Landslide Disaster Reduction

National Institute of Disaster Management

Ministry of Home Affairs, Govt. of India

5 B, I.P. Estate, Ring Road, New Delhi – 110 002

www.nidm.gov.in

A Study on Flash Floods and Landslides Disaster on 3rd August 2012 along Bhagirathi Valley in Uttarkashi District, Uttarakhand

by

Surya Parkash, Ph.D.



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Report Prepared and Submitted by Dr. Surya Parkash to NIDM, New Delhi during August 2012

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Towards a disaster free India.....

प्रो. संतोष कुमार

कार्यकारी निदेशक

Prof. Santosh Kumar

Executive Director



Foreword

As per sections 42 and 43 of Chapter VII of Disaster Management Act 2005, National Institute of Disaster Management has been mandated to undertake documentation studies related to disasters in the country as part of its activities for disaster risk reduction. The Institute has already published some of such documentation studies, viz Kumbhkonam Fire incident, Kosi Floods, Barmer Floods, Sikkim Earthquake, Kutch Earthquake etc. The present report is an endeavour in the same direction where the recent disaster in the Uttarkashi district of Uttarakhand has been studied by Dr. Surya Parkash, Associate Professor, NIDM and published in this document as “A Report on the Study of Flashfloods and Landslides (3rd August 2012) in the Bhagirathi Valley of Uttarkashi district, Uttarakhand.

NIDM expresses its unfathomable grievances and condoles the untimely deaths of the victims in this disaster and hopes that the document would bring out various issues, challenges and opportunities that would help in reducing the risk from such disasters in future. The efforts made by Dr. Surya Parkash, Associate Professor, NIDM, are immensely appreciated, especially the fact that he had visited the affected area immediately after the event and gathered relevant information, ideas and experiences to derive lessons from the event and propose onsite suitable recommendations to the relevant stakeholders for avoiding, preventing or reducing the risks in a systematic manner.

The readers of the document are requested to provide feedback, comments and suggestions to the Institute for improving specifically the quality of documentation and making it more effective and user friendly to the public, administration, professionals, government and other stakeholders.

(Prof. Santosh Kumar)

Executive Director

अगर उचित है आपदा प्रबंधन, तभी मिलेगा विकास को धन।



Preface

The monsoon period i.e., June to September is infamous for causing catastrophic and devastating disasters due to cloudbursts, flashfloods and landslides in the hilly terrains, particularly the habituated areas of Himalaya. However, such events also happen during other periods of the year as well, when heavy to very heavy precipitation occurs on susceptible slopes with poor drainage system. Besides the natural factors like geodynamically active seismic belt, immature topography and high to very high intensity rainfalls, the role of human beings in aggravating the impacts of these catastrophic events cannot be over-sighted. The increasing concentration of population over susceptible unstable slopes and ill-developed planning / mining / construction of habitations as well as highways, infrastructure in close proximity with the rivers or footslopes without proper protective measures have added to the woes of the people who suffer from the impacts of these hazardous events. The victims include the local community, pilgrims, tourists, trekkers, labourers, shopkeepers and visitors in the affected locality and indirect impacts are faced by people who depend on trading / resources from these hills.

In addition to the haphazard and unscientific developments, lack of adequate disaster risk reduction measures and in efficient disaster management system, results in chaotic and adverse approach leading to delayed and poor risk management. Thus, it is the dire need of the society to revamp the whole system of development and disaster risk management in a proper systematic and scientific way so that incidences and the adverse impacts of such catastrophic events on humanity, environment development and resources can be reduced. The present study of recent disasters (flashfloods and landslides) in the Upper Bhagirathi valley of Uttarkashi district in Uttarakhand, India is an endeavour in this direction.

The present document provides an insight on the incidences of past disasters, and administrative, demographic, socio-economic and infra-structure perspective of the Uttarkashi district for assessing the vulnerability and capacity of the district in disaster risk reduction. The author has also attempted to discuss the causes and consequences of the recent event along with the response by various stakeholders. The report summarises the lessons learnt achieving and recommends measures that would be useful in devising strategies for achieving disaster risk reduction.

The readers are requested to provide their free and frank opinion about the usability of this report vis-a-vis its aims and objectives. Any good and practically acceptable suggestion which would help in strengthening our efforts towards disaster risk reduction would be welcome.

A handwritten signature in black ink, appearing to read 'S. Parkash', written over a horizontal line.

(Surya Parkash, Ph.D.)

Head

Knowledge Management & Communication Division,

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I would like to express my sincere gratitude to Prof. Santosh Kumar, Executive Director, National Institute of Disaster Management, New Delhi for his kind encouragement and support in carrying out the field study and in preparing the present document on Study on Flash floods and Landslides (3rd August 2012) in the Bahgirathi Valley of Uttarkashi district, Uttarakhand.

I am grateful to Shri Om Prakash, Principal Secretary (Disaster Management), Government of Uttarakhand; Dr. R. Rajesh Kumar, Deputy Commissioner, Uttarkashi and other civic servants of the state, viz; Shri Sanjay Gunjyal, DIG Police; Shri B.K. Mishra, ADM; Dr. S.K. Baranwal, Dy. Collector; Mr. Ghildyal, District Information Officer; Shri D.C. Nautiyal, AE (PWD), Uttarkashi; Mr. Kamal Singh Rawat, Local Representative; Mr. Sharad Singh Chauhan, Mr. Phool Babu, Mrs. Urmila Semwal, Digvijay Singh Negi and Attar Singh Negi – people directly affected by the disaster; Mr. Yogesh Mishra of Information and Public Relations Department, Dehradun; and Mr. Girish Gairola, Bureau Chief Garhwal Mandal from Avanti Media Limited (TV 100) for their kind cooperation during the field visit and meeting held with them on the matter. Their inputs and experience sharing have added a great value to this report.

Thanks are due to Dr. Piyoosh Rautela, Executive Director, Disaster Mitigation and Management Centre, Dehradun and Shri Davender Singh Patwal, District Project Officer, Disaster Management, Uttarkashi for sharing valuable experiences on disaster management.

All district and the state officials as well as the local representatives and affected people who have shared information and experiences deserve appreciation for highlighting the response actions, challenges and difficulties faced in managing the disaster.

The role of central government agencies in the area, NDRF, ITBP and army in the affected area can never be over emphasized. Special thanks are due to the officials from Border Roads Organization (Shri K.K. Razdan, Shri U.K. Pandey, Col. Sunil Sharma and Mr. Rajesh Singh), Inspector Ajay Pal Singh from ITBP 6th Battalion, the 8th Battalion of NDRF, and Shri Anand Sharma Director, IMD, Dehradun.

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Last but not the least, I would like to thank my wife Reeta and my daughter Rasika Gupta, without whose consistent moral and logistic support, I would not have been able to give due attention and time to this work. I am indebted for their tolerance to bear with me when I was busy with work related to this publication and could not give due attention and care to them.

Finally, I am grateful to the Almighty God without whose grace and kindness, I would not have been capable to carry this task successfully.

A handwritten signature in black ink, appearing to read 'S Parkash', with a long horizontal line extending from the bottom of the signature.

(Surya Parkash, Ph.D.)

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Abbreviations and Acronyms

BDO	Block Development Officer
CBO	Community Based Organisation
CEO	Chief Executive Officer
DCR	District Control Room
DPO (DM)	District Project Officer (Disaster Management)
DDMAP	District Disaster Management Action Plan
DDMC	District Disaster Management Committee
DDN	Dehradun
DEOC	District Emergency Operation Centre
DGP	Director General of Police
DHO	District Health Officer
DHS	Directorate of Health Services
DITs	Disaster Intervention Teams
DMAP	Disaster Management Action Plan
DMMC	Disaster Mitigation and Management Center
EE	Executive Engineer
ERP	Emergency Response Plan
FCI	Food Corporation of India
GIC	General Insurance Corporation
GIC	Government Inter College
GIS	Geographical Information System
GMVN	Garhwal Mandal Vikas Nigam
GoI	Government of India
GoUK	Government of Uttarakhand
GSI	Geological Survey of India
IMD	Indian Meteorological Department
ITI	Industrial Training Institute
MLA	Member of Legislative Assembly
MO	Medical Officer
MP	Member of Parliament
NDMA	National Disaster Management Authority
NGO	Non-Government Organization

NHPC	National Hydro Power Corporation
NIDM	National Institute of Disaster Management
NTPC	National Thermal Power Corporation
PHC	Primary Health Centre
PWD	Public Works Department
SDO	Sub-Divisional-Officer
SOC	Site Operation Centre
SEB	State Electricity Board
SEOC	State Emergency Operation Centre
THDC	Tehri Hydro Development Corporation
UJVNL	Uttaranchal Jal Vidyut Nigam Limited
UKI	Uttarkashi
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal

Executive Summary



Worldwide, flash floods and landslides have always scared us as swift and stealthy killers. These often attack without any premonition and give no time to respond. Landslides, too, bury more than 5000 people alive every year globally, along with economic losses of over 4 billion USD. These are one of the worst forms of natural disasters that humanity has experienced. But just fearing them alone won't help, one needs to understand them and learn how to deal with these disasters. The present document is an attempt to highlight the lessons learnt from the landslide and flash flood disaster that hit a part of the Uttarkashi district in the Upper Bhagirathi Valley of Garhwal Himalaya during the first week of August 2012.

On the unfortunate night of Friday, 3rd August 2012 at about 10pm, the upper catchment areas of Asi Ganga and Bhagirathi rivers received very heavy (64.5 – 124.4mm) rainfall/cloudburst accompanied with thunderstorms and lightning. The atmospheric phenomena was followed by blocked drainage channels due to tree logs, sediments and boulders resulting in damming of water channels and formation of transient lakes in some tributaries of Asi Ganga and Bhagirathi rivers. These transient lakes bursted after a short span of damming and added large volumes of water, tree logs boulders and sediments into the Bhagirathi River. Not long ago, the area had received very heavy precipitation on the 4th and 25th July 2012 in the Asi Ganga valley and a transient dam was formed by debris material. Besides transient dams and lakes in these channels, the natural lakes like Dodi Tal on the upstream side were also full of water and even started overflowing. Asi Ganga basin is narrow and long with a large watershed area and is susceptible to flashfloods, landslides and debris flows. In comparison, the river Bhagirathi has a wide valley and is fed by numerous tributaries (including Asi Ganga) and glaciers. Both the Asi Ganga as well as Bhagirathi river were in high spate at the time of the tragedy.

The flash floods, landslides and debris flows during the night took away 34 human lives (who were sleeping unawakingly in their homes close to the river) and caused heavy destruction to buildings, infrastructures and projects located by riverside. Gangori and Swarigad both lying in Bhatwari Tehsil of Uttarkashi district, were cut-off from other areas due to washing away of roads by flash floods and landslides, and pilgrims were stranded on their trek from Gangotri to Uttarkashi. The torrential rains raised the water level in the Bhagirathi River by about 4m. The consequent flash floods swept away people, livestock, bridges, roads, houses, some hydel projects, electric poles, water pipelines mainly along the banks of the rivers of Asi Ganga and Bhagirathi.

The fire station at Gangori was washed away by the flash floods claiming lives of 3 firemen / constables and damaging the building, equipment and vehicles of the fire station. The power plant on river Asi Ganga was also hit by the flash floods leading to loss of lives of 23 workers camping at the site. The bridge at Gangori was washed away, disrupting the traffic Gangori. The Tiloth bridge on the other side of the river Bhagirathi that connects the Uttarkashi city, also collapsed. Apart from that, many pedestrian bridges were also washed away. Roads were blocked due to landslides and collapse of bridges which resulted in pilgrims being stranded at Gangori, Bhatwari, Harsil and Chinyalisaur. In the twin disaster of flashfloods and landslides in the district, 28 people died and 6 went missing (who were also considered later as dead).

Table Loss / Damages due to Flashfloods and Landslides in Uttarkashi district

S.No.	Description	Impacts
1	Lives Lost: 3 Firemen/constable, 6 Local residents and 19 Labourers of UJVNL	28
2	Missing Persons	6 (also considered as probably dead)
3	Injured Persons	12
4	Livestock loss: Big-68, Small-338	406
5	Agricultural landloss	55.699 hectares
6	Affected villages	55
7	Affected Families	1,159
8	Affected Population	7,389
9	Fully Damaged houses	129
10	Severely Damaged houses	125
11	Partially Damaged houses	257
12	Fully Damaged Kutcha Houses	7
13	No. of passengers stranded – 393 at Gangori and 120 in Bhatwari	513

The following major roads were closed due to cloudburst, flash floods and consequent landslides:

- Dharasu – Nalupani – Uttarkashi Road (upto 15km)
- Kuteti Devi (due to collapse of Tiloth Bridge)
- Rishikesh – Gangotri National Highway (NH-108) blocked due to debris flow at Thirang, Gangnani, and Bishanpur.

Response

Search and rescue work was immediately taken up on a war footing. It was reported that three rescuers of the fire brigade department also died at Gangori. The district administration of Uttarkashi immediately set up relief camps and made arrangements for the affected families in different places and made provisions for food and other essential supplies, safe drinking water, kerosene and LPG cylinders etc. Medical teams were put into service; they distributed ORS and other necessary medicines including chlorine tablets to the affected people taking shelter in relief camps. Electricity department immediately restored electric supply at Chinyalisaur and Dharasu. The Border Roads Organization (BRO) established a Bailey bridge on Gangori and Swarigad, it helped in evacuation of stranded people.

One team of 8th Battalion of NDRF located at Ghaziabad and consisting of 50 personnel along with 5 boats was deployed in Uttarkashi since 8th August 2012 onwards. The team was engaged in flood rescue and relief operations. Army and ITBP personnel also extended assistance to the district administration in relief works. In addition, Non-Governmental Organizations (NGOs) and local community also contributed and supported the search, rescue, relief and rehabilitation works.

Considering the high vulnerability of Uttarakhand state from natural disasters, Shri K.M. Singh, Hon'ble Member, NDMA considered strengthening the response mechanism by deploying two companies of NDRF along with equipment and stores in Uttarakhand to ensure ready availability of NDRF in the state subject to availability of land.

Hon'ble Member Shri V.K. Duggal held a meeting on 3rd September 2012 at Delhi to discuss the issues related to this disaster with officials of the state government as well as central government agencies/ministries/departments including representatives from Planning Commission, MHA and NIDM.

Aims and Objectives of Study



The present study was carried out with an aim to learn lessons from the disastrous event of flash floods, landslides and debris flows on the evening / night of 3rd August 2012 in the Upper Catchment Areas of Bhagirathi River Valley and its tributaries like Asi Ganga. The lessons learnt from the event, its impacts and response are likely to help in disaster risk reduction in future.

The study was done with the following objectives:

- To enlist the past history of disasters in the Uttarkashi District
- To take an overview of the socio-economics, climatic and geodynamic characteristics of the area
- To study the disastrous event of flash floods and landslides that happened on 3rd August 2012 in Asi Ganga Valley of the Bhagirathi River System
- To assess the losses / damages incurred due to the said event and the needs of the people in the affected area
- To make field observations and carry out interactions with different stakeholders for documenting the lessons learnt from the event
- To propose recommendations for disaster risk reduction in future
- To present relevant data / information on the specific affected area, disaster management planning, disastrous event and the hardships from the community
- Any other items related to the above objective

Chapter 1

Uttarkashi District and Its Environs

1.1 Genesis and History

Uttarkashi district was created on 24th February 1960 out of what then constituted the parganas of Rawain and Uttarkashi of Rawain tehsil of erstwhile Tehri Garhwal district. It sprawls in the extreme north-west corner of Uttarakhand . The holy town of Uttarkashi, the district headquarter, is an ancient place with rich cultural heritage and as the name suggests, it is the Kashi of north (Uttara) with almost as high a veneration as Kashi(Varanasi). Varanasi a sacred place of Hindus is located on the left bank of Ganga River in Uttar Pradesh the state adjacent to it, likewise Uttarkashi is also located on the banks of river Ganga known as Bhagirathi in this part. The town lies between the rivers Syalam Gad (also known as the Varuna) and Kaligad (also known as the Asi). Varuna and Asi are also the names of rivers between which the Kashi of the plains lies. One of the holiest Ghats in Uttarkashi is Manikarnika, so is also in Varanasi. Both have temples dedicated to the Hindu God Vishwanath.

The hill tribes namely Kiratas, Uttara Kurus, Khasas, Tanganas, Kunindas and Pratanganas find references in the Upayana Parva of Mahabharata (A Hindu Epic). The land of Uttarkashi district has been revered by Indians since ages where the seers and sages had found solace and spiritual aspirations and performed penances. Here Devas performed their sacrifices and Vedic language was best practiced. People came here for learning Vedic languages. According to an account in the 'Mahabharata', Jada Bharatha, a great sage performed penances at Uttarkashi. The Kedar Khand of Skanda Purna refers Uttarkashi and also the rivers Bhagirathi, Jahanavi and Bheel Ganga. The district of Uttarkashi was part of Garhwal Kingdom ruled by Garhwal Dynasty that carried the cognomen 'Pal' which was changed to Sah during 15th century conferred by Sultan of Delhi perhaps Bahlul Lodi. In 1803 Gorkhas of Nepal invaded Garhwal and Amar Singh Thapa was made Governor of the region.

The Gorkhas came in contact with the British empire in 1814 as their frontiers in Garhwal became determinous with those of the British. The border troubles prompted the Britishers to invade Garhwal. In April 1815, Gorkhas were ousted from Garhwal and the region was annexed as British district and was split up into eastern and western Garhwal. The eastern Garhwal was retained by the British Government. The western Garhwal, lying to the west of the Alaknanda river with the exception of the Dun was made over to the heir of Garhwal dynasty Sudarshan Sah. This state came to be known as Tehri Garhwal and in 1949 was merged with the state of Uttar Pradesh in 1949 after India attained independence.

1.2 Location

Uttarkashi is the border district of the state, is bounded between 30°44'2" N 78°17'2" E and 30.73°N 78.45°E with Tibet and Kinnaur district of Himanchal Pradesh to its north, Tibet and China to the east, Tehri Garhwal to the south and the district of Dehradun and part of Himachal Pradesh to the west. The district covers a total area of 8,016 sq. kms, with a total population of 330,086 (2011 Census). More than 92% of the population live in rural areas. The maximum stretch from east to west is 154 km and from north to south is 109 kms respectively. The district comprises 6 Tehsils, 6 blocks, 677 revenue villages & 427 gram sabhas. The district headquarter is located at 30.44°N and 78.26°E.

The nearest airport Jollygrant, 162 km from Uttarkashi and the nearest railway station, Rishikesh is 145 kms. Uttarkashi is well connected by motorable road (NH-108) to Dehradun, Rishikesh, Haridwar and other major towns of the state and the region.

Stay arrangements available at Uttarkashi are:

Government - P.W.D. Inspection House, Forest Rest House, Nim Rest House, Tourist Rest House, Travellers Lodge

Hotels - Bhandari Hotel, Laxmi Hotel, Joshi Lodge, Shekhar Hotel, Vijay Raj Hotel, Mandakini Hotel, Ralax Hotel, Bhandari Annexe, Hill View, Yuv-Raj Hotel, Shivam Hotel, Gomukh Hotel, Gangotri Hotel, Hari Om Hotel, Sahaj Villa, Neel Kanth Hotel, Amba Hotel, Satkar Hotel, Kapoor Hotel, Natraj Hotel, Bhagirathi Hotel, Aakash Ganga Hotel, Himanshu Hotel, Satyam Hotel, Govind Hotel, Aman Hotel, Hanslok Hotel, Suvidha Hotel, Monal Tourist Home, Ekant Tourist Complex, Subham Hotel, Rishilok Hotel etc

Dharamshalas - Birla Dharamshala, Baby Kali Kamli, Punjab Sindh Kshetra, Shree Panch Mandir, Gangotri Dharamshala etc

Ashrams - Kailash Ashram, Shivananda Ashram, Bajoriya Ashram, Mata Satyawati Ashram, Tapovan Ashram, Dandi Kshetra Ashram, Swami Ramanand Ashram, Pushupati Ashram, Somnkar Math Ashram

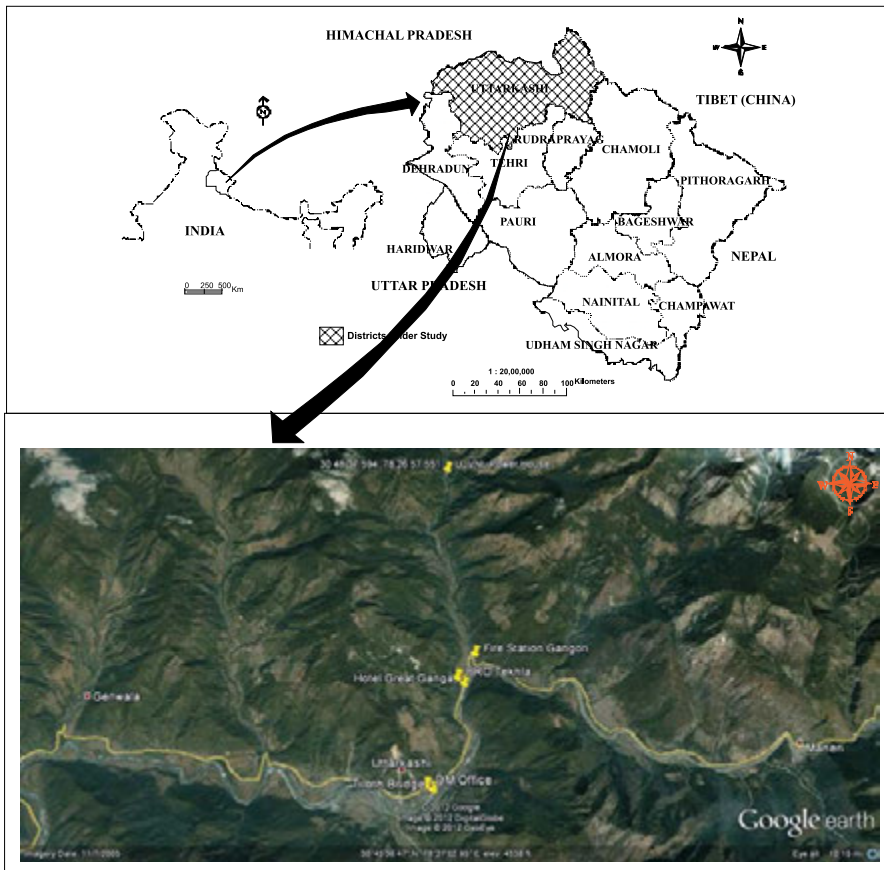


Figure 1.1: Location Map of Uttarkashi District



Figure 1.2: Access Route from New Delhi to Uttarkashi

1.3 Socio-economic setup of the area

The socio-economics of any area is one of the determining factors in assessing the degree of risk to the different elements that are likely to be exposed or affected by the hazards. It also provides an insight into the existing capacity within the affected community to cope / resist the impacts of disasters.

1.3.1 Agriculture and Irrigation

In the Himalayan region, there are many constraints in the agriculture sector like the availability of cultivable land. It can be seen from the fact that as much as 88% of the area is either covered by forests or is barren and uncultivable. The land is poor in fertility, except in valleys and such land is too little and distantly placed. Shorter agricultural season, low temperatures, high altitude, small land holding, perpetual problems of soil erosion due to steep gradients etc., are other inhibiting factors affecting agriculture. It, therefore, does not offer too much hope for bringing about well being to the people of the area. Sheep rearing for wool and meat, orchard raising, spinning and weaving of wool and other cottage industries etc. offer much scope and their potential be exploited to the fullest extent. The cultivation in these areas are carried on largely by making terraces on the sloping hillsides, and sometimes cultivation is even done on steep hills also where terracing and tilling cannot be done and the place is cleared by burning scrubs and bushes. The seeds are sown with the help of a hoe. This practice of cultivation is known as 'Katil' and both Rabi as well as Kharif crops are harvested. The main Kharif crops are paddy, small millets and potato and the Rabi crops are wheat and barley. These crops account for over 80 percent of the total cropped area. Horticulture is another field that could boost up the economy of the district. However, it has not made much headway due to difficulties in marketing the produce remoteness and poor communications setup.

1.3.2 Animal Husbandry

Animal husbandry is an important source of supplementing income of the rural population. Of the total live-stock, bovine population and that of sheep accounts for almost one third each. The production of milk per milch animal is very low. Efforts are under way for introducing high yielding strain. Sheep rearing is an important industry. Yet it does not provide full time employment and it is only a vocation for those engaged in its pursuit.

1.3.3 Industries

There is scanty knowledge regarding occurrences of minerals in the district. As per limited information, there are localised occurrences of soap stone, iron minerals, graphite,

lime stone, kyanite and mica deposits occur in the district. There has been hardly any industrial development in the district. The cottage and village industries play an important role in the economy of the district. The most important cottage industry is wool and woollen goods. Sheep are reared in large numbers and the industry flourished at an altitude between 1525 metres and 2440 metres. Carpets (namdas), tweeds, blankets etc. are produced. Other cottage industries are basket-making, mat weaving and wood craft. The potentials of forest and horticulture can be better exploited by locating forest and horticulture based industries within the district. This will bring down transportation cost making them competitive. Tourism industry possesses tremendous possibilities of development. The terrain produces some of the rarest spectacles contrasting between awesome ruggedness and breathtakingly beautiful landscape which have charmed and challenged man since ages. The location of Hindu religious places takes it beyond the pale of connoisseur and lovers of nature to the common man who throngs for religious satiety.

Table 1.1: Tehsil wise population detailes (Source:Census of India 2001)

S	Tehsils	TotalPopulation	Male	Female	0-6 years age	Male	Female
1.	Purola	62,794	32,258	30,536	11,381	5,691	5,690
2.	Rajgarhi(Barkot)	62,274	32,122	30,152	10,971	5,737	5,234
3.	Dunda	100,130	49,553	50,537	17,337	8,901	8,436
4.	Bhatwari	69,815	38,043	31,772	10,069	5,290	4,779

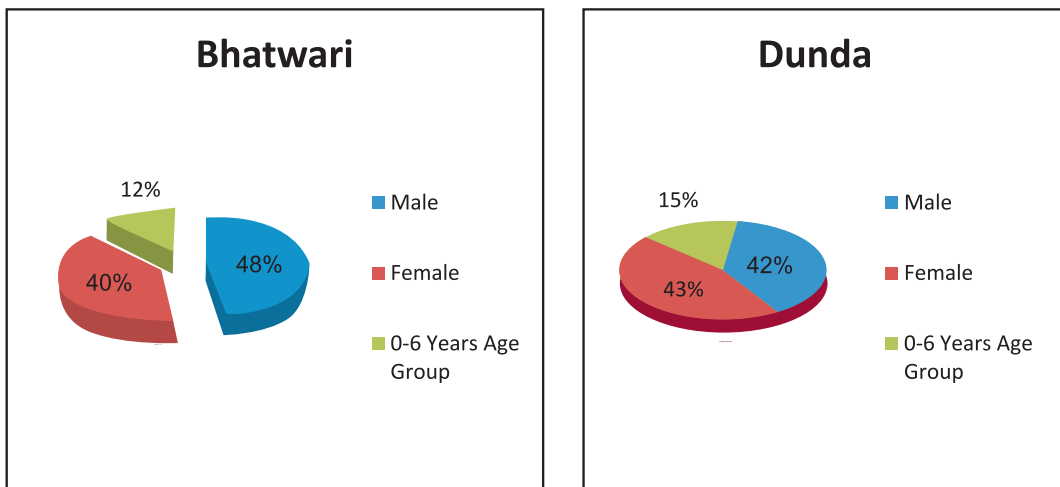


Figure 1.3a: Tehsil-wise population distribution in Uttarkashi District

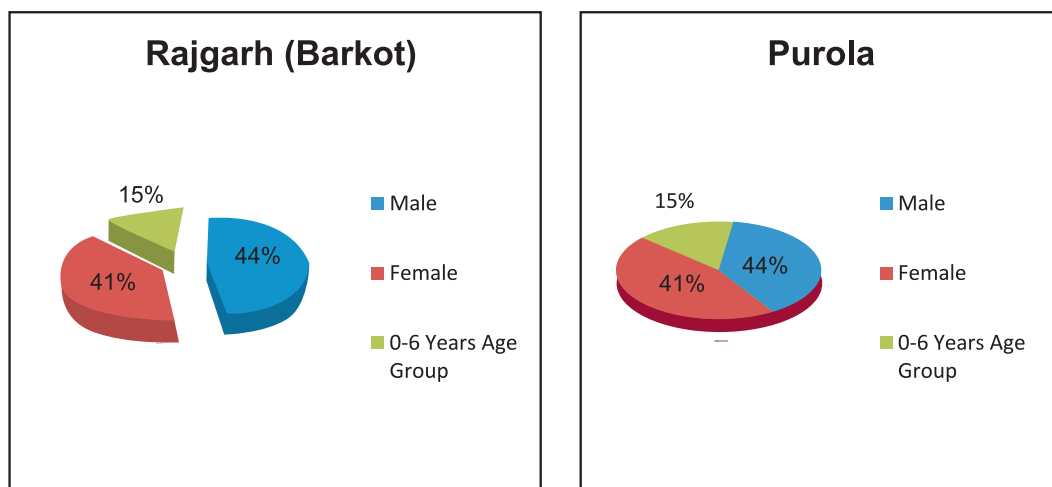


Figure 1.3b: Tehsil-wise population distribution in Uttarkashi District

Table 1.2: Distribution of SC and ST Population (Source:Census of India 2001)

S	Tehsils	TotalPopulation	SC Population	%	ST Population	%
1.	Purola	62,794	18,800	29.9	388	0.6
2.	Rajgarhi(Barkot)	62,274	16,072	25.8	356	0.6
3.	Dunda	100,130	24,252	24.2	830	0.8
4.	Bhatwari	69,815	8,343	12.0	1,111	1.6

Table 1.3: Number of households, population & household size (Source:Census of India, 2001)

S	Tehsils	No of Households	Population	Household Size
1.	Purola	10,903	62,794	5.8
2.	Rajgarhi(Barkot)	11,239	62,274	5.5
3.	Dunda	18,960	100,130	5.3
4.	Bhatwari	14,456	69,815	4.8

Power Projects in District:**Table 1.4: Projects under operation in the district**

S	Name of Project	Installed Capacity (MW)	Sector	Agency
1	Maneri Bhali-I	90.00	State	UJVNL
2	Pilangad	2.25	State	UJVNL
3	Harsil	0.20	State	UJVNL
4	Gangori*	0.80	State	UJVNL
5	Koti*	0.20	State	UJVNL
6	Hanuman Ganga	4.95	IPP	M/S Regency
	TOTAL	98.40		Energy Pvt.Ltd.

* Koti SHP, Gangori SHP are under renovation & modernization

Table 1.5: Projects under construction

S	Name of Project	Installed Capacity (MW)	Sector	Agency
1	Maneri Bhali-II	304.0	State	UJVNL
2	Loharinag-Pala	600.0	CPSU	NTPC
3	Pala Maneri	480.0	State	UJVNL
4	Asiganga- I	4.5	State	UJVNL
5	Asiganga- II	4.5	State	UJVNL
6	Kaligad	9.0	State	UJVNL
	TOTAL	1402.0	-	-

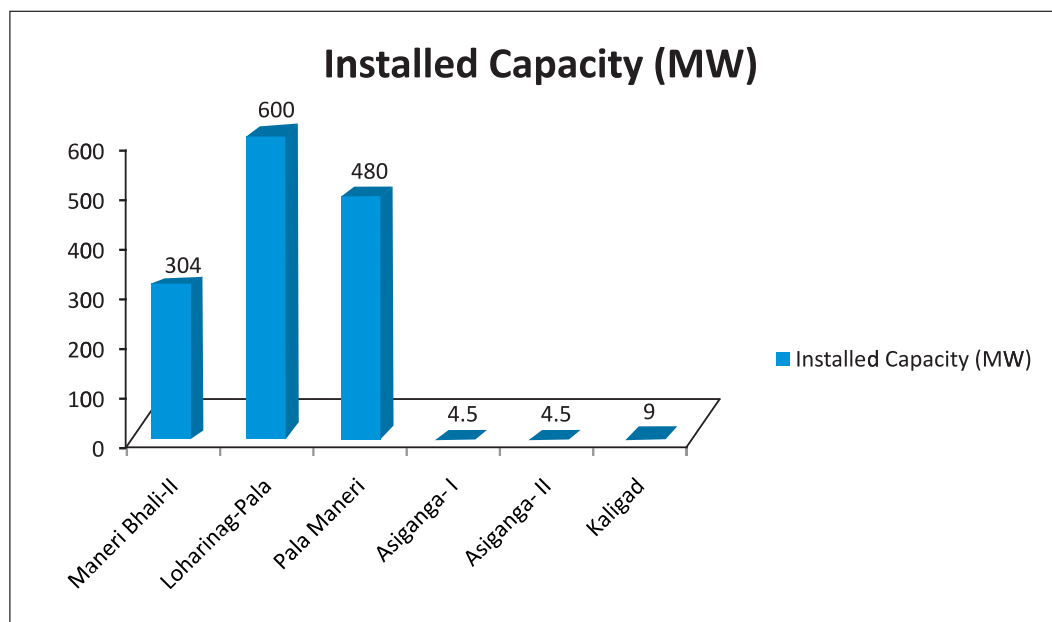


Figure 1.4: Installed Capacity of different Hydel Projects in Uttarkashi District

Table 1.6: Projects (Large & Medium HEP's) under development

S	Name of Project	Installed Capacity (MW)	Sector	Agency
1	Karmoli	140	CPSU	THDC
2	Jadhganga	50	CPSU	THDC
3	Bhaironghati*	381	State	UJVNL
4	Taluka Sankari**	140	State	UJVNL
5	Jakhol Sankari	33	CPSU	SJVNL
6	Devra Mori (Naitwar Mori)	30	CPSU	SJVNL
7	Mori Hanol	63	IPP	M/s Krishna Knitwear
8	Hanol Tuni	60	IPP	M/s Sunflag
9	Arakot Tuini	72	State	UJVNL
	Total	969		

* Local residents have been agitating over the Bhairighati project that in view of religious sentiments and Cultural and emotional attachment with Gangotri and the fact that the area lies in high seismic zone. In consequence of same final phase of investigations are affected.

** Project of Taluka Sankari could not be taken up as this is infringing with Govind Pashu Vihar.

Table 1.7: Projects (Small HEP's) under development

S	Name of Project	Installed Capacity (MW)	Sector	Agency
1	Asiganga-III	3.0	State	UJVNL
2	Pilangad-II	4.0	State	UJVNL
3	Gangnani	8.0	IPP	M/S Regency Energy Pvt. Ltd
4	Badyar	4.9	IPP	M/S Regency Energy Pvt. Ltd
5	Kakoragad	5.0	IPP	M/S Harsil Hydro Ltd.
6	Jalandharigad	11.8	IPP	M/S Harsil Hydro Ltd.
7	Syangad	4.9.	IPP	M/S Harsil Hydro Ltd.
8	Rupin-3	3.0	IPP	M/S Tons Valley Power Ltd.
9	Rupin-4	3.0	IPP	M/S Tons Valley Power Ltd.
10	Rupin-5	15.0	IPP	M/S Tons Valley Power Ltd.
	Total	62.6		

Table 1.8: Transportation Network: Vehicles in District

S	Type	Heavy Trucks	Light Goods Vehicles	Mini Buses	Buses	Ambulances	Taxi Cabs	Maxi Cabs	Water Tankers	Other Tankers
1	Govt	-	-	-	8	-	-	-	-	-
2	NonGovt	244	110	3	74	9	54	239	1	3
	Total	244	110	3	82	9	54	239	1	3

- **Link District at the Time of Disaster**

1- Tehri Garhwal 2- Dehradun 3- Shimla

Table 1.9: Main Routes and Alternative Routes of the District

S	Route	Distance	Vehicles Plying in Road				Tehsils	Altern- ative Route	Dist ance
			Pvt Buses	Road ways	other Passenger	Total Vehicles			
1	Chinyali- saur, Dharasu- Dunda- Uttarkashi- Bhatwari- Gangotri	143 km	22	3	245	270	Chinyali- saur, Dunda, Bhatwari	Devidhar- Pipali- Fold- Barsali- tiloth-Uki	45 km
2	Dharasu- Yamunotri- Barkot	90 km	5	-	42	47	Barkot, Mori, Chinyali- saur	There is no alternative Route	—
3	Damta- Barkot	56 km	5	-	40	45	Barkot	There is no alternative Route	—
4	Uttarkashi- Chaurangi- Khal- Lambgaon	58 km	6	-	15	21	Bhatwari Dunda	Devidhar- Lamgaon	53 km
5	Barkot- Naugaon- Purola- Mori	112 km	8	-	50	58	Purola, Mori	There is no alternative Route	—

Table 1.10: Helipads & Airstrips in District (Source: Revenue Department)

S	Place	Coordinates	Tehsil
1	Harsil Registered	31°02'20" N and 78°44'36"E	Bhatwari
2	Matli Registered	30°44'28"N and 78°22'58"E	Dunda
3	Maneri	30°44'25"N and 78°32'E	Bhatwari
4	Dyara	30°49'40"N and 78°34'54"E	Bhatwari
5	Raithal	30°48'57"N and 78°44'36"E	Bhatwari
6	Gangotri	30°59'40"N and 78°56'46"E	Bhatwari
7	Bhatwari	30°48'22"N and 78°37'24"E	Bhatwari
8	Chinyalisaur	30°35'00"N and 78°19'40"E	Chinyalisaur
9	Purola	30°52'20"N and 78°04'20"E	Purola
10	Aarakot	31°02' 30"N and 77°49'E	Mori
11	Kharsari	30°58'30"N and 78°04'30"E	Purola
12	Mori	30°01'N and 78°03'E	Mori
13	Rajgari	30°51'N and 78°11'31"E	Barkot
14	Naugaon	30°47'19"N and 78°08'41"E	Barkot
15	Kharsali	30°58'31"N and 78°26'20"E	Barkot
16	Barkot	30°49'N and 78°11'31"E	Barkot

1.4 Physiography

Lying in the upper Himalaya, the terrain of Uttarkashi contains varying geographic environments ranging from snow free valleys and outer hills to high peaks with perpetual snow and glaciers. It runs into series of ridges and valleys. Each ridge leads to another, coiling up in seemingly unending chains. It is mostly mountainous consisting of high rise ridges, hills and plateaus, the flat pieces of land are rare. The land in these areas is infertile due to large contents of boulders and gravels. Made-up of alluvial soils, the valley is a stream bed. Generally, forest occurs on the upper ridges that bound the valleys. On their sloping hill sides lie a chain of sparsely populated settlements interspersed with terrace cultivation.

The terrain of the district is prominent hilly with high peaks and deep troughs. The main rivers flowing in the district are Bhagirathi, Yamuna and Tons. In addition, there are tributaries and Nallahs like Asi Ganga, Indravati, Badiyar, Gar, Banal-Gar, Kamal, Rupin-Supin, and Jalkur Gadh. These rivers which contribute towards prosperity of the district become a cause of

disaster during prolonged sustained rains. Excessive rains and cloud burst during monsoons result in erosion of the land. While there is no accumulation of rainwater, as in plains, the water from the hills, along with the eroded soil and boulders, goes into the rivers and causes a substantial rise in their water levels. Landslides also obstruct the flow of rivers causing tremendous increase in water level at places and these results in washing away of bridges and roads.

Nature expresses itself in breath-taking variations from awing landscape luxuriously decked with vegetation punctuated by streams, brooks and rivers to high rise awesome rocky ridges and mountains gently tapering off into lofty snow-capped peaks. It is the land of Uttarkashi district that gives rise to two great and revered rivers of India, the Bhagirathi, called the Ganga in the plains and the Yamuna. The Ganga originates and traverses 128 km in Uttarkashi district. The third important river of this district is Tons, besides host of smaller tributaries.

1.5 Salient Characteristics of Bhagirathi River Valley

River Bhagirathi originates from the Gangotri Glacier near Gaumukh on the western slope of Chaukhamba at an elevation of about 3,900m amsl. The river initially has a north westerly course and meets river Jhanvi at the tip of Bhaironghati, where it has an east west course. The river has carved out deep gorges and many smaller tributaries which joint it almost at right angle. From Harsil, the river flows towards south west and then towards south and suddenly has a wide valley upto some distance. The valley slopes are steep and covered with moraines (Prasad and Rawat, 1980). Upstream of Maneri, it appears to occupy a glaciated valley. Upstream of Bhatwari, viz. after crossing the Main Central Thrust, the valley looses its sinuosity, but continues to be a narrow gorge. The valley again becomes wide and has a meandering channel beyond Sukki and upto Harsil. Beyond Harsil and through Bhairon Ghati, it occupies a narrow glaciated valley, with its tributaries occupying valleys and forming conspicuous waterfalls.

The river Bhagirathi occupies an antecedent gorge, which is deep, narrow and sinuous. The valley is wide at Tehri with very wide variety terraces between Bhilangana and Bhagirathi. Towards upstream, the gorge becomes highly sinuous and the channel shows meandering. The valley becomes wide around Uttarkashi where two or more distinct pairs of terraces are noticed. Downstream of Uttarkashi, the valley again becomes wide.

The danger level for Bhagirathi River at Uttarkashi is at 1123m whereas the alert level is 1122m. However, the discharge measurements and gauge records available for the period between 1st and 10th August 2012 do not indicate water levels above 1120.85m. It may be due to the fact that the gauge records are taken three times in a day, i.e. at 8am, 2pm and 6pm. But the peak rise in river water level was observed at night (around 10pm) on 3rd August 2012 when flash floods occurred.

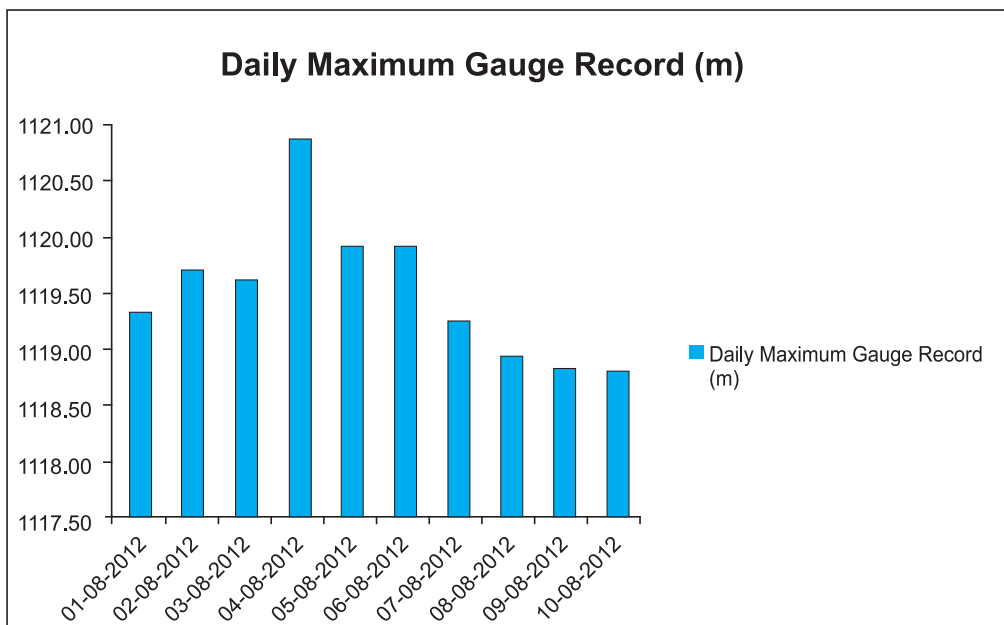


Fig. 1.5: Daily Gauge Records indicating maximum water level in the Bhagirathi river during 1-10 August 2012

1.6 Landuse Patterns

The wide varying climate and topography has produced a wide range of vegetation which serve as habitats to diverse species of wild life. Forests are a pride, in the environment of the district not only for the sheer bulk of the area they occupy but also for the richness of variety of vegetation. As much as 88 percent of the total area of the district is administered by the Forest Department. Pine forests occur between the altitude of 900-2000 metres, Deodar forests between 2000-3000 metres, Fir and Spruce forests over 3000 metres and Kharshu, Birch and Junipers forests upto the height of 4000 metres. Above the Fir and Spruce forest zone, alpine pastures are found throughout the district between the height of 3500 metres to 4877 metres above sea level. Rich varieties of grass, shrubs and herbs come up during June- September while during the remaining part of the year these areas remain covered with snow. A large number of medicinal plants of great commercial value grow spontaneously in the forests. Some of these grow in the valleys; some in sub-montane tracts while some other on higher altitudes. Forestry too does play an important role in the economy of the district. It employs persons for preservation and propagation of forests as well as in their exploitation. Herbs are the most important minor forest produce. A large variety of herbs are wild.

The landuse pattern of the area indicates the presence of dense forest covering about one-third of the area and open forest covering about half of the area. Rest of the area is occupied by agriculture, habitation, snow-cover, water bodies and open areas.

1.7 Climate and Rainfall

The area receives heavy (64.5-124.4mm) to very heavy rainfall intensity (124.5-244.5mm) during the monsoon period with average annual rainfall of the district ranging from 921mm (least during the year 2009) to 1817mm (highest during the year 2010) over a period between the years 2000 and 2011 (please refer Table 1.11).

An analysis of daily rainfall records from different tehsils of the Uttarkashi district reveal that the daily precipitation more than 100mm is received once or twice in a year in a particular Tehsil (Please refer to some of heavy rainfall records in different Tehsils). Most often the rainfall is recorded over a period of 24 hours, daily at 8am. Hence rainfall intensity records are not available for relating the slope movement with rainfall thresholds.

It is thus, recommended that the district should have a dense network of automatic raingauges for recording rainfall intensity (at least on hourly basis). As there are large variations in the amount of rainfall over different slopes directions and places, it is highly desirable that raingauges should be kept close to unstable slopes where landslides may be expected. The team found one automated weather system (AWS) at the BRO office in Tekhla. But it was reported that the sensors are not working properly and hence, rainfall data is obtained from some other sources.

An attempt has been made in the present study to find out the distribution of the number of rainy days during each month over a period of 6 years between the years 2006 and 2011. It is indicated by the figure 1.9 that the monsoon periods between June and September has the maximum number of rainy days. Further attempts have been made to find out relationship between amount of rainfall and time. It is indicated that maximum rainfall occurs during the period between July and September (please refer figures 1.7 and 1.8).

Table 1.11: Rain fall Data for the period between 2000 and 2011

S	Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Annual Rainfall (mm)
1	2000	52	122	78	25	68	282	436	201	116	0	5	0	1387
2	2001	54	11	106	46	124	192	342	289	91	7	0	29	1291
3	2002	58	148	93	72	55	185	117	495	327	11	3	7	1572
4	2003	45	108	72	68	45	91	405	347	160	2	4	41	1388
5	2004	107	22	0	50	60	161	268	440	101	155	3	9	1376
6	2005	101	150	68	21	55	91	578	288	331	22	0	21	1725
7	2006	96	8	94	67	164	38	420	286	54	28	9	33	1297
8	2007	0	153	161	70	76	84	302	312	157	16	0	28	1358
9	2008	88	28	21	82	154	290	321	273	165	13	3	0	1438
10	2009	6	40	25	41	77	40	294	120	234	21	22	1	921
11	2010	23	73	5	25	46	143	383	492	538	16	11	63	1817
12	2011	29	93	33	97	75	287	384	583	149	4	1	6	1741

The highest and the lowest mean temperatures observed are 32°C in the district and 3°C respectively.



Fig 1.6: Automated Weather Station for recording rainfall, temperature and pressure at DGBR office, Tekhla

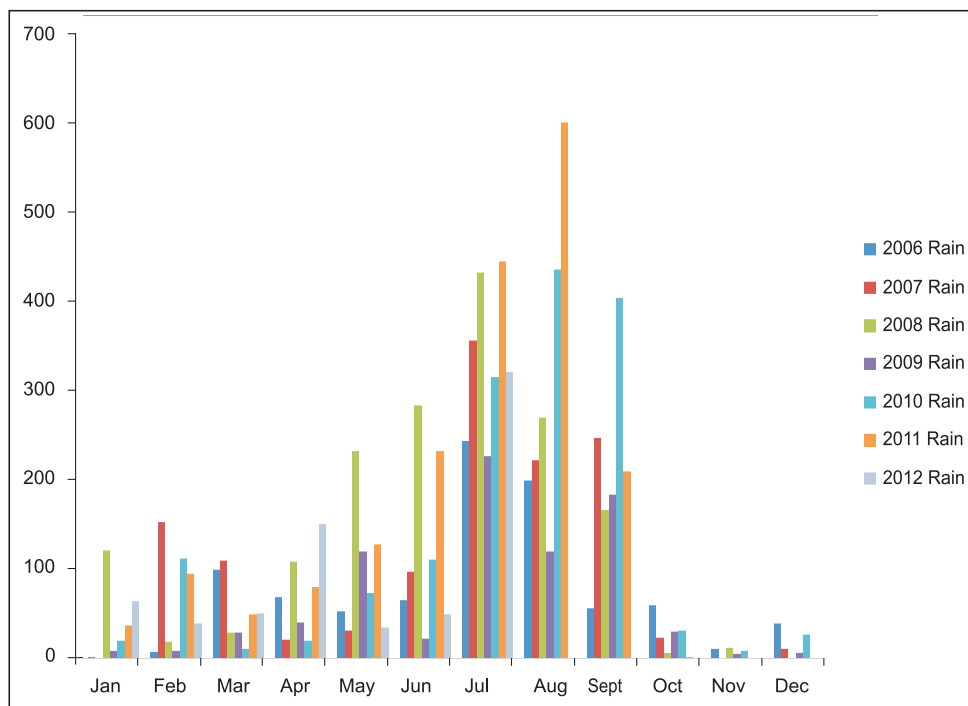


Fig. 1.7: Average Monthly Cumulative Rainfall in the study area during the period between the years 2006 and 2012

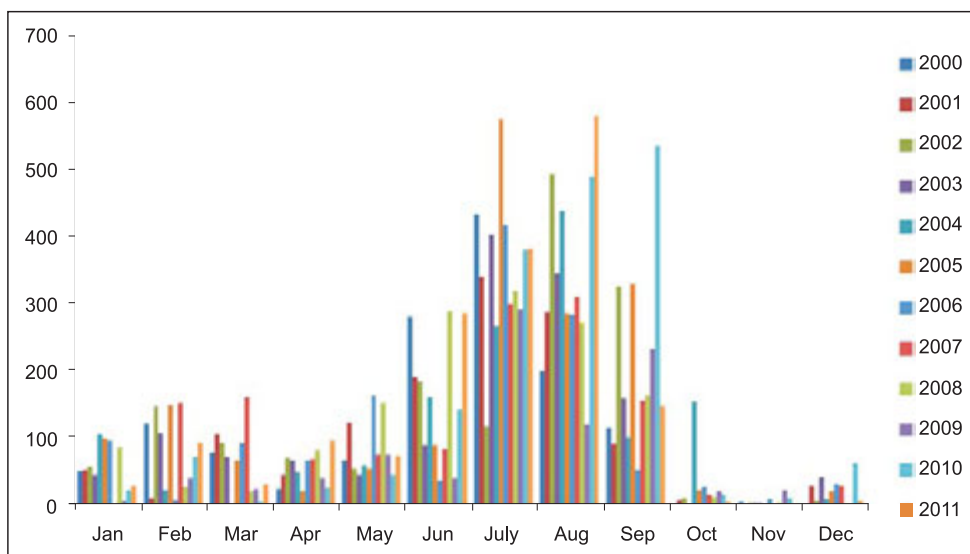


Fig. 1.8: Average Monthly Cumulative Rainfall in the Uttarkashi district during the period between the years 2000 and 2011

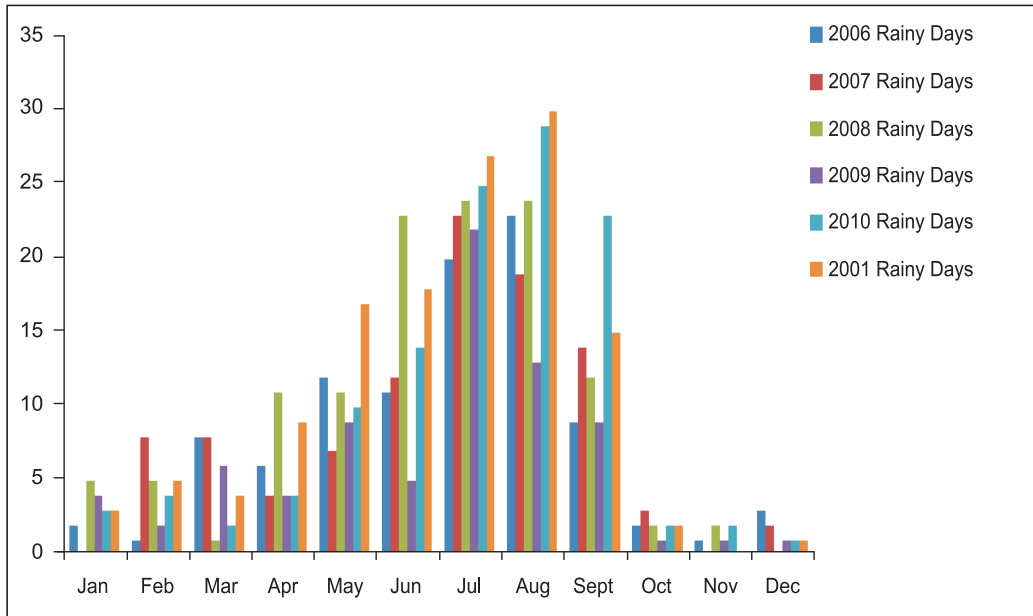


Fig. 1.9: Monthly Cumulative Number of Rainy Days during the period between the years 2006 and 2011

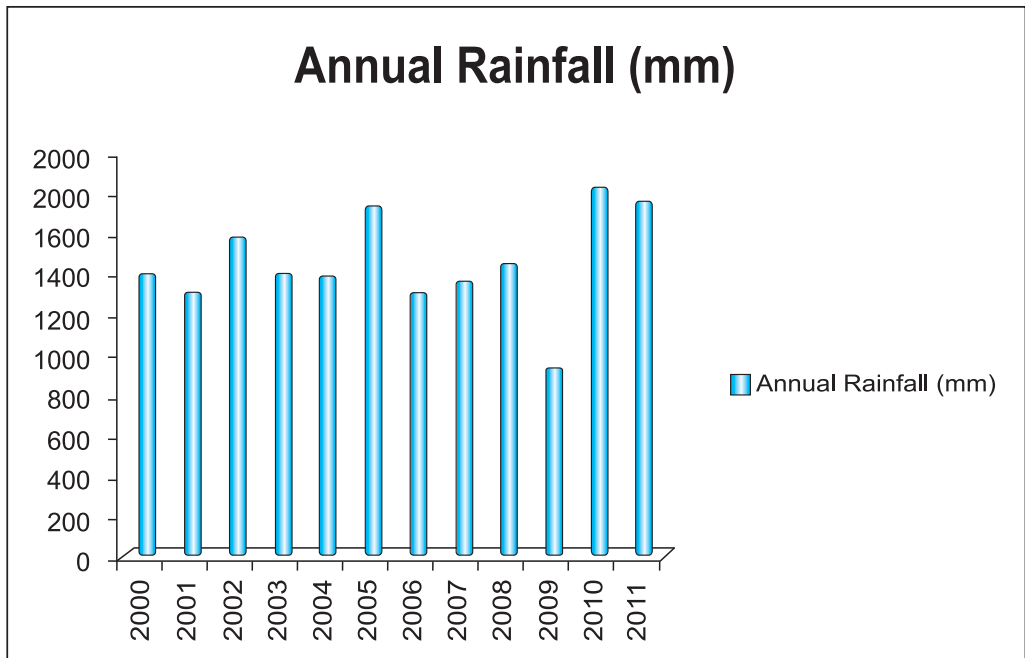


Fig. 1.10: Average Cumulative Annual Rainfall in the Uttarkashi district during the period between the years 2000 and 2012

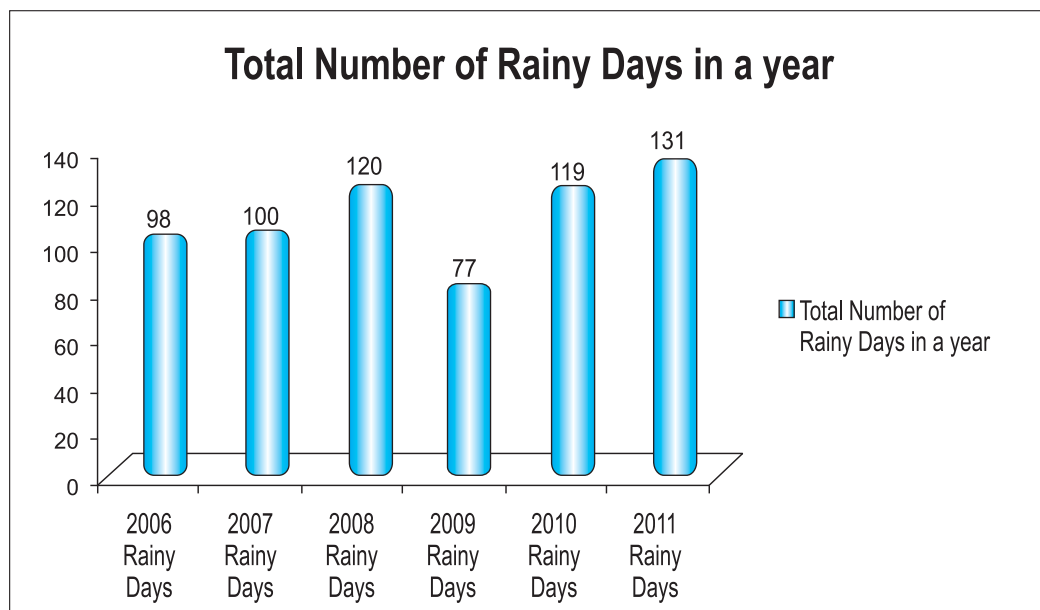


Fig. 1.11: Cumulative Number of Rainy Days per year in the study area during the period between the years 2006 and 2011

1.8 Geology, Tectonics and Seismicity

The geology of Upper Bhagirathi valley and its catchment area has been worked out by Heim and Gansser (1939), Gansser (1964), Jain (1971), Agarwal and Kumar (1973). The catchment of Bhagirathi falls under Central Himalaya and the rocks belong to the Central Crystallines. The Uttarkashi district comprises the rocks of Lesser Himalayan and Greater Himalayan Formations. The predominant rock types are phyllite, metabasics, gneisses and amphibolites with some intrusives at places. The rock sequences are traversed by major faults and thrusts which have deformed these rocks to a great extent and made them highly fragmented and sheared.

The Main Central Thrust (MCT) is situated near Sainj, south of Bhatwari, where it separates the Granite Gneisses and Garnetiferous Schists of Central Crystallines and the cream colored Gamri Quartzites. Beyond Bhatwari, the Bhagirathi passes through by numerous fault zones, viz. at Hinna, the quartzites and the dolomitic limestones of Uttarkashi Formation are met. Going downstream, other faults are between Bareti and Nakuri with exposures of metabasics; at Dunda gain with metabasics and then at Singnni with limestones and Gamri

Quartzites. The North Almora Thrust or Dharashu Thrust is met further downstream near Margaon (Jain, 1971). The Bhagirathi possesses depositional terraces with Quaternary sediments, between Harsil and Gangnani, around Uttarkashi and again around Dunda.

Geological Survey of India has published a seismotectonic atlas of India and its environs (Fig. 1.12) which depicts the seismotectonic setting of the Uttarkashi district as well as the iso-seismal map of the area. The maps in the atlas are on 1: 1,000,000 scale. The atlas provides information on the chronology of earthquakes of $M \geq 5.5$ for the period between 1816 and 1997. It has also provided the focal mechanism solutions for the important earthquakes during the period between 1958 and 1991. In addition to these informations, one can also find the frequency distribution of earthquakes.

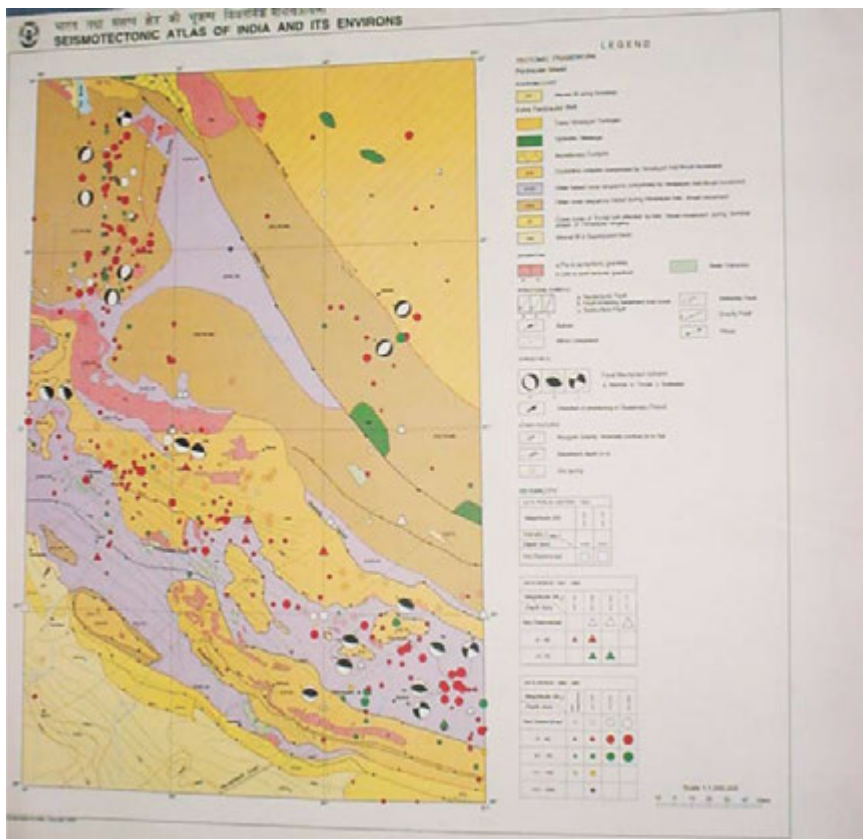


Fig. 1.12: A snap of the seismotectonic map of the study area
(Source: Seismotectonic Atlas of India and its Environs, GSI, 2000)

The Indian Meteorology Department (IMD) and Wadia Institute of Himalayan Geology (WIHG) have been monitoring the seismic activity in the study area. The seismic records indicate that the area is geodynamically active and poses threats from the potential earthquakes in the region. In addition to IMD and WIHG, seismic activities are also monitored by the major hydel projects like Tehri Dam, for the safety of dams and reservoirs. A seismograph of WIHG is located at Bhatwari.

1.9 Publication on Uttarkashi Earthquake

The studies done by various workers after the Uttarkashi earthquake on 20th October 1991 have been well documented and published by Geological Survey of India. The publication highlights the issues related to the occurrence of earthquakes in the regions, impacts of the earthquakes on ground, buildings, structures and infrastructure as well as the occurrence of co-seismic landslides (including both freshly triggered and reactivated landslides). The district authorities must draw lessons from such incidents and educate the communities accordingly.

Chapter 2

Hazard, Vulnerability, Capacity and Risk (HVCR) Profile of Uttarkashi District

2.1 History of Disasters

The district is located in the seismic zones IV and V. It is traversed by the Main Central Thrust (MCT) and witnessed a massive earthquake (6.6 on the Richter scale at shallow depth of 15 km) on 20 October 1991 at 2:53am. The epicentre of the earthquake was located in Agora village of Bhatwari Tehsil. The earthquake resulted in heavy loss of life and property. 768 people lost their lives and approx 5,066 were injured, in addition, 3096 cattleheads also perished. Most of the casualties were due to the collapse of buildings. A large number of fatalities and damages were also reported due to earthquake related landslides. Huge rock fragments and boulders came loose and hit the villages. A major bridge at Gawana collapsed.

Another disastrous event affected Varunavat hills where a major landslide struck on 26 September 2003. An estimated 50,000-60,000 m³ of material was displaced. It rolled down the slope of Varunavat Parvat along three different tracts and got accumulated in three accumulation zones namely –Tambakhani zone, Ramlila Ground zone and Jal Nigam Colony. Vast areas of the district are prone to heaving landslides and flash floods, particularly during the raining season due to heavy rains or sudden cloud bursts. Such incidents have often been witnessed in the past at places Gyansu, Mori and Agora and in the river Indravati. Similarly, because of loose structure of soil in the mountain range along the banks of river Yamuna in Khanera, there is always a possibility of heavy landslide in the area. The river at this place is about 3-3.5m wide and a landslide can obstruct the flow of River Yamuna resulting in a flood like situation upstream. Almost 88% of the total area of the district is covered by forests. Forest fires have often taken place during the summer in the past resulting in loss of animal life and vegetation.

T.H. Holland of the Geological Survey of India undertook the survey of a landslide during the year 1894 and recorded that a 1000 feet high dam was formed across the river at

Gohna, 160 miles north of Haridwar. The blockade gradually submerged the area and a four-mile long and one mile wide lake was formed. Holland noted that water in the lake was rising at the rate of six inches per day. The observations of Holland were so precise that not only he calculated the rate of submergence of the land, but also predicted the period by which the water of the artificial lake will overflow. As per that on the night of 25/26 August 1884, the top 380 feet of the dam was washed away. The breach in the dam released 10,000 cubic feet water in merely four and half hours causing devastating floods downstream. The magnitude of the floods can be realized from the fact that at Chamoli, the water level rose by 160 feet and at Haridwar by 13 feet. By 1936 the lake had shrunk to two miles and was only a square mile in 1959. G. Pant, an expert on landslides from the GSI observed in 1967 that the lake was less than a mile and by 1997 it was completely silted.

The higher reaches of the rivers in Garhwal have sacred pilgrim places. The pilgrimage to Gangotri Glacier and temple area from where the Bhagirathi River begins its journey to become the might Ganga later was obstructed by a landslide in the late 1950s. An avalanche along the Lod gad, a tributary of the Bhagirathi River led to the damming of the stream. Later when the natural dam was breached the pilgrim path to Gangotri and a steel girder bridge at Dabrani were severely damaged.

Some other catastrophic slides in recent years are Dhauliganga in 1956, Rishi Ganga in 1967, Patal Ganga in 1970, Bhagirathi blockade of 5-6 August 1978, yet another blockade of Bhagirathi in July 1992 and Madhyamaheshwar in 1998.

Each time the story is almost same. A heavy precipitation infinite water into the scope mass and increase scope water pressure and see pace forces into the loosely jointed rocks in these areas and causes huge mass movement, which tumble down into the rivers and blocks them. Invariably a lake is formed. Either the impounded water overflows the natural dam or the loose barrier gives way. Net result is flash floods and heavy destruction downstream. The Bhagirathi, when it was blocked in 1978, a 30m high dam was formed across Kanoldiabad. A breach in the dam caused major flash floods in Uttarkashi and more areas downstream. The 1992 blockade of Bhagirathi led to the closure of the Uttarkashi-Gangotri road for more than 25 days. It is a challenge for our engineers for clearing such blockade by systematic and controlled blasting.

The question arises why such incidences are more in Garhwal as compared to the adjoining areas? The answer is steep hill with loosely jointed slope mass that has been inadvertently used for anthropogenic activities, is the main reason for these disasters. During monsoon, rainwater enters the joints in the rocks and elevated pore water and seepage from that trigger landslides. At Madhyamaheshwar, it was noticed that the roots of the Cedar trees on the mountain slopes had opened huge fissures in the rocks, providing access for water. Freezing and thawing of water present in the open joints and fissures of rocks, is also responsible for landslides in high altitudes.

Table 2.1: Historical account of major landslides, flashfloods and earthquakes in Uttarakhand (after Parkash Surya, 2011)

Sl.	Location	Month/ Year	Damage
1.	Daur Gaon, Narendranagar block, Tehri distt.	11 Sept 2011	6 members of a family killed and 4 houses collapsed
2.	Almora distt	21 July 2011	1 killed 4 injured, jeep damaged
3.	Chamoli	21 July 2011	1 killed 1 injured, bus damaged
4.	Chamoli	30 June 2011	10 killed, Rishikesh-Badrinath closed
5.	Uttarkashi distt	1 June 2011	1 killed, Rishikesh-Yumnotri NH closed
6.	Joshimath, Chamoli	22 Sept 2010	2 killed
7.	Almora	19 Sept. 2010	31 died and 7 injured
8.	Dehradun	18 Sept 2010	NH for Chardham Yatra disrupted, tourists trapped
9.	Nainital	18 Sept 2010	8 killed
10.	Pilkha and Devali villages	18 Sept 2010	5 killed 15 trapped, houses collapsed
11.	Avalbagh block, Almora distt.	18 Sept 2010	6 killed 14 injured
12.	Rudraprayag	8 Sept 2010	1 killed
13.	Pitthoragarh	6 Sept 2010	2 killed
14.	Shumgarh Landslide, Bageshwar distt.	18 August 2010	18 school students aged between 5 and 12 years were buried alive, 12 injured, entire school destroyed
15.	Chamoli	5 Aug 2010	5 killed, 1 house destroyed
16.	Uttarkashi	30 July 2010	9 injured
17.	Almora distt.	22 July 2010	1 killed
18.	Nainital	20 July 2010	1 killed
19.	Tehri distt.	23 Feb 2010	2 killed 1 injured, 1 house demolished

Sl.	Location	Month/ Year	Damage
20.	Uttarkashi distt.	9 Sept 2009	3 killed, pilgrims and tourists stranded
21.	Almora distt.	8 Sept 2009	3 killed 5 injured
22.	Almora distt.	2 Sept 2009	2 killed
23.	Pitthoragarh	28 Aug 2009	1 killed
24.	Pitthoragarh	17 Aug 2009	1 killed
25.	Champawat distt.	17 Aug 2009	2 killed
26.	Nachni, Pitthoragarh	8 Aug 2009	43 killed, 3 Villages Nachni, La and Jhekla were completely buried under landslides
27.	Chamoli	26 June 2008	8 killed 2 injured
28.	Rishikesh	20 June 2008	10 killed
29.	Uttarkashi, Chamoli, Almora, Pitthoragarh and Champawat districts	29 Sept 2007	4 killed 3 injured, tourists/ trekeers and locals affected
30.	Nainital	28 Sept 2007	1 killed 3 injured
31.	Tehri distt	23 Sept 2007	19 killed 20 injured
32.	Pitthoragarh distt.	6 Sept 2007	14 killed
33.	Dehradun	17 Aug 2007	7 killed, crops and houses destroyed
34.	Hat Kalyani, Deval	6 August 2007	4 persons killed and 2 livestock lost
35.	Chamoli, Pitthoragarh and Dehradun districts	27 July 2007	3 killed, several houses damaged, traffic disrupted
36.	Devpuri village, Chamoli distt.	12 July 2007	8 killed
37.	Uttarakhand	4 July 2007	5 killed
38.	Uttarkashi district	26 June 2007	1 killed
39.	Govindghat, Joshimath	Aug 2005	11 killed
40.	Vijaynagar, Rudraprayag	22 July 2005	9 killed
41.	Varunawat Landslide, Uttarkashi	26 September 2003	About 400 houses/ shops affected

Sl.	Location	Month/ Year	Damage
42.	Budhakedar and Khetgaon Landslide, Bal Ganga Valley, Tehri	10 Aug 2002	29 people killed
43.	Khanera Landslides	2001	Yamuna blocked and a transient lake formed
44.	Dharchula	27 July 2001	5 killed
45.	Phata and Byung Gad Landslides, Chamoli	17 July 2001	21 killed and several houses damaged
46.	Ukhimath, Rudraprayag	16 July 2001	28 persons killed
47.	Earthquake and landslides in Chamoli and adjoining districts	29 March 1999	Massive destruction
48.	Barua Bhenti landslide	19 Sept. 1998	15 people died, several livestock killed at about 8 km north of Okhimath along the left bank of Madhmaheshwar river
49.	Madhya Maheshwar, Rudraprayag	17 Aug 1998	40 persons killed and 10 livestock lost
50.	Banswara slide	Aug 1998	2 persons died, 100m road damaged about 25 km from Rudraprayag
51.	Malpa landslide, Kali River	17/18 Aug 1998	Wiped out Malpa village with >210 persons killed
52.	Ukhimath landslide blocked Madhyamaheshwar river (tributary of Mandakini)	12 August, 1998	109 deaths and 1908 families from 29 villages affected and 820 houses daamaged
53.	Bhimtala landslide	1996	Heavy damages to raods and houses
54.	Ratauri, Pitthoragarh	July 1996	16 killed
55.	Aungi landslide	1993	2 labourers killed and bulldozers went into the river
56.	Earthquake and landslides in Uttarkashi and other areas	20 Oct 1991	768 persons killed and 5066 injured; Massive destruction

Sl.	Location	Month/ Year	Damage
			of houses, bridges, roads and other infrastructure
57.	Gopeshwar, Chamoli	16 Aug 1991	36 killed and 26 livestock lost in 6 villages
58.	Landslides at Jakholi in Tehri Garhwal and Devaldhar in Chamoli	1986	32 lives lost
59.	Kapkot, Bageshwar	Aug 1984	9 killed
60.	Uttarkashi - Kedarghati landslide	1981	Houses and road damaged
61.	Gyansu Nala Tragedy	24/25 June 1980	24 lives lost and large number of houses destroyed
62.	Ukhimath landslide	1979	39 persons killed
63.	Bhagirathi Flashfloods	6 August 1978	one kilometre long, 100m wide and 30m deep lake bursted. Heavy damage had been done to the Maneri Bhali Hydel Project. Equipment valued at more than Rs.20 million is reported to have been washed away
64.	Dobata, Dharchula	19 July 1971	12 killed, 37 building damaged
65.	Belakuchi slide, km 259	July 1970	Village Belakuchi and Belakuchi bridge washed away
66.	Alaknanda Floods, Chamoli district	20 July 1970	Landslide formed an artificial lake in the upper catchment of Alaknanda river; affected 101 villages, >100 persons killed and 142 animals died; about 36 vehicles drowned by flashfloods; district headquarter of Chamoli

Sl.	Location	Month/ Year	Damage
			devastated and subsequently shifted to Gopeshwar
67.	Karnaprayag Landslide	1965	Damages to road and infrastructure
68.	Kaliasaur Landslide	1963	Damages to road and traffic blockade
69.	Nainital Landslide	1963	Damages to road and houses
70.	Patalganga Landslide	1945	Road breached and damaged
71.	Kaliasaur slide	1920	Road damaged (147 km on NH-58)
72.	Helang landslide	1906	Massive road damage occurred
73.	Landslide dam bursted at Gohna	1894	Breaching of Gohna Lake caused Birehi Disaster in Alaknanda valley
74.	Landslide blocked Birehi Ganga	1893	Landslide blocked the river and formed a lake at Gohna village in Garhwal Himalaya
75.	Nainital Landslide	1880	Massive destruction , killed >150 persons
76.	Landslide at Chamoli Garhwal blocked Alaknanda river	1868	Swept 2 villages and killed 70 pilgrims
77.	Landslide dam on Mandakini river	1857	Bursting of landslide dam caused loss of lives and properties
78.	Joshimath Landslide	1842	Damaged roads and blocked traffic
79.	Pauri Landslide	1816	Road damages and traffic blockade
80.	Earthquake Induced –triggered Landslides in Garhwal	1803	Garhwal earthquake affected about 80% of the population

2.2 A Brief Note on Past Disasters - The following paragraphs briefly discuss about major significant disasters in Uttarkashi district.

2.2.1 Bhagirathi Flashfloods

On 6 August 1978, landslides and flash floods were reported near Dabrani, about 27km from Gangotri and 55km from Uttarkashi. The Bhagirathi was dammed by the huge landslide debris, which were created by cloudburst. The first incident occurred when little water behind the giant landslide gouged out part of the river bank and rushed down the valley. The remaining water has formed a lake – one kilometre long, 100m wide and 30m deep. Earlier in the morning of 4 August 1978, people living on its banks downstream noticed a sudden drop in water level and realised that some havoc must have occurred on the upstream side. They promptly evacuated the low lying areas. Still the physical damage caused by floods was immense. Several villages were marooned. The Maneri Bhali Hydel Project suffered heavy damages. Equipment valued at more than rupees two crore was reportedly washed away. Most of the shops and houses in Joshiara (near Uttarkashi) were swept away. Some, which were spared by the 6th August floods, were destroyed by two subsequent floods on 10 August 1978.

According to some villagers, the massive landslide was result of a cloudburst. They observed that on the night of 5th August, there was heavy rainfall. At around midnight, they heard a loud thunder that shocked the area as far as Harsil, 20 km upstream, and down to Bhatwari about 32 km downstream.

On account of very steep gradient of the Kanoldia Gad, it is a common phenomenon that huge landslides and avalanches occur whenever there are heavy rains or cloudbursts. A temporary lake was formed by landslides in the upper courses of Kanoldia Gad. According to an investigation made by Nehru Institute of Mountaineering, Uttarkashi, the newly formed lake got breached on account of heavy rains which triggered the sweeping of dam on which continuous pressure was exerted by adjoining formations. The floods of Kanoldia Gad brought huge amount of loose materials, comprising boulders, gravels, sand and silt which blocked the Bhagirathi 1.5km downstream of Dabrani and formed 1km long lake. The condition was further worsened by huge landslides in the Bhagirathi.

According to another report of Ravi Bhatia in the Indian Express of 16 August 1978, havoc was caused by a part of the water that was dammed up when the entire side of a mountain side fell into the Bhagirathi river below its confluence of the Kanoldia Gad. It is probable that the debris of landslide in both the Kanoldia gad and Bhagirathi might have been responsible for damming of Bhagirathi.

2.2.2 Gyansu Nala Tragedy

The Gyansu locality has witnessed several debris flows for more than three decades. On the night between 24 and 25 June 1980, the debris flow had taken a toll of 24 lives and washed

away many houses in its vicinity. The Gyansu Nala had also been affected by debris flows during July / August 2003 when considerable damage was caused to the shops on both sides of the Nala and check dams as well as other protection structures. The active scarp of Gyansu nala has been enlarging every year due to undercutting by nala during monsoons and consequently there has been an increase in the volume of slide material and boulders there. Hence, suitable measures for reducing the slope failures and impacts of debris flow along the nala must be considered.

2.2.3 Uttarkashi Earthquake

On October 20, 1991, at 2.53 am, an earthquake occurred in the Garhwal Himalaya. The earthquake caused strong ground shaking in the district of Uttarkashi, Tehri, and Chamoli. Official information indicates that about 307,000 people in 1,294 villages were affected; 768 persons died while 5,066 were injured. In addition the earthquake claimed 3,096 head of livestock. As many as 42,400 houses were damaged. The road link between Uttarkashi and Gangotri were disrupted.

Numerous massive landslides took place on the Uttarkashi-Harsil road, particularly on a 42 km stretch between Uttarkashi and Bhatwari, believed to be the area of intense shaking. While landslides on this route are common in rainy season, many caused by the earthquake were totally new. Deep fissures resulted on the road and these pose a potential threat of slope failure in the near future. Fissures were most prominent on the Maneri, Bhatwari stretch. A few landslides also took place on the Uttarkashi- Lumgaon route and on Ghansyali-Koti road.

As an initial response, some relief material was air dropped and once the road network was restored, the area was flooded with relief material. However, numerous villages which are accessible only by foot, did not get the relief materials. There appeared to be a lack of appropriate leadership at the village level. While many administrators and politicians are experienced in the handling of flood relief work, it appears that earthquake relief poses a rather difficult task for which they have no prior experience or training.

2.2.4 Khanera Landslide site

It is located at about 14km upstream of Barkot on Barkot - Yumunotri highway. The landslide had partially blocked the flow of Yamuna River on 30th August / 1st September, 2001. It is an old landslide, which probably initiated in 1977 and in 1980s seriously affected the only highway to Yumnotri gravely. The slide often used to block the road and in the late 1980s, the highway was passing over the main body of this slide. The problem became very gigantic after the Uttarkashi earthquake in 1991 after which it was decided to provide an alternate route on the right bank of the river. But in 1994, another road was cut in the landslide zone on its toe side. This resulted in loss of basal support and the slope mass got displaced extensively. As usually

practised, the displaced which used to block road was also being put on the downhill side of the road at the same site. On 30th August, 2001, the heavy rains caused high pore pressures in the slope mass, which was already adversely affected by antecedent rains in July and August, 2001, and resulted in downslope movement of the slope mass, blocking the river which was flowing at its base. The river width of about 30m was reduced to 4-5m after the slide. A lake 300m long, 30-40 m wide and 5-6m deep was formed in the adjacent upstream portion. The water level in the river reached upto few centimeters below the bridge. The river way was partially opened by the district authorities after 2-3 days.

Geologically, the site is located in the Garhwal Group of rocks belonging to Lesser Himalayan sequences. On its north, North Almora Thrust passes in its proximity near Gangnani and the Main Central thrust passes further north near Wazri. The main rock types are quartzites and degraded metabasics. The quartzites are highly jointed and fractured as well. Three prominent plains of joints can be observed at this site. The joint data is given below:

J1: 29°/N275°, J2: 70°/N23°, and J3: 58°/N98°

The slide has a width of about 300m and a height approximately 150m. The depth of slide may be about 8-10m.

Immediate Remedies- Removal of the slide mass resting on quartzites at the left bank slope of Yamuna river. The displaced mass must be cleared before the onset of monsoons. Excavators and loaders can be used to remove this material and thrown on the down stream side to be disposed of by high velocity currents of the river. Controlled blasting can also be adopted to disperse the boulders set in the slided debris at river level. A retaining structure may be constructed in the upper part to protect farmer's agricultural land from being affected by the landslide activity. Drainage on the slide body should be diverted towards nearby channels using flexible drainage pipes.

Long term solution - The slide needs to be investigated in detail and the past history of its activity should be properly analysed to understand its behaviour and thereafter plan for remedial measures. The rainfall data and knowledge of position of road at different times during the past two decades over the slide section would be quite useful for site investigations.

2.2.5 Pali Gad Boulder Fall

The slide is located along the Pali Gad near Pujargaon on the Barkot - Yumnotri highway. The slide consists mainly of boulders and rock falls which often fall on road and cause blockade. Although it appears to be very difficult to control it yet it is suggested that plantation on these slopes may hinder the movement of falling boulders and rock pieces and help in stabilising the

site. Drains if any, at the boulder / rock fall site should be diverted away from these unstable slopes.

2.2.6 Pujargaon Village

The site is located on Barkot - Yumnotri highway (NH-74). The cloud burst in July 2000 caused massive debris flows along the right valley slopes of Pali Gad. These debris flows consist, of boulders and debris resting on steep slopes and damaged few meters of road and some agricultural fields at lower slopes in Pujargaon. Fresh debris flows during rainy season can not be ruled out. Plantation, drainage measures and construction of retaining structures may reduce slide activity. It is advised to shift the people residing below these slopes to avoid more mishaps.

2.2.7 Tamba Khani Boulder Fall site

It is a boulder falling site located at km 150 from Rishikesh, i.e. just before entering Uttarkashi. The slope consists of highly jointed, fractured and weathered quartzite with a thin layer of soil. The falls endanger the passers-by and vehicles on the National highway 74. The road needs frequent clearing through continued deployment of bulldozers. It is suggested to drop high tensile strength nets from the top of the slide and the net be properly nailed to the adjacent stable slopes. Rock traps should be provided at the middle and lower portions of the slope. These nets will trap the falling boulders and provide benches to reduce their velocity. In order to stabilise the slope, it is suggested that anchored mesh nets may be used to trap falling boulders. Boulder trap ditches and catch walls may also be constructed to restrain the movement of falling boulders on road side. The O.C., DGBR, Tekhla, has been given the address of the concerned firms which can take up this job on contract basis for the supply of high tensile strength nets and execute the operation of putting these nets on the slopes.

2.2.8 Netala Landslide

This landslide is located at km 159 from Rishikesh near village Netala, on Uttarkashi Gangotri National Highway (NH-74) near village Netala, at latitude 30°44'35" and longitude 78°29'43". It is a debris slide with multiple / successive rotational failure. The height of the crown is about 50-60m above the road. Geologically, the rocks exposed in this region belong to Garhwal Group of rocks, consisting mainly of quartzites and phyllites. The rocks strike N20° and dip at about 25° towards ESE. These rocks are moderate to highly weathered. Quartzite and phyllite have degraded to form a dark grey powdery cohesive soil. The hill slopes on the upper side of the road is 40 - 45° whereas the slope below the road is 60-70°.

The main causative factors of the landslide are heavy rainfall in this region, seepage of water into the slopes, presence of a shear plane and deep weathering of rocks. The slide can

be stabilised by construction of retaining structures at the toe of the slide. The design of these structures should also consider the momentum of slope mass that is expected to move.

2.2.9 Lata – Malla Sinking Zone

The zone is located at km 172 from Rishikesh on Uttarkashi-Gangotri National Highway (NH-74), at latitude 30°46'45" and longitude 78°36'27". The slide area is located very close to Bhatwari and covers a stretch of approximately 1.5 – 2.0 km. It is a rock-cum-debris slide. The zone actually represents a sinking area which perhaps started after 1978 Bhagirathi floods. The field observation indicated different levels of road at different times in the past. Geologically, the region has metabasics and schistose rocks, which are highly weathered. Huge blocks of weathered rocks are overlain by large amount of loose silty soil over them. The rocks are thickly bedded and highly jointed. Several drains are passing through this zone. In addition, high degree of fracturing, jointing and weathering of rocks permit greater amount of water to pass through these rocks. The main causative factors appear to be heavy precipitation, high degree of fracturing, jointing and sheared nature of rocks. Toe cutting by the Bhagirathi river could also be a causative factor.

Stabilisation measures can be suggested only after detailed investigations of the site. It is said that the road section has subsided at least by 3-4m but evidences about changes in road alignment are not obvious. Therefore, more information is required to understand this site.

2.2.10 Sangam Chatti Landslide

The slide is located at about 9 km from the National Highway (NH-74) from Gangori along the Asi Ganga river, a tributary of Bhagirathi. It is an old landslide, which gets reactivated time and again. The main rocks are phyllites overlain by quartzites. Previously, a double bend of road was there over this slide area. The present condition of slide indicates that it is not advisable to construct any road over these unstable slopes. If at all any road construction is necessary, that should be properly planned to avoid any disturbance to this zone.

2.2.11 Varunawat Landslide 2003

A major landslide took place on 26 September 2003 on Varunawat hills along the national highway 108 at Uttarkashi and affected the buildings, highway and other infrastructure very badly. The estimated damages / losses by the Uttarakhand state government were about Rs. 300 Crores.



Fig. 2.1: Image of Varunawat Landslide as seen from Google Earth



Fig. 2.2: A view of the hotels prior to burial under landslide at varunawat hill



Fig. 2.3: A view after landslide engulfed the hotels shown in the photo Fig. 2.2



Fig. 2.4 : An example of Landslide Hazard Zonation Map prepared by NRSC

2.3 Elements at Risk

As pointed out above, the area is prone to different types of hazards that have varying probabilities in terms of their occurrence in the given space and time. It is also evident that these hazards do not affect every element present in the affected area similarly or to the same extents. Depending upon the vulnerability of the elements, their location and duration of exposure, degree of impacts are variable. The present paragraph attempts to identify the different elements that are likely to get exposed or affected by these hazards. The elements at risk from specific hazards have been grouped together and classified based on homogeneity in their nature and characteristics. The major elements at risk from the above mentioned hazards are:

- Human beings
- Livestock
- Residential buildings / habitation
- Road network
- Power and communication Services
- Hydel projects
- Land properties
- Agricultural yield
- Drinking water supply
- Livelihood - trade and commerce, shops, hotels, tourism

2.4 Vulnerability Assessment

Vulnerability of the elements exposed to risk from potential hazards depend upon the frequency and magnitude of the hazard, duration of exposure to it, sensitivity of the elements, mobility and resisting capacity vulnerability assessment etc. can be carried out on hazard / event specific basis. Aggregate / composite vulnerability can be considered using a multiple hazard scenario. The details about the type and degree of vulnerability as well as the factors affecting the vulnerability of elements at risk are discussed below:

2.4.1 Types and Degree of Vulnerability

The types of vulnerability can be physical, social, economic, political, environmental and so on, depending upon the kind of elements involved in the risk. But the degree of vulnerability each of these elements can vary from 0 to 1 or can be described between 0 and 100%, based on resistive capacity of the elements when exposed to a hazardous event of a given character.

2.4.2 Factors affecting vulnerability

The significant factors affecting the vulnerability of different elements at risk from various kinds of disasters include terrain / geographical, strategic, social, economical, governance and administrative, political and systemic. Due to its position as border district, the vulnerability of Uttarkashi assumes greater significance because of strategic point of view.

As discussed in the previous chapter, Uttarkashi district has undergone intense changes due to developmental projects including hydel projects for power generation and irrigation, highway / road construction for transportation and providing access to different areas, drinking water supply, transmission lines, communication towers, building construction and so on. All these developmental activities combined with increased influx of tourist population have lead to rise in the vulnerability of elements exposed to hazards present in this area.

The level of vulnerability is also affected by the ignorance of the exposed population (tourists/pilgrims/labourers from outside) about the hazards in the area and low level of preparedness by the affected community. The changing climatic conditions, rapid non-systmatic urbaization global warming and population growth are also affecting the valnerabetty of different elements.

2.5 Preparedness and Capacity Assessment

2.5.1 Monitoring Prediction and Warning Systems

There are no such systems for prediction of earthquakes. However, areas prone to possible landslides in the district can be earmarked and people residing in those areas can forewarned of any possible disaster by constant monitoring of such areas based on the weather forecasts and seismic vibrations so that loss of life and property can be reduced to a minimum.

2.5.2 Mass Media and Communication Facilities

There is no television centre in the district. There are 3 T.R relay stations through which national and international news and various other informations are relayed. There is one Radio Station in the district headquarters from where state level broadcasts are relayed. Through District Information Officer, various news items can be published in the local newspapers from Dehradun. Through district centre of N.I.C., the district is connected with almost all the District Informatics Centres of the state and the nation. Internet facility is also available in the district.

2.5.3 Administrative Preparedness

2.5.3.1 Existing Emergency Action Plan

For better co-ordination among various agencies in the district at the time of any disaster, as per the Institutional Arrangements, 7-system desk has been formulated in the district.

2.5.3.2 District Disaster Management Committee

This Committee is headed by the District Magistrate. Other members of this committee are ADM, SP, CDO, CMO, Executive Officer-Nagar Panchayat, Executive Engineers of Jal Nigam, Jal Sansthan & Electricity department, Zila Parishad, PWD, District Agriculture Officer, District Education Officer, Principal NIM, Commandant ITBP, Commanding Officer 19 Grenadiers, Officer Commanding NCC, Officer Commanding BRO, Harsil, District Sainik Kalyan Adhikari, Commandant Home guard, Coordinator Nehru Youth Centres and Chief Veterinary Officer.

The District Magistrate shall form a District Disaster Management Committee, which will assist the District Disaster Manager in:

- a. Hazard analysis and in reviewing the threat of hazards
- b. Vulnerability analysis and evaluation of the preparedness level
- c. Risk analysis
- d. Emergency management
- e. Management strategies and
- f. consider suggestion for improvement of the response document (DDMAP).

This committee will meet quarterly once in three months under the chairmanship of D.M.

Tehsil/ Block Level Disaster Management Committees:- These committees have been constituted with respective SDM as their head. The other members comprise Tehsildar, Naib Tehsildar, concern Executive Engineer PWD and officers of Electricity and water departments of the particular Tehsil.

Village Level Disaster Management Committees:- These sub committees are at village level.

2.5.3.3 District Control Room in the District

A District Emergency Control Room has been setup at District headquarter near the Collectorate. Telephone has been provided in this control room (Tel. No. 226126 & 226461). A wireless set has also been provided in it. All relevant and useful information pertaining to the subject and being obtained from various sources is made available in the control room. All the activities pertaining to rescue and relief operation at the time of any disaster are controlled from here under the leadership of District Magistrate. In addition, such control rooms have also been established at Tehsil and Block levels.

District Emergency Operation Centre (DEOC)

The District Emergency Operation Centre, under the control of District Magistrate is the nerve centre :

- (a) to monitor
- (b) to coordinate, and
- (c) to implement the actions for disaster management.

Normal Time Activity of DEOC

The normal activities of the DEOC are :

- a. to ensure that all warning and communication systems, instruments are in working condition
- b. to receive information on a routine basis from the district departments on the vulnerability of the various blocks and villages to disasters.
- c. to receive reports on preparedness from the relevant district level and other department.
- d. to upgrade and update DDMAP according to changing scenarios in the districts
- e. to update data bank and maintain an inventory of resources as per given table
- f. to monitor preparedness measures and training activities including simulation exercises undertaken by various departments
- g. to ensure proper dissemination of DDMAP at the district level, local level and disaster prone areas
- h. to encourage formation of DITs in vulnerable areas

Warning or Occurrence of Disaster

The DM invokes the DDMAP in the following conditions:

- 1. on the basis of reports from the possible disaster site, or
- 2. the agencies competent to issue such a warning, or
- 3. on receipt of warning or alert from SEOC, and
- 4. on the invocation of DDMAP, the DM will exercise the powers and responsibilities of the DDM. (District Disaster Manager)

2.5.3.4 Community Education and Preparedness Programmes

At the time of possible disaster, the knowledge pertaining to safety and security is made public through pamphlets, newspapers and loudspeakers under DRM programme. The nodal officers & Co-ordinating officers were assigned duties in DEOC under Seven Desk System. The list of inventories as per the latest entries in IDRN are also kept in hard copy along with the neighbouring Districts of Tehri Garhwal, Dehradun & Shimla. The copies of this inventory are circulated to all the officers.

2.5.3.5 Promotion of life/property/crop insurance

Life Insurance: There are several Government and LIC institutions for providing life insurance

Crop Insurance:

- It is being promoted through national banks and is done on crop basis; once the crop is harvested the insurance automatically ceases to exist.
- **Kishan Credit Card:** through Nationalised banks & cooperatives. Loaning to farmers was done if he possess the Kishan Credit Card without any formalities. One more benefit of the KCC is that the farmer comes under the life risk cover of Rs 50,000/-.
- **Narayan Krishak Kavach Yojana:**

To make compensation available for losses during the disaster a wide publicity among people as made for making the insurance of life through LIC, crop insurance through Banks and property insurance through GIC. In addition, people are also made aware regarding Govt. run group insurance schemes, cottage insurance schemes and other allied insurance schemes

2.6 Disaster Specific Capacity Assessment

2.6.1 Floods and Cyclones

During flood ravages, the immediate requirement is of swimmers, divers, surgeons and rehabilitation of flood affected people. For this purpose, services of fire brigade department & paramilitary forces available in the district can play an active and significant role in protecting the life and properties during such disasters. Panchayat Bhawan and Relief Camp have been built in all Gram Sabhas in which affected people can be accommodated. Orthopedic surgeon is deputed in the district that will lead the medical team during emergency. Besides, the concerned departments will provide relief for losses incurred in agriculture & horticulture.

2.6.2 Epidemics

The vaccination campaigns are continuously run by the health departments at village level for control of disaster. Jal Sansthan and Jal Nigam constantly work to check the water pollution. Despite all this, if any trouble comes in the relief and medical committees will come into action immediately. Similarly, special vaccination campaign is also run for protecting animals from possible epidemics. 24

2.6.3 Road Accidents

At the time of road accidents, the services of medical, fire brigade & police departments are needed. To fight this reduce the risk/losses from accidently, district hospital with 110 beds, one ambulance & 18 doctors, is available at headquarters. In addition, the district has 45 allopathic, 30 ayurvedic and 4 homeopathic hospitals. Apart from this, police departments has two fire brigades vans and one crane while ITBP has two fire extinguishers, ten searchlights & mountaineering appliances. PWD is equipped with three dozers and one crane, which can be used during any of disaster.

2.7 Public & Private Sector Resources Inventory

2.7.1 Infrastructure available

There are 580 Basic Schools, 180 Junior High Schools, 61 Inter Colleges, 4 I.T.Is , one Polytechnic , Panchayat Bhawan in each village, 441 relief homes, 45 allopathic, 39 Ayurvedic, 4 homeopathic hospitals, 24 veterinary hospital and 31 live stock centres in the district. These infrastructure resources are preserved and maintained by the respective deptt and gram sabhas and are utilized during disaster.

2.7.2 Adequacy of existing inventory for disaster management

All school, ITI's, Polytechnic buildings, Panchayat Bhawan & earthquake resistant buildings available in the distt. can be utilized to facilitate rehabilitation of affected families. All vehicles rested with the deptt and private sector will be switched into action carrying displaced persons & transportation of relief material in various camps. The services of ITBP can also be taken during disaster as they have mountaineering appliances and expertise required who can help relief works in the shortest possible time. Four helipads located in the district can also be utilized in bringing relief material from other neighbouring district at the earliest.

2.7.3 Institutional Arrangements at the District Level

Disaster management at district level would have three focal levels viz. state, the district and the site of the disaster. The agency at State level would be involved in policy decisions, resource allocations, and prioritization of activities and budget allocation.

District Disaster Management Committee is the apex planning body and has a major role in planning and mitigation. The district level response will be coordinated under the guidance of District Magistrate who will act as District Disaster Manager.

2.7.3.1 Responsibilities of District Magistrate

The District Magistrate is responsible for :

- (a) Preparation of District Disaster Management Action Plan with assistance of District Disaster Management Committees.
- (b) Setting up of District Emergency Operation Centre (DEOC).
- (c) Being an integral part of DCR.
- (d) Encouraging formation of Disaster Intervention Teams (DITs).
- (e) co-ordinating all field responses viz. setting up transit camps, relief camps, feeding centres and cattle camps etc.
- (f) Providing directions, through district level agencies (under DDMAP), field intervention through various agencies right from the stage of warning to relief and rehabilitation.
- (g) Site Operating Centre (SOC) headed by Site Manager (SM) will assist the district magistrate.

For proper division of tasks, information gathering, record keeping and accountability to DDM for specific function, the desk arrangement system will be followed in the control room. The capacity of various desks to co-ordinate amongst themselves and with the units to be co-coordinated will ultimately decide the quality of response. A flow chart representation of co-ordination structure at district level will thus be :-

Table 2.2: Nodal Ministry / Agency responsible for specific types of disasters

Disaster	Nodal Ministry / Agency
Earthquake	Indian Meteorology Department (IMD)
Landslide	Geological Survey of India (GSI)
Flood	Central Water Commission
Aviation	Ministry of Civil Aviation
Epidemics / Health	Ministry of Health and Family Welfare
Industrial & Chemical Accidents	Ministry of Environment and Forests
All other disasters	Ministry of Home Affairs

The invocation of the plan is communicated to:

1. Chief Secretary, Principal Secretary Disaster Management, SEOC and DMMC
2. Divisional Commissioner
3. All district level officers, Municipal Chairmen of the affected areas, DITs
4. The officials of central government located within the district
5. Non-officials namely MP, MLA, Chairmen Zila Panchayat from the district or affected area
6. Local units of the Defence Services

The invocation of the DDMAP would essentially bring into force the following:

- a. The DM will activate the DCR as the DDM
- b. The DCR will be expended to include desk arrangement with responsibilities for specific task as given in the following table:

Table 2.3: Components of District Control Room

(Desk Arrangement on Invocation of DDMAP at the existing DCR at the Collectorate)	
District Disaster Manager	
•	Establishing Priorities
•	To direct and coordinate the services of
✓	Defense Services, CRPF, Home Guards
✓	Fire Brigade, SSB
✓	P&T DD, AIR
✓	SEB, SRTC, PWD
✓	IMD, GSI
✓	State Government Aircrafts and Helicopters
•	Coordinate with NGOs and DMMC for National and International Aid Agencies

- c. All district level staff from various departments will be under the direction and control of DDM. These would also include the district staff of
 - Zilla Parishads
 - Municipal Authorities
 - SEB
 - Nigams and Area Development Authorities
 - PWD
 - SRTC
 - Irrigation
 - District Industry Office
 - District Supply Office
 - Others

- d. Leave of all officers and staff working with the above organizations, as requisitioned by the DDM, would automatically stand cancelled and the organizations would direct their staff to report on duty immediately.
- e. The DDM will access district level relief fund account with a maximum limit to be fixed (which will be replenished by GoUA on an on-going basis as per the provisions).
- f. The DDM may in case of large-scale disaster get in touch with the local Army unit for assistance for rescue, evacuation and emergency relief measures
- g. The DDM will have the authority to requisition of resource, materials and equipment from private sector
- h. The DDM will setup SOC in the affected area with desk arrangements
- i. The DDM will authorize establishment of transit and/ or relief camps, feeding centre cattle camps
- j. An ongoing wireless communication and contact arrangement from the DCR to the EOC, DMMC and SOC, transit camps, feeding centre, relief camps and cattle camps will be activated
- k. The DDM will send the First Information Report and Action Taken Report, as per the available information to the EOC/ DMMC and the Divisional Commissioner
- l. The DDM will authorize immediate evacuation whenever necessary
- m. In the event of possibility of disasters in adjoining districts, including those beyond state borders, the DDM will issue an alert warning to them.
- n. In multi - district disasters, if Additional Commissioner of Disaster Management is appointed at the multi-district level, the DDM will report to the Additional Commissioner, Disaster Management.

Chapter 3

Recent Cloudburst, Flashfloods and Landslides in the Upper Bhagirathi Valley of Uttarkashi District

3.1 Chronology of Events

The chapter provides information about the sequence of events in a temporal framework and the ground situation as well as risk perception, preparedness and response by the community and administration.

3.2 Pre- disaster conditions and genesis of Disaster

Prior to the major catastrophic event on 3rd August 2012, the affected area had received heavy to extremely heavy rainfall at least two times during the previous month on 4th July and 25th July 2012. The tributaries of Asi Ganga and Bhagirathi were blocked at some places in the upper catchment areas of the valley, thereby forming transient landslide / debris dammed lakes that withheld huge amount of water, boulders, tree logs and sediments washed away from the slopes. As the area is thinly populated and has difficult access, these lakes were not well reported to the administration by the people of the affected area. However, the conditions were favourable for triggering flashfloods if and when the area received heavy precipitation. Thus, the very high intensity rainfall accompanied by thunder and lightning, resulted in bursting of these lakes as well as over-spilling of water from the existing lake at Dodi Tal.

3.3 Consequences of Disaster

From 10pm on Friday, 3rd August 2012 to 3am on Saturday, 4th August 2012, intense heavy rains (cloudburst) were reported in the Asi Gnaga Valley and Sawari Gad of Bhatwari Tehsil in Uttarkashi district of Uttarakhand State. The cloudburst led to formation of transient lakes at some places in the Upper Catchment areas where it gathered a huge amount debris and water for some time. At night, these lakes bursted and created flash floods in the abovesaid valleys as well as the major river Bhagirathi in this region. The voluminous water and debris resulted in numerous landslides along the river banks and damages /destruction to the various

elements along its way in Sangam Chatti, Bhatwari and Uttarkashi areas. The affected villages are situated on both the sides of Assi Ganga and Bhagirathi. Heart-wrenching scenes were witnessed at Gangori where the maximum numbers of deaths were reported so far. About 700 pilgrims were stuck and efforts were made to move them to the safer place on foot, as the roads were totally damaged, and the hostile weather was not allowing airlifting of the people. According to the government data,, 31 deaths and 5 people missing so far. However, according to informal sources and local prediction the missing number is more than 500.

3.4 Situational analysis

- Bhatwari Tehsil of the Uttarakhand block was mostly affected by the flash floods.
- The road linking Uttarkashi and Bhatwari could not be made fully functional, and the continuous rain was making it difficult for normalcy to return.
- Around 18 villages in this block were affected and among them 12 villages were worst affected. The number of families living in those seven villages Bhangkoli, agora, dhasana, Dhandalka, Sheku, Gajoli, Naogaon villages are 575 (approx 3000 people). The following table explains the accessible, inaccessible, worst affected villages and those accessed by Action Aid partners so far.
- Many families were living in the forest. We have identified 10 families (they have infants in the family) from Rewara village who were staying in the forest of Chingwa. They were facing serious problem as the Forest department was trying to move them out of the forest.

The following losses and damages have been reported by the district administration.

3.5 Post-disaster Situation

Immediately after the disaster struck the area on the night of 3 August 2012, the people in the affected community left their homes and went towards upside slopes, away from the banks of Asi Ganga and Bhagirathi Rivers. The catastrophic events swept away several people who were living close to the river and washed off the embankments, bridges and roads located in proximity with the river channel. Next morning was a grave scene. The foundations of the buildings were eroded by the flashfloods and the space in the building was filled with debris (boulders, tree logs and sediments) brought by the river. It buried all the belongings of the people in those buildings. The big boulders upto 3-4m size, were seen in the river course and several of them lying on the slopes over the roads. At some places, some cloths, footwears and other belongings of the victims lay scattered in the river debris. Some of the livestock were also washed away by flashfloods and some were found buried in the debris. Many vehicles were also damaged.

The incident left the pilgrims stranded at different places due to breaching of roads and damages / loss of bridges. The district administration immediately responded to the disaster situation and extended necessary evacuation, search, rescue and relief actions for saving the lives of the people trapped in the disaster. Temporary shelters were identified to rehabilitate people who have become homeless due to destruction of their houses by the flashfloods and provided them with food, water, medicine and other facilities.

Action Aid (an NGO) provided 175 litres milk has been distributed among the villagers Gangori, Joshiyara, and people staying in the camps of Uttarkashi. 11 tripals (plastic sheets) has been given to those who are staying in the forest in the Village Chingwa. The immediate needs of victims in the reachable villages were

- Solar lamps (which comes with mobile charging points)
- Ration and Cooking ingredients like oil, salt, match box etc
- Plastic sheets/ Tripals
- Utensils
- Female sanitary products e.g. sanitary napkins
- Water purification products e.g. chlorine drops

3.6 Future Implications

The disaster event is a reminder of the nature about the potential susceptibility of the area to the threats of landslides, flash/floods and earthquakes further the changing climate conditions, global warming glacial retreat combined with aggravating anthropogenic activities like blasting, mining, constraction, excavation, deforestation and improper dramage modifications are likely to extend areas population and affected by such disasters if proper regulating and scientific environment friendly measure not timely enforced and implacemented to prevent such disasters in advance & reduce risk/losses from them.

Chapter 4

Post-disaster Damage/Loss and Needs Assessment (PDNA)

4.1 Introduction

Post disaster damage / loss and needs assessment is one of the most important activities that need to be taken on emergent basis for assessing the degree of damages / losses as well as identifying the needs of the victims in the affected community of the locality. The district administration made a quick survey of the affected area and estimated the amount of damages / losses to provide necessary relief and response to the affected community. The initial assessments indicated that few people were killed by the flashfloods and landslides and many pilgrims / villagers were stranded due to road breaching and washing away of the bridges in the Asi Ganga and Bhagirathi valleys. As it was dark night disaster, detailed information could be sought by the administration only on the next day morning. The present chapter provides information about the losses of human lives and livestock, number of people injured and made homeless/jobless after the disaster as well as the degree of damages to roads, bridges, water supply, power supply, communication network etc. Based on the impacts of disaster, the needs of the victims were assessed to extend requisite relief.

4.2 Impacts on Human Lives and Livestock

The catastrophic events resulted in loss of 35 human lives that included 19 labourers working for a hydel projects. Among the dead, were several Nepalese.

4.3 Impacts on Buildings

A large number of buildings on the banks of river Asi Ganga and Bhagirathi were damaged or destroyed due to flashfloods. The huge amount of debris in the river water entered into the building premises and punctured the walls and filled the space with sand, debris, boulders and wooden logs. The high velocity of water currents along with debris eroded the

foundations of the buildings, thereby resulting in collapse of the structure and making them unusable and unsafe. The photographs (Figures 4.5 to 4.35) depict the conditions of buildings after the flashfloods and landslides in the Upper Bhagirathi valley on 3rd August 2012.

4.4 Impacts on Roads and Bridges

The flashfloods adversely affected adversely not only the buildings on the river banks but also the roads adjoining it and the bridges located over the Asi Ganga and Bhagirathi rivers. Several villages were cut off from the district headquarters due to breaching of roads and washing away of bridges. It also resulted in delayed response and evacuation actions by the administration. Search and rescue operations were hampered due to inaccessibility to the affected areas by the quick response teams and national disaster response force. The conditions of the roads and bridges after the flashfloods and landslides are depicted in the form of few photographs (Figs. 4.52 to 4.59).



Fig. 4.1: Google Image showing sinuosity of the Bhagirathi river and bridges located over it at Uttarakshi

4.5 Impact on Vehicles and Equipment

The flashfloods and landslides have badly damaged the vehicles, and equipment including bikes, cars, vans, emergency vehicles, fire tenders, bull-dozer etc. The impacts are evident from the field photographs (Figs. 4.36 to 4.43). BRO's staging area for equipment and construction of bridge near Gangori was completely washed away by the flood waters and all the resources were lost from the staging area. The economic value of these equipment and other resources is quite high.

4.6 Impact on Power Projects

The event demolished the upcoming power project on Asi Ganga River being constructed by Uttaranchal Jal Vidyut Yojana Nigam (UJVNL). The flashfloods damaged the power house, equipment inside the power house as well as adversely affected the tower locations. Many labourers working for the power project have lost their life due to this event. In fact, the largest number of casualties was reported among the labourers of this project. The project work was delayed for quite a long time Figs. 4.60 to 4.67 reveal the impacts of the recent flashfloods to the power project.



Fig. 4.2: Google Image showing location of the affected UJVNL Power House

4.7 Impact on River Banks and Reservoirs

The high velocity of water currents mixed with sediments led to toe erosion of the slope adjacent to riverside. The loss of toe support resulted in numerous landslides and thereby increasing the load of sediments in the water and also the rise in river water level of the rivers due to aggradation of boulders and sediments on the river bed. The wooden logs which drifted with high velocity water currents, got accumulated in the reservoir areas where the velocity of water gets reduced. The wooden logs and debris were also observed in the eddy areas where river water got locked and left the sediment there.

4.8 Impacts on Tourism, Commercial and Social Activities

The flashfloods have disrupted the tourism, commercial as well as social activities. Schools and colleges were shutdown for a period of about 2 weeks and victims were

rehabilitated in the school and college buildings. The socio-cultural programmes were also postponed due to the adverse impacts of flashfloods.

Table 4.1: List of Affected Villages

S.	Name of the affected village
1	Aungi (Bhatuka Saur Tauk)
2	Odar (Salang)
3	Kankradhi
4	Pala Maradhi
5	Mastadhi
6	Kamar
7	Bagyalgaon
8	Agora
9	Dasda
10	Bhankoli
11	Kiarak
12	Mando
13	Kunjan
14	Uttro ki Lingkuwari / Ghattukhal Tok
15	Rawra Chiwa, Tok in Gram Nald
16	Astal – Gunalgaon – Ranadi
17	Genwala
18	Olya
19	Masaun
20	Kodafedhi
21	Junga Dangsa, Riyani and Chhitkyana Tok
22	Virpur
23	Khurmola
24	Chhamroli
25	Matli
26	Matti
27	Udri
28	Kamad (Khalad Tok)
29	Gorsada

S.	Name of the affected village
30	Thandi
31	Sem Gajna
32	Nugaon
33	Kanwa ka Kadkhet Tok
34	Bhadhkot
35	Badethi
36	Chinyali ka Kudroli Tok
37	Tulyara ka Sunargaon Tok
38	Hadiyarhi
39	Khand ka Tirhyan Tok
40	Kansi
41	Trakot ka Pather Tok
42	Garhwal gad
43	Bhunyara
44	Dharkot
45	Banchora
46	Neri
47	Pipalmandi – Chamiyala
48	Dhanpur
49	Badethi ka Chamiyala, Bhatsaur, Dhuladhar Tok
50	Badhangaon
51	Rauntal
52	Kauda
53	Kainthogi
54	Madesh
55	Gadal Gaon
56	Paletha
57	Manjiyali
58	Bigradhi ka babedha Tok
59	Nagar Panachayat Barkot, Ward No.7
60	Chharha, Nailarhi and Chaptadhi
61	Naitwar Bazar and Gram Kasla



Fig.4.3: A hotel building lost its foundation during flashfloods in Asi Ganga River



Fig.4.4: A panoramic view of the damaged hotel building situated near Asi Ganga River at Gangori



Fig.4.5: Debris entered behind the rooms on riverside and choked the way



Fig.4.6: The building got filled with river debris upto the lintel level above windows near Asi Ganga River at Gangori



Fig.4.7: Hotel building completely choked with river debris after flashfloods in Asi Ganga River at Gangori



Fig.4.8: Boulders and river sand seen lying on the road after the flashfloods in Asi Ganga Valley



Fig.4.9: River debris damages and blocks the way in the hotel building situated near Asi Ganga River at Gangori



Fig.4.10: River debris damages and blocks the way in the hotel building situated near Asi Ganga River at Gangori



Fig.4.11: Roof collapse and debris accumulation on the top of a house at Gangori



Fig.4.12: Complete collapse of bank building situated near Asi Ganga River at Gangori



Fig.4.13: Victim who lost his house (in the background). River sediments and tree logs damaged building and over-rided building and over-rided roof



Fig.4.14: Front view of the hotel building affected by the flash flood debris



Fig.4.15: Complete collapse of building near Asi Ganga River at Gangori



Fig.4.16: A Collapsed building on riverside after the flashfloods in Asi Ganga



Fig.4.17: Link road to the bridge at Tiloth destroyed by flashfloods in Bhagirathi river



Fig.4.18: Debris flow at Khari poses risk to the shop and school below



Fig.4.19: Completely collapsed building falls in the river



Fig.4.20: Government Inter College where victims got temporary shelter



Fig.4.21: Habitation in close proximity of Bhagirathi river likely to face risk during flashfloods



Fig.4.22: School building endangered after erosion of river banks and partially damaged foundations



Fig.4.23: Embankment walls and building foundations eroded after flashfloods cause structural collapse



Fig.4.24: River sand and tree logs hit the Ganga Hotel and fill the building



Fig.4.25: Completely collapsed building near Tiloth Bridge at Uttarkashi



Fig.4.26: River water fills the ground floor of a building situated near Asi Ganga River at Gangori



Fig.4.27: Village women bringing fodder on their back in Uttarkashi area



Fig.4.28: Eroded river bank put buildings at risk after the flashfloods in Bhagirathi river



Fig.4.29: Foundation and floor of the building eroded completely by flashfloods



Fig.4.30: Insufficient Embankment protection works for safety of building close to river



Fig.4.31: Completely collapsed building near Asi Ganga River at Gangori



Fig.4.32: Frontal part of the building completely collapsed after the flashfloods in Bhagirathi river



Fig.4.33: Power house gets damaged and filled with river debris during flashfloods in Asi Ganga River



Fig.4.34: Erosion of foundation leads to columnar failure and collapse of a new building after the flashfloods



Fig.4.35: Damaged motorbike after flashfloods in Asi Ganga River at Gangori



Fig.4.36: Damaged vehicle of Fire Department after flashfloods in Asi Ganga River at Gangori



Fig.4.37: Damaged Car and a house after flashfloods in Asi Ganga River at Gangori



Fig.4.38: Damaged Private vehicle after flashfloods in Asi Ganga River at Gangori



Fig.4.39: Protection provided by sand bags at Tiloth Bridge



Fig.4.40: Frontal view of the damaged vehicle of Fire Department



Fig.4.41: Damaged vehicle of fire department after being hit by flash floods at Gangori



Fig.4.42: A van and a truck of the fire department swept and damaged during flash floods



Fig.4.43: Landslide due to toe failure near river bank after flashfloods in Asi Ganga River at Gangori



Fig.4.44: Toe induced landslides occurred after flashfloods in Asi Ganga River at Gangori



Fig.4.45: Landslides in the reservoir area of Tehri Dam result in siltation and reduction of reservoir capacity



Fig.4.46: Toe induced landslides along reservoir rim of Tehri dam results in land loss and siltation

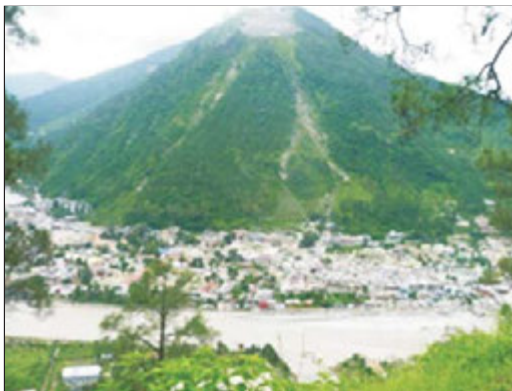


Fig.4.47: Varunawat hills that posed a landslide challenge during the last week of September 2003



Fig.4.48: Huge treatment works at the headscarps of Varunawat landslide tends to reduce the problem



Fig.4.49: A house located on debris slopes lost its foundation partly



Fig.4.50: Huge wooden logs collect in the Tehri dam reservoir brought by Bhagiathi river



Fig.4.51: The tower of a suspension bridge fails after flashflood in Uttarkashi



Fig.4.52: Rescue and relief workers help villagers cross Asi Ganga River at Gangori using Bailey bridge



Fig.4.53: Narrow section and placement of piers on or close to river poses danger of its being washed away during flashfloods



Fig.4.54: The tower on rock beds still exists while the tower on the other side of suspension bridge washed away by flashfloods



Fig.4.55: A view of the suspension bridge whose one pier / towers were damaged during flashfloods



Fig.4.56: Such location where the river section suddenly narrows down are susceptible to erosion during flashfloods



Fig.4.57: A temporary wooden bridge constructed by local community after flashfloods in Asi Ganga River at Gangori



Fig.4.58: A damaged building, connecting road and park near Tiloth bridge after flashfloods



Fig.4.59: Equipments of the Power Project were damaged and washed away by flashfloods



Fig.4.60: Support works for bridge construction got badly damaged at Gangori after the flashfloods



Fig.4.61: Damaged support works of the Gangori bridge after flashfloods in Asi Ganga Valley



Fig.4.62: Building Foundations on the riverside were eroded and damaged after flashfloods, leaving it unusable



Fig.4.63: Bridge washed away, buildings damaged after flashfloods in Asi Ganga Valley



Fig.4.64: A primary school building located at the crown of a landslide poses an impending risk at Khari



Fig.4.65: Tree logs and boulders seen lying on road after flashfloods in Asi Ganga Valley



Fig.4.66: A hotel building on the verge of collapse due to damages to foundation after the flashfloods in Asi Ganga Valley

4.9 Needs Assessment of Victims

The needs of the victims have been assessed as the immediate / urgent needs as well as the long terms needs for safety of life, economy and environment from such risks in future. The immediate needs of the victims are:

- Rapid damage /loss and needs assessment
- Information about the dead and displaced people
- Search, rescue and evacuation of the trapped villagers, local residents and pilgrims/ tourists from the affected areas
- Medical and First Aid (including vaccination and immunization) for the injured and portability of the severely injured victims to hospitals

- Relief distribution and vital requirements including food, water, utensils, cloths, sanitation materials, fuel etc.
- Immediate temporary rehabilitation of the displaced people who lost their homes
- Temporary tents / shelters with provisions of kitchen and toilet facilities
- Repair and Restoration of drinking water supply, electric supply, road network, communication facilities etc.
- Arrangement of fuel (LPG and kerosene) for cooking and fuel for conveyances/vehicles (Petrol, Diesel)
- Psycho-social counseling

Chapter 5

Response Actions against Recent Disaster

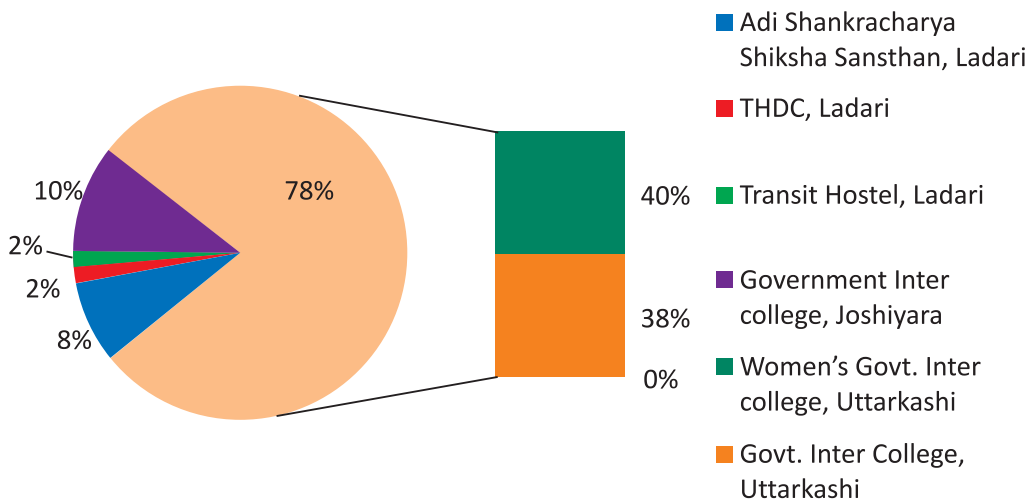
5.1 Response

The district administration took the following actions as immediate response to the disaster and the state government provided resources for search, rescue and relief.

- It evacuated the stranded pilgrims (>160) from the affected areas by using helicopters. Air force provided 2 ALH and 2 MI-17 helicopters for rescue, relief and evacuation operations.
- Equipment – 4 additional inflatable lights, 10 search lights and 1 satellite phone
- Food Items – About 6000 kg immediate food supply including biscuits, bun, rusk etc. About 5000kg of rice, pulses, salt, sugar, tea etc. were also sent through helicopters and trucks to the affected areas
- The food supplies department provided additional fuel resources to the district which included 2000 litres of petrol, 8000 litres of diesel, 10,000 litres of kerosene oil through a truck and 558 LPG cylinders through 2 trucks.
- Additional human resources – 6 Deputy Collectors / SDMs and 5 Tehsildars were provided to the district for carrying out emergency operations. Besides, 50 NDRF personnel were sent by the Central Government to the affected site. 4 medical doctors and essential medicines were also additionally supplied for the response to the disaster. A team comprising a medical doctor and 2 pharmacists was also sent to the district under the leadership of Joint Director, Health.

Table 5.1: List of Temporary Relief Centres established by administration

S.	Relief Centre	Number of Families at the relief centre
1.	Adi Shankracharya Shiksha Sansthan, Ladari	10
2.	THDC, Ladari	2
3.	Transit Hostel, Ladari	2
4.	Government Inter College, Joshiyara	13
5.	Women's Govt. Inter College, Uttarkashi	50
6.	Govt. Inter College, Uttarkashi	47
7.	Masih Dilasa School, Tiloth	00
	Total – 7 Relief Shelters	124

**Figure 5.1: Distribution of homeless families in different temporary rehabilitation centres**

The temporary relief centres have been provided with the facilities for food, water, electricity and sanitation. Some of the affected families were also living at Uttarakhand Jal Vidyut Nigam Colony with food and their belongings.

Availability of Essential Commodities in the district

The status is given below:

- Wheat - 10,101.5 Quintals
- Rice - 8001.68 Quintals
- Sugar - 1907.5 Quintal
- Petrol - 23,933 Litres
- Diesel - 17,885 Litres
- Kerosene - 33,800 KLitres
- LPG - 376 Cylinders

Table 5.2: Drinking Water Supply By Jal Sansthan

S.no	Tehsil	Projects Severely Affected	Partially affected	Closed projects
1.	Bhatwari	26	23	3
2.	Dunda	16	16	-
3.	Chinyalisaur	9	8	1
4.	Purola	10	10	-
5.	Naugaon	13	13	-
6.	Mori	6	6	-

- Uttarkashi city's water supply maintained through an 8" water supply pipeline.
- Water supply in Gangori was also restored.

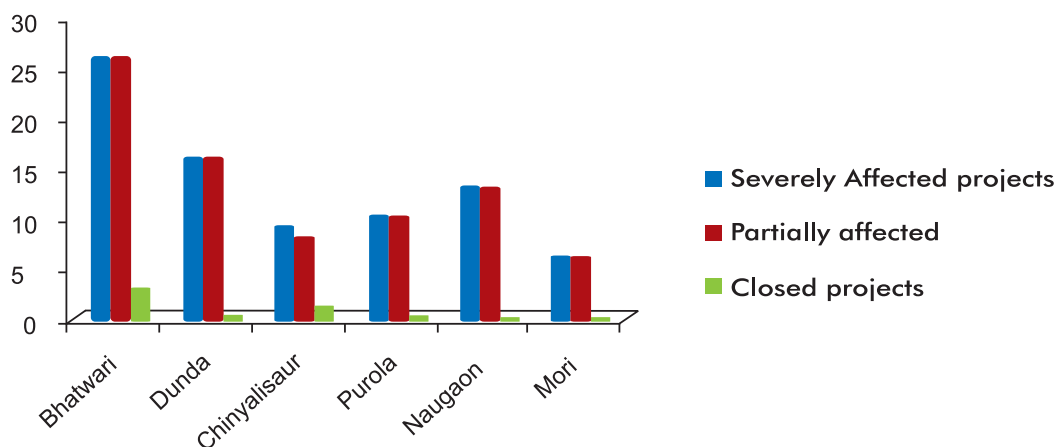


Figure 5.2: Number of Projects affected in different Tehsils of Uttarkashi District



Fig.5.3: District Emergency Operation Centre in operation at Uttarkashi



Fig.5.4: Relief services rendered by volunteers from Shantikunj, Haridwar



Fig.5.5: NDRF personnel helping the villagers in crossing Bailey bridge after flashfloods in Asi Ganga River at Gangori



Fig.5.6: Helicopter services were used for evacuation and supply of relief to victims



Fig.5.7: The condition inside a relief camp at Government Inter College, Uttarkashi



Fig.5.8: Victims with their belonging at the relief camp in Uttarkashi



Fig.5.9: A victimized family at the relief camp tries to adjust with family including children



Fig.5.10: RSS volunteers trying to provide food to the affected community at Gangori



Fig.5.11: Personnel from Border Roads Organization trying to make a temporary bridge to cross the river



Fig.5.12: Room of the District Project Officer, Disaster Management, Uttarkashi



Fig.5.13: Seven Disk system in operation at the district control room in Uttarkashi



Fig.5.14: Local volunteers extend relief services to the affected community at Gangori



Fig.5.15: Police Personnel carrying out search and rescue operation at Gangori



Fig.5.16: ITBP extends water supply services using water tanks for the disaster affected people at Uttarkashi



Fig.5.17: 50 persons team of the 8th Battalion of NDRF from Ghaziabad arrives Uttarkashi on 8 August 2012



Fig.5.18: An inside view of the community kitchen for the affected people at Gangori



Fig.5.19: State Emergency Operation Centre is located at the Secretariat in Dehradun



Fig.5.20: Communication and transmission facilities at SEOC



Fig.5.21: SEOC prepares the daily reports on disasters during the monsoon period



Fig.5.22: Video-conferencing facilities for emergency communication from SEOC to district officials



Fig.5.23: SEOC / DMMC are equipped with remote sensing and GIS capabilities and staff



Fig.5.24: Daily reports and situations are displayed using maps, graphs, data and texts in the SEOC boards



Fig.5.25: Map depicting disaster affected areas in Uttarkashi at display in SEOC



Fig.5.26: Electronic media played an active role in highlighting the panic and problems of victims

5.2 Health and Medical Aid

- Some cases of diarrhoea were reported from Gajoli area and necessary life saving drugs and medicines were sent along with a team of doctors. No other cases of epidemics or diarrhoea were reported from any other place.
- A team was sent to Community Health Service Centre at Mori.
- Sufficient stocks of medicines were available at Chinyalisaur, Bhatwari, Barkot, Naugaon, Gangori.
- Essential medicines, equipment and stretchers were available at District Hospital- Uttarkashi, Primary Health Centre – Naitwar, Dunda, Mori, Community Health Centre – Chinyalisaur, Purola, SAD – Barkot.
- Sufficient Medicines were also been sent from Dehradun store to the affected areas.
- 11 Medical Relief Posts were established by the Health Department in the district Naitala, Dokri, Bangoli, Agora, Faku, Gajoli, Tiloth, Sangamchatti, Naugaon, Akora and Gangori. One doctor, a pharmacist and two first aid medical responders and social volunteers were prepositioned at each medical post.
- The Health Department also sent 1 Central Mobile Team from Dehradun, to monitor and coordinate the work with district headquarter. The team included a Joint Director, a doctor, two pharmacists and two first aid medical responders.

5.3 Conveyance and Transport System

- The district administration provided regular and cheap (Rs.5/- per person) transport facilities by arranging 2 buses in affected areas.
- The buses plied from 8:30am and 7:30pm, regularly on Gangori to Matli and Gangori-Vikas Bhawan-Tiloth routes.
- The buses were provided diesel from SDRF so that these could ply regularly if the number of passengers is less.
- The district administration established the transport with light vehicles for about 15 km between Gangori and Maneri. The vehicles were provided with fuel for ensuring regular service to the affected areas.

5.4 Condition of Roads, Highways and Bridges

- After the disaster 98 roads were blocked in the Uttarkashi district 66 were opened in a short time period while the rest took longer time.

- In all 14 bridges were damaged and two were partially affected.
- 21 JCBs were deployed by PWD to open the closed routes.
- PWD Uttarkashi was installing a trolley system to connect the disconnected villages from Athali.
- BRO worked for constructing a bailey bridge and the material for the bridges was brought to the site through trucks.

5.5 Power / Electric Supply

- Six electric supply lines were affected in the Uttarkashi area which were restored soon. Three electric supply lines were damaged in Bhatwari area and a team of engineers was working on it.

5.6 Availability of Tents and Other Essential Items

- The district administration distributed 248 bags of food, 500 packets of candles, 91 blankets, 91 utensil sets to 113 families in Gangori, to Chiwa, Nald, and Ghatsaur. One tent was provided to an affected family at Gangori.

5.7 Search and Rescue Operations

- A 50 member team of NDRF was working at the affected sites for search, rescue, relief and evacuation operations.
- The district administration was supported by the army and ITBP in search and rescue operations.
- Volunteers of the White Army from Kolhapur, Maharashtra (NGO) were also assisting in search, rescue, relief and evacuation activities.
- ITBP deputed 25 persons in Gangori, 15 in Chinyalisaur and 16 at Joshiyara for search and rescue operations.
- Nehru Institute of Mountainering, Disaster Management Teams, Bhuvneshwari Mahila Ashram and other social workers were also supporting the SRR operations.

5.8 Priority Works

- To reconcile the departed family members in relief camps and provide temporary shelters to the homeless.
- To make family unit arrangements in the relief camps
- To carry out vaccination of victims and provide them medical aid

- To restore transport and communication facilities in the affected areas
- To make damage and loss assessment of the affected areas for submission of memorandum to the Government of India
- To construct wooden bridges or trolleys in areas for transportation, where the suspension or steel girder bridges have been completely damaged.



Fig.5.27: Collapsed building situated near Asi Ganga River at Gangori



Fig.5.28: Collapsed building situated near Asi Ganga River at Gangori



Fig.5.29: A temporary Bailey bridge constructed by BRO after flashfloods in Asi Ganga River at Gangori



Fig.5.30: Suspension bridge in Uttarkashi was detached after its pier/tower got damaged by flashfloods



Fig.5.31: Buildings as well as vehicles were destroyed by flashfloods in Asi Ganga River at Gangori



Fig.5.32: Road traffic disrupted due to landslides on way to Uttarkashi



Fig.5.33: Staging area and equipments of BRO heavily damaged during flashfloods



Fig.5.34: Badly damaged water pipeline due to striking boulders during flashflood

Table 5.3: Data on Damages and Losses due to Landslides and Flashfloods of 3rd August 2012 in Uttarkashi District

Tehsil-wise Damage Distribution											
S. Tehsil	Number of affected villages	Number of Families affected	Number of affected people	Persons killed	Persons Injured	Livestock lost	Buildings completely destroyed	Severely Damaged buildings	Partially damaged buildings	Kutcha bldgs destroyed	Agricultural land loss (in hectares)
1 Bhatwari	13	1301	5250	33	17	35	86	64	83	9	27.686
2 Dunda	32	220	1100	2	2	2	2	21	35	0	7.564
3 Chinyalisaur	30	65	317	0	0	1	1	24	32	0	0.230
4 Barkot	38	213	920	0	0	21	41	16	92	0	11.857
5 Purola	29	40	250	0	0	6	0	7	26	0	0.000
6 Mori	34	347	3301	0	1	20	1	5	22	0	8.362
Total	176	2186	11138	35	20	85	131	137	290	9	55.699

Chapter 6

District Disaster Management Plan

6.1 Introduction

The district administration in Uttarakashi district was working on preparation of a district disaster management plan as per disaster management act 2005, under the supervision and guidance of District Magistrate and support of the District Project Officer (Disaster Management). Various efforts were made to compile the relevant information and develop draft district disaster management plan for implementing actions to reduce the risks from envisaged disasters in the district. The present chapter takes an overview of the information and action plans worked out in the draft district disaster management plan by the concerned authorities. The district has constituted the District Disaster Management Authority (DDMA) under the chairmanship of District Collector and representatives from local elected public representative, police, health, PWD, and other departments. The DDMA has formed various disaster management committees for specified tasks and established a district level Emergency Operation Centre (EOC) for disaster risk reduction. All the contact information and inventory of resources are kept updated in the EOC where the work is coordinated through a district project coordinator for disaster management.

The district was opted for the seven desk system for disaster risk management and defined the standard operational procedures, functions and duties of relevant desks, groups and officials. It provides sufficient scope for implementation of requisite actions timely by the concerned personnel without resulting in delays due to confusions or conflict in operational part of any emergency operation group or official. The state also issued necessary guidelines for State Disaster Response Fund (SDRF) based on the guidelines for SDRF released by Ministry of Home Affairs on behalf of the Central Government.

Besides identifying the strengths in terms of governance and administration, the DDMP also gathered information about non-governmental organizations and community based

organizations active in the district and working in various sectors. The contact details and concerned personnels information along with areas of expertise/skills/resources were also worked out by the district administration.

However, there was lack of adequate number of trained and skilled manpower in the district as the geographical area is large and it takes along time to reach to affected sites / people if a community is not prepared against disaster risks. The Disaster Mitigation and Management Centre (DMMC), Dehradun attempted to train several people in search and rescue technique but more such training and capacity development initiatives are desirable to reduce the future risks. Thus, training and capacity enhancement in various sectors of disaster risk reduction need to be strengthened. The following text provides information related to DDMP and initiatives by DDMA.

6.2 Seven Desk System and District Emergency Operation Group

The seven desk system is highlighted in a tabular form along with name of the desk, nodal officer and assistant officers; followed by the functions of the respective desks.

Table 6.1: List of District Emergency Operation Desk Officers

S.no	Name of Desk	Nodal Officer	Assistant Officer
1.1.	Operation Desk	1. In-charge collatorate / disaster management 2. District Development Officer 3. CO, Uttarkashi	Commandant ITBP Matli 1. Commandant Garhwal Scout Harsil 2. Divisional Forest Officer (Land Conservation) 3. Divisional Forest Officer (Tehri Dam)
2.2-	Service Desk	1. SDM Bhatwari District supply Officer 2. Divisional Forest Officer	1. Commandant ITBP maidanda 2. Ex. Engineer PWD (P.D.) 3. Ex. Engineer Jal Sansthan 4. Ex. Engineer Jal Nigam 5. District Milk Production Officer 6. Fire Service Officer 7. District soldier welfare officer 8. Assist. Registrar Uttarkashi 9. Vice. Principal / Registrar NIM
3.3-	Infrastructure Desk	1. Supt. Engineer PWD 2. Supt. Engineer Irrigation	1. Commandant BRO 2. Ex. Engineer NH (PWD)

S.no	Name of Desk	Nodal Officer	Assistant Officer
		Maneri Bhali 3. Supt. Engineer Power corporation Maneri Bhali	3. Ex. Engineer Irrigation Division 4. Ex. Engineer Rural Engineering services 5. Ex. Engineer Power distribution Division 6. District youth coordinator, NYK 7. District social welfare Officer 8. Principal Govt. P. G. College Uttarkashi 9. General Manager District Industry center
4.4-	Health Desk	1. Chief Medical Officer 2. Dy. Chief Medical Officer 3. Chief Medical Superintendent	1. Surgeon (Doctor) 2. Orthopedic (Doctor) 3. Eye specialist (Doctor) 4. Lady Medical Officer 5. Child specialist (Doctor) 6. Physician (Doctor) 7. District Aayurvadic and Unani Medical Officer 8. Chief Veterinary Officer 9. District Malaria Officer
5.5-	Logistic Desk/ Agriculture Desk	1. DPO Disaster Risk Management Project 2. Divisional Forest Development Officer 3. A.M.A. District Panchayat	1. District Basic Education Officer 2. District Agriculture Officer 3. District Plant Protection Officer 4. District Horticulture Officer 5. Assist. Registrar Cooperative Societies 6. District Programme Officer 7. Regional Tourism officer 8. Project Director DRDA
6.6-	Communication and Information Desk	1. District Panchayat Raj Officer 2. District Information Officer	1. Assist. Engineer Telecommunication 2. Assist. District Information Officer

S.no	Name of Desk	Nodal Officer	Assistant Officer
		3. District Education Officer	3. Radio station Officer Police Department 4. Local Intelligence Unit 5. Office In-charge Control Room 6. Assist. Engineer Doordarsan 7. Assist. Engineer Radio station
7.7-	Resource Desk	1. District Economics & Statistics Officer 2. Lead Bank Manager SBI 3. Senior Treasury Officer	1. Chief Revenue Accountant and his Department
	Total	21	47

6.3 Functions and Arrangement of Desks

6.3.1 Functions of Operation Desk

- ☞ Rescue and evacuation
- ☞ Salvage operations
- ☞ Corpse disposal
- ☞ Emergency supplies of water and cooked food
- ☞ Immediate transfer of affected persons to transit camps
- ☞ Within shortest possible time, provisions for affected persons, water, medicines, first-aid, cooked food etc were supplied
- ☞ Immediate emergency transport for the seriously injured
- ☞ Transit Camps for a maximum of six days to be setup as the earliest
- ☞ Feeding centres for a fortnight to be setup at the earliest

6.3.1.1 Implement procurement / purchase/ hire / requisition plans of materials available at the district level

6.3.1.2 Establishing communication links

- ☞ EOC/DMMC
- ☞ Office of Divisional Commissioner
- ☞ Police, Railways, Fire Brigade, Defence Services, Civil Defence, CPWD, PWD, SEB, Irrigation, RTO, IMD, GSI and inter-departmental relief activities within the district
- ☞ Mutual AID and Response Group
- ☞ NGO's and NGO Coordinating Committee
- ☞ Private Donors

6.3.1.3 Reporting

- ☞ Despatch of First and Second Information Reports as per the information to EOC/DMMC and Divisional Commissioner
- ☞ Despatch of all information and any other asked for by EOC/DMMC and Divisional Commissioner
- ☞ Report to EOC/DMMC and Divisional Commissioner on deployment and reinforcement of staff and resources
- ☞ Identify specific items for follow-up actions on the directives of the DDM

6.3.1.4 Supervision and monitoring of disaster management and relief activities within the district

6.3.1.5 Market Intervention

- ☞ Promote and encourage revitalization of local economic activities for speedy recovery
- ☞ Prevent hoarding, price hiking and corruption and unauthorized sale of relief materials
- ☞ Initiate legal action on those engaged in hoarding, price hiking, corruption and unauthorized sale of relief materials

6.3.1.6 General

- ☞ Disseminate details about legal and official procedures, eligibility criteria with respect to relief and compensation for loss of life , injuries, livestock, crop, houses, required to be adopted, as provided by EOC/DMMC
- ☞ Maintenance of records (date of joining, period of service, leave record, overtime, etc.) for all persons deployed for relief work within the district
- ☞ Obtaining orders, instructions, clearances, clarifications from Divisional Headquarters
- ☞ Ensure implementations of orders, instructions from EOC/DMMC and Divisional Headquarters at the disaster sites.
- ☞ Requisition of accommodation, structures, vehicles and equipments for relief duty
- ☞ Issue of passes and identification stickers for vehicles on relief duty
- ☞ Issue of passes and identity cards to relief personnel including persons from NGO's
- ☞ Sanctioning expenses for reimbursement with the approval of DDM

6.3.2. Functions of Service Desk

6.3.2.1 Assets

- ☞ Search and rescue requirements as per information
- ☞ Relief requirements as per information
- ☞ Cash compensation requirements as per information

6.3.2.2 Organize and Coordinate

- ☞ Relief Camps to be setup at the earliest
- ☞ Establishment of cattle camps for arrangements for dry rations and family kits for
- ☞ Relief supplies to Transit and Relief Camps or to SOC
- ☞ Supplies of fodder and cattle-feed to cattle camps
- ☞ Supply of seeds, agriculture inputs and services to SOC
- ☞ Welfare services
- ☞ Law and order (e.g. prevention looting and theft)

6.3.2.3 Coordinate NGO activities through necessary support to ensure community participation

- ☞ Establishing coordination, through DMMC, among Wireless sets district level NGOs and other such as Indian Red Cross.
- ☞ Identification of NGOs to serve on committees, task force
- ☞ Assign well-defined area of operations and report to EOC
- ☞ Assigning specific response functions to specialized NGO's and report to EOC/ DMMC
- ☞ Reporting upon procurement and disbursement of relief materials received through government and non-government channels
- ☞ Mobilization and coordination of volunteers ensuring community participation
- ☞ Relief supplies to Transit and Relief Camps or to SOC
- ☞ Supplies of fodder and cattle-feed to cattle camps
- ☞ Supply of seeds, agriculture inputs and services to SOC
- ☞ Welfare Services
- ☞ Law and order (e.g. prevent looting and theft)

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- ☞ Assigning specific response functions to specialized NGO's and report to EOC/ DMMC
- ☞ Reporting of procurement and disbursement of relief materials received through government and non-government channels
- ☞ Mobilize and coordinate work of volunteers ensuring community participation

6.3.3. Functions of Infrastructure Desk

6.3.3.1 Organize and Coordinate Clearing of Debris

6.3.3.2 Temporary Repairs to Damaged Infrastructure

- ☞ Power
- ☞ Water
- ☞ Transport
- ☞ Telecommunication
- ☞ Roads
- ☞ Bridges
- ☞ Canals
- ☞ Public Buildings

6.3.3.3 Construction of Facilities

- ☞ Shelters with sanitation and recreation facilities
- ☞ Provision of hand-pumps and bore wells
- ☞ Temporary structures for storage
- ☞ Educational facilities
- ☞ Medical facilities
- ☞ Postal facilities
- ☞ Helipads

6.3.4 Functions of Health Desk

6.3.4.1 Organize and Maintain Records of

- ☞ Disposal of dead bodies
- ☞ Disposal of carcasses
- ☞ Treatment of the injured and sick
- ☞ Preventive medicine and anti-epidemic actions
- ☞ Reports on food, water supplies, sanitation and disposal of waste

6.3.4.2 Assess, supply and supervise

- ☞ Number of ambulances required and hospitals where they could be sent, (public and private);

- ☞ Medical equipment and medicines required
- ☞ Special information required regarding treatment as for epidemics etc.
- ☞ Medical relief for the injured

6.3.4.3 Supervision of maintenance of standards

- ☞ Identification of source for supply of drinking water through tankers and other means of transport
- ☞ Transit and relief camps for cooking arrangements, sanitation, water supply, disposal of waste, water stagnation and health services
- ☞ Communities for storage of rations, sanitation, water supply, disposal of waste, water stagnation and health services.

Standards in cattle camps with arrangements for water, fodder, disposal of solid waste, veterinary services.

6.3.5 Functions of Logistics Desk

6.3.5.1 General

- ☞ Assessment of reinforcement needs including manpower and deployment of resources as per need
- ☞ Requirement, availability and location of depots, and transportation of wood to the locations for mass cremation
- ☞ Identification of location where mass cremation/ burial would be carried out and manpower and transport that would be required.
- ☞ Identification of location where carcasses could be disposed of and manpower and transport that would be required;
- ☞ Requesting for additional resources from other districts/ divisional headquarters / EOC/DMMC
- ☞ Arrangements with petrol pumps for supply of fuel for authorized relief vehicles against credit coupons
- ☞ Coordinating and supervising issuing of Village relief tickets to affected families
- ☞ Ensuring safe storage, and transport of relief supplies
- ☞ Coordinate supplies distributed directly by NGO's and other organizations including private donors.
- ☞ Ensure proper maintenance of vehicles and equipment

6.3.5.2 Coordination of Transport with

- ☞ SRTC
- ☞ Private transporters
- ☞ State Government Helicopters

6.3.5.3 Organizing Transport for

- ☞ Rescue parties
- ☞ Relief personnel
- ☞ Affected persons
- ☞ Water, medicines, first aid and cooked food for affected persons
- ☞ Volunteers
- ☞ Relief Materials
- ☞ Seriously injured and sick

6.3.6 Functions of Agriculture Desk

6.3.6.1 Organise and coordinate

- ☞ Rehabilitation of agricultural production
 - ☞ Ensuring interim crop production through supply of seeds and other inputs
- Services of extension staff

6.3.7 Functions of Communication and Information Management Desk

Set-up an information centre in DCR to organise sharing of information with mass media and community

Monitor disaster warnings and weather conditions and coordination with and on the advise of EOC/DMMC,

6.3.7.1 General

- ☞ Send Out- Messages on behalf of DDM
- ☞ Maintaining In-Message, Out-Message Register
- ☞ Collect information from SOC
- ☞ Organise information for EOC and information on demand from Divisional Commissioner / EOC/DMMC
- ☞ Serve as data bank required for managing operational aspects of disaster situations

6.3.7.2 Keep readily available all the information contained in DDMAP, including

- ☞ Office and residence telephone numbers, fax numbers, and mobile numbers where applicable of Chief Secretary and other Secretaries including Divisional Commissioner
- ☞ Phone numbers, names, address and mobile numbers wherever applicable of the officers and staff of the district and EOC/DMMC

- ☞ List of people on the spot who can organise and co-ordinate the relief activities.
- ☞ Phone numbers; fax numbers, wireless, etc. of the other control rooms.
- ☞ Phone numbers, names and addresses of the field officers
- ☞ Phone numbers, names and addresses of non-officials (like MPs, MLAs) in the District
- ☞ Planning information required including maps incorporated in DDMAP
- ☞ Disaster site map and indications on extent to which other areas may be affected etc.

Information regarding alternative routes, water sources, layout of essential services which may be affected, etc.

6.3.8. Functions of Resources Desk

6.3.8.1 Maintenance of

- ☞ Books of account for all cash receipts according to source of funding
- ☞ Books of accounts for all cash disbursements according to source of funding
- ☞ Stock register for all relief materials
- ☞ Issue register for all relief materials
- ☞ Dead stock register for all non-consumables (inventory)
- ☞ Record of all personnel payment of TA&DA, daily wages and other incidentals made to relief personnel
- ☞ Record of all expenses incurred on administration and disaster management
- ☞ Record of all transfer of funds (as advances) to other government departments (suspense account)
- ☞ Record of all cash vouchers and credit vouchers
- ☞ Record of all gratuitous relief'
- ☞ Record of all compensation paid
- ☞ Preparation of records relating to finance and accounts as per formats for dispatch to EOC

6.3.8.2 Issuing of: All cash receipts

- ☞ All materials receipt

6.3.8.3 General

- ☞ All payments of approved expenses dues, claims, daily wages
- ☞ Reimbursement of expenses approved by administration
- ☞ Issue of cash vouchers and credit vouchers for petrol and diesel

6.4 Site Operation Centre (SOC) and Relief Camps

6.4.1 Planning Assumptions

- ☞ A small scale disaster can be managed through DM's office without comprehensive desk arrangements at the DCR
- ☞ A disaster affecting
 - I. a number of villages
 - II. doing considerable damage to housing
 - III. spread geographically over a large area and different locations
- a. creates problems of management and logistics
- b. decentralization of relief activities will improve the efficiency of DCR. This will require organization of desk arrangements at the camp sites
- c. Site Operation Centre and location of Relief Camps will ensure effective decentralization and organization of relief activities.

6.4.2 Site Operation Centre

Depending on the nature of disaster and the type of damage, it may be necessary to set-up a number of relief camps and/or cattle camp.

- ☞ In such a situation, the DDM will setup a SOC to reduce the pressure on DCR for field coordination
- ☞ Depending on the disaster locations and the number of camp sites, the DDM may decide to set-up more than one SOC.
- ☞ The SOC and the camps would be wound up after the relief and rehabilitation work is called off or after the relief camps and cattle camps are dismantled whichever is later
- ☞ The SOC will be managed by Site Manager of the rank of Sub- Divisional Officer/SDM

The DDM may assign some such relief camps or feeding centres to willing non-governmental organisations (NGOs) with demonstrated capacity and required manpower. However, such camps would also come under coordinating mechanisms established through SOC of DCR

Table 6.2 : Activities of site operation centre SOC (at a convenient location from the disaster site for coordinating site operations)

Activities	
A. Response Action for	
	Rescue and evacuation
	Salvage Operations
	Corpse disposal
	Transit camps
	Feeding Centres for two weeks to be set-up at the earliest
	Emergency supplies of water and cooked food
B. communication with	
	EOC/DMMC
	DCR
	District administration staff in the area
	Camp officer for transit camps, relief camps and cattle camps
	NGO's and NGO coordinating committee
C. Communicate to DCR	
	Search and rescue requirements
	Resource requirements
	Cash Compensation
	Receive, store, secure, transport, relief materials for transit, relief and cattle
	Camps, and affected villages
	All information and subsequent demands to district control room
D. Organise	
	Preventive medicine and anti-epidemic actions
	Inspection of food, water supplies, sanitation and disposal of waste

6.4.3 Relief Camps: As the name suggests, relief Camps, will be established at a convenient location from the site of disaster for providing immediate relief. Relief Camps would also function on desk system basis. A desk assignments at relief camps would be as given below:

Components of Relief Camps (to be set up at a convenient location from the disaster site for relief)

6.4.3.1 Functions of Operations Desk

A. Undertake Response Action for

-  Salvage Operations

- ☞ Feeding Centres (in accordance to the Checklist) for two weeks to be set-up at the earliest

B. Coordination with

- ☞ SOC
- ☞ DCR
- ☞ District administration staff in the area
- ☞ NGOs
- ☞ Private donors

C. Manage

- ☞ Dispatch of all information (as per formats) and subsequent demands to DCR/SOC
- ☞ Organize shifts for staff and Supervision of the same

D. General

- ☞ Maintenance of records (date of joining, period of service, leave record, overtime, etc.) for all the persons deployed for relief work at operation centerGet sanction for expenses for reimbursement from the DDM through SOC.

6.4.3.2 Functions of Services Desk

A. Assess

- ☞ Resource requirements

B. Organize

- ☞ Arrangements for dry rations and family kits for cooking within two weeks of the disaster
- ☞ Relief supplies to families or to households including water, clothing, and food

C. Provide Welfare Services

- ☞ Restoration of family (including locating missing children, relatives, friends)
- ☞ Assistance in locating missing cattle
- ☞ Assisting students to continue with their studies
- ☞ Services for the orphans
- ☞ Assisting individuals with the special needs (pregnant women, infants, handicapped, old, widows etc)
- ☞ Counseling services
- ☞ Promotive services for mental health

6.4.3.3. Function of Infrastructure Desk

A. Clear debris**B. Mobilise community participation and coordinate management of**

- ☞ shelters for affected people with sanitation facilities
- ☞ temporary structures for storage
- ☞ kitchens
- ☞ medical facilities
- ☞ education facility
- ☞ recreational facility
- ☞ postal facility
- ☞ temporary repairs to damaged infrastructure

6.4.3.4 Function of Health desk**A. Organize**

- ☞ disposal of dead bodies
- ☞ disposal of carcasses
- ☞ disposal of waste and waste water
- ☞ treatment of the injured and sick
- ☞ preventive medicine and anti-epidemic actions
- ☞ inspection of food, water supplies, sanitation and disposal of waste

6.4.3.5 Functions of Logistics desk

- ☞ Issue village relief tickets to affected families
- ☞ Organize distribution of relief supplies
- ☞ Receive, store, secure, relief supplies
- ☞ Coordinate supplies distributed directly by NGOs and other organisations including private donors
- ☞ Ensure proper maintenance of vehicles and equipments
- ☞ Ensure optimum utilisation of resources such as fuel, food, and other relief materials
- ☞ Mobilise and coordinate work of volunteers ensuring community participation
- ☞ Organize facilities for staff and volunteers

6.4.3.6 Functions of Communication and Information Management Desk

Collect and dispatch following information (as per the performa) to SOC

- ☞ Data collection
- ☞ Record keeping
- ☞ Assistance in locating missing persons
- ☞ Information Center

- ☞ Organisation of information for SOC and on specific demands
- ☞ Maintaining In-Message and Out- Message Register
- ☞ Sending all Out- Message on behalf of Camp Office of Relief Camp

6.4.3.7 Functions of Resources Desk

A. Maintenance of

- ☞ Books of accounts for all cash receipts
- ☞ Books of accounts for all cash disbursements
- ☞ Stock register for all relief materials
- ☞ Issue register for all relief materials
- ☞ Dead stock register for all non-consumables (inventory)
- ☞ Record of all personal payment for daily wages and other incidentals made or relief personnel
- ☞ Records of all expenses incurred on administration and disaster management at relief camp
- ☞ Records of all gratuitous relief
- ☞ Records of all compensation paid
- ☞ Preparation of records relating to finance and accounts as per the formats for dispatch or SOC

B. General

- ☞ All cash donations must be deposited with DCR and a receipt for the same obtained.
- ☞ All material donations must be entered in stock register and made available for inspection to officer from the DCO or SOC

Maintain record of all issue of cash vouchers and credit vouchers for petrol and diesel.

6.4.4 Facilities/ Amenities in the DCR

6.4.4.1 Planning Assumptions

The District Magistrate office in the district has an adjoining meeting room which will be used as a conference room. The DCR has been located near the District Magistrate Office and will have desk arrangements during disaster situations. A communication room will be established next to DCR. Efforts will be made to provide Telephones, with STD facilities, to each desk in DCR.

6.4.4.2 Communication Room (Main Message Room)

The Communication room will have the following:

Existing police wireless system will continue to be in contact with the DCR.

In addition, the following facilities will be available in the communication room

- ➔ Telephones/satellite phone
- ➔ Fax
- ➔ Intercom units for contact within the DM
- ➔ Civil Wireless Network upto Tahsildar level
- ➔ Manual typewriter
- ➔ Photocopying machine
- ➔ Major newspapers for news monitoring

6.4.4.3 During disaster, communication room will be connected to

- ⇒ Chief Secretary
- ⇒ Secretary, Disaster Management
- ⇒ Commissioner Disaster Management
- ⇒ Divisional Commissioner
- ⇒ EOC/DMMC at Secretariat
- ⇒ Superintendent of Police of the district
- ⇒ C M O
- ⇒ Operations Center
- ⇒ Relief Camps
- ⇒ Medical Centres
- ⇒ Fire Brigade
- ⇒ PWD
- ⇒ Irrigation Department
- ⇒ Local Army

Separate tables are provided for each communication instruments such as:

- ⇒ Telephones
- ⇒ Fax
- ⇒ Computer
- ⇒ Printer
- ⇒ Typewriter

6.4.5 Transport

Provision should be made for a jeep with wireless communication, if possible, will be assigned to DCR during normal times. Additional vehicles will be requisitioned as per the requirements during the emergency.

6.4.6 Staffing requirements for DCR

Three categories of staff viz. Regular Staff for Communication Room, Staff-on-call and

Staff on Disaster Duty will be available for DCR.

A. Regular Staff

The regular staff will be posted permanently in the DCR, which will be responsible for manning the Communication Room on a 24 -hour basis.

The regular staff recommended would include the following:

⇒ **Desk Officer-Communication Room**

One SDM from the collectorate will function as the Desk Officer- Communication Room. He will be incharge of the day -to- day operation of the Communication Room during official working hours. He will be assisted by officers of the rank of Naib Tahsildar from the Collectorate in rotation during non working hours.

⇒ **Communication Room Assistant**

The person holding this position will be of the rank of Kanoongo. He will always be physically present in the Communication Room. He will be responsible for processing all messages and information received and maintained by the Communication Room and communicating the same to the Desk Officer and DM.

⇒ **Stenographer**

He will provide all secretarial assistance to the Communication Room.

⇒ **Communication Operators (for 24 hours)**

The communication Operator will attend to wireless set.

⇒ **Driver cum Messenger/ Attendant (for 24 hours)**

Drivers will be attached to the DCR and kept on stand-by duty. Efforts will be made to train these drivers to operate the wireless fitted in the vehicle attached to the DCR.

B. Staff- on - call

Staff on-call is available for immediate duty in cases of a disaster.

Two SDMs will make up the staff- on-call. During a disaster, these officers will always be available "on-call".

The staff-on-call will be appointed in rotations from some identified departments.

C. Staff on Disaster Duty

Staff on Disaster Duty will be required to shoulder additional responsibility in the case of a disaster. This, additional staff will be in the nature of a reserve and will be drawn from various departments. During normalcy, the staff will not be called on to perform any duty in the DCR. This staff will be responsible for managing the desk arrangements mentioned earlier.

The departmental officers nominated as "Officer-in-Charge" from the concerned line departments and other agencies will be available in the DCR during the disaster period.

In a district, DM ADM, all SDM, Tahsildars will familiarize themselves with the functioning of DCR.

6.5 Multi District Disaster :

The role of Divisional Commissioner in disaster in question is much crucial which may be enumerated as under :

- i) He will direct every control room established in all affected district enmasse.
- ii) He will ensure availability of resources in all district.
- iii) He will seek cooperation of all Divisional Officers.
- iv) He will setup co-ordination of PAC, ITBP, Fire brigade, Post & Telegraph department & will also direct them to assist control room in their respective district.
- v) He will also keep in touch with disaster management.

During disaster, the Divisional Commissioner would enjoy & exercise all powers at par with the Commissioner Disaster Management.

6.6 Response Structure:-

6.6.1 Planning Assumptions:-

- (a) To prepare list for necessary information & also to collect them co-ordinating through different communication media and various institutions.
- (b) To exhibit activities pertaining to & depending upon disaster flow chart.

6.6.2 Response Plan on Warning :-

The prediction of disaster and consequently warning must be communicated through various media and the activities related to solution for disaster will be made known through flow chart.

6.6.3 Response Plan on Occurrence of disaster:-

The necessary information in relation to different types of disaster will be maintained separately. According to the actions taken in respect to different types of disaster will be displayed on flash chart separately so that the actions could be given practical shape within shortest possible time. Allocation of duties to different deptts is also being emplannd.

6.7 Involvement and Assistance Available to Departments from Private Sector:-

(i) Police : NCC, Scout Guide, Yuvak Mangal Dal, PRD, Mahila Mangal Dal, established by Nehru Yuva Kendra and workers of private institutions established in the district will assist the police during disaster.

(ii) P.W.D. : In clearance of blocked roads, temporary construction of roads for transportations and local people will be taken into account.

(iii) Agriculture Department :- Trained people by Bhuvaneshwari Mahila Ashram & HARC in agriculture will extend their cooperation during distress. Agriculture & Agro department would ensure the supply of seed & agricultural implements at that time.

(iv) R.T.O. :- Private vehicles can be attached to the deptt for maintaining transportation arrangement during disaster.

(v) Health Deptt :- During disaster, the medical facilities available in different Ashrams in the district, viz., Kailash, Shivananda, Pashupati, Maharshi Chikitsa Ashrams & Red Cross can be sought and it is hoped that they will co-operate in this matter.

(vi) Animal Husbandry :- N.G.O.s & public will extend their co-operation during disaster in sending cattle to safer places, disposal of animal corpses and availability of fodder.

(vii) District Information Centre :- About 80% villages are connected telephone network in the district. so the information can be had using even private phones during such emergency.

6.8 N.G.O. and Community Participation

The non-governmental organisations and voluntary agencies can play an important role in disaster management and can provide a strong of committed volunteers, experienced in managing the disasters. Their strength lies in the choice of their manpower, the informality in operations and flexibility in procedures. These organisations enjoy a fair degree of autonomy and hence can respond to changing needs quickly.

However, in order to maintain uniformity in operations and also a unified command, it is desirable that they follow common ground rules, particularly with respect to standards of services, information exchange and reporting so as to enable the DM to have a total picture of resource availability, disbursements and requirements. NGOs therefore would be assigned specific locations by the DCR to undertake relief work within the overall institutional framework.

The plan therefore expects that the NGOs would follow the guidelines, standards, formats, and checklists and be a part of overall institutional framework at district level in assisting the authorities. As and where possible, NGOs may also be able to improve the quality of delivery of welfare services in camps organised and manned by the administration.

Table 6.3: List of NGOs and Specific Assistance Capabilities

S.	Name of Agency	Available Resources
1.	Peedit Kalyan Evam Mahila Bal Utthan Samiti Lambgaoun Road Joshiyara , Uttarkashi	The Sanstha has its own dispensary. Adoctor, pharmacist and young attendants in different blocks of Uttarkashi
2.	Bharat Ratna Baba Saheb Ambedkar (Multipurpose) Bahuuddeshiya Samiti	Experienced personnel for building houses, protection walls, check dams, mitigation of forest fires and constructing alternative roads
3.	Snow Spider Treks	Expeienced man power in the field of search & rescue operations.
4.	Varun Gram Udyog Samiti,Barethi Uttarkashi	The Samiti has experienced personnel for constructing check dams, relief activities and medical attendants
5.	Kalp Vikas Sansthan	Experienced man power in the field of agriculture and medicine
6.	Janjati Mahila Kalyan Evam Balothan Samiti	The samiti has health workers and volunteers
7.	Uttaranchal Devi Apda Peedit Sahayata samiti, Keshav ashram, Keshavpuram, Maneri,Uttarkashi	Samiti has a team of experienced, expert volunteers.
8.	Maharshi sansthan Uttarkashi	The sanstha has a helipad, vehicles, dispensary and social workers
9.	Jai Maa Lok Vikas Paashu Sansthan	The Santhas have experienced personnel for building houses, managers, Accountants, Civil engineers, watershed trainers in different villages of Dunda block
10.	Himalayan Trekkers Sankri Samiti	Expeienced man power in the field of search & rescue operations
11.	Uma Himalayan Research Institute, Josiyara, Uttarkashi	The Institute has a team of experienced and expert volunteers in disaster management.

6.9 Encouraging Community Preparedness

6.9.1 Private Sector Units in the District

Private Sector can be encouraged by providing training. The knowledge of first aid can be given to some volunteers so that good co-ordination of public can be achieved. The knowledge and training of first aid will be given by Anganwari workers in the district.

List of private sectors in the district is as under:

- i. Anganwari workers
- ii. Adult Education workers
- iii. Private schools
- iv. Mahila Mangal Dal
- v. Yuvak Mangal Dal.
- vi. Ashrams
- vii. Red Cross
- viii. N.C.C
- ix. Different Unions e.g. Taxi Union, Bus Union, Truck union, Trade union
- x. Search and Rescue Teams

6.9.2 Areas of Community Participation

Every officer at the disaster site should ensure maximum community participation in all stages of operation in order to maintain community morale and confidence, maximize the use of local resources, reduce costs of operation and promote faster recovery. It is important to note that the so-called victims are not always helpless but offer tremendous manpower resources and ingenuity to overcome the crises. Disaster Management situations offers a wide range of choice and demands immediate decision-making. The participation of communities and their representatives would reduce the pressure on administration with regard to the choice and uncertainties of community response in decision-making process. The following guidelines may help in evolving such a strategy. Further, every attempt to enlist community support and participation will reassure the community about the administration's intent and seriousness about managing the disaster.

6.9.3 Community Participation can be ensured by

- ☞ Identifying situational, opinion and position leaders in the community and voicing administration's confidence in their capabilities to undertake the tasks.

- ☞ Consultations and dialogues expressly indicating the need for assistance would encourage the community and its leaders to come forward
- ☞ Regular feedback meetings and an open book approach to demonstrate transparency
- ☞ Involving community in decision making at local levels

6.10 During Evacuation

For appropriate security and law and order evacuation should be undertaken with assistance from the community leaders and Community Based Organisations (CBOs).

It is always preferable to encourage the entire area to evacuate together as a unit. However, to avoid stampede and confusion encourage community for emergency evacuation in case of inadequate transport or limited time in the following order:

- i. Seriously injured and sick
- ii. Children, women and handicapped
- iii. Old persons
- iv. Able-bodied

The amount of time you have to evacuate will depend on the magnitude of disaster. If the event can be monitored, like a flood, you could have a day or two to get ready. But many disasters offer no time for people to gather even the most basic necessities.

For emergency evacuations, the families should be encouraged to take along water, food, clothings and emergency supplies to last at least three days.

The families should be encouraged to assemble the following disaster supplies kit:

- ☞ Waters supply (3 liters per person per day). Store water in sealed, unbreakable containers
- ☞ Non-perishable packaged food
- ☞ Clothings, rain gear and sturdy shoes
- ☞ Blankets, bedsheets and towels
- ☞ Plastic buckets, plates, glasses, plastic mugs
- ☞ Soap, toothbrushes, toothpaste
- ☞ A battery- powered radio, torch, lantern, matches
- ☞ Cash and jewelery
- ☞ Personal medicines
- ☞ An extra set of car keys For car owner
- ☞ A list of important family documents including ration card, passport, bank passbook, address/telephone book (of relatives), certificates, driving licence, property documents, insurance documents etc.

- ☞ Special items including food, for infants, elderly or disabled family members

Encourage people to keep fuel in their cars as petrol pumps may be closed during emergencies. Ask people to shut off electricity, gas and water at main switches and valves before leaving. Ask people to listen to battery-powered radio and follow local instructions. If the danger is a chemical release, people should be instructed to evacuate immediately.

6.10.1 In other cases, advise people to follow these steps:

- ☞ Wear protective clothing and sturdy shoes
- ☞ Secure homes; Close and lock doors and windows
- ☞ Turn off the main water supply and electricity
- ☞ Leave early enough to avoid being trapped
- ☞ Follow recommended evacuation routes: not to take shortcuts; these may be blocked.
- ☞ Not to move or drive into flooded area.
- ☞ Stay away from downed power lines.
- ☞ Animals may not be allowed in public shelters, with respect to livestock, community should be instructed to set the livestock free before evacuating in order to avoid extensive loss of livestock. If possible, the community may be advised to carry the livestock along if the evacuation does not involve transportation by vehicles.

6.11 During the Disaster

6.11.1 Make community leaders responsible for the following behavior:

- ☞ Let the people remain calm and panic behavior is not encouraged. Regulate *helter - skelter* running or crowding of people
- ☞ Encourage people to stay at a secured place and protect themselves from injuries.
- ☞ Parking of vehicles in a safe area and not block the roads
- ☞ People should not enter damaged buildings or structures, even if these are their own houses (except in chemical disasters)
- ☞ People should not touch electric poles, utility wires/cables
- ☞ People should not use lifts
- ☞ People should not use telephones except in life-threatening situations
- ☞ Preparedness of community for recurrence of disaster, increase in severity, or consequential emergencies
- ☞ Check for injuries; do not attempt to move seriously injured persons unless they are in immediate danger of death or further injury.
- ☞ Undertake first-aid-activities as per guidelines given in preparedness and mitigation document of DDMAP

- ☞ Visually inspect utility lines and appliances for damage
- ☞ If water pipes are damaged shut off the water supply from the main valve
- ☞ People should stay away from damaged areas, unless their assistance is specifically requested by police, fire or relief organisations.
- ☞ Mobilise people to put out small fires and people inside are made to evacuate
- ☞ One of the basic instructions that may be given in a chemical emergency is to shelter-in-place. This is a precaution aimed to keep community safe while remaining inside their homes
- ☞ People should not throw away any damaged goods until an official inventory has been made
- ☞ If requested, assist police to maintain law and order and watch evacuated property during the disaster.

6.12 During Relief and Rehabilitation

Immediately after the disaster, the members of the community may look depressed and helpless, but when they find that after all everything is not lost they may become euphoric. Participation of community at this stage helps in early recovery and promotes mental health. It is necessary to see that member of the community are continuously engaged in some sort of helping activity so as to draw them out of their depression.

6.12.1 Relief authorities at the site should

- ☞ Promote cultural and recreational activities in order to protect the mental health and sustain the ethical and moral values
- ☞ Encourage self-help in every activity of their day-to-day living
- ☞ Encourage assistance for location and identification of dead, disposal of dead bodies, disposal of carcasses and disposal of damaged food stocks
- ☞ Encourage contribution of labour (loading, unloading, distribution, temporary constructions, salvaging and restoration of water supplies, feeding centres, relief camps, cattle camps etc.)
- ☞ Enlist assistance for updating records of damages and losses
- ☞ Enlist assistance in maintenance of law and order
- ☞ Enlist assistance in maintaining sanitation standards and disposal of waste

6.13 Encouraging Family Level Preparedness

6.13.1 Checking for Inhouse Hazards

Family members should check their houses, find out that in the event of a disaster which part of the house would be the safest and which would be susceptible to damage; on

that basis a plan should be made.

6.13.2 Emergency Planning and Checkout

In making emergency planning it should be ensured that in emergency situation the duties of each family member is assigned some duties. Likewise planning for the safety of valuables should be made. A list of materials/resources should be made which may be needed during emergency and should be kept at fixed place.

6.13.3 Evacuation preparedness

Family members should prepare themselves to evacuate the house if a warning is issued by the district administration. Responsibility of family members should be fixed to safeguard valuables and to carry them.

6.13.4 Shelters

In each house a shelter (if possible underground) should be made so that family could take shelter in emergency situation. In case a warning is declared by District Administration to evacuate houses, public shelters should be used. A list of material to be used in shelters should be prepared in advance and kept clearly

6.13.5. Helping after the disaster

After the disaster family members should prepare themselves to help each other.

6.14 Disaster Specific Family Preparedness Measures

6.14.1 Earthquakes –

- (a) Household goods should be kept properly (say fixed almiras with door) and that it should not hurt alive persons.
- (b) Identify safe places in the house. Generally such places are where two walls meet, below heavy furniture and in between door chauth shelter should first be taken at such places.
- (c) First aid should be given to injured persons and/or take them to hospitals
- (d) Construction of earthquake resistant houses should be promoted

6.14.2 Flash floods

- (a) In case of flash floods take shelter at higher places
- (b) Injured should be taken to hospitals
- (c) Cattle should be kept open
- (d) As soon as information of floods received/observed it should be conveyed to other villagers

(e) In flood situations shelter point should be away from electric poles, wires and trees

6.14.3 Landslides

- i. Whenever there is continuous / heavy rains keep a watch on slopes
- ii. Plan appropriate drainage around your house
- iii. Keep emergency kit ready to run out of the building when landslide starts or a debris flow hits the building
- iv. Keep a torch ready to find the way during late evening/night and early morning. Plan your safe evacuation route and safe shelter location in pre-disaster phase
- v. Do not try to cross an active landslide area; inform / alert all family members about it

6.15 Dissemination of DDMP

In order to make DDMP to be effective, it must disseminate at two levels:

- to the district authorities, government departments, NGOs and other agencies and institutions within the district, and
- to general public

The contents of the plan should be explained through well-designed and focussed awareness programs

The responsibility for dissemination of the plan should be vested with DCR, at the DM, and carried out by DMMC as well as through awareness programmes organised by each of the agencies participating in disaster management. The DCR should also involve NGO's in preparing suitable public awareness material to be distributed to the public.

The awareness programs should be prepared in the local language to ensure widespread dissemination. The media should be extensively involved in such programmes

- ☞ Newspapers
- ☞ TV
- ☞ Local cable networks
- ☞ Radio
- ☞ Folk media
- ☞ Publicity materials

Schools, colleges and other public institutions should be specifically targeted.

In addition to dissemination of literature related to DDMP, disaster response drills should be conducted on a regular basis especially in the disaster prone areas to maintain readiness of

communities and departments as regards operational procedures, personnel and equipment and orderly response. Examples include tests of outdoor warning systems and the Emergency Broadcast System.

Local agencies such as fire, police and ambulance staff should familiarise themselves with possible disasters in an area. It is also desirable to include mutual aid organisations and public emergency response organisations in drills.

The objectives of full-scale drill is to evaluate of the following:

- Practicality of the plan (structure and organisation)
- Adequacy of communication and interactions among agencies and the public
- Emergency equipment effectiveness
- Adequacy of first aid and rescue procedures
- Adequacy of emergency personnel response and training
- Public relations skills
- Evacuation and count procedures

6.15.1 Plan Evaluation

The purpose of evaluation of DDMAP is to determine

- Adequacy of resources
- Coordination between various agencies
- Community participation
- Partnership with NGOs

The case of understanding and using the plan will also be important considerations

The plan will be updated when shortcoming are observed in

- Organisational structures
- Technological changes render information obsolete;
- Response mechanism following reports on drills or exercises and
- Assignments of state agencies

Adaptation, improvisation and optimisation are corner stone of any planning pertaining to disasters. It must be emphasized that the Documents or manuals prepared as disaster management plan have a limited purpose. These can at best serve as reminder of tasks and activities.

Individuals and agencies assigned specific responsibilities within such plans will prepare appropriate supporting plans and related standard operating procedures, periodically review and update alerting procedures and resource listings, and maintain an acceptable level of preparedness.

The DDMAP should be evaluated by at the district and the state levels.

6.15.2 Post-Disaster Evaluation

A post-incident evaluation should to be done after the withdrawal of relief and rehabilitation activities in order to assess:

- Nature of state intervention and support
- Suitability of the organisation structure
- Institutional arrangements
- Adequacy of operating procedures
- Monitoring mechanisms
- Information tools
- Equipment
- Communication system, etc.

Impact studies on the above operations for long-term preventive and mitigation efforts should be undertaken

At the community level, evaluation exercises may be undertaken to assess the reactions of the community members at various stages in the disaster management cycle and to understand their perceptions about disaster response in terms of :

- ❖ Adequacy of training
- ❖ Alert and warning systems
- ❖ Control room functions
- ❖ Communication plans
- ❖ Security
- ❖ Containment
- ❖ Recovery procedures
- ❖ Monitoring

6.15.3 Plan Update

The DDMAP is a “living document” and the DM along with DMMC will update it every year taking into consideration:

- ❖ Resource requirements
- ❖ Updates on human resources
- ❖ Technology to be used
- ❖ Coordination issues

An annual conference for DDMAP update will be organised by the DM. All concerned departments and agencies would participate in that and give recommendations on specific issues.

The following guidelines should be adhered to while updating the DDMAP:

- A procedure should be in place to update the plan on a regular basis to ensure that the items requiring updating are considered and are currently in vogue.
- When an amendment is made to a plan, the amendment date should be noted on the updated page of the plan.
- Senior officials should be designated in all agencies to ensure that all plan-holders are notified of changes as soon as possible. Plan-holders should be requested to verify that they have received the changes.

The plan envisages a core organisational structure as per recommendation of High Power Committee of GOI, accepted by GoUA. Any change in this core organisational structure will require a legislative amendment.

Chapter 7

Mitigation and Preparedness Measures

7.1 Introduction

Geodynamically active and young immature topography of the Himalaya within an adverse geotectonic setting and seismicity, in combination with the unfavourable climatic conditions of intense rainfalls due to monsoons and sometimes due to fusion of westerlies with monsoons, makes the region prone to natural hazards like landslides, flash floods and earthquakes. More particularly, the region is frequently invaded by widespread, recurrent and often devastating landslides. Such landslides, released by torrential rains, seismic activity or anthropogenic interferences, sometimes cause ephemeral dams across river courses and result in the impoundment of immense volumes of water. Subsequent overtopping of, or breaking through, the dam result in flash floods. Although these phenomena are well known to local people, they are sudden and unpredictable and therefore, cause serious loss of life and critical damages to economy, environment, heritage, socio-cultural resources.

The chapter focuses on the mitigation and preparedness measures that may be considered for implementation to reduce the risks from landslides and flash floods including glacial lake outburst floods (GLOFs) and landslide dammed lake outburst floods (LLOFs).

7.2 Landslide Issues and Indicators

Growing pressure of rising population and rapid urbanization has increased non-systematic pressure of human activities for development over unstable slopes, under unfavourable climatic changes and adverse geodynamic processes. This has also led to large scale deforestations and faulty practices like unscientific mining, unplanned construction of roads, undesirable use of explosives, inefficient dams and inadequate river training works - while ignoring natural features

and processes. Landslides are the most frequent and widespread disasters that threaten our entire hill economy and infrastructure including human settlements, farms and fields, vast stretches of border roads and railway lines, aerial ropeways, open cast quarries and tunnels, hydro-electric projects, water supply and transmission line projects, heritage buildings, trekking / pilgrimage routes and holy tourist spots etc. The absence of large scale landslide hazard maps made people being caught unaware especially when the first time landslides strike.

Like in any other disaster, the most affected are the socio-economically weaker sections of the society who inhabit the susceptible areas. They have a meager source of livelihood, which when wiped out by a hazard, leaves them without food and shelter. Apart from this, the injury and the casualties add to the woes of the affected families. The biggest loss is that of the property to both, individuals and the government, as well as damage/destruction of heritage structures.

The frequent obstructions caused to the movement of traffic by numerous landslides during rainy season for days together, brings untold miseries to the people inhabiting the villages and townships in the landslide prone hilly terrains. The landslides also reduce the effective life of and output from hydroelectric and multipurpose projects by adding enormous amount of silt load to the reservoirs.

The following landslide indicators if observed and inspected by community, municipal officials and property owners, may assist in assessing potential landslide hazards. It is important to note that some of these features can also be due to causes other than landslides, such as swelling clays.

- Saturated ground or seeps in areas that are not typically wet
- New cracks and scarps or unusual bulges in the ground, roads or pavements
- Movement of ancillary structures such as decks and patios in relation to a house
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- Soil moving away from foundations
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences

- Offset fence lines or retaining walls
- Sunken or displaced road surfaces
- Rapid increase in creek water levels, possibly accompanied by increased turbidity
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Springs, seeps or saturated ground in areas that have not typically been wet
- Thorough cracks in walls, gaps between roof and wall etc.
- Damages to building elements

In most cases in the field, one may find the presence of combination of landslide risk indicators. It is important that local bodies provide a means of keeping records, preferably in written format, about the occurrence of landslides, with photographs and /or diagrams wherever possible. This will provide means to sustain landslide knowledge through time and it is important that such landslide information is made available, in some manner, to general public.

7.3 Mitigation Measures for Landslides

Landslide management had so far been confined to adhoc solutions of the site specific problems and implementation of immediate remedial measures including debris removal and dumping them either down slope or into the river.

In view of above, National Disaster Management Authority, Government of India released National Guidelines for Management of Landslides and Avalanches during June 2009. The guidelines proposed a nine point strategy for landslide hazard mitigation as follows:

- i. Research to develop predictive understanding of landslide processes
- ii. Hazard mapping to delineate landslide susceptible areas
- iii. Real-time monitoring of active landslides
- iv. Loss assessment to determine impacts on life and economy
- v. Information collection, interpretation, and dissemination to provide an effective system for information transfer
- vi. Guidelines for training of scientists, engineers and decision makers

- vii. Public awareness and education
- viii. Implementation of Loss Reduction Measures
- ix. Emergency preparedness, response and recovery to build resilient communities

Reducing risks posed by landslides through appropriate landuse, engineering and other interventions will help protect individuals and property from harm as well as reduce the repair and recovery costs that landslides pose for the government, public and individuals. The impacts attributable to landslides provide enough justification for an action to reduce both harmful impacts and costs due to landslides. An effective and coordinated effort should address these risks by providing leadership, knowledge and other assistance to landslide risk reduction programmes / projects at local and state levels. Such efforts could be part of the broader agenda to address risks posed by multiple types of hazards.

Broadly the mitigation measures for landslides risk reduction can be considered as below in the Table 7.1.

Table 7.1: A brief list of landslide mitigation measures

A. Modification of Slope Geometry

- Removing material from the area driving the landslide (with possible substitution by lightweight fill)
- Adding material to the area maintaining stability (counterweight berm or fill)
- Reducing general slope angle and height (Fig. 7.7)
- Debris basins (Fig. 7.8)

B. Drainage

- Surface drains (Fig. 7.1) to divert water from flowing onto the slide area (collecting ditches and pipes)
- Shallow or deep trench drains filled with free draining geomaterials (coarse granular fills and geosynthetics)
- Buttress counterforts of coarse grained materials (hydrological effect)
- Vertical (small diameter) boreholes with pumping or self draining
- Vertical (large diameter) wells with gravity draining
- Subhorizontal or sub-vertical boreholes

- Drainage tunnels, galleries or adits (Fig. 7.2)
- Vacuum dewatering
- Drainage by siphoning
- Electro-osmotic dewatering
- Vegetation planting (hydrological effect)

C. Retaining Structures

- Cut-stone Retaining walls with concrete bands (Fig. 7.3)
- Crib block walls· Gabion walls (Fig. 7.4)
- Passive piles, piers and caissons
- Cast in situ reinforced concrete walls
- Reinforced earth retaining structures with strip/sheet polymer/metallic reinforcement elements
- Buttress counterforts of coarse grained material (mechanical effect)
- Retention nets for rock slope faces
- Rock fall attenuation or stopping systems (rock trap ditches, benches, fences and walls)
- Protective rock/concrete block against erosion

D. Internal Slope Reinforcement

- Micropiles
- Soil nailing
- Anchors with tie beams (Fig. 7.5)
- Pre-tensioned Rock bolts (Fig. 7.6)
- Grouting
- Stone or lime/cement columns
- Heat treatment
- Freezing
- Electro-osmotic anchors
- Vegetation planting (root strength, mechanical effect)



Figure 7.1: Landslide mitigation through lined surface drains



Figure 7.2: Sub-surface drainage works for landslide mitigation



Figure 7.3: Landslide Mitigation using retaining wall made of cut-stones arranged in zig-zag manner bounded with concrete bands



Figure 7.4: Gabion wall made with wire crated boulders used for landslide mitigation



Figure 7.5: Anchors used with tie-beams for mitigating a landslide



Figure 7.6: Landslide mitigation using pre-tensioned rock bolts



Figure 7.7: Geometrical and Structural Mitigation Measures for Debris Flows



Figure 7.8: Debris basin for mitigating the impacts of landslides

Landslide mitigation typically involves decisions at local level. Informed decisions require adequate information concerning landslides mechanisms and mitigation alternatives, and this must be available to all sectors of the society. Five activities that may be applied to address landslide problems are suggested below:

- Adequate understanding of landslide triggering and landslide movement mechanisms are a fundamental requirement for other activities, and improvement of the science base is an essential first step to fill gaps in current understanding
- Technology integration and transfer is important for both dissemination of scientific understanding of the hazard and identification of appropriate mitigation methods
- Mapping provides fundamental database for identification and delineation of landslide hazards
- Risk assessment integrates many factors relating to slide occurrence and consequence. It can be applied at various levels, ranging from qualitative to quantitative
- Mitigation takes many forms, with landuse regulation being the most important. Other mitigation activities include stabilization through engineering activities and construction of diversion works

Landslide hazard management involves the measures taken to avoid or mitigate the risk posed by the landslide hazard. The most important role in this process is played by the local government machinery. Once this body receives the information about the probability of landslide occurrence within its jurisdiction, it initiates steps to warn the communities living in the area about the risk involved and tries to convince landowners and building occupiers to shift to safer places. Moreover, further development is avoided in such high risk zones. The mitigation strategies might not be possible in every landslide hazard prone area both due to their prohibitive costs and indifferent attitude of public. The efforts to reduce the risk are also made by road construction and maintenance agencies by implementing treatment measures.

Other simple mitigation measures to minimize the impact of the landslides, or even control its occurrence include

- ☞ Placing simple warning signs in landslide prone areas with some useful information for emergency management
- ☞ Posting and distributing materials on basic safety tips for landslide prone areas to general public

- ☞ Imposing stringent planning and design requirements in landslide prone and unstable areas – ideally, all future land development should be directed towards areas with low or very low risk of slope instability
- ☞ Engineering and geotechnical investigations that define the landslide hazard and risk at site-specific levels of investigation
- ☞ Mapping of landslide vulnerability that can help with the development of emergency response scenarios. This should further advance into a comprehensive Hazard Zonation Mapping

7.4 Preparedness Measures for Landslides Risk Reduction

Mechanism should be developed to identify institutions active in the field of landslides, assess their capabilities, enhance and strengthen their capacities in terms of expertise, knowledge and resources for effective management of landslide hazard. Main areas requiring capacity development in the context of landslide disaster management are as follows:

- Establishment of an organized vibrant pro-active, systematic and scientific institutional mechanism that would replace the current piecemeal, ad-hoc, less recognized and poorly appreciated landslide management practices
- Enhancement of expertise and capacities of knowledge centres in different parts of the country for dependable and timely geomorphological, geotechnical and hydro-geological investigations and for scientific design and speedy and effective implementation of control measures

Preparedness measure can be discussed for (i) Pre-disaster Preparedness, (ii) Response Preparedness (iii) Community Preparedness

7.4.1 Pre-disaster Preparedness

What to do before the Landslides

- ☞ Familiarize yourself with the land around you. Knowing the land can help you assess your risk
- ☞ Watch the patterns of storm water drainage on slopes near your home and especially the places where runoff water converges, increasing flow over soil covered slopes. Watch the hillsides around your home for any signs of land movement, such as small landslides or debris flows, or progressively tilting trees
- ☞ Those who are at risk of landslides should first develop an emergency evacuation plan. In simpler terms, if their home gets damaged, they should know where to go. Contact

local authorities to learn about the emergency response and evacuation plans for your area and develop your own emergency plans for your family and business

- ☞ The evacuation plan should include and inform all members of the family – also keep ready the phone number and address of an out of location relative or friend for emergency communication. Plan at least two evacuation routes since roads may become blocked or closed
- ☞ Keep ready emergency supplies like Food, Water, First aid kit, Flashlights and batteries, Battery-operated radios, Special medications/eye care products
- ☞ Prepare an evacuation kit that includes small cash, important documents like Birth certificates, insurance policies, marriage certificates and mortgage documents. Also throw in some games, toys for children
- ☞ Try and stay out of harms way. Build plant ground cover on slopes and build retaining walls. In mudflow areas, build channels or deflection wall to direct the flow around buildings (Remember: If you build walls to divert debris flow and the flow lands on a neighbour's property, you may be liable for damages).
- ☞ Do not build at bottoms or mouths of steep ravines, steep slopes and drainage facilities
- ☞ The local insurance companies may cover landslide risks under natural calamities

Learn to recognize the landslide warning signs

It is crucial to recognize the early signs of landslides to protect your family and property from the potential hazard. Let's list them out:

- Doors or windows stick or jam for the first time.
- New cracks appear in plaster, tile, brick, or foundations.
- Outside walls, walks, or stairs begin pulling away from the building
- Slowly developing, widening cracks appear on the ground or on paved areas such as streets or driveways.
- Underground utility lines break.
- Bulging ground / wall appears at the base of a slope.
- New holes or bare spots on hillsides
- Water breaks through the ground surface in new locations.

- New springs appear or sudden disappearance of existing springs
- Muddy water in creeks, rivers
- Fences, retaining walls, utility poles, or trees tilt or move.
- You hear a faint rumbling sound that increases in volume as the landslide nears. The ground slopes downward in one specific direction and may begin shifting in that direction under your feet.

What to do during the Landslides

- ☞ If outside, quickly move out of the path of the landslide or debris flow to stable / safer area would reduce your risk
- ☞ Run to the nearest high ground in a direction away from the path of the landslide and reach a stable area.
- ☞ If escape is not possible, curl into a tight ball and protect your head. A tight ball position provides the best protection for body.
- ☞ If inside a house or building, take cover under a sturdy table or desk when landslide is moving
- ☞ If rocks or debris are approaching you, run to the nearest shelter such as group of trees or big and heavy rock mass that are unlikely to move with the slide
- ☞ Be careful of sinkholes – they occur when ground water dissolves a vulnerable land surface such as limestone, causing it to collapse due to lack of support

The immediate danger is over but it's not all safe just as yet. Like earthquakes, landslides may also have aftershocks – so its better to leave the rescue operation on trained people and take yourself and your family and friends to a safe location.

What to do after the Landslide

- ☞ Stay away from the slide area – there may be danger of additional slides
- ☞ Remember that one slide can follow another or the slide area can be further enlarged with subsequent movement of debris.

- ☞ Define the limits of the area as landslide affected area. It is better if a signboard is placed to warn others not to trespass or disturb the affected area
- ☞ Do not enter the area without permission from authorities
- ☞ Do not enter the damaged buildings until the authorities declare them as safe
- ☞ Go to established meeting point and follow instructions of assigned responsible person
- ☞ Check for injured and trapped persons near the slide, without entering the slide area directly. Direct rescuers to their locations.
- ☞ If you are engaged in the removal of debris or the digging up of bodies buried in the mass, do so in an organized way. Consult members of the affected community before using any heavy machinery or equipment. Lives can be saved if services of experienced rescuers is obtained
- ☞ Try to remove water from the debris deposit. Divert all water paths away from the affected slope area and debris.
- ☞ Do not allow children to go through the loose and new deposits of debris. The surface may appear to be dry but the wet conditions may be prevailing within the mass.
- ☞ Help those who may require special assistance, e.g. infant, elderly people and people with disabilities. People who care for them or who have large families may need additional assistance in emergency situations.
- ☞ If you are trained, give first aid to victims
- ☞ Use local radio or television to get the latest emergency updates
- ☞ Keep a watch for flooding – which may occur after a landslide or debris flow. Floods sometimes follow landslides and debris flows because they may both be started by the same event
- ☞ Look for and report broken utility lines to appropriate authorities. By doing this, you might be saving lives because these broken lines will immediately be turned off, preventing further hazard and injury
- ☞ If a landslide occurs near your home, check the foundation, chimney and walls of your home for cracks / damages. Search for any new cracks in the surrounding area; also lookout for any symptoms of landslide movement; be vigilant during the monsoon period, especially during and after intense rainfall.

- ☞ Replant damaged ground as soon as possible. This is important, since erosion caused by loss of ground cover leads to flash flooding.
- ☞ Seek the advice of landslide expert for evaluating hazards or designing corrective techniques to reduce landslide risks.,without creating further hazard
- ☞ Consult a specialized agency before carrying out future development work in and around affected area; advise community members accordingly.
- ☞ Make representations to your local authority to divert roads, pipelines and telecommunication lines from the affected area. Help them to find suitable safe areas to relocate them

7.4.2 Response Preparedness to Reduce Landslides Risks

Responses to early warnings involve activating coping mechanisms (mainly for orderly movement of people away from risk locales, seeking shelter and safely securing assets) before a disaster strikes. In contrast, post-disaster response implies the wider range of relief, restoration, rehabilitation, reconstruction and recovery efforts in the aftermath of disasters. However, both are part of disaster preparedness and employ common emergency procedures. Warnings of hazard events must be issued with clear instructions about the most appropriate actions to be taken to avoid losses as far as possible. The success of early warning depends on the extent to which it triggers effective response measures and warning systems will include preparedness strategies and plans to ensure effective response to warning messages. Warnings trigger a variety of responses from different agencies at various levels, which must be coordinated. A number of governmental agencies, including various Ministries, institutions national disaster management institutions, municipal and local administration authorities are responsible for coordinating disaster preparedness. People are more likely to listen and act upon warnings when they have been educated about their risks and warning-reaction plans are in place.

Geological Survey of India offers colour coded Landslide alerts to authorities. The colour yellow means small landslides – incidents that do not have major impacts. The colour orange is larger in dimension that could affect infrastructural and civil installations – some of them may occur on the fringes of inhabited areas. The largest ones are the landslides in colour coded Red. These are the devastating and / or catastrophic ones – resulting in heavy losses.

A prompt, well-coordinated and effective response not only minimizes loss of life and property but also facilitates early recovery. The essential ingredients of an effective response system are:

- ☞ Integrated institutional arrangements
- ☞ State of the art forecasting and early warning systems
- ☞ Failsafe communication system
- ☞ Rapid evacuation of threatened communities
- ☞ Quick deployment of specialized response forces and
- ☞ Co-ordination and synergy among various agencies at multiple levels in dealing with any disaster.

Last but not the least, all agencies and their functionaries must have a clear understanding of their specific roles and responsibilities during a disaster. In case of a disaster situation like a massive landslide, the first response comes from the community. Their awareness and sensitization is crucial for an effective disaster management.

The need of the hour is to develop a comprehensive awareness campaign of following safe practices before, during and after a landslide. This campaign has to have a no-holds-barred presence across all people, especially in high risk areas.

Depending on the magnitude of the landslide and scale of required response, the corresponding role players should be identified and mobilised at the district, state or national levels. The preliminary assessment of severity of the landslides is based on their magnitude and the amount of loss these inflict on the infrastructural elements and habitations. Agencies like BRO/ State PWDs, State Directorates of Mining and Geology, Forest Department, Municipal/ Panchayat body would immediately communicate information of the occurrence of a landslide along with preliminary details like its location, magnitude and damage caused etc. to the District Emergency Operation Centre or District Disaster Management Authority. This will help to undertake field observation for making an accurate assessment and follow-up actions.

The Disaster Management (DM) plans prepared by all concerned agencies, should incorporate detailed guidelines for activities related to the impact of landslide. The response component of the DM plans should consider the rapid deployment of designated people, supplies and logistics to the site of disaster with function of each functionary clearly defined. The individual teams may be required to vacate the site as soon as their job is over because considering the nature of hazard during the rainy season it is possible that they may be required at another site within short duration. These plans should prescribe appropriate coordination mechanisms among all the agencies working in the affected areas.

7.4.3 Community Preparedness for Landslide Risk Reduction

Handbooks, posters and handbills containing status of landslide hazard should be distributed and details of landslide indicators along with precautions to be adopted and suggestive measures should be displayed near the landslide prone sites. These documents should be translated into local and regional languages. Short video films on the landslide risk, vulnerability and importance of preparedness and mitigation measures should be prepared for the general public. The electronic and print media should also be made integral part of the campaigns.

Communities need to be alerted and made aware of:

- What are the major disaster threat perceptions in the localities of immediate concern to them, and what are the projected likely disaster scenarios (landslide included)
- What are the possible landslide hazard distribution scenarios and major known landslide spots and identified elements at risk in the area?
- What lessons should be learnt from the past landslide disasters and also from their (mis)management?
- What are the precursors and early indicators that can avert landslide disaster?
- What are the elements like roads, housing, schools etc. exposed to landslide risk?
- What is the role and responsibility of the government and local bodies before, during and after a disaster?
- What are the expected roles and responsibilities of communities and people at large before, during and after a disaster? How much responsibility does the residents and communities are willing to assume in choosing to live or do business in high risk areas?
- What is the role of public sector, NGOs and other voluntary organizations?
- Is the construction materials, design and construction conform to prevalent building codes and establish engineering practices?

7.5 Flash Floods Issues and Indicators

The sudden increase of volume of stream / river water, causing rapid inundation of low lying areas is termed as flash flood. It carries large quantities of water and sediments and produces flood waves of unusual magnitude. Such floods are often triggered by extreme cloudbursts; glacial lake outbursts; or the failure of man-made dams or dams caused by landslides,

debris, ice, or snow. Because of their rapid occurrence, little warning can be given about their imminence and people are caught off-guard.

The intensity of flash floods is increasing due to climate change, urbanization and land use modifications. Further, the processes that lead to flash floods are difficult to predict. In addition, the processes are often combined, increasing the complexity of the problem of prediction. It is argued that flash floods cannot be predicted, but that their impacts need to be reduced through efficient early warning systems.

Impacts of Flash Floods

The frequent occurrence of flash floods within the Himalayan region poses a severe threat to lives, livelihoods, and infrastructure both within the mountains and downstream. The hardest hit are the socially most vulnerable – the poor, women, and children – who often can only find places to live in floodplains or other hazard susceptible areas. Lack of adequate communication and transportation means often lead to difficulties of access and delayed response.

The major impacts of flash floods are:

- i. Damages to / destruction of buildings, poles, transmission/power lines, roads, and other expensive infrastructure, including sewer lines, bridges, water pipelines and water tanks
- ii. Loss of lives, injuries, disabilities and diseases
- iii. Damages to livestock, crops and plantations and personal belongings
- iv. Degradation of environment – causes soil erosion, silting, water pollution and denudation of land
- v. Economical and social consequences like loss of livelihood, production, migration, psychological effects

Despite their frequency, and likely rise in incidences within the Himalayan region, there is little recognition of the higher risk that flash floods pose to human life and livelihoods in comparison with the more regular riverine floods that build up over days when there is heavy rainfall upstream. The tendency for flash floods to carry with them much higher debris flows with consequent higher damage to hydropower stations, power lines, roads, bridges, buildings, and other expensive infrastructure is also not widely appreciated. Little attention has been paid to disaster preparedness and response at the policy or operational level.

The frequency of flash floods in particular appears to be increasing. Climate change is causing glacial lakes to grow and burst more rapidly. Many of these flash floods, and others caused by extreme cloudbursts, are transboundary in nature – starting in one place and ending in another. Even the period of occurrence of heavy rains as well as the places of heavy precipitation seem to be dynamically changing in pattern, duration and intensity due to climate change and landuse modifications.

Glacial retreat and increases in the size of glacial lakes have accelerated during the 20th century, and thereby increased the risk of GLOFs. Landslides and debris flows, released by torrential rain or seismic activity, often cause ephemeral dams across river courses which result in the impoundment of immense volumes of water. Subsequent overtopping of, or breaking through, the earth dam will result in landslide and debris outburst floods, events similar to GLOFs. Although these phenomena are well known to local people, these are sudden and unpredictable and may cause serious loss of life and damage to property. Most often, the people begin to occupy the flood plain and bank areas of these rivers when such events do not happen for long periods but face heavy loss of lives due to sudden encounter with flashfloods and landslides in a dynamically variable atmospheric and landuse condition.

7.6 Mitigation Measures for Flash Floods

Flash floods cannot be prevented, but their impacts and damages can be altered. Hence, managing flash floods through proper means is imperative.

Flash flood management at institutional / stakeholders level:

- a) Building up legislations, policies, strategies, and plans to tackle disaster situations
- b) Ascertaining the roles of lead agencies (mentioned above)
- c) Community awareness and preparedness
- d) Capacity Development
- e) Assessing vulnerability and taking steps for hazard control
- f) Forecasting and warning systems

Flash flood management by technical measures

Apart from institutional level management, mitigation measures are to be adopted by stakeholders and communities to reduce the impact of flash floods as preventing it is not possible but mitigation and preparedness can dissolve its impacts.

Guiding principles for taking up these measures are:

- i. Diversion of water and sediment to locations where they will cause less harm
- ii. Distribution of water over larger areas to break the high energy impact
- iii. Ensuring enough space on both sides of torrent as force is too strong to be managed
- iv. Knowing the formal natural hydraulics of the rivers
- v. Constructing houses with strong foundations and entrances sufficiently high above the ground and away from rivers.
- vi. Designing of safe places where people can take shelter during emergency.

Therefore, following structural and non-structural measures can be taken to manage flash floods accounting for geology, vulnerability and associated risks.

The main strategies have been adopted over the years: modification of floods, modification of susceptibility to floods, modification of the loss burden, and bearing the loss. For flash-flood mitigation, the non-structural methods of floodplain zoning and management, flood proofing, flood forecasting and warning, disaster preparedness and response planning, flood fighting, flood relief and rehabilitation, use of indigenous knowledge and community awareness and flood insurance are being used.

7.6.1 Bioengineering Mitigation Measures for Flash Floods

Bioengineering mitigation measures are closely related to the physical structural approach, and are often used in combination with and complementary to structural measures as they are cost effective and does less harm to the environment. Vegetation acts as anchors, provides reinforcement, intercepts raindrops, decreases runoff speed, binds soil particles properly and dense roots lead to good drainage.

- i. Locally species of vegetation are usually adopted due to their easy adaptability.
- ii. Species like grass (*Thysanolaena maxima*), Napier grass (*Pennisetum purpureum*), vetiver grass (*Vetiver zinzaniodes*), durva grass (*Cynodon dactylon*), turf grass (e.g., *Festuca arundinacea*, *Poa (pratensis)*), kans grass (*Saccharum spontaneum*), different types of bamboo, giant cane (*Arundo donax*), Malabar nut (*Adhatoda vasica*), male fern (*Dryopteris filixmas*), artemesia (*Artemisia spp.*), weeping willow (*Salix babylonica*), mulberry (*Morus alba*), ghogar tree (*Garuga pinnata*), tiger's milk spruce (*Sapium*

insigne) and eastern cottonwood (*Populus deltoides*) may be grown for effective mitigation.

- iii. **Mulching:** Non living materials like straw, grass fiber, wood fibers, seaweed, hay, gravel and paper products can be spread over soil surface to provide protection from surface erosion by rain and retention of soil moisture.
- iv. **Bamboo fencing:** Bamboo fencing can be used to prevent soil creep or surface erosion on a slope to hinder gully extension, particularly in seasonal water channels, and to control flood waves along a river bank. Live bamboo pegs about 1.5 m long and 10-15 cm in diameter can be used for the main posts so that the whole structure becomes rooted.
- v. **Brush layering.:** In brush layering, live cut branches are interspersed between layers of soil to stabilize a slope against shallow sliding or erosion. Fresh green cuttings are layered in lines across the slope. As the roots grow, they anchor and reinforce the upper soil layers.
- vi. **Fiberschine:** Fiberschine is a roll of material made from coconut fibre used to form a toe protection structure on a slope and to trap any sediment derived from erosion and can also be used to stabilise other measures like Brush Layering.
- vii. **Jute netting:** Jute netting is a useful way of stabilizing steep slopes of 35°–80° where it is difficult to establish vegetation.
- viii. **Live crib wall:** A crib wall is a box structure made of interlocking struts (either logs or precast structures made of concrete, recycled polymers, or other material) 1-6 cm in diameter and 1-2 m long and back-filled with boulders, soil, or similar. They are mainly used to stabilize steep banks and protect them against undercutting.
- ix. **Fascines:** A fascine is a bundle of sticks or brushwood used in construction, generally to strengthen an earthen structure, fill ditches, or make a path across uneven or wet terrain. They are most effective on soft cut slopes or slopes with consolidated debris.
- x. **Palisades:** A palisade is a fence or wall made from wooden stakes or tree trunks. Palisades were used historically as a defensive structure. They are used to prevent the extension of deep, narrow gullies and the erosion of V-shaped rills by forming a strong barrier which stabilizes the gully floor and traps material moving downwards. They are also effective on steep landslide or debris slopes.

- xi. **Wattle fence:** A wattle fence is made by weaving flexible branches or vines between posts, rather like a large basket. The main purpose of wattle fences is to catch debris moving down a slope and to reinforce and modify the slope.

7.6.2 Physical Mitigation Measures

The following physical mitigation measures can be adopted:

- a) **Terracing:** Terracing is the technique of converting a slope into a series of horizontal step-like structures, spacing depending on the steepness of the slope.
- b) **Diversions:** Diversions are ridges of soil or channels with a supporting ridge on the lower side. They are built across the slope to intercept runoff and dispose of it at a selected location. They are used to break up long slopes, to direct water away from active erosion sites, to direct water around agricultural fields or other sites, and to channel surface runoff to suitable outlet locations.
- c) **Drainage:** The simplest way to safely drain off springs and surface water is to use an open ditch (drain) or a system of open ditches. The main ditch is located in the direction of the slope gradient (downhill); secondary or lateral ditches are located in a fishbone pattern. Pipe drains, culverts, channel drains shall be used designed according to the runoff discharge.
- d) **Grassed waterways:** Grassed waterways are natural or artificially constructed water courses shaped or graded to the required dimensions and planted with suitable vegetation.
- e) **Conservation Ponds:** Conservation ponds, also known as farm ponds, are small reservoirs constructed for the purpose of collecting and storing water from surface runoff. Storing water runoff during excessive rainfall helps to reduce the peak flow and surface erosion reducing the probability of floods. Conservation ponds can be broadly classified into
 - i. **Embankment type ponds** – An earthen dam constructed between two hillsides.
 - ii. **Dugout type ponds** – Simple earthen ponds or curved trenches in the shape of eyebrows
- f) **Retaining walls:** Retaining walls are engineered structures that hold back soil, rock, or water from a building, structure, or area. They prevent down slope movement and soil erosion, and provide support for vertical or near-vertical changes in gradient. The

walls are generally made from timber, masonry, stone, brick, concrete, vinyl, steel, or a combination of these.

Based on designing and mechanics, these are mainly of following types:

- i. Gravity type retaining wall
 - ii. Semi gravity retaining wall
 - iii. Cantilever Retaining Wall
 - iv. Counterfort retaining wall
 - v. Buttressed retaining wall
- g) Check dams: Check dams are small low drop structures built across a gully or channel to prevent it from deepening further by decreasing the gradient of slope. Gully plugging using check dams, accompanied by planting between the dams to stabilize the channel, can be one of the most effective ways to conserve soil and water and rehabilitate land degraded by gullies. These can be constructed by brushwood, loose stone, boulder, gabion, masonry etc.
- h) Sabo dams: They are similar to check dams but their purpose is to limit debris flow rather than runoff velocity.
- i) Gully control measures: Gully control measures include check dams, Diversion of surface water above gully head and following bioengineering methods.

River Training Methods

River training' refers to the structural mitigation measures, taken to improve a river and its banks. For flash flood mitigation, the main aim is to control the water discharge regime in the watercourse by limiting its dynamic energy to reduce sediment transportation and bed and bank erosion. These are classified into two main categories as given below.

Transversal Protection Structures

Transversal protection structures are installed perpendicular to the water course. They are used to lower the river gradient in order to reduce the water velocity and protect the river bed and banks from erosion.

- a) Check dams: Check dams are constructed along river courses and require additional protection structures in the bed or on the banks to prevent undermining.

- b) Spur: A spur (Fig. 7.9), spur dyke, or groyne is a structure made to project flow from a river bank into a stream or river with the aim of deflecting the flow away from the side of the river on which the groyne is built. Two to five structures are typically placed in series along straight or convex bank lines where the flow lines are roughly parallel to the bank.
- c) Sills: A sill (also called a bed sill or ground sill) is a transverse gradient control structure built across the bed of a river or stream to reduce bed or headward erosion, installed along river stretches with a medium to low morphological gradient. It can be constructed of concrete, rock, gabion, stone or wood.
- d) Screen dams and Beam dams: They are sediment retention structures installed in alluvial fans, along stretches with a steep slope, in wooded areas, in areas with frequent mass movements, and along narrow channel beds at the end of a valley just before the stream or river enters an alluvial fan or plains area. They must be constructed with strong materials such as concrete or cement to withstand the impact of heavy debris with supporting structures and retention portion can be built with other materials. Proper maintenance of dams is required concerning removal of trapped debris.
- e) Porcupines: Porcupines are a form of permeable structure designed to reduce flow and trap sediment. They have pole-like projections in all directions, resembling a porcupine with its quills sticking into the air. They can be made of (i) Wood or bamboo, (ii) Reinforced or prestressed cement in tetrahedral and prismatic shape

Longitudinal protection structures

Longitudinal protection structures are installed on river banks parallel to the river course, generally with the aim of protecting adjoining areas from inundation, erosion, and river meandering.

- a) Levee or Earth Fill embankments: Levees, or marginal embankments, are dam-like earthen structures constructed along a river in order to protect the surrounding countryside from flooding and/or to confine the course of a river to provide higher and faster water flow. Levees are usually constructed by piling earth on a cleared level surface
- b) Guide banks: Guide banks are structures built to guide a stream or river through a bridge opening or towards other hydraulic structures such as weirs, especially when river flow level is markedly higher than usual

- c) **Revetments:** Revetment refers to a continuous artificial surface on a river bank or embankment slope and of the river bed which is designed to absorb the energy of the incoming water and protect against erosion by the river current placed along concave side of river.

They can be constructed from various materials including rock, stones, stone-filled gabions, concrete slabs, timber piles, bamboo piles, old tyres, and sandbags.

Other measures are:

- i. **Sandbags:** Sandbags can be used to reinforce structures and to build (emergency) dikes. Sandbags can also be stacked (Fig. 7.10) to make a barrier against rising flood water as well as in areas where flash floods are likely. The sandbag wall or barrier should be constructed on a firm flat surface to prevent seepage
- ii. **Channel lining:** Channel lining is a protective layer used to protect the banks and bed of a watercourse against erosion. It can help increase the velocity of flow to ensure easy transport of sediment and reduce deposition in the channel bed. Channel lining structures can be made from materials like concrete, gabions, and wood, earth, rocks, asphalt, and plastic.
- iii. **Bamboo piles:** Bamboo can be used in the form of piles to strengthen a foundation or stabilize a flood embankment or river bed. The rows of bamboo piles should be firmly fixed with a rope or iron wire.

Bioengineering methods in combination with river training methods (physical construction like banks and spurs) are best for reducing damage during flash floods as river training methods adopted alone can have negative effect on environment.



Figure 7.9: Transverse spurs along river sides to reduce toe erosion



Figure 7.10: Sand-bags used for mitigating the erosion by river water

7.6.3 Non Structural Mitigation Measures

Non-structural measures involve land use planning, keeping in view the environment and susceptibility to flash floods assessed through history of precipitation and formation of other reasons. It also involves the participation of community in controlling factors contributing to flash floods like deforestation, failure in managing drainage, degraded soil conditions and proper awareness of causes/impacts. The duties of institutions in setting up risk assessment, emergency dealing systems, post catastrophe recovery and insurance against damage. Non structural measures are more sustainable, have less bad impacts on environment, involves community and are cost effective.

Following are the measures to be taken beforehand to reduce the risk associated with flash floods:

Watershed Management

The flash floods are associated with the outbreak of excess water without any warning due to various associated reasons. Therefore, managing the area of land where all of the water that is under it or drains off of it goes into the same place defining a watershed is very important. Measures to reduce the risk of flash floods are:

Agricultural Measures

- Growing plants on a larger surface area to reduce the soil erosion and water runoff would be better, especially during rainy season
- Following contouring and terracing methods ensures less runoff
- Multiple cropping helps in reducing the harm to the crops
- Grazing should be done in rotation with minimum number of livestock to avoid complete clearance of vegetation
- Slash and burn activities should not be followed

Floodplain Measures

After carrying out detailed hazard mapping of floods showing vulnerability the flood plain can be divided into:

- Critical zone: It is the waterway/river channel that gets flooded every year and where any human interference should be prohibited to give river its right of way.

- **Restrictive Zone:** It gets flooded every three to five years, and construction should be restricted. Only agriculture shall be permitted and every 3-5 years one crop gets lost due to flood and harvests takes place in flood-free years.
- **Regulatory Zone:** Adequate protection measures shall be provided such as embankments, flood proofing etc.
- **Warning Zone:** It experiences flooding rarely, averaging once every 25 years and construction in the area should have tolerance against flash floods. Flood warning plays an important role here.

Building permits in flood plains within 200 meters of river/stream should not be given and vegetation should be promoted. No unplanned settlements near rivers/streams should take place. There should clear escape routes and refuge areas at higher ground. Integration of land use planning and water management should take place.

7.7 Preparedness Measures for Reducing Risk from Flash Floods

The flash floods represent challenges to disaster management. Strong cooperation, trust, and confidence are needed for successful implementation of mitigation works.

The preparedness measures involve preparation of an inventory of flash flood events and an assessment of how to address the problem: community awareness and preparedness, hazard control, forecasting and warning systems, the institutional framework, policies, strategies, and plans. Its strategy is based on reducing people's physical, economic, and social vulnerability and facilitating information exchange, capacity, and cooperation in the region. The technical mitigation measures may be complemented with community-based disaster management strategies that are built on local knowledge, skills and resources, which are sustainable.

Central Water Commission issues flood warnings and disseminate it to the offices of district administration, irrigation, state flood control rooms, police, and other authorities for further action. Warnings to public are issued by the state authorities and flood bulletins are aired by the radio, television and newspapers. In some places, the villagers make necessary preparations in advance in areas where floods are frequent. This includes storing food, fodder, and other essential items in safe locations. They also stockpile boulders and sand bags.

Preparedness and capacity development are needed for institutions at all levels as well as an integrated approach to managing flash floods. The governance structure normally falls under three headings: a) the enabling environment incorporating policies and legislation as well

as people's empowerment; b) Different institutions have specific roles (here decentralisation as well as demarcation of management boundaries is important); and c) management instruments. In efficient, integrated flash-flood management, a number of institutions from central and state governments should be involved, the private sector, media, individuals, informal institutions, donors, and NGOs. Since there are so many different players in the field, there is a great need for improved dialogue among different governance levels and among different sectors and institutions. Both vertical and horizontal dialogues need to be improved.

Flash floods can have an impact hundreds of kilometres downstream; yet the warning time available is counted in minutes or, at most, hours. Thousands of people, their lives, livelihoods, and homes – along with expensive infrastructural investments – are at great risk from flash floods in the Himalayan region every year. Despite severe exposure to flash-flood risks, there are still no forecasting, warning, and management systems in operation to prevent or mitigate flash-flood disasters. There is an urgent need for new and improved mechanisms for forecasting and real-time warning, both nationally as well as across state/country borders. It would include strengthening preparedness among all government and private stakeholders, with special emphasis on community preparedness and response.

Warning System for Flash Floods

For altering the risks associated with flash flood warning system (Fig. 7.11) shall be efficient, disaster proof involving monitoring, forecasting and response system.

- Data collection and monitoring system: Collecting data through various tools of rainfall measurement, runoff, temperature, stream flow and discharge. Then, using data to make flood routing and analyzing flood frequency, helps to understand Hydrometeorological events. Satellite estimations and monitoring through surface measurements helps to forecast flood events to some extent and can provide early warning for being prepared.
- Data transmission system: A proper system for timely data transfer from a monitoring site to data analysis center shall be there such that important warnings can be sent timely. Digital transmission through terrestrial telephone, GSM or satellite communication system should be made effective. VHF radios can also be used.
- Forecasting system: The forecasting system through data collection can predict scenarios of potential flash flood events, but the model may be complicated resulting in accurate forecasting but Flash floods are rapid processes. Lack of sufficient data regarding land

characteristics hinders the application of sophisticated models. Simplistic models, such as flash flood guidance tables shall be preferred.

- **Warning and Dissemination system:** Flash Flood warning is given by Central Water Commission based on volume of rainfall in given duration (usually 1 to 6 hours). The proper warning system should be established to disseminate information to stakeholders such that appropriate steps can be taken and they can further warn people through radio/televisions.
- **Response system:** A response system shall already be aware of their duties in case of emergencies and prior mock drills should be conducted for effective results. A response system consists of actions by groups such as Police and fire brigade, Disaster Management authorities (e.g., dissemination of targeted information), Voluntary groups (e.g., assisting the injured, allocating resources), Armed forces (e.g. Relief and rescue operations), Media (dissemination of information), NCC/NSS, Civil Defence, and many more according to institutional set up.

7.8 Mitigation and Preparedness Measures for Landslide Dammed Lake Outburst Floods

The natural damming of rivers by landslides is a significant hazard in many areas. Landslide-damming is particularly common in the high rugged mountains of Himalayan Region. Many landslide-dams have failed catastrophically, causing major downstream flooding and loss of life.

Causes of Landslide Dams

Landslide-dams are common in the steep, narrow valleys of high rugged mountains because these valleys require relatively small amounts of material to form blockages. Landslidedams can be caused by a broad range of mass movements in different physiographical settings. Most landslidedams are formed by rock and earth slumps, slides, debris and mudflow, rock and avalanches debris. A very few have been caused by rock and soil falls or by slope failure (liquefaction) in sensitive clays.

It has been found that the two most important causes behind the initiation of landslidedams are excessive precipitation (rainfall and snowmelt) and earthquakes. Other mechanisms, including ice-dam failure, deforestation, and stream undercutting and entrenchment, account for very small percentage of triggering processes. Large landslidedams are formed by large earth and rockslide/slumps and avalanches debris, which commonly occur

on steep slopes and attain high velocities that allow stream blockage before the material can be sluiced away by river action. Complex landslides that start as slumps or slides and break up into avalanches debris can also create large dams. The size of landslide dams ranges in height from only a few metres to hundreds of metres. The size is controlled primarily by the volume of the mass failed down to the valley and the geometry of the valley.

Failure of Landslide Dams

Landslide dammed lakes may last for several minute/hoursto several thousand years, depending upon many factors, including volume, texture, sorting of the dam material, rate of seepage through the dam, and rate of the sediment and water inflowto the newly formed lake.

Because of the lack of a protected spillway, landslide -dams commonly fail by overtopping followed by breaching from erosion by the overflowing stream. A very small percentage of landslidedam failures contribute to seepage and piping or slope failure of the dam.

Floods from Landslide-Dam Failure

Landslide-dams create the potential for two very different types of flooding: (1) upstream flooding as the dam-lake fills and (2) downstream flooding as a result of the failure of the dam. The threat to life from upstream flooding is minimal because the water-rise behind the dam is relatively slow, but damage to property can be substantial as the basin of the natural impoundment is filled. Downstream floods resulting from the failure of landslide-dams are usually much larger than floods originating directly from snowmelt or rainfall and constitute a significant threat.

Prevention and Mitigation Measures for Landslide Dam Failure

In recent years, construction of control measures has been attempted on many landslidedams, as soon as possible after the formation, to prevent dam failure and subsequent flooding. Spillways are the most simple and most common method. In a few cases, large-scale blasting is used to excavate new river channels through landslide dams.

Lessons learnt and suggestions

- Monitoring of weather parameters and run-off from streams and rivers in disaster prone areas

- Afforestation of slopes to reduce erosion
- Monitoring and Installation of Early Warning System for Cloudburst, Landslides and Flashfloods
- Avoid construct of habitations and other structures on the paleochannels and flood plain areas of rivers
- Development of stormwater drainage system in the hills and training of river courses close to human habitations
- Mandatory disaster risk assessment and auditing before any construction and development on the ground. It should include housing, dams, bridges, roads, power projects etc.

7.9 Mitigation and Preparedness Measures for Glacial Lake Outburst Floods (GLOF):

Lakes formed by glaciers can be of two types based on their composed materials:

- Moraine dammed*: Formed between the glacier terminus and exposed end of deposited debris at sides of glaciers due to thinning and retreating of glacier.
- Ice dammed*: Formed on the surface of glacier between the glacier and valley wall

Due to hydrostatic pressure created by increasing water on the walls of dams, breaching due to overtopping and piping or volcanic eruptions, these glacial lakes cause flash floods accounting to excess amount of water.

Structural Mitigation measures to control such outburst are:

- Blasting (Fig. 7.15 and 7.16): Glacial lakes with careful precaution in evacuation of downstream area before blasting, can be blasted if at an early stage of formation as water volume is small.
- Construction of a spillway or open channel (Fig. 7.12): Construction of spillway with proper engineering techniques (Fig. 7.13) can lower the water level in glacial lakes. The risk of rapid erosion of the spillway and uncontrolled release of water needs to be ascertained.
- Siphoning: A simple siphon (Fig. 7.14) can lower 5 meters of water, appropriate for remote areas and their number can be chosen according to the desired level after taking rate of inflow into account.

- d) Drilling and tunneling: Drilling can be done to install water pipe to drain out water, but inhomogeneous and poorly consolidated material of the dam can cause trouble. Tunnels can also be constructed, but in solid rock into the lake from the deeper lying valley.



Figure 7.11: Installation of early warning system

(Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)



Figure 7.12: Channel for creating outlet form glacial lakes

(Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)



Figure 7.13: Channel and moraine dam built in reducing impact of GLOFs.

(Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)



Figure 7.14: Installation of siphons for diverting water from glacial lakes

(Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)

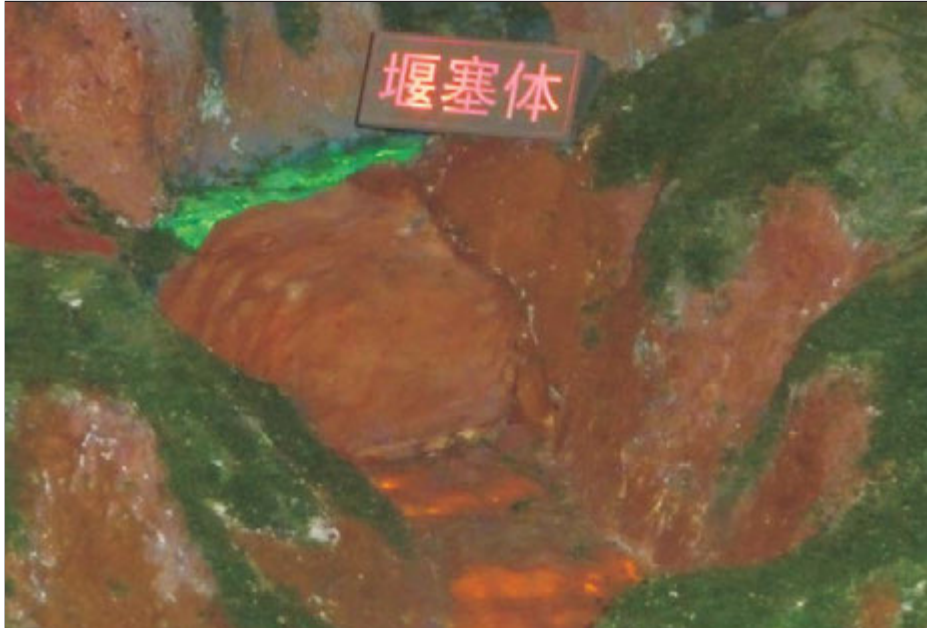


Figure 7.15: Landslide dammed lake formed after Wenchuan earthquake



Figure 7.16: Controlled supervised blasting to breach the landslide dammed lake formed after Wenchuan earthquake

Chapter 8

Recommendations

8.1 Introduction

As highlighted in the previous chapters, the Uttarkashi district is very much prone to landslides, flash floods including glacial lake outburst floods and landslide dammed lake outburst floods and earthquakes. The author has emphasized the need for understanding the nature and characteristics of these events for planning and implementing efficient economical and environment friendly sustainable measure to avoid, prevent, mitigate, prepare and respond for disaster risk reduction.

This chapter deals with the major recommendation with particular focus on landslides and flash floods including GLOFs and LLOFs.

8.2 Recommendations for Reducing Risks from Landslides

Landslides risks can be reduced by five approaches used individually or in combination, to reduce or eliminate losses.

a. Restricting Development in Landslide-Prone Areas

Landuse planning is one of the most effective and economical way to reduce landslide losses by avoiding the hazard and minimizing the risk. This is accomplished by removing or converting existing development or discouraging or regulating new development in unstable areas. Disclosing hazards and risks to buyers by making public records of disasters, posting warning of potential hazards, restraining utility and public facilities in disaster prone areas, discouraging non-conforming uses, acquiring or exchanging hazardous properties, removing unsafe structures, informing and educating affected

communities are some of the actions that can be taken by authorities. However, there are no widely accepted procedures or regulations for landslides.

b. Codes for Excavation, Construction and Grading

Excavation, construction and grading codes should be developed and enforced for construction in landslide-prone areas. Enact hillside grading ordinances, adopt hillside development regulations, amend landuse plans and regulations, enact drainage / storm water run-off measures for safer construction and development.

c. Protecting Existing Developments

Control of surface water and groundwater drainage are the most widely used, and generally the most successful slope-stabilization methods. Stability of a slope can be increased by removing all or a part of a landslide mass, or by adding earth buttresses placed at the toes of potential slope failures. Restraining walls, piles, caissons, or rock anchors, soil nailing are commonly used to prevent or control slope movement. In most cases, combinations of these measures are used.

d. Monitoring and Warning Systems

Monitoring and warning systems are utilized to protect lives and property and not to prevent landslides. However, these systems often provide warning of slope movement in time to allow the construction of physical measures that will reduce the immediate or long-term hazard. Site-specific monitoring techniques include field observation and the use of various ground motion measuring instruments, trip wires, radar, laser beams, and vibration meters. Data from these devices can be telemetered for real-time warning.

e. Landslide Insurance and Compensation for Losses

Landslide insurance would be a logical means to provide compensation and incentive to avoid or mitigate the hazard. Landslide insurance coverage could be made a requirement for mortgage loans. Controls on building, development, and property maintenance would need to accompany the mandatory insurance. The insurance and appropriate government intervention can work together, each complementing the other in reducing losses and in assessing compensation to victims. Clarify legal liability of property owner and enforce conditions for financial assistance by the government.

8.3 Specific Recommendations for Planners and Decision Makers to Reduce Landslide Risks

Planners and Decision Makers should learn from past tragic events and impose stringent planning and design requirements in landslide-prone and unstable areas. These may include:

- Implementation of regional hazard and risk assessments into land planning policies. This ensures that appropriate processes are in place whereby new development applications are assessed with respect to slope stability issues and zoning for future development is directed towards areas with low or very low risk of slope instability
- Engineering and geotechnical investigation that define the landslide hazard and risk at site specific levels of investigation
- Mapping of landslide vulnerability that can help with development of emergency response scenarios
- Insist on Landslide Assessment Report of the site / locality that should fulfil the requirements listed below

8.3.1 Requirements for Landslide Assessment Report

If unacceptable levels of landslide safety are identified, it may be appropriate and required, that the professionals provide recommendations for measures to reduce landslide hazards and/or risks. Measures can be relocation of proposed buildings, or stabilization or protective works. Residual risks, or those that remain should the recommendations be implemented, should be estimated and clearly explained. Typically, a landslide assessment report should include the following:

- Legal description of the property
- Location map or description of property relative to well known geographic features
- Objective, method of landslide hazard or landslide risk analysis, and the level of effort
- List of background information available, collected and reviewed, and its relevance

- Terrain or physical description of the study area
- Map or plan of the property including topography, natural features, existing structures, roads, infrastructure and surface drainage
- Description of proposed residential development
- Methods and intensity of field work
- Observations of topography, geology, landslide processes and elements at risk
- If applicable, adopted level of landslide safety used for comparison
- Results of landslide assessment
- Conclusions, accompanied by supporting rationale
- Recommendations, if requested and as required, to reduce landslide hazards and/or risks
- An estimate of the associated residual risks if recommendations are implemented
- If required, recommendations for further work and requirements for future inspections, and by whom, should be specified
- Definitions of qualitative terms, technical terms, concepts and variables
- Other information as specified in the agreement with the client, or as required by jurisdictional guidelines
- References, including maps and photographs
- Limitations and qualifications of the assessment and report, assumptions, error limits and uncertainties

Reports should be accompanied by drawings, figures, sketches, photos, test reports/logs, tables and other support information/data as required. Graphic information should be consistent with the information in the text. Maps or plans should delineate the areas of landslide hazards and risks in relation to existing and proposed residential development. The report should be

written clearly to allow reviewers to understand the methods, information used and supporting rationale for the conclusions and recommendations, without necessarily visiting the site. A peer review of landslide assessment report, prior to its submission to the client and / or authority, is strongly recommended as part of quality assurance/control programme.

8.3.2 Codes, Guidelines and Bye-Laws for Landslide Management, Landuse & Construction

The following Codes and Guidelines related to landslide have been published by Bureau of Indian Standards (BIS). The professionals responsible for any development should follow these codes, guidelines and bye-laws.

- IS 14496 (Part 2): 1998 Guidelines for preparation of LHZ maps in mountainous terrain: Part 2 Macro Zonation
- IS 14458: Guidelines for Retaining Wall for Hill Areas.
 - Part 1: Selection of Type of Walls
 - Part 2: Design of retaining/breast walls
 - Part 3: Construction of Dry stone walls
- IS 14680:1999 : Guidelines for Landslide Control
- IS 14804:2000 : Guidelines for Siting, Design and Selection of Materials for residential buildings in Hilly Areas
- National Building Code (NBC) 2005

8.4 Proposed Actions to Reduce the Landslides Risks

- Try to protect the slopes, Prevent people from excavating, removing materials from soil or cutting trees without proper advice from specialized institutions / experts
- Replant trees at slopes and slope bases that is from where they have been removed to prevent soil erosion

- Keep records of erosion, landslide masses and falling rocks. Never construct buildings on their debris without proper guidance. Loosened masses can subside when load is added to them.
- Avoid building houses at the base of slopes that are prone to landslides. Before purchasing a piece of land or exceeding building on your own land, try to get as much information as possible on the history of landslides there. Elders of the area can give you information on past incidents.
- Observe the features on the upslope area before you start any construction. Fill areas constructed above lacking appropriate retaining structures, rock debris or boulders can move into your land. Make sure about the stability of the upslope area before you start to build on your land. If you are in doubt, obtain advice from a specialist on the subject.
- Do not obstruct natural streams or drainage paths during construction. Be mindful of the other structures on the downslope. Avoid dropping rock pieces, boulders, loose earth etc. down the slope during construction. Introduce a retaining structure to prevent movement of fill material, if you need to fill your land located on the slope.
- When constructing on a slope, use a design that suits the natural slope. This also saves on the cost of construction. Do not remove vegetation and large trees while constructing.

Below are the **additional recommendations for specific locations** to reduce landslide risks:

For those living at the base of mountains in areas with high seismic activity

- There is strong possibility that an earthquake, even though a minor one, may trigger landslide movements especially in areas where landslides occur regularly. Therefore, be alert when an earthquake occurs. Try to organize groups to monitor the situation.
- Organize groups to inspect slopes during and after heavy rains. In case of impending danger remain awake in the night and be ready to evacuate at short notice.
- An earthquake can be a warning for a landslide. If a noticeable change is observed in upslope such as appearance of cracks, the fall of boulders, collapse or smaller mudflows, do not stay at the base of the slope, move away.

- Ground shaking associated with earthquake will continue for some time. There can be a series of earthquakes known as aftershocks that follow a major earthquake. If you are requested to evacuate, do not return until the authorities announce that the area is safe.
- Landslides that occur as a result of ground shaking can create a large volume of mudflow along the slope into the valley. Therefore, do not move in the direction of the valley if you are requested to evacuate; move to elevated areas.

For those living adjacent to filled ground or reclaimed land where slope protection measures are not adequate to retain the filled mass

- Observe any land subsidence. If your house is located on the fill or at the edge of such an area, inform the authorities when you notice any change.

For those living adjacent to river banks

- Listen to weather forecasts especially for heavy rains in the upstream areas, these may cause floods in the lower areas
- Observe any cracks that may appear parallel to the river bank.
- Observe any cracks on the ground where your house is located
- Observe any crack on the walls or foundation of your house
- If you notice any expansion of these cracks, inform the authorities and immediately move to safer areas.
- Such observations have to be made both during the rise and decline of water levels. Rapid drawdown of water may cause more dangerous slips on the river banks than while the water is rising.
- Do not send children to make such observations. The river bank may collapse without warning. Keep children away from the slopes on river banks.

For people living at the foothills closer to stream beds with large upstream catchment area

- People living in these areas can be taken unaware by flash floods
- Weather forecasting institutions (IMD) can not predict flash floods. Listen to weather forecasts about heavy rainfalls. Observed cloud movements towards mountain peaks. Heavy rainfalls, which have a potential to trigger landslides, may be caused by cloud bursts. Resulting flash floods can contain a considerable quantity of mud and can be very dangerous
- Be alert if you are living in an area where flash floods occur regularly. Organize groups to inspect river flow conditions
- Living or camping out in the rainy season on flood plains where there is history of flash floods, is very dangerous; be extremely careful
- Observe any unusual movement of wild animals into the village during heavy rains. It may be an indication of the development of floods in upstream area

For those living on a slope or at the base or in an area close to a spring or small stream

- Be especially alert. If you observe a sudden drop or increase in water flow together with water changing from clear to muddy, alert your neighbours and keep away from that area

8.5 Recommendations for Reducing Risk from Flash Floods

- State should develop adequate disaster-management policies and plans, including for flash floods
- The capacities of institutional entities responsible for disaster management, in general, and flash-flood management, in particular, should be strengthened. The roles and responsibilities of all institutions involved must be clearly defined and appropriate institutional arrangements should be in place at all administrative levels
- Communities should be empowered to play a central role in flash-flood management – including preparedness, adaptation, and mitigation

- A standard methodology for documenting flash-flood events, their causes, and impacts should be established
- Awareness should be raised among politicians, policy-makers, communities, and the public at large about the threats posed to communities by flash floods. Vulnerable groups need particular attention. Awareness-raising programmes should be conducted through, mass media, social institutions, and community-based organisations as well as through formal and informal education systems. Specially-designed awareness campaigns should be launched for non- and semi-literate people
- Knowledge about flash floods and their management, including their nature, origin, impact, and mitigation, should be improved and increased resources made available for research of this kind
- Communication and coordination among relevant institutions, both laterally and vertically, from community to national levels should be fostered. In doing so, national stakeholders should be encouraged to establish formal and informal platforms to facilitate cross-sectoral dialogues to improve flash-flood management.

8.6 Recommendation for Reducing Risks from LLOFs

- Uttarakhand faces frequent and recurring threats from natural hazards like cloudbursts, flashfloods, landslides, forest fires, avalanches. Large scale hazard zonation maps based on inputs on natural factors like geological, seismic, hydrological, climatic parameters as well as consideration of socio-economic and political conditions, should form the basis of justifiable landuse planning and development decisions
- Prepare Guidelines for Disaster Prevention through Landuse Regulation and Construction Bye-laws, particularly for hazard prone areas. The guidelines should promote and encourage safer sustainable good practices over bad practices as outlined from the experiences / lessons learnt from past disasters, with a focus on interplay of natural and anthropogenic factors
- The large scale hazard zonation maps should indicate the progressive levels of a given expected hazards for different return periods. The hazard maps should be limited to user requirements and present comprehensive clear information. These maps should be validated for their soundness, clarity and user friendliness before making them public. The maps can also be used as counter checks to contain or control hazards in susceptible areas

- State can prepare large scale hazard specific as well as multi-hazard maps for landuse planning, construction regulations and disaster risk reduction. These maps should be accompanied by corresponding resources, infrastructure, planning and developments maps on the same scale for identifying the elements/group of elements at risk and assessing the degree of vulnerability and capacity within a given place and time
- Landslide Atlas of Uttarakhand published by National Remote Sensing Centre, Hyderabad on 1:25,000 scale for pilgrim routes along Rishikesh-Rudraparayang-Chamoli-Badrinath, Rudraprayag-Ukhimath-Kedarnath, Chamoli-Usara-Ukhimath, Rishikesh-Uttarkashi-Gangotri-Gaumukh, Pitthoragarh-Khela-Malpa can be used after proper validation
- The state departments should conduct systematic scientific investigations and mapping based on practical knowledge / experiences so that casual approach to planning may be eliminated and well informed and properly administered decision making process is encouraged

8.7 Recommendations for Reducing Risk from GLOFs

- Extend the early warning system to the downstream reaches of the river and adjoining areas to cover the entire area at risk of GLOF
- Raise awareness among local people of the probability and magnitude of GLOF risk in the area and provide them with skill development training for preparedness planning and rescue and relief operations
- Formulate a preparedness plan for GLOF risk reduction together with local communities
- Strengthen regional, national, and local capacities for GLOF risk reduction through awareness creation and skill development activities
- Establish an emergency fund and community shelter with provisions for food, clothing, drinking water, and health services
- Develop and implement land use guidelines and building codes together with the local community
- Integrate and coordinate road network development, land use planning, and settlement and market centre development with disaster risk reduction activities
- Form a transboundary team to conduct field investigations on glacial lakes and the river channel to determine the probability and potential magnitude of GLOFs towards

developing a flood forecasting model and an early warning system with enough lead time to enable evacuation

- Establish a network of institutions dealing with disaster risk reduction at the regional / transboundary, national, and local levels to share information on GLOF risk
- Establish institutions that focus on flash flood management with dense community networks

Glossary

Acceptable Risk - A risk one is prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks .

Cloud Burst: Clouds are formed when water vapors reach a height where temperature is low and condense to form small water droplets. When nucleation of such clouds takes place, water droplets grow in size to form raindrops, depending on the thickness of clouds and low temperature, the rain is light or heavy. In case of cloud bursts, cyclonic winds virtually compress the clouds and forced nucleation amounting to sudden precipitation whereby water from clouds is poured out in a short time. The clouds involved are stratus.

Heavy rains, on the other hand are caused by nimbus / cumulo-nimbus clouds which are dark in color and suspended at lower heights.

Controlling (Perpetuating) Factors dictate the condition of movement. These are the factors which control the form, rate and duration of movement.

Hazard - A condition with the potential for causing an undesirable consequence. Alternatively, the probability of a particular landslide to occur in a given at a specific location.

Individual Risk - The risk of fatality and/or injury to any identifiable (named) individual who lives within the zone exposed to the landslide, or who follows a particular pattern of life that might subject him/her to consequence of the landslide.

Landslides are simply defined as down slope movement of rock, debris and/or earth under the influence of gravity. This sudden movement of material causes extensive damage to life, economy and environment. **Landslide** is the most common and universally accepted collective term for most slope movements of the mass movement type. The term has sometimes been considered unsuitable as the active part of the word denotes sliding.

Mass Movement is outward or downward gravitational movement of earth material without the aid of running water as a transporting agent. It neither denies the importance of water in solid/liquid state as a destabilising factor nor does it excludes, subsidence and other movements on flat ground.

Mass Wasting is a broad term commonly used in conjunction with the erosion cycle to refer to the mass reduction of the interfluvies as opposed to the degradation by streams. In effect it must include the action of all non-linear erosional processes working on the slopes between streams.

Preparatory Factors dispose the slope to movements; i.e. these are the factors which make the slope susceptible to movement without actually initiating it and thereby tending to place the slope in a marginally stable state.

Risk - A measure of the probability and severity of an adverse effect to individuals or populations, property or to the environment.

Risk Management - The complete process of risk assessment and risk control.

Slope Failure refers to the process of rupture or shearing in materials rather than to a particular ground feature. Terzaghi (1950) advocated this term for slope movements on engineered slopes.

Slope Instability refers to the predisposition of a slope to mass movement. The condition may be recognised by analysing stress within the slope, by various slope characteristics or by analysis of historical records of slope development.

Slope Movements restricts to mass movements on slopes.

Societal Risk - The risk of multiple injuries or deaths to society. Society would have to bear the burden of a landslide accident involving deaths of several people, injuries, along with financial, environmental and other losses.

Stability Factors - All forces determining stability are controlled or influenced by identifiable phenomena are referred as Stability Factors. When operate to induce instability, they are called destabilising or causative factors. e.g. climate, slope strength, vegetation etc. Indeed there are many components of the slope system which can change independently to destabilise the slope but the significance of any change is dependent on the aggregated effect of all the components. An examination of the *temporal variability* of factors identifies some as being **passive** (slow or gradually changing) e.g weathering, and **transient or active** (fast changing), eg landslides floods

Triggering Factors initiate movement; these are responsible for shifting the state of slope from marginally stable to actively unstable state.

Tolerable Risk - A risk that society is willing to live with so as to secure certain net benefits in the confidence that it is being properly controlled, kept under review and further reduced as and when possible.

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Table 1.12:Uttarkashi District at a Glance

S.No	Item	Details
1.	Geographical Area	7951
2.1.	Population (census 2011)	
2.1.1.	Male (In thousands)	168.34
2.1.2	Female(In thousands)	161.35
2.1.3	Total(In thousands)	329.69
2.1.4	Rural(In thousands)	305.47
2.1.5	Urban(In thousands)	24.22
2.1.6	Density (No of people/sq.km)	41
2.1.7	Proportion to Uttarakhand Population (%)	3.26
2.2.	No of Literates (census 2011)	
2.2.1	Total (In thousands)	216.32
2.2.2	Male(In thousands)	129.29
2.2.3	Female(In thousands)	87.03
3	No of Constituencies, Tehsils, Blocks, Panchayats	
3.1	Lok Sabha Constituencies	1
3.2	Vidhan Sabha Constituencies	3
4	No. of Tehsils	6
5	Blocks	6
6	Nyay Panchayats	36
7	Gram Panchayats	427
8.1	Inhabited Villages	665
8.2	Un Inhabited Villages	4
8.3	Forest Villages	—
8.4	Total Villages	669
9	Towns /Cities	3
10	Nagar Nigams	—

11	Nagar Palika Parishads	1
12	Cantonements	—
13	Nagar Panchayats	2
14	Census Towns	—
15	Police, Bus and Railways Stations	
15.1	Rural P.S.	3
15.2	Urban P.S.	2
16	Bus Stations/Bus Stops	301
17	Railway Stations	—
18	Railway Line	
18.1	Broad Gauge (Km)	—
18.2	Narrow Gauge (Km)	—
19	Post Office and telephone exchange (Census 2011)	
19.1	Post Office	130
19.2	Telegraph Offices (This facility has been withdrawn from across the country)	1
20	Telephone Exchanges	3
21	Telephone Connections	8564
22	Branches of Commercial Banks	
22.1	Branches of Nationalised Banks	28
22.2	Others	—
23	Branches of Rural Banks	6
24	Branches of Cooperative Banks	12
25	Co-operative Agriculture and Rural Dev. Banks	1
26	Fair Price Shops (2005-2006)	
26.1	Rural F.P.S	462
26.2	Urban F.P.S	11
27	Biogas Plants	507

28	Cold Storage	—
	Agriculture (2004-05)	
29.1	Net sown area (in Thousand Hectares)	27
29.2	More than once sown area (in Thousand Hectares)	14
29.3	Net irrigated area(in Thousand Hectares)	5
29.4	Total Irrigated area(in Thousand Hectares)	9
	Agricultural Production (2004-05)	
29.5.1	Food Grain (in Thousand MT)	47.33
29.5.2	Sugar Cane(in Thousand MT)	—
29.5.3	Tilhan(in Thousand MT)	0.87
29.5.4	Potato(in Thousand MT)	27.92
30	Climate	
30.1	Rainfall (2005)	
30.1.1	General (mm)	1698
30.1.2	Actual/measured (mm)	1024.6
30.2	Temperature (2005)	
30.2.1	Maximum (°C)	33.8
30.2.2	Minimum (°C)	0.4
31	Irrigation (2005-2006)	
31.1	Length of Canals (Km)	661
31.2	Govt. Tubewells (no.s)	—
31.3	Private Tubewells and Pumpsets (no.s)	—
32.	Animal Husbandry (2003, 2005-06)	
32.1	Total LiveStock (2003)	356147
32.2	Veterinary Hospitals (2005-06)	25
32.3	Live Stock Service Centres(2005-06)	31
32.4.1	Artificial Breeding Centres(2005-06)	17
32.4.2	Artificial Breeding Sub Centres(2005-06)	—

33	Co-operative (2005-06)	
33.1	Primary Agriculture Loan Societies	44
33.2	Members in Societies (in Thousands)	52
34	Industries (2005-06)	
34.1	Working Industries registered under the industrial Act 1948	—
34.2	Khadi and Small Scale Industries (2005-06)	
34.2.1	Units	243
34.2.2	No. of persons working	493
35	Educational Institutions (2005-06)	
35.1	Junior Basic Schools	901
35.2	Senior Basic Schools	252
35.3	Higher Secondary Schools	83
35.4	Degree Colleges	3
35.5	PG Colleges	2
35.6	Universities	—
35.7	ITI	5
35.8	Polytechnic Institutes	1
36	Public Health	
36.1	Hospitals and Dispensaries (2005-06)	
36.1.1	Allopathic	24
36.1.2	Ayurvedic	47
36.1.3	Homeopathic	6
36.1.4	Yunani	—
36.2	Primary Health Centres	11
36.3.1	Community Health Centres	2
36.3.2	Family Welfare Centres	4
36.3.3	Family Welfare Sub Centres	75
36.4	Specialised Hospitals (2005-06)	

36.4.1	Tuberculosis	—
36.4.2	Leprosy	—
36.4.3	Communicable Diseases	—
37	Metal Roads (2005-06)	
37.1	Total Length of roads (km)	1294
37.2	Roads Constructed by PWD (km)	1100
38	Electricfication (2005-06)	
38.1.1	Electrified Villages	668
38.1.2	Electrified Inhabited Vilages	668
38.2	Electrified Towns	3
38.3	Electrified SC localities	—
38.4	SC localities not covered under Electrification	—
39	Villages/towns/cities having access to water supply through taps/hand pumps	
39.1	Villages	668
39.2	Towns/Cities	3
39.3	Scarcity Villages	—
39.4	SC localities not covered under water supply through Taps/Hand pumps	—
40	Entertainment houses	
40.1	Cinema Halls	—
40.2	Seats in Cinema Halls	—

Table 1.13: Public Representatives Member of Parliament

Tehri Garhwal Parliamentary Constituency	Shri Vijay Bahuguna
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Table 1.14: Member of Legislative Assembly

Assembly	Name of MLA
01-Purola Constituency	Shri Malchand
02-Gangotri Constituency	Shri Vijaypal Singh Sajwan
03-Yamunotri Constituency	Shri Pritam Singh Panwar

Table 1.15: Representatives of Local Bodies

Chairman, Zila Panchayat	Shri Narayan Singh Chauhan
Chairman, Nagar Palika, Uttarkashi	Shri Bhupendra Singh
Chairman, Nagar Panchayat, Barkot	Shri Budhi Singh

Table 2.4: Data on Landslide Locations in Bhatwari and Dunda Taluks of Uttarkashi district, Uttarakhand based on Records from IRS LISS III+PAN, National Remote Sensing Centre, Hyderabad

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
1.	Bhatwari	78.435442	30.732163	6331	Active
2.	Bhatwari	78.437989	30.732244	113839	Old
3.	Bhatwari	78.391559	30.732271	4126	Active
4.	Bhatwari	78.392718	30.732453	5931	Active
5.	Bhatwari	78.433898	30.733094	6639	Active
6.	Bhatwari	78.438030	30.735162	27718	Active
7.	Bhatwari	78.419296	30.736169	3556	Active
8.	Bhatwari	78.417183	30.736216	3395	Active
9.	Bhatwari	78.411906	30.736942	37672	Active
10.	Bhatwari	78.427499	30.739075	268007	Old
11.	Bhatwari	78.435912	30.739256	6940	Active
12.	Bhatwari	78.497355	30.739627	5341	Active

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
13.	Bhatwari	78.517768	30.740266	16223	Old
14.	Bhatwari	78.519536	30.740554	11253	Old
15.	Bhatwari	78.494003	30.742973	12807	Active
16.	Bhatwari	78.370129	30.743087	6844	Active
17.	Bhatwari	78.364891	30.743259	25503	Active
18.	Bhatwari	78.406577	30.745909	70835	Active
19.	Bhatwari	78.516077	30.750236	28518	Active
20.	Bhatwari	78.474010	30.752955	3772	Active
21.	Bhatwari	78.483380	30.753667	50998	Old
22.	Bhatwari	78.561277	30.755174	42915	Active
23.	Bhatwari	78.479700	30.754913	24071	Active
24.	Bhatwari	78.572156	30.756936	81363	Old
25.	Bhatwari	78.462783	30.759911	60627	Old
26.	Bhatwari	78.577906	30.765172	4682	Old
27.	Bhatwari	78.599297	30.767206	3683	Old
28.	Bhatwari	78.591094	30.767199	1773	Active
29.	Bhatwari	78.590884	30.775597	1811	Old
30.	Bhatwari	78.602503	30.776431	3751	Active
31.	Bhatwari	78.608210	30.778680	5995	Old
32.	Bhatwari	78.611149	30.779916	1322	Active
33.	Bhatwari	78.615335	30.791211	5703	Active
34.	Bhatwari	78.620408	30.798755	14703	Old
35.	Bhatwari	78.622048	30.799714	87392	Old
36.	Bhatwari	78.612874	30.801067	199453	Active

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
37.	Bhatwari	78.619014	30.819655	2099	Old
38.	Bhatwari	78.617420	30.822995	2896	Old
39.	Bhatwari	78.621672	30.823689	1712	Old
40.	Bhatwari	78.620230	30.827638	2325	Active
41.	Bhatwari	78.631923	30.843878	525	Active
42.	Bhatwari	78.638669	30.849460	13512	Active
43.	Bhatwari	78.647799	30.858986	10029	Active
44.	Bhatwari	78.657106	30.865451	1627	Old
45.	Bhatwari	78.657446	30.866303	1527	Old
46.	Bhatwari	78.654559	30.866350	2002	Old
47.	Bhatwari	78.659803	30.871761	5110	Active
48.	Bhatwari	78.663917	30.877712	2059	Old
49.	Bhatwari	78.673244	30.887702	3176	Active
50.	Bhatwari	78.678556	30.893890	1595	Old
51.	Bhatwari	78.675868	30.894574	17071	Active
52.	Bhatwari	78.680199	30.895204	2168	Old
53.	Bhatwari	78.683467	30.902941	703	Active
54.	Bhatwari	78.683389	30.903692	1504	Active
55.	Bhatwari	78.680163	30.905004	5416	Old
56.	Bhatwari	79.087329	30.927065	47402	Active
57.	Bhatwari	79.090010	30.929657	57986	Active
58.	Bhatwari	79.077790	30.933636	55075	Active
59.	Bhatwari	79.058910	30.935707	18143	Active
60.	Bhatwari	79.075829	30.935734	12727	Active

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
61.	Bhatwari	78.689397	30.935674	3075	Active
62.	Bhatwari	78.728837	30.938270	6451	Active
63.	Bhatwari	78.726541	30.938398	5035	Active
64.	Bhatwari	79.070594	30.938891	10548	Active
65.	Bhatwari	79.056250	30.940448	14218	Active
66.	Bhatwari	78.670637	30.941833	1222020	Old
67.	Bhatwari	79.070667	30.942300	10379	Old
68.	Bhatwari	79.069934	30.942577	8044	Old
69.	Bhatwari	78.662076	30.943493	1389420	Active
70.	Bhatwari	78.678993	30.945635	280465	Active
71.	Bhatwari	79.063043	30.945891	45135	Old
72.	Bhatwari	78.664721	30.946247	247442	Old
73.	Bhatwari	78.663618	30.946631	16882	Active
74.	Bhatwari	78.744240	30.946781	6782	Active
75.	Bhatwari	78.680458	30.947128	299219	Old
76.	Bhatwari	78.742639	30.948599	12772	Active
77.	Bhatwari	78.660181	30.949305	4753	Old
78.	Bhatwari	79.057778	30.950522	11131	Active
79.	Bhatwari	78.658147	30.950383	64785	Old
80.	Bhatwari	79.056974	30.951706	12031	Old
81.	Bhatwari	78.655767	30.952253	42122	Old
82.	Bhatwari	78.665126	30.952382	7791	Active
83.	Bhatwari	79.054776	30.953062	10716	Old
84.	Bhatwari	79.056125	30.953196	17997	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
85.	Bhatwari	79.054059	30.953918	14597	Old
86.	Bhatwari	78.655818	30.954348	10846	Old
87.	Bhatwari	79.039093	30.956462	32649	Active
88.	Bhatwari	79.055082	30.957384	68003	Active
89.	Bhatwari	79.045552	30.960298	15786	Active
90.	Bhatwari	79.043933	30.961119	66453	Active
91.	Bhatwari	79.044942	30.961220	18354	Old
92.	Bhatwari	79.043707	30.961823	12477	Old
93.	Bhatwari	78.682912	30.962481	51921	Active
94.	Bhatwari	78.730104	30.962692	6173	Active
95.	Bhatwari	78.685138	30.962887	37817	Active
96.	Bhatwari	78.679431	30.963182	20237	Active
97.	Bhatwari	78.688530	30.964373	16145	Active
98.	Bhatwari	78.690026	30.964665	15404	Active
99.	Bhatwari	79.034599	30.965117	7585	Active
100	Bhatwari	79.039060	30.965117	4228	Active
101	Bhatwari	79.042407	30.965558	13020	Old
102	Bhatwari	79.028050	30.966280	43989	Active
103	Bhatwari	79.038715	30.966346	4187	Active
104	Bhatwari	78.690632	30.966268	9528	Active
105	Bhatwari	79.022694	30.966804	95302	Active
106	Bhatwari	78.697853	30.968165	20267	Active
107	Bhatwari	79.029626	30.969643	23264	Old
108	Bhatwari	79.037333	30.971232	6091	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
109	Bhatwari	79.021468	30.971449	106173	Active
110	Bhatwari	79.037099	30.973216	12372	Old
111	Bhatwari	79.035375	30.973768	6249	Old
112	Bhatwari	79.025601	30.974250	32481	Active
113	Bhatwari	79.050113	30.974820	14445	Active
114	Bhatwari	79.034062	30.976240	5254	Active
115	Bhatwari	78.698244	30.976335	4537	Active
116	Bhatwari	79.031338	30.976703	23653	Old
117	Bhatwari	79.019238	30.976764	5579	Active
118	Bhatwari	78.937618	30.977423	11332	Old
119	Bhatwari	79.030353	30.977616	3234	Old
120	Bhatwari	78.697027	30.977478	9228	Active
121	Bhatwari	79.019631	30.978181	4405	Active
122	Bhatwari	79.021413	30.978182	3268	Active
123	Bhatwari	79.032806	30.978578	5996	Active
124	Bhatwari	78.950052	30.979237	23600	Old
125	Bhatwari	79.018263	30.979924	27938	Active
126	Bhatwari	79.031596	30.980099	4023	Active
127	Bhatwari	78.916748	30.980937	11101	Active
128	Bhatwari	78.689926	30.981993	12867	Active
129	Bhatwari	78.995348	30.982935	9873	Old
130	Bhatwari	79.027019	30.983121	30298	Old
131	Bhatwari	78.696521	30.983136	16798	Active
132	Bhatwari	78.673439	30.983248	11854	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
133	Bhatwari	79.022448	30.983583	21460	Active
134	Bhatwari	78.706128	30.984668	6589	Active
135	Bhatwari	78.701928	30.985247	3272	Active
136	Bhatwari	79.015457	30.987628	6681	Active
137	Bhatwari	78.993229	30.987726	10938	Old
138	Bhatwari	78.991172	30.987850	5625	Old
139	Bhatwari	79.013512	30.987923	17611	Old
140	Bhatwari	78.701939	30.988896	98303	Old
141	Bhatwari	78.922659	30.991165	14876	Old
142	Bhatwari	78.999845	30.991260	6504	Active
143	Bhatwari	78.708350	30.991456	38703	Old
144	Bhatwari	79.007703	30.991995	8389	Active
145	Bhatwari	79.001388	30.992019	9041	Active
146	Bhatwari	78.965881	30.992563	10866	Active
147	Bhatwari	78.994047	30.993046	12315	Active
148	Bhatwari	78.997229	30.994401	8320	Active
149	Bhatwari	78.990190	30.995429	3853	Active
150	Bhatwari	78.988162	30.995967	18330	Active
151	Bhatwari	78.984632	30.996163	7447	Active
152	Bhatwari	78.967808	30.996453	52382	Active
153	Bhatwari	78.983913	30.996983	3249	Active
154	Bhatwari	78.705010	30.996816	6818	Active
155	Bhatwari	78.958413	30.997035	83097	Active
156	Bhatwari	78.969317	30.997133	8119	Active

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
157	Bhatwari	78.974303	30.997359	5347	Active
158	Bhatwari	78.963289	30.997458	35019	Active
159	Bhatwari	78.983351	30.997577	9035	Active
160	Bhatwari	78.951580	30.997643	7537	Active
161	Bhatwari	78.975606	30.997729	4843	Active
162	Bhatwari	78.867721	30.997763	24700	Active
163	Bhatwari	78.972775	30.998437	18536	Active
164	Bhatwari	78.970631	30.998466	3946	Active
165	Bhatwari	78.702264	30.998503	13974	Active
166	Bhatwari	78.890472	30.998759	36748	Old
167	Bhatwari	78.946213	30.999389	12769	Active
168	Bhatwari	78.875100	30.999416	6614	Old
169	Bhatwari	78.933596	30.999457	5180	Active
170	Bhatwari	78.939504	30.999646	75503	Active
171	Bhatwari	78.972365	30.999852	9240	Active
172	Bhatwari	78.699502	30.999957	5191	Active
173	Bhatwari	78.953661	31.000487	75550	Active
174	Bhatwari	78.964830	31.000611	21619	Active
175	Bhatwari	78.924933	31.000746	3901	Active
176	Bhatwari	78.957944	31.001001	5415	Active
177	Bhatwari	78.927291	31.001068	5177	Active
178	Bhatwari	78.978581	31.001065	11733	Active
179	Bhatwari	78.921154	31.001900	7154	Active
180	Bhatwari	78.912052	31.002179	14641	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
181	Bhatwari	78.917267	31.002220	25782	Active
182	Bhatwari	78.930007	31.002359	17467	Active
183	Bhatwari	78.983725	31.002815	26389	Active
184	Bhatwari	78.899884	31.003005	11322	Active
185	Bhatwari	78.915040	31.003135	5981	Active
186	Bhatwari	78.697657	31.003290	4275280	Old
187	Bhatwari	78.984985	31.004992	13897	Active
188	Bhatwari	78.898637	31.005448	8773	Old
189	Bhatwari	78.988808	31.006114	7199	Active
190	Bhatwari	78.713515	31.006931	270624	Active
191	Bhatwari	78.916968	31.007434	10432	Active
192	Bhatwari	78.988897	31.007500	25057	Active
193	Bhatwari	78.866187	31.008808	23950	Old
194	Bhatwari	78.929341	31.009349	17588	Active
195	Bhatwari	78.889836	31.011383	12440	Old
196	Bhatwari	78.898167	31.011648	7076	Old
197	Bhatwari	78.890751	31.011941	5076	Old
198	Bhatwari	78.925130	31.012176	20967	Old
199	Bhatwari	78.916536	31.013002	7404	Active
200	Bhatwari	78.855594	31.013529	9186	Active
201	Bhatwari	78.754784	31.013664	6258	Old
202	Bhatwari	78.757587	31.013796	8638	Old
203	Bhatwari	78.863692	31.015764	70630	Active
204	Bhatwari	78.881002	31.016604	6250	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
205	Bhatwari	78.861135	31.016773	10231	Old
206	Bhatwari	78.866931	31.017085	4278	Active
207	Bhatwari	78.870056	31.017684	6215	Active
208	Bhatwari	78.878305	31.017909	6293	Old
209	Bhatwari	78.871905	31.018568	2844	Active
210	Bhatwari	78.707717	31.018967	4440	Active
211	Bhatwari	78.870852	31.019272	5025	Active
212	Bhatwari	78.866701	31.021333	4643	Old
213	Bhatwari	78.833644	31.027826	4606	Active
214	Bhatwari	78.838015	31.029718	5010	Old
215	Bhatwari	78.837007	31.030984	3410	Active
216	Bhatwari	78.869545	31.032383	6743	Active
217	Bhatwari	78.693101	31.036415	11802	Active
218	Bhatwari	78.859668	31.036757	42390	Active
219	Bhatwari	78.830077	31.037177	17241	Old
220	Bhatwari	78.871336	31.037820	6969	Active
221	Bhatwari	78.887877	31.041273	8350	Active
222	Bhatwari	78.898815	31.041988	18161	Active
223	Bhatwari	78.758968	31.041985	7616	Active
224	Bhatwari	78.850748	31.043357	11969	Old
225	Bhatwari	78.802884	31.044059	7652	Active
226	Bhatwari	78.880743	31.044700	11841	Old
227	Bhatwari	78.883014	31.044758	6718	Active
228	Bhatwari	78.807398	31.044814	4470	Active

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
229	Bhatwari	78.821191	31.047752	7213	Active
230	Bhatwari	78.868418	31.047825	5959	Active
231	Bhatwari	78.844600	31.049965	4571	Active
232	Bhatwari	78.821802	31.050053	5579	Active
233	Bhatwari	78.861421	31.050434	2088	Active
234	Bhatwari	78.862088	31.050934	2804	Active
235	Bhatwari	78.753676	31.050996	6118	Old
236	Bhatwari	78.833470	31.051576	20826	Active
237	Dunda	78.359533	30.533499	53338	Active
238	Dunda	78.346772	30.549959	28093	Active
239	Dunda	78.329816	30.560369	2363	Active
240	Dunda	78.341944	30.560528	17282	Active
241	Dunda	78.327558	30.562340	6383	Active
242	Dunda	78.325314	30.565738	55862	Old
243	Dunda	78.333833	30.583929	54970	Active
244	Dunda	78.313460	30.600796	2692	Active
245	Dunda	78.316820	30.602670	6762	Active
246	Dunda	78.323231	30.606192	41230	Active
247	Dunda	78.315409	30.606409	6016	Active
248	Dunda	78.313850	30.606741	4060	Active
249	Dunda	78.321256	30.607087	8673	Active
250	Dunda	78.315810	30.608925	13527	Active
251	Dunda	78.326245	30.611912	12002	Active
252	Dunda	78.315233	30.611900	30822	Old

S.no	Taluk	Longitude (East)	Latitude (North)	Area (sq.m)	Slide Type
253	Dunda	78.316256	30.614914	26984	Old
254	Dunda	78.319638	30.616788	29720	Old
255	Dunda	78.329924	30.628266	4310	Active
256	Dunda	78.330274	30.646769	43680	Old
257	Dunda	78.332315	30.648590	32415	Old
258	Dunda	78.335743	30.653492	57141	Active
259	Dunda	78.337411	30.659112	11591	Active
260	Dunda	78.339440	30.663465	14181	Active
261	Dunda	78.348389	30.666918	5294	Active
262	Dunda	78.347091	30.667930	6068	Active
263	Dunda	78.347424	30.669629	222405	Old
264	Dunda	78.360696	30.673600	125393	Old
265	Dunda	78.342923	30.673579	268552	Old
266	Dunda	78.346183	30.706978	51031	Old
267	Dunda	78.334366	30.717871	103057	Old
268	Dunda	78.355187	30.728210	100214	Old
269	Dunda	78.350094	30.733360	9751	Active
270	Dunda	78.348075	30.739280	6438	Active
271	Dunda	78.345716	30.739567	7201	Active

Inventory and evaluation of resources :-**Table 2.5: List of Food stores**

S.no	Block	Name of Food Store	Capacity (MT)
1	Bhatwari	Bhatwari	200
		Jhala	300
		Netala	2500
		Gyansu	400
2	Dunda	Gyansu	
		Dhontri	300
		Chinyalisaur	400
3	Chinlayisor	Chinyalisaur	
		Banchora	170
4	Naugaon	Barkot	343
5	Purola	Purola	250
6	Mori	Naitwar	94
		Dhoni	95
		Jakhol	45
		Aarakot	75
		Taluka	300
		Total	5472

Tehsil wise Inventory of Health Department**Table 2.6: Inventory of Health Department , Tehsil :- Bhatwari**

S	Name of Hospital	No. of Beds	Available Facilities
A. Allopathic Facilities			
1.	District Hospital, Uttarkashi	110	Pathology, X-Ray, Operation Theater, Medicine Store , Ambulance
2.	T.B. Clinic	-	Pathology, X-Ray

S	Name of Hospital	No. of Beds	Available Facilities
3.	Mahila Hospital, Uttarkashi	-	Operation Theater, maternity Service , Family Planning Service
4.	P.H.C., Bhatwari	4	Pathology, Operation Theater, Medicine Store
5.	Mahila Hospital, Bhatwari	4	maternity Service , Pathology, Operation Theater, Medicine Store
6.	Govt. Allopathic Hospital, Gagnani	4	General treatment
7.	Govt. Allopathic Hospital Hashil	4	General treatment
8.	Govt. Allopathic Hospital Maneri	4	General treatment
9.	Govt. Allopathic Hospital Utroun	4	General treatment
10.	Seasonal Dispensary Gangotri (April to Nov., during Yatra)	-	Amnulance, General treatment
11.	Govt. Allopathic Hospital Raithal	-	General treatment facilities e
12.	M.R.P. Manpur	-	Medicine Store
B. Ayurvedic Facilities			
1.	Govt. Ayurvedic Hospital, Hanuman Chouk, Uttarkashi	-	General treatment facilities
2.	Govt. Ayurvedic Hospital, Sora	-	General treatment facilities
3.	Govt. Ayurvedic Hospital, Bhankoli	-	General treatment facilities
4.	Govt. Ayurvedic Hospital, Maneri	-	General treatment facilities
5.	Govt. Ayurvedic Hospital, Bhatwari	-	General treatment facilities
6.	Govt. Ayurvedic Hospital, Taknor	-	General treatment facilities
7.	Govt. Ayurvedic Hospital, Gangotri	-	General treatment facilities
8.	Govt. Ayurvedic Hospital, Sald	-	General treatment facilities
9.	Govt. Ayurvedic Hospital, Mustiksour	-	General treatment facilities
C. Homeopathic Facilities			
1.	Govt. Homeopathic Hospital, Uttarkashi	-	General treatment facilities

Table 2.7 : Inventory of Health Department , Tehsil :- Barkot

S	Name of Hospital	No. of Beds	Available Facilities
A. Allopathic Facilities			
1.	C.H.C. Naougaoun	30	Pathology, X-Ray, Operation Theater, Medicine Store
2.	Govt. Allopathic Hospital Barkot	4	Pathology, Operation Theater, Medicine Store, Ambulance
3.	Govt. Allopathic Hospital Damta	4	General Treatment
4.	Govt. Allopathic Hospital Karadi	4	General Treatment
5.	Govt. Allopathic Hospital Gadoli	4	General Treatment
6.	Govt. Allopathic Hospital Kaphnol	4	General Treatment
7.	Govt. Allopathic Hospital Rana	4	General Treatment
8.	Govt. Allopathic Hospital Rajgari	4	General Treatment
9.	Seasonal Dispensary Jankychatti	4	General Treatment
B. Ayurvedic Facilities			
1.	Govt. Ayurvedic Hospital Kndari	-	General Treatment
2.	Govt. Ayurvedic Hospital Gatu	-	General Treatment
3.	Govt. Ayurvedic Hospital Kunwa	-	General Treatment
4.	Govt. Ayurvedic Hospital Kotiyad	-	General Treatment
5.	Govt. Ayurvedic Hospital Chamkot	-	General Treatment
6.	Govt. Ayurvedic Hospital Kuthnor	-	General Treatment
7.	Govt. Ayurvedic Hospital Kharsali	-	General Treatment
8.	Govt. Ayurvedic Hospital Chamradi	-	General Treatment
9.	Govt. Ayurvedic Hospital Rajgari	-	General Treatment
10.	Govt. Ayurvedic Hospital Balari		General Treatment Facilities
C. Homeopathic Facilities			
1.	Govt. Homeopathic Hospital Jatun	-	General Treatment Facilities
2.	Govt. Homeopathic Hospital Syalna	-	General Treatment Facilities

Table 2.8: Inventory of Health Department , Tehsil :- Purola

S	Name of Hospital	No. of Beds	Available Facilities
A. Allopathic Facilities			
1.	P.H.C. purola	40	Pathology, X-Ray, Operation Theater, Medicine Store, jeep
2.	Mahila Hospital purola	4	Operation Theater, maternity Service, Family Planning Service
3.	Govt. Allopathic Hospital kumola	4	General treatment
4.	Govt. Allopathic Hospital gundiya Gaoun	4	General treatment
5.	P.H.C. mori	4	General treatment
6.	P.H.C. arakot	4	General treatment
7.	Govt. Allopathic Hospital natwar	4	General treatment
8.	Govt. Allopathic Hospital liwadi	4	General treatment
9.	Govt. Allopathic Hospital tikochi	4	General treatment
10.	Govt. Allopathic Hospital gangad	4	General treatment
B. Ayurvedic Facilities			
1.	Govt. Ayurvedic Hospital hudoli	-	General treatment
2.	Govt. Ayurvedic Hospital moltaldi	-	General treatment
3.	Govt. Ayurvedic Hospital pori	-	General treatment
4.	Govt. Ayurvedic Hospital Sarbadiyar	-	General treatment
5.	Govt. Ayurvedic Hospital Dobhal Gaoun	-	General treatment
6.	Govt. Ayurvedic Hospital Sankri	-	General treatment
7.	Govt. Ayurvedic Hospital Dhatmeer	-	General treatment
8.	Govt. Ayurvedic Hospital Jakhol	-	General treatment
9.	Govt. Ayurvedic Hospital Phitadi	-	General treatment
10.	Govt. Ayurvedic Hospital Dhoni		General treatment
11.	Govt. Ayurvedic Hospital Thadiyar		General treatment
12.	Govt. Ayurvedic Hospital Chutanu		General treatment
13.	Govt. Ayurvedic Hospital Chinwa		General treatment
C. Homeopathic Facilities			
1.	Govt. Homeopathic Hospital Mashri	-	General treatment

Table 2.9: Medical facilities are also available in the Institutes of Uttarakshi

S	Name of Institute	Telephone No.	Ambulance
1.	DGBR Tekhla	222268	1
2.	DGBR Bhatwari	-	-
3.	DGBR Bharonghati	-	-
4.	ITBP Matli	222505	
5.	NIM Ladari	222124	1
6.	Kalash ashram ujali	222361	1
7.	Bhirgu ashram	222705	-
8.	Shivanand ashram	-	-
9.	Pashupati ashram kotbangla	-	
10.	Meharsi Chikitsa Center	-	
11.	Shiva Nand Kutir Naitala	222624	

Table 2.10: List of Private Clinics

S.No	Name
1.	Sonam Clinic, Main Market
2.	Joshi Clinic, Ganga Mandir Marg
3.	Khanna Clinic, Main Market
4.	Dutta Clinic, Vishwanath Marg
5.	Uniyal Clinic, Bhairav Chowk
6.	OP Nautiyal Clinic, Gyansu
7.	Bisht Clinic, Gyansu
8.	Mehar Clinic, Lamgaon Road, Joshiyara
9.	Bhandari Clinic, Joshiyara

Table 2.11: List of Chemist Shops

S.No	Name of Chemist	Contact no
1	Avasthi Chemist, Bhairav Chowk	94123-94468
2	Shivalik Chemist, Bhairav Chowk	
3	Uniyal Chemist, Bhairav Chowk	222377
4	Prasad Medical, Bhairav Chowk	222295
5	Puri Medical Store, Vishwanath Chowk	222118
6	Vishwanath Medical, Vishwanath Chowk	
7	Sonam Medical, Hanuman Chowk	222209
8	Raja Chemist	226339
9	Ganga & Sons, Main Market	222160
10	Mishra Medical Store, Main Market	
11	Joshi Medical Store (Ganga Mandir Marg)	222598
12	Prakash Medical Store (Ganga Mandir Marg)	222492
13	Radhika Medical Store, Joshiyara	94120-27914
14	Pawar Medical Store, Joshiyara	
15	Vicky Medical Store, Gyansu	
16	Payal Medical Store, Joshiyara	98972-93383
17	Joshi Medical Store, Gyansu	94120-26883
18	Garhwal Pathology	222492
19	Om Pathology	222377
20	Lingwal Pathology	

Table 2.12: Tent Houses

S.No	Name	Contact Person	Contact no
1	Shivani Light & Tent	Dharmanand Misra	94129-8441398978-00691
2	Raja Tent House	Bhisma Rana	94111-45278
3	Kiran Tent House	Hari Bhatt	94113-32736
4	Ganga Tent House	Rajan Bisht	94115-19109
5	Chauhan Tent House	Khushal	94111-85825
6	Bholu Tent House	Bholu	93198-90650224535
7	Utsav Tent House		94124-72899
8	Rana Tent House		94111-45278

Table 2.13: Petrol Pumps

S.No	Name	Contact no
1	Bansal Petrol Pump, Uttarkashi	01374-222145
2	Vishawanath Filling Station, Matli	01374-235010
3	Petrol Pump, Chinyalisaur	01374-237118
4	Petrol Pump, Naugaon	01375-245215

Table 2.14: Kerosene Wholesellers

S.No	Name	Place	Contact no
1	Avinash Oil	Gangori	94120-56776
2	Jaideep Oil	Chungi Barethi	94129-98607
3	Sai Oil	Naugaon	94117-22072
4	Himalaya Oil	Rajgarhi	94120-46972
5	Avinash Oil	Purola	94120-56776

Table 2.15: Gas Agencies

S.No	Name	Place	Contact No
1	Garhwal Mandal Vikas Nigam	Uttarkashi	222264
2	Vishwanath Gas Service	Uki, Dunda	244999
3	Roshney Gas Service	Barkot	01373-223750
4	Garhwal Mandal Vikas Nigam	Purola	01375-245676
5	GMVN, Extension Counter	Naugaon	01375-245393
6	GMVN	Chinyalisaur	237181

Block wise Education Department, District Uttarkashi**Table 2.16: Other Registered and Private Colleges, District Uttarkashi**

S.No	Name of Private College	Contact No.
1	Goswami Ganesh Dutt Inter College	222450
2	Adya Shankaracharya Shikshan Sansthan Intert College, Joshiyara	222883
3	Babu Nand Kishore Shikshan Sansthan, Kotbangla	222432
4	Rishi Ram Shikshan Santha	222694
5	Maharishi Vidya Mandir, Gyansu	
6	Suman bal Vatika Highschool, Gyansu	223158
7	Central School, Manera	222663
8	Masiha Dilasa School, Tiloth	222279

Table 2.17: Email-Directory

Designation / Office	E-Mail Address
District Magistrate	dm-utt-ua@nic.in
Suptt. of Police	sp-utt-ua@nic.in
Sr.Treasury Officer,Uttarkashi	treas-utt-ua@nic.in
Treasury Officer,Purola	treas-pur-ua@nic.in
Distt. Economics & Statistical Officer (DEStO)	dsto-utt-ua@nic.in

Table 2.18: Telephone Directory

Designation / Office	Phone Office
District Administration	
District Magistrate	01374-222280 Phone: 01374-222280 ,Fax-222119 Camp Off.- 222101
A.D.M.	01374-222109 Phone 01374-222109 , 224840(R)
S.D.M., Bhatwari	01374-222166 Phone 01374-222166
S.D.M., Dunda	01371-225405 Phone 01371-225405

S.D.M., Barkot	01375-224423 Phone 01375-224423
S.D.M., Purola	01373-223321 Phone 01373-223321
Tehsildar, Bhatwari	01374-244322 Phone 01374-244322
Tehsildar Dunda	01371-225405 Phone 01371-225405
Tehsildar Barkot	01375-224201 Phone 01375-224201
Tehsildar Purola	01373-223200 Phone 01373-223200
Tehsildar Mori	01373-234323 Phone 01373-234323
Tehsildar Chinyalisaur	01371-237893 Phone 01371-237893
Judiciary	
Distt. Judge	01374-222287 Phone 01374-222287
Chief Judicial Magistrate	01374-222142 Phone 01374-222142
Police Department	
Superintendent of Police	01374-222116 Phone 01374-222116 , 222102 (R)
Thana Uttarkashi	01374-222219 Phone 01374-222219
Thana Maneri	01374-236204 Phone 01374-236204
Thana Dharasu	01371-237203 Phone 01371-237203
Thana Barkot	01375-224241 Phone 01375-224241
Thana Purola	01373-223347 Phone 01373-223347
Fire Service	01374-222201 Phone 01374-222201
Other Departments	
Chief Development Officer	01374-222724 Phone 01374-222724
District Development Officer	01374-223444 Phone 01374-223444
B.D.O. , Bhatwari	01374-244349 Phone 01374-244349
B.D.O. , Dunda	01371-225410 Phone 01371-225410

B.D.O. ,Chinyalisaur	01371-237283 Phone 01371-237283
B.D.O. ,Naugaon	01375-245228 Phone 01375-245228
B.D.O. ,Purola	01373-223367 Phone 01373-223367
B.D.O. ,Mori	01373-234402 Phone 01373-234402
Project Director, DRDA	01374-222269 Phone 01374-222269
Chief Agriculture Officer	01374-226057 Phone 01374-226057
Chief Veterinary Officer	01374-222320 Phone 01374-222320
District Horticulture Officer	01374-222143 Phone 01374-222143
District Social Welfare Officer	01374-223731 Phone 01374-223731
District Panchayat Raj Officer	01374-222327 Phone 01374-222327
District Stat. & Eco. Officer	01374-222292 Phone 01374-222292
Project Officer UREDA	01374-222538 Phone 01374-222538
GM District Industry Centre	01374-222744 Phone 01374-222744
District Supply Officer	01374-223839 Phone 01374-223839
Regional Tourist Officer	01374-223573 Phone 01374-223573
Adventure Tourism Officer	01374-223573 Phone 01374-223573
District Sport Officer	01374-212007 Phone 01374-212007
District Employment Officer	01374-222134 Phone 01374-222134
District Information Officer	01374-222213 Phone 01374-222213
District Informatics Officer	01374-222668 Phone 01374-222668
Distt. Soldier Welfare Officer	01374-223305 Phone 01374-223305
Distt. Commandant HomeGuard	01374-222318 Phone 01374-222318
Commandant ITBP , Matli	01374-222504 Phone 01374-222504 ,222183
Commandant ITBP, Mahidanda	01374-222169 Phone 01374-222169
Disaster Management Officer	01374-226126 Phone 01374- 226126 ,226461(F),1077(Tollfree),7500337269

Distt. Youth Welfare Officer	01374-223468 Phone 01374-223468
A.R. Cooperative ,Uttarkashi	01374-226137 Phone 01374-226137
Asstt. Comm. Tax Circle	
Office,Uttarkashi	01374-226036 Free 01374-226036
A.R.T.O.,Uttarkashi	01374-211174 Phone 01374-211174
Health Services	
Chief Medical Officer	01374-222106 Phone 01374-222106
C.M.S. ,Distt. Hospital	01374-222103 Phone 01374-222103
Dy. CMO, Distt. Hospital	01374-222738 Phone 01374-222738
Dy. CMO, Distt. Hospital	01374-223249 Phone 01374-223249
Distt. Ayurvedic Unaani Officer	01374-226577 Phone 01374-226577
Red Cross	01374-222738 Phone 01374-222738
Engineering Services	
Superintendent Engineer, PWD,13th Cir., Uttarkashi	01374-222127 Phone 01374-222127
Ex. En. ,Maneri Bhali Const.,Stage-2 Uttarkashi	01374-222249 Phone 01374-222249
Ex. En. (Prov. Div.) PWD,Uttarkashi	01374-222108 Phone 01374-222108
Ex. En.,PWD, Joshiyara	01374-222970 Phone 01374-222970
Ex. En.,PWD, Bhatwari	01374-244321 Phone 01374-244321
Ex. En.,PWD, Purola	01373-223324 Phone 01373-223324
Ex. En. Rural Engineering Services	01374-222326 Phone 01374-222326
S.E. Irrigation,Uttarkashi	01374-223952 Phone 01374-223952
Ex. En. Irrigation,Uttarkashi	01374-222131 Phone 01374-222131
Ex. En,Elec.Distribution Div.,Uttarkashi	01374-222178 Phone 01374-222178

S.D.O.,Power House,Tiloth	01374-222163	01374-222163
Ex. En. Jal Nigam, Uttarkashi	01374-222135	Phone 01374-222135
Ex. En. Jal Sansthan,Uttarkashi	01374-222206	Phone 01374-222206
Project Manager , Swajal Dhara	01374-223403	Phone 01374-223403
Education Departments		
District Education Officer	01374-222122	Phone 01374-222122
ADEO (Basic)	01374-224318	Phone 01374-224318
P.G. College,Uttarkashi	01374-222148	Phone 01374-222148
G.I.C , Uttarkashi	01374-226565	Phone 01374-226565
G.G.I.C, Uttarkashi	01374-222632	Phone 01374-222632
Polytechnic Uttarkashi	01374-222240	Phone 01374-222240
Central School,, Uttarkashi	01374-222263	Phone 01374-222263
Goswami Ganesh Dutt Sarawat Vidya Mandir, Main Market, Uttarkashi	01374-222450	Phone 01374-222450
Forest Departments		
Divisional Forest Officer, Uttarkashi	01374-222444	Phone 01374-222444
D.L.M.,Forest Div. , Uttarkashi	01374-222196	Phone 01374-222196
DFO, Apar Yamuna Forest Div., Barkot	01375-224233	Phone 01375-224233
DFO ,Soil Conservation	01374-222257	Phone 01374-222257
Tehri Dam, Forest Div.	01374-222315	Phone 01374-222315
DFO , Tauns Forest Div., Purola	01373-223328	Phone 01373-223328
Treasury/Bank/Post Office		
Senior Treasury Officer	01374-222308	Phone 01374-222308
Superintendent of Post, Uttarkashi	01374-222229	Phone 01374-222229

Leed Bank Officer	01374-222235	Phone 01374-222235
S.B.I , Uttarkashi	01374-222895	Phone 01374-222895
P.N.B. , Uttarkashi	01374-222156	Phone 01374-222156
Oriental Bank of Commerce, Uttarkashi	01374-223371	Phone 01374-223371
Ganga Jamuna Gramin Bank,Uttarkashi	01374-222353	Phone 01374-222353
Sahakari Bank , Uttarkashi	01374-222246	Phone 01374-222246
Asstt. Director, Small Saving	01374-222259	Phone 01374-222259
Branch Manager, L.I.C. , Uttarkashi	01374-222285	Phone 01374-222285
Election Officer		
Distt. Election Officer	01374-222177	Phone 01374-222177
Distt. Election Officer (Panchsthani)	01374-222613	Phone 01374-222613
Local Bodies		
Jila Parishad	01374-222158	Phone 01374-222158
NagarPalika	01374-222265	Phone 01374-222265
Miscellaneous		
Registrar Nehru Instt. of Mountaineering	01374-222123	Phone 01374-222123 , 224663, 223344(Fax.)
Petrol Pump , Uttarkashi	01374-222145	Phone 01374-222145
Bus Stand TGMO, Uttarkashi	01374-222154	Phone 01374-222154
Taxi Stand, Uttarkashi	01374-222399	Phone 01374-222399
Telephone Complaint , Uttarkashi	01374-222199	Phone 01374-222199 ,01374- 222437
Gas Service, Uttarkashi	01374-222264	Phone 01374-222264
Tourist Rest House, Uttarkashi	01374-222271	Phone 01374-222271

Petrol Pumps		
Bansal and Co. Petrol Station, Main Bus Stand, Uttarkashi	01374-222145	Phone 01374-222145
Srishti Service Station ,Purola, Uttarkashi-249185	01373-223651 223651 , 09411726787 Phone 09411726787 ,09720465996 Phone 09720465996	Phone 01373-
Banking/Post Offices/Lic Services		
Senior Treasury Officer	01374-222308	Phone 01374-222308
Superintendent of Post, Uttarkashi	01374-222229	Phone 01374-222229
Leed Bank Officer	01374-222235	Phone 01374-222235
State Bank of India , Uttarkashi	01374-222895	Phone 01374-222895
Punjab National Bank , Uttarkashi	01374-222156	Phone 01374-222156
Oriental Bank Of Commerce, Uttarkashi	01374-223371	Phone 01374-223371
Ganga Jamuna Gramin Bank, Uttarkashi	01374-222353	Phone 01374-222353
Distt. Co-operative (Sahakari) Bank , Uttarkashi	01374-222246	Phone 01374-222246
Asstt. Director, Small Saving	01374-222259	Phone 01374-222259
Branch Manager, L.I.C. , Uttarkashi	01374-222285	Phone 01374-222285
Transportation Facilities		
Bus Stand TGMO, Uttarkashi	01374-222154	Free 01374-222154
Taxi Stand, Uttarkashi	01374-222399	Phone 01374-222399
Mobile Shops		
Arjun Communications,Main Market, Uttarkashi	09412027195 Phone 09412027195	

Computer And Accessories Shop		
Network Computer Centre,Joshiyara,Uttarkashi	09410177908	Phone 09410177908
Cooking Gas Agency		
Vishwanath Gas Service Agency, Gangotri Road, Gyansu , Uttarkashi (HP gas)	01374-224999	Phone 01374-224999
Uttarkashi Gas Service,Gas Godown, Gyansu, Uttarkashi (Indane gas)	01374-222264 222264 , 01374-224609 Phone 01374-224609	Phone 01374-
Courier Services		
Dhawan PCO & Courier,Main Market, Uttarkashi	01374-223526	Phone 01374-223526
Cyber Cafe For Inerter Access Facility		
Cyber World,Main Market, Uttarkashi	01374-226366	Phone 01374-226366
Choice Computer,Bhatwari Road, Uttarkashi	01374-223601	Phone 01374-223601
Shiv Electric House,Near Session Court,Court Road, Uttarkashi	01374-224171	Phone 01374-224171
Cyber Zone,Opposite Hotel Akash Ganga,NIM Road, Uttarkashi	01374-226599	Phone 01374-226599
Dharmshalas/Ashrams		
Baba Kali Kamli Ashram and Dharamshala,Baba Kali Kamli Panchayat kshetra, Uttarkashi	01374-222239	Phone 01374-222239

Dandi Kshetra Yatri Niwas, Gandhi Marg, Uttarkashi	01374-222587	Phone 01374-222587
Swami Yogeshwarananda Saraswati Ashram,Near Kedar Ghat, Uttarkashi	01374-222615	Phone 01374-222615
Punjab Sindh Kshetra Trust Ashram,Near Kedar Ghat, Uttarkashi	01374-226176	Phone 01374-226176
Punjab Sindh Kshetra Trust Ashram,Near Kedar Ghat, Uttarkashi	01374-226176	Phone 01374-226176
Abdhuta Mandal Ashram, Bhatwari road	01374-223386	Phone 01374-223386
Birla Dharmshala,Bus Stand, Uttarkashi	--	
Kedarnath Mandir Dharmshala, Kedar Ghat Road, Uttarkashi	01374-222321	Phone 01374-222321
Sri Kailas Ashram ,Gangotri Road, Uttarkashi 01347-222361		
Community Halls/ Auditoria/Baratghar		
Shri Bhuvaneshwari Mahila Ashram ,Joshiyara, Near LIC, Building, Uttarkashi	01374-223208	Phone 01374-223208
Bhagirathi Wedding Point, Joshiyara, Uttarkashi	01374-222383	Phone 01374-222383
Emergency Services		
Snow Spider Search and Rescue Team,Ladari, Uttarkashi		

Disaster Management team (Aapda Prabandh team), Police Lines, Gyansu, Uttarkashi	01374-222102 ,222140	Phone 01374-222102
Thana, Uttarkashi	01374-222219	Phone 01374-222219
Fire Service ,Gangori, Uttarkashi	01374-222201	Phone 01374-222201
Medical Store/Nursing Home		
District Hospital , Uttarkashi	01374-222103	Phone 01374-222103
Prasad Medical Store,Vishwanath Road, Uttarkashi	01374-222295	Phone 01374-222295
Vishwanath Medical store, Vishwanath Chowk, Uttarkashi	01374-222793	Phone 01374-222793
Hari Singh Govind Singh Rana Chemists and Druggists, Main Market, Uttarkashi	01374-222157	Phone 01374-222157
Ganga & Sons Chemists and druggists, Main Market, Uttarkashi	01374-222160	Phone 01374-222160
Mishra Medical Hall , Main Market, Uttarkashi	09412077657	Phone 09412077657
Khanna Clinic, Main Market, Uttarkashi	01374-222647	Phone 01374-222647
Om Pathology Lab, Bhairon Chowk, Uttarkashi	09412027904	Phone 09412027904
Government Accommodation		
PWD Guest House Uttarkashi, Collectorate Road, Uttarkashi	Permission From District Magistrate, Uttarkashi, Collectorate Road Uttarkashi	
GMVN, Uttarkashi,Near Tilothe Pul, Barahat,Uttarkashi Booking :Log on to	01374-222271 Phone 01374- 222271 , 01374-222222 Phone 01374-222222	

www.gmvnl.com/newgmvn/ touristbunglows/ or contact the GMVN Yatra Office at Rishikesh	
Forest Guest house ,Uttarkashi district	01374-222444 Phone 01374-222444 Permission From Division Forest Officer (Dfo) Uttarkashi
Shikhar Nature Resort,Garam Pani, Ganeshpur, Uttarkashi . Url : www.naturecampsindia.com	01374-223762 Phone 01374- 223762 ,011-23323660 Phone 011-23323660 (Fax)
Shivom Hotel,Uttarkashi	01374-222880 Phone 01374-222880
Hotel Akash Ganga,NIM Road, Joshiyara, Uttarkashi	01374- 222440 Phone 01374- 222440
Shivananda Hotel,Main Bus Stand, Uttarkashi	01374-222574 Phone 01374-222574
Mahima Resort,Netala, Distt. Uttarkashi	01374-222252 Phone 01374-222252
Hotel Bhandari Annexe, Gangotri Road, Uttarkashi	01374-222384 Phone 01374-222384
Vijay Raj Residency,Gangotri Highway, Uttarkashi	01374-222334 Phone 01374-222334
Hotel Varun,Bhatwari Road, Uttarkashi	9412984480 Phone 9412984480
Hotel Satyam Tourist Complex, Tiloth Marg, Uttarkashi	01374-222566 Phone 01374-222566
Hotel Himanshu,Bhatwari Road, Uttarkashi	01374-222735 Phone 01374-222735
Hotel Hanslok,Hanuman Chowk, Uttarkashi	01374-222324 Phone 01374-222324
Rawat Guest House ,Mall Road, Uttarkashi	01374-222385 Phone 01374-222385

Table 2.19: List of Facilities, Resources, Agencies and DMCs

S.No	Name	STD Code	Ph. -Off	Ph.-Resi	Fax No.
1	Chief Minister	0135	2665090	2755100	2665722
2	E.O.C. state level	0135	2712093		712114
3	D M M C Dehradun	0135	2710232	2710233	
4	Chief Secretary Uttaranchal	0135	2711100 / 2712200	2712079	2712500
	Secretary Disaster Management	0135	2712094	2721599	2712113
6	Add. Secretary Disaster Mgm.	0135	2712809	2733396	
7	Divisional Commissioner	01368	222564	222563	222378
8	D M	01374	222280	222101 / 9412077101	222119
9	ADM	01374	222109	9412077109	
10	DPO Disaster Management	01374	226126	9412347265	
11	S P	01374	222116		222116
12	DCR Uttarkashi	01374	226126		
13	Disaster Management Cell Nainital	05942	235011		237642
14	Officer Incharge (Relief)	01374	222121		
15	Control Room at Tehsil level				
	i. Bhatwari	013744	224322		
	ii. Dunda	013712	225405		
	iii. Barkot	013752	224423		
	iv. Purola	013732	223321		
16	CDO Uttarkashi	01374	222724	222181	222269
17	District Judge	01374	222287	222289	
18	Project Director DRDA	01374	222269	224646	222269
19	District Dev. Officer	01374	223444	222190	
20	C.M.O. Uttarkashi	01374	2221106		
21	MP Tehri	011	23782818	01376- 227306	
22	Vidhayak Gangotry	013740135	223204 2669657	222277	

23	Vidhayak yamunotry	013710135	237215 2520187	237207	
24	Vidhayak Purola	013732	223746		
25	Chairman District Panchayat	01374	222158	222317 941277158	
26	Block Pramukh dunda	013712	225678	9412380116	
27	Block Pramukh Bhatwari	01375	244349		
28	Block Pramukh Chinyalisour	013712	237283		
29	Block Pramukh Naougaoun	013732	225270		
30	Block Pramukh Purola	013732	223367	223593	
31	Block Pramukh Mori	013732	223301		
32	Fire service Department	01374	222201		
33	SDE Telephone Uttarkashi	01374	222456	222455 / 9412000729	223434
34	Hospital Uttarkashi	01375	222103		
35	Hydil Uttarkashi	01374	222138		
36	Nagar palika Uttarkashi	01374	222265		
37	B. M. LIC Uttarkashi	01374	222285		
38	Electricity maintainanc and Supply Dept.	01374	222174		
39	Bus station Uttarkashi	01374	222154		
40	Taxi stand Uttarkashi	01374	222399		
41	Petrol Pump Uttarkashi	01374	222145		
42	Ex. Engi. Center water commissionDehradun	0135	2761562	27606311	2765995
43	Director Doordarshn CenterDehradun	0135	2789010	2677441	
44	Doordarshn Center Uttarkashi	01374	223384		
45	Director Askash wani Najibabad	01341	230098	230137	230114
46	Director Geological surveyof India Dehradun	0135	2765097 / 2769034	2720953	
47	Survey of India Dehradun	0135	2744268	2744064	2744804

48	Akashwani center- Ladari, Uttarkashi	01374	222631		
49	Red cross socity Uttarkashi		222738		
50	Garhwal mandal vikash nigam	01374	222290 / 222222		
51	Tourist guest house	01374	274761		
52	TGMOU LTD. Rishikesh	0135	2430074		
53	Taxi				
54	Yatra Office Rishikesh	0135	2431783 / 2431793		
55	Vice President Char Dham Vikash Parishad, Dehradun	0135	2666755/ 2666704		
56	Badri- Kedarnath mandir Samitti	0135	2430261		

Table 2.20: Tourist rest Houses in Uttarkashi

S	Name of Rest House	Phone No.	Available No. of Beds
1.	Tourist rest House Chinyalisour	013713-237393	04
2.	Tourist rest House Uttarkashi	01374-222271	120
3.	Tourist rest House Harsil	013773-22210	30
4.	Tourist rest House Lanka		100
5.	Tourist rest House Bhairaw Ghati		32
6.	Tourist rest House Gangotri	013772-22221	82
7.	Tourist rest House Bhojvasa		20
8.	Tourist rest House Barkot	013752-24326	44
9.	Tourist rest House Syanachatti		18
10.	Tourist rest House Hanumanchatti		30
11.	Tourist rest House Janakichatti		78
12.	Tourist rest House Sankri		20
13.	Tourist rest House Taluka		20
14.	Tourist rest House Osla		20
15.	Tourist rest House Har Ki Doon		20

Tehsil / Block level Disaster Management Committees**Table 2.21: Disaster Management Committee, Tehsil / Block- Bhatwari**

S.	Designation /Department	Telephone No.	
		Office	Residence
1.	SDM Bhatwari (Chairman)	222166	225055
2.	CO, Uttarkashi	222116	222778
3.	Divisional Forest Officer	222444	225366
4.	In-charge Medical Officer (PHC Bhatwari)	244326	244357
5.	Block Development Officer	244349	
6.	Tehshildar Bhatwari	244322	
7.	Principal G. I.C. Bhatwari	244309	
8.	Ex. Engineer PWD Bhatwari	244321	244327
9.	Ex. Engineer Jal Nigam Uttarkashi	222135	222120
10.	Assist. Engineer Tele Communication Bhatwari	244399	
11.	Representative Maneri Bhali Project	222436	222369
12.	Ex. Engineer Power/ Irrigation	223952	223854
13.	Commandant ITBP Maidanda	222183	222186
15.	Fire Service Officer Gangori	222201	
15.	Block Pramukh Bhatwari		

Table 2.22: Disaster Management Committee, Tehsil- Barkot / Block- Naogaon

S.	Designation /Department	Telephone No. Office
1.	SDM Barkot (Chairman)	01375-224423
2.	Assistant Superintendent of Police	01374-222778
3.	Subdivisional Forest Officer, Yamuna Forest Division	01375-224233
4.	In-charge Medical Officer (PHC Naougoaun)	01375-245357
5.	Block Development Officer	01375-225228
6.	Tehshildar	01375-224201
7.	Principal P.G. College Barkot	01375-224426
8.	Ex. Engineer PWD	
9.	Assist. Engineer Jal Sansthan Barkot	01375-224105
10.	Assist. Engineer Irrigation Department Barkot	01375-224610
11.	Block Pramukh Naougaoun	01375-225270
12.	Land conservation Officer	01375-224246
13.	Assist. Engineer Haidill Department	01375-224231
14.	President Nager Palika Barkot	01375-224252

Table 2.23: Disaster Management Committee, Tehsil- Dunda

S.	Designation /Department	Telephone No. Office
1-	SDM Dunda (Chairman)	225405
2-	SHO (Police Station) Uttarkashi	222219
3-	SHO (Police Station) Dharasu	237203
4-	Block Development Officer Chinyalisour	237283
5-	Block Development Officer Dunda	225228
6-	Tehshildar Dunda	225454
7-	Principal G.I.C.Dunda	
8-	Principal G.I.C. Chinyalisour	
9-	Pramukh chetra Panchayata,Chinyalisour	
10-	Pramukh chetra Panchayata, Dunda	

Table 2.24: Disaster Management Committee Block- Dunda

S.	Designation /Department	Telephone No. Office
1-	SDM Dunda (Chairman)	225405
2-	SHO (Police Station) Uttarkashi	222219
3-	Block Development Officer Dunda	225228
4-	Tehshildar Dunda	
5-	Pramukh chatra Panchayata, Dunda	
6-	In-charge Medical Officer Dunda	
7-	Assist. Engineer Jal Nigam	222135
8-	Assist. Engineer PWD	
9-	Assist. Engineer Jal Sansthan	222366
10-	Assist. Engineer Irrigation Department	
11-	Sub divisional Officer Haidill Department Chinyalisour	
12-	Block Education Officer Dunda	
13-	Block Organizer, PVD.	
14-	Fire service Officer Uttarkashi	101

Table 2.25: Disaster Management Committee, Block- Chinyalisaur

S.	Designation /Department	Telephone No. Office
1-	SDM Dunda (Chairman)	225405
2-	SHO (Police Station) Dharasu	237203
3-	Block Development Officer Chinyalisour	237283
4-	Tehshildar Dunda	
5-	Pramukh chatra Panchayata, Chinyalisour	
6-	In-charge Medical Officer Chinyalisour	
7-	Assist. Engineer Jal Nigam	222135
8-	Assist. Engineer PWD	222971
9-	Assist. Engineer Jal Sansthan	222366
10-	Assist. Engineer Irrigation Department	237703
11-	Sub divisional Officer Haidill Department	
12-	Block Education Officer Chinyalisour	
13-	Block Organizer PWD.	
14-	Fire service Officer Uttarkashi	101

Table 2.26: Disaster Management Committee , Tehsil / Block- Purola

S.	Designation /Department	Telephone No.	
		Office	Residence
1-	SDM Purola (Chairman)	223321(Fax- 223321)	223331
2-	SHO (Police Station) Purola	223347	
3-	Block Development Officer Purola	223367	
4-	Tehshildar Purola	223200	
5-	Block Pramukh Purola		223593
6-	Medical Officer In-charge Purola	223845	
7-	Ex. Engineer PWD Purola	223324 (Fax-223324)	223323
8-	Assist. Engineer Jal Sansthan		
9-	Ex. Engineer Irrigation Division	223325	223863
10-	Assist Engineer Haidill Department Purola	223528	
11-	Divisional Forest Officer Tonce	223328	
12-	Principal G.I.C. Purola		
13-	Principal P.G.College. Purola	223018	
14-	Jilla Panchayat member Chandali		223645
15-	Jilla Panchayat member Sukdali		

Table 2.27: Disaster Management Committee, Block- Mori

S.	Designation /Department	Telephone No.	
		Office	Residence
1-	SDM Purola (Chairman)	223321(Fax- 223321)	223331
2-	Tarajary Inspector Thadiyar		223244
3-	Tarajary .Inspector. Naitwar		223237
4-	Block Development Officer Mori	239402	
5-	Tehshildar Mori	223200	
6-	Block Pramukh, Mori	223301	
7-	In-charge Medical Officer Mori		
8-	Assist. Engineer PWD Purola	223324	
9-	Assist Engineer R.E.S. Mori	223152	
10-	Assist. Engineer Irrigation Division	223325	
11-	Assist Engineer Haidill Department Purola	233384	
12-	Rang Forest Officer siktur	233452	
13-	Principal G.I.C. Mori		
14-	Jilla Panchayat member Naitwar	237001	
15-	Jilla Panchayat member Arakot	237009	

Table 2.28: List of Search & Rescue Team Police Department Uttarkashi

S.No	Group No.	Name (Shri)	Designation
1.	-	. Kundan Lal Arya	Sub Inspector
2.	37	Arvind Kumar	Head Constable
3.	158	Lakhpati singh	Constable
4.	143	Anil Kumar	Constable
5.	138	Ashok Kumar	Constable
6.	159	Kiran Kumar	Constable
7.	64	Vinod Kumar	Constable
8.	156	Sanjay Kumar	Constable
9.	77	Pramod Kumar	Constable
10.	151	jyoti Prasad	Constable
11.	136	Vipin Chauhan	Constable
12.	48	Ramesh Rawat	Constable
13.	73	Bachan singh	Constable

14.	135	Dinesh singh	Constable
15.	12	Umesh Negi	Constable
16.	66	Subhash Rawat	Constable
17.	10	Bharat singh	Head Constable
18.	99	Arun Kumar	Constable
19.	52	Boby singh	Constable
20.	58	Sunil Kumar	Constable
21.	25	Styandra singh	Constable
22.	88	Dharm singh	Constable
23.	32	Deepak Mathani	Constable
24.	89	Suresh Kumar	Constable
25.	70	Oshaph Khan	Constable
26.	155	Jayapal singh	Constable
27.	139	Dinesh Samwal	Constable
28.	147	Ashok Rana	Constable
29.	150	Sanjay Kumar	Constable
30.	57	vijyandra Kandapal	Constable
31.	90	Manoj Kumar	Constable
32.	-	Arvind singh	Constable
33.	-	surat singh	Constable
34.	-	Atar singh	Constable
35.	-	kalmi Ram	Constable

Table 2.29: List of NGOs

S.	Name of NGO	Official Address	Residential Address
1	Uttaranchal Devi Apda Peedit Sahayata Samiti	Camp Office keshavpurm, Maneri UKI	Dr. Manmohan,10 Convent Road, Dehradun
2	Gramopyogi Vigyan evam Proddhogiki Vikas Kendra Kakari Road,Puroal UKI	Puroal Near Munsif Magistrate Court	Dr. Prahlad Singh Rawat,Vill. Kalari, PO Puroala UKI
3	Preeti Kalyan evam Balothan Samiti,Pashupati Ashram Kot Bangla UKI	Pashupatipati Ashram Kot Bangla UKI	Kishore Chauhan Vill. Kiran,PO Tikochi Mori,UKI
4	Janjati Mahila Kalyan evam Balothan Samiti,Barkot Surkhet UKI	Camp Office ,690 Court Road UKI	Smt. Shanti Thakur Vill. Barnala,PO Chivan UKI
5	Gangotri Prayavaran Saranshan evam Samajothan Samiti Bhatwari UKI	Radha Bhawan Baldev Bazar,Bhatwari	Dharmendra Singh Rana,Vill. Purali PO Jhala UKI
6	Mahila Utthan evam Vikas Sanshthan ,Gainwla ,Brahmkhal Uki	Gainwla,Brahmkhal UKI	Karan Singh vill. Panath,Bhandarsyun UKI
7	Uttaranchal Mahila Visas Commiittee, Barkot UKI	Barkot UKI	Smt. Rukmani vill &PO Barkot UKI
8	Badri Vishal Prashikshan Birla Gali Parisar Bhawan UKI	NIM ,Joshiyara UKI	Harihar Prasad Srivastava,Birla Gali UKI
9	Kalyan Samiti, Monda Dhanpur, PO Chivan UKI	Tekhala UKI(Gangori)	Mahanand Singh Rana vill &PO Chivan UKI
10	Gramin Mahila Vikas Samiti Vill. Chhivali, PO Puroala UKI	Chhivali,Puroala UKI	Guru Prasad Bijlwan Bijlwan Medical store Puroala UKI
11	Himtaskh Sahsik Sewa Samiti Gainwala,Brahmkhal UKI	Gainwal,Brahmkhal UKI	S L Bharti ,Gainwla Brahmkhal UKI

12	Yamuna Ghati Vikas Samiti Nagar Panchayat, Barkot UKI	Nagar Panchayat Barkot UKI	Kirtan Singh ward no. 2 ,Nagarpalika Barkot
13	Nav Yuvak Viskas Samiti Shinghot Barsali UKI	Shinghot Barsali UKI	Kulbeer Singh Vill Shinghot PO Barsali UKI
14	Gramin Mahila Sewa Sansthan Naugaon UKI	Naugaon UKI	Rajkumar Singh Naugaon UKI
15	Uttaranchal Mahila Vikas Sansthan Matli UKI	Matli Uki	Smt. Savitri Semwal Matli UKI
16	Rawai Janjati Gramodyog Vill. Agoda PO Purola UKI	Vill, Agoda(Purola) UKI	Davadoma, Vill. Agoda PO Purola UKI
17	Bahuddeshiya Mahila Kalyan evam Hastsilp Vikas Sanssthan Pipalkhanda,Gamri Uki	Pipalkhanda,Rauntal UKI	Smt. Anandi Devi Vill. Pipalkhanda Rauntal UKI
18	Himalika Mahila Rojgar Vikas evam Prashikshan Kendra, Ganeshpur UKI	Ganeshpur UKI	Smt. Hema Gairola Ranchipura (Bamangali) Majra,Dehradun
19	Nav Chetan Vikas Sanssthan Vill. & PO New Barsali UKI	New Barsali UKI	Tejendra Singh Bist New Barsali UKI
20	Devvan Gramodyog Vikas Sansthan Dagoli(Tikochi) UKI	Dagoli(Tikochi) UKI	Smt. Ela devi Dagoli(Tikochi) UKI
21	Gayatri Shiksha Samiti Barkot UKI	Barkot UKI	Shankar Prasad Chamoli Barkot UKI
22	Vikas evam Lok Prasar Samiti Naitala UKI	Naitala UKI	Smt. Dilla Devi Naitala UKI
23	Mahila Jagriti Sansthan Sald UKI	Sald UKI	Smt. Bhuvneshwari Nautiyal,Vill & PO Sald UKI
24	Harkidoon Gramodyog Vikas Sanssthan ,Dhatmeer UKI	Dhatmeer Uki	Bhajan Singh Rawat Dhatmeer, UKI
25	Ashiya Shiksha Evan Prashikshan Sansthan ,Dhanpur,1/2 Pushpvihar Dharampur,Dehradun	Camp Office ,Near Semwal Cloth House UKI	Km. Pratima Pant1/2,Pushpvihar ,DDN

26	Adarsh Gramodyog Sewa Mandal Sansthan, Main Bazar ,hanuman Chowk UKI	Main Bazar,Hanuman Chowk UKI	Smt. Prabha Chauhan Main Bazar,UKI
27	Bharat Ratna Bhim Rao Ambedkar Bahuuddeshiya Samiti Barkot UKI	Barkot UKI	Bachan Lal Rongta Vill. Ponti,Barkot UKI
28	Mahila Jagriti Evam Chetana Samiti ,Harshil,Gangori UKI	Harshil Gangori UKI	Smt. Gayatri Semwal Gangori UKI
29	Uttarakhand Mahila Vikas Samiti Bon UKI	Bon UKI	Smt. Urmila Padiyar Bon UKI
30	Airospace and Communication Education Welfare Society Block -I ,Karanpur DDN	Karanpur,Dehradun	Vipin Panchhi, 88,Dharampur Chowk DDN
31	Uttarakhand Jan Jagriti Samiti UKI	Mandir Marg,Purola Uki	Trepan Singh Rajwar Mandir Marg Purola
32	Gramin Shramik Utthan Samiti Barkot Uttarkashi	Kanderu .Barkot Uki	Gajendra Singh Rana Near Tehsil Barkot
33	Alfrasco Adventure and Environment Conservation Samiti UKI	Uttarkashi	Madan Singh Gosain UKI
34	Himalaya ITI ,Joshiyara UKI	Joshiyara Uki	Smt. Vijaylakshmi
35	Gangotri Alan Gramodyog Sansthan Gagori UKI	Gangori UKI	Smt. Manju Rana Gangori UKI
36	Himalayan Jan Kalyan Samiti Nakuri UKI	Nakuri UKI	Man Singh Nakuri UKI
37	Himalayan Jan Kalyan Samiti Ishali UKI	Ishali(Arakot)	Chain Singh Rana Vill. Ishali PO Arakot
38	Uttaranchal Mahila Utthan Gaur Sadan UKI	Gaur Sadan UKI	Smt. Prabhawati Gaur Gaur Sadan Uki
39	Society For Himalayan Training & Guidance ,22/10 , Nanhi Duniya School marg,Dehradun	Dehradun	Vinayak Badoni Dehradun(Vikasnagar)
40	Society for Himalayan Environment Research,Sher Chakrota Road Vikasnagar , DDN	Dehradun	Dr. SS Rawat Vill. Silla, Gumiyaana Patalidhar,Agastmuni

41	Mahila Utthan Samiti Barkot UKI	Barkot UKI	Smt. Dasrathi Devi Barkot UKI
42	Lakshya Kalyan Samiti, MIG Flats, Kedar Marg UKI	Kedar Marg Uki	Lokendra Singh Bisht MIG Flats UKI
43	Gangotri Yamunotri Prayavaran Sansthan ,Kandari ,Barkot Uki	Barkot UKI	Syam Lal Gaur Kandari,Godar UKI
44	Samaj kalyan Samiti Barkot UKI	Oadgaon ,Barkot	Ram Chandra Bahuguna Oadgaon, Naugaon UKI
45	Rastriya Jalvayu Pradushan Nivaran Sansthan,AIEM ,Joshiyara UKI	Joshiyara UKI	L S Tariyal NIM Road, Joshiyara UKI
46	Pravatiya Vikas Sansthan ,Dunda UKI	Dunda UKI	Sri Uniyal Dunda, Uttarkashi
47	Kalp Vikas Sansthan Uki	Hitanu UKI	Purna Nand Bhat Vill. Asthal PO Ranari, UKI
48	Gramin Mahila Sansthan, Barkot UKI	Naugaon UKI	Rajkumar Singh, Vill, &PO Naugaon UKI
49	Jai Ma pashulok Sewa Samiti Dhauntri UKI	Dhauntri UKI	Jayanti Lal ,Vill & PO Dhauntri UKI
50	Varun Gramodyog Society Matli UKI	Barethi,Matli UKI Vill. Barethi,Matli UKI	Pratap Singh Rana,
51	Himalayan trekkers sankri samiti	P.O- sankri, Mori	Bharat singh rawat P.O. Sankri, Mori
52	Society for environment and employment development (seed)	NIM road, Joshiyara Uttarkashi	NIM road, Joshiyara Uttarkashi
53	UMA Himalayan shodh asnsthan	Nautiyal bhawan lamb sanw road Joshiyara Uttarkashi	Nautiyal bhawan lamb sanw road Joshiyara Uttarkashi
54	Snow spider trek & tour	Bhagawat semwal Near Petrol Pump Uttarkashi	Bhagawat Semwal near Petrol Pump Uttarkashi

Table 2.30: List of Ashram with Telephone No. in Uttarkashi

S.	Name of Ashram	Phone No.
1.	Swami Uma Nand Giri President Adya Shankracharya Shikchan Sasthan Ladari	222883
2.	Swami Kamlesh Nand Sarashwati Geeta Gayatri Trust Ujali	222572
3.	Swami Ganmbheer Nand Shivanand Ashram Ujali	222672
4.	Swami Paripurnanand Giri Yoga Pramhansh Ashram	222747
5.	Swami Purna Nand Ji Pashupati Ashram Kotbangla	222571
6.	Swami Prama Nand Sarshwati Shivanand Ashram Ganeshpur	222524
7.	Bhramchyara Sankernath Ashram Gandhi Marg	222343
8.	Swami Sanaten Devi Ji Awdhoot Mandle Ashram Ujali	222386
9.	Manager Kashi Mumuksh Bhawan Dandi Chatra	222587
10.	Manager Panjab Sindh Chatra Uttarkashi	222359
11.	Manager Berla Dharmshala Uttarkashi	222239
12.	Manager Baba Kali Kamli Chatra Uttarkashi	222321
13.	Manager Yog Nikaten Trust Uttarkashi	222615
14.	Swami Sachidanand Giri Trust Ashram Gangotri	222234
15.	Yog Nikaten Gangotri	222213
16.	Tourist Rest House GMBN Gangotri	222221
17.	President Gangapurohit Sabha Gangotri	222207

Table 2.31: Search & Rescue Team with Equipment (Disaster Risk Management project

Uttarkashi) Snow Spider Search & Rescue Team

Chief coordinator :- Bhagwat prasad semwal

S.	Name	Address	Sex	Age	Post	Qualification
1.	Bhagwat Prasad Semwal	Ladari Uki	Male	27	M.D. Communication/ 9412027243	B.Com.
2.	Kalyan Singh	Dunda Uki	Male	27	Mem./ Technical	B.A.I st
3.	Rajendra Singh	Bonga Uki	Male	28	Member	12 th

4.	Vishweshwar Semwal	Ladari Uki	Male	26	Command Control	B.Com.
5.	Parmod Kaintura	Joshiyara Uki	Male	28	Member	B.Com.
6.	Rakesh Rana	Dhanari Uki	Male	28	Member/ Technical	B.Com.
7.	Govind Semwal	Ladari Uki	Male	35	Member	12 th
8.	Kishan Singh Panwar	Kotiyal Gown Uki	Male	27	Member	B.Com. II year
9.	Kedar Singh	Bonga Uki	Male	25	Member/ Technical	12 th
10.	Davesh Bhatt	Bhairav Chowk	Male	28	Camp Incharge	B.Sc.
11.	Nastan Bhandari	NIM Uki	Male	26	Member/ Technical	B.Com.
12.	Bhagiyan Singh	Agoda Uki	Male	29	Member/ Technical	10 th
13.	Narendra Singh	Haryana	Male	27	Member/ Technical	12 th
14.	Vijay Kumar	Baonga Uki	Male	26	Member/ Technical	10 th
15.	Desh Raj Singh	Musticsour Uki	Male	30	Member/Supporting	12 th
16.	Urmila Rawat	Munikireti	Female	28	Member/ Technical	12 th
		Rishikesh				
17.	Prakash Kapurwan	IDPL Rishikesh	Male	30	Member/ Technical	B.Sc.
18.	Panna Lal	Manali Hp	Male	28	Member/ Technical	12 th
19.	Ashok Kumar	Manali HP	Male	29	Member/ Technical	B.A.I st
20.	Rinku	Simla HP	Male	30	Member/ Technical	B.A.I st
21.	Deepu Shai	NIM Uki	Male	26	Member/ Technical	12 th
22.	Airchan	Barsu Uki	Female	24	Member/ Technical	B.A.II year
23.	Vinod Bharti	Dhanari Uki	Male	26	Clerk/Supporting	M.A.
24.	Manoj Bahuguna	Ladari Uki	Male	28	Pharmacist	Poli.
25.	Shravan Kumar Bhadur	Joshiyara Uki	Male	36	Member/ Technical	5 th

Table 2.32: List of Members District Red Cross Society Uttarkashi

S.	Designation Name	Designation in society	Telephone
1.	D. M. Uttarkashi	Chairman	222101
2.	C. M. O. Uttarkashi	Vice chairman	222106
3.	DIOS Uttarkashi	Vice chairman	222123
4.	Dy. CMO Uttarkashi	Secretary	222738
5.	CDO Uttarkashi	Vice chairman	222724
6.	Social worker	Non-payble secretary	
7.	CMS Uttarkashi	Vice chairman	222103
8.	Reg. Ayu. Officer Uttarkashi	Member	
9.	Medical Officer Uttarkashi	Life time member	
10.	Medical Officer Uttarkashi	Secretary IMA	
11.	Treasurer	Treasurer	

Table 2.33: List of News Paper Representatives

S.No	Name	News paper	Telephone		Mobile No.
			Office	Resi.	
1-	Shri Surat Singh Rawar	Ammar Ujala	222605	224873	9412439922
2-	Shri Kunwarsab Singh Kalura (Reporter)	Naw Bharat Time's	224400	224400	9412323264
3-	Shri Lokendra singh Bist (Reporter)	Sahara samaya (T.V.)/ jan satta	222868	222868	9412027190
4-	Shri Kanti Prasad Joshi	Hindustan	222423	222323	9412394437
5-	Shri Santosh Shah (Reporter)	Sahara Samaya / NNI	224824	224824	9412323320
6-	Shri Pradeep Dabral (Reporter)	Panjab Kashri (Delhi)			9412026610
7-	Shri Jeetmani Panuli (Reporter)	Shah Times/ DateLine	222091		9412381597
8-	Shri Rajendra Bhatt (Reporter)	Panjab Keshri (Ambala)	222371		9412323337
9-	Shri Vinod Pokhriyal (Reporter)	Danik jagran	223410	223410	9412026555

10-	Shri Ramcharndra Uniyal (Reporter)	Danik Jayant	222377		9412027244
11-	Shri Mukesh Panuly (Reporter)	Badri Vishal	224420	224422	9412996927
12-	Shri Shankar Dutt Ghildiyal (Reporter)	Seemant Varta	237212	237212	9412323388
13-	Shri Ramesh Uniyal (Reporter)	PTI/ Bhasha	224118	224118	941298437
14-	Shri Pratap Singh Rawat (Reporter)	P. Nainital Samachar	236288	236288	9412394645
15-	Shri Harish Raturi (Reporter)	M. yugwani	224499	224499	9412077586
16-	Shri Anand Nautiyal (Reporter)	Dy. Hak.	222893	222567	9412326305
17-	Shri Rajendra Shing Panwar (Reporter)	S. Seemant Prahari			
18-	Shri Surendra Bhatt (Reporter)	M. Gad Raibar	223198	223198	9412005924
19-	Shri Rajendra Singh Ashwal (Reporter)	S. Rawai Mail	223286	223352	
20-	Shri Dhirendra Pokhriyal (Reporter)	Saryu Sagar Mail			
21-	Shri Dinesh Prashad (Reporter)	Gadwally Dy.			
22-	Shri Surendra Nautiyal (Reporter)	Seemant varta (Bhatwari)	223908	223008	9412077169
23-	Shri Sunil Thapliyal (Reporter)	NNI (Barkot)			

Table 2.34: List of District Panchayat Members in District Uttarkashi

S.	Name (Area of DPM)	Selected Member's Name	Name of Father / Husband	Educational Qualification	Address
1-	Bhatwari	Khushal singh (taknor)	Kunwar singh	B.A.	Vill. Mukhwa P.O.- Harshil
2-	Nald kathud	Smt. Sushma	Elam singh Panwar	M.A.	Vill. – jamak P.O. maneri
3-	Badahat	Smt. Vijayalakhmi	Jagat Ram	B.A.	Vill. –Gawana P.O. Gangori
4-	Badagaddi	Smt. Rampyari	Jagat singh	M.A.	Vill. – Alath P.O. Manpur
5-	Barsali	Bharat singh	jaybeer singh	M.A. (L.L.B.)	Vill. / P.O. manglisera
6-	Bhandarsun	Suraji	Ghran Dass	M.A.	Vill. – Malna P.O. kalyani
7-	Dhanari	Nathi Lal Shah	Ratan Lal	Inter	Vill. – Hitanu P.O. Pujar Gaoun
8-	Gajana	Smt. Sumni Devi	Braf singh	M.A.	Vill. – seri P.O. Dhontri
9-	Dasgi Banchora	Smt. Kamla Devi	Suraj Lal	Literate	Vill. – Kyari P.O. Jivya
10-	Chinyalisour	Ghonker singh	Dham singh	Literate	Vill. – Indra P.O. Indra
11-	Dichli	Smt Sulochna	Gothiwar singh	Literate	Vill. – Jagad Gaoun P.O. Bichli
12-	Kuthnor	Jyandar singh	Lakhi singh	High School	Vill. – Kharsali P.O. Kharsali
13-	Dekhyat Gaoun	Rukam singh	sundar singh	Inter	Vill. – Nagad Gaoun P.O. Gangtadi
14-	Naugaoun	Pram Lal	Sabbu	Inter	Vill. – Tunalka P.O. Naou Gaoun

15-	Kaphnol Damta	Chandrmohan singh	Attar singh	Inter	Vill. /P.O. Kaphnol
16-	Hudoli	Govind Ram	Gorr Dutt	8 th	Vill. /P.O. chandali
17-	Sukdala	Smt. Muni	Santram	Literate	Vill. – Dhawra P.O. Sunali
18-	Doni	Mr. Roji singh	Mr. Jyot singh	8 th	Vill. / P.O. Doni
19-	Arakot	Mr. Rajendra singh	Mr. surbeer singh	B.A.	Vill. / P.O. Arakot

Table 2.35: List of Yuvak Mangal Dal/Mahila Mangal Dal - Block- Bhatwari

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1.	Shri. Mahabeer Singh	Athali	Athali	Joshiyara
2.	Smt. Mhini Devi	-do—	—do—	—do—
3.	Smt. Parvati Devi	Dilshaur	Joshiyara	-do—
4.	Smt. Vidya Gosain	Joshiyara	-do—	-do—
5.	Shri. Mhan Singh	-do—	-do—	-do—
6.	Smt. Jamuna Dei	Dangpokhri	-do—	-do—
7.	Shri. Mohan	Ladari	-do—	-do—
8.	Smt. Krishna Devi	Bonga	-do—	-do—
9.	Shri. Ram Chandra	Tiloth	Tiloth	-do—
10.	Shri. Vinod Prasad	Mando	-do—	-do—
11.	Shri. Ram Chandra	Jaspur	-do—	-do—
12.	Smt. Deependra	Kuroli	Mustik Saur	Mustiksaur
13.	Smt. Jalma Devi	-do—	-do—	-do—
14.	Shri. Hari Singh	Kankrari	-do—	-do—
15.	Smt. Meena Nautiyal	thalan	Thalan	-do—
16.	Shri. Kailash Prasad	Manpur	Manpur	-do—
17.	Smt. Pirshani Devi	Sald	Sald	Sald
18.	Shri. Mukesh	-do—	-do—	-do—
19.	Shri. Bachan Singh	Basunga	-do—	-do—

20	Smt. Nirmala Devi	Gyanja	-do—	-do—
21.	Shri. Mahadev Bhatt	Uttaraun	Uttaraun	Gangori
22.	Smt. Rukma Devi	Sangrali	Sangarali	-do—
23.	Smt. Mohini Devi	Bagyalgaon	-do—	-do—
24.	Shri. Vinod Prasad Bhatt	Pata	-do—	-do—
25.	Smt. Bhagyan Devi	Bhankoli	Bhankoli	-do—
26.	Shri. Man Singh	Agoda	-do—	-do—
27.	Shri. Sohan Singh	Nald	Nald	-do—
28.	Shri. Avtar Singh	Maneri	Maneri	saura
29.	Shri. Ratahn Lal	Didsari	Didsari	-do—
30.	Shri. Keshav Ballabh	Bayana	-do—	-do—
31.	Shri. Hari Om Singh	Saura	Saura	-do—
32.	Shri. Swadesh	Silla	Silla	-do—
33.	Smt. Avtari Devi	Raithal	Raithal	Bandrani
34.	Shri. Jogendra Singh	Malla	Malla	-do—
35.	Shri. Jagmohan	Sainj	Sainj	-do—
36.	Shri. Virendra Singh Rana	Gorsali	Gorsali	-do—
37.	Shri. Digambar Prasad	Bhatwari	Bhatwari	-do—
38.	Smt. Mangal Dei	Jhala	Jhala	Harshil
39.	Shri. Shailendra Singh	Dharali	Dharali	-do—
40.	Smt. Atra Devi	Mukhva	Dharali	-do—

Table 2.36: List of MembersYuvak Mangal Dal/Mahila Mangal Dal; Block- Chinyalisaur

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1	Purnadei	Bangaon		Jivya
2	Vineeta Devi	Kamda		—do—
3	BalKrishan	—do—		—do—
4	Vijay Singh	Ramoli		—do—
5	Ram Pyari	—do—		—do—
6	Prahlad Singh	Manthali		—do—
7	Rashmi Dei	—do—		—do—
8	Uttam Singh	Tarakot		—do—
9	Alender singh	Jhajula		—do—
10	Jayanti Prasad	Tandol		—do—

11	Dil Singh	Tipri		Dharkot
12	Brij Mohan	Khadara		—do—
13	Virendra Singh	Dharkot		—do—
14	Meera Devi	Dharkot		—do—
15	Pyar Singh	Jokhani		—do—
16	Chain Singh	Jestwadi		—do—
17	Sripal Singh	Gadth		—do—
18	Sanji Devi	Gadoli		—do—
19	Sobat Singh	Chilkot		Barethi
20	Atol Singh	Srikot		—do—
21	Jagmohan Singh	Banmati		—do—
22	Babeer Singh	Barethi		—do—
23	Dilla Sevi	Barethi		—do—
24	Kishan Singh Panwar	Mathali		—do—
25	Kishan Singh	Tipri		—do—
26	Govind Singh	Indra		—do—
27	Satpal Singh	Chinyai		—do—
28	Kishori Lal	Nagni		—do—
29	Vijay Singh	Jaspur		Chamyari
30	Bhesam Singh	Margaon		—do—
31	Bishan Singh	Margaon		—do—
32	Murlidhar	Ranthali		—do—
33	Harshmani	Adni		—do—
34	Mohan Lal	Tulyara		—do—
35	Jasoda Devi	Tulyara		—do—
36	Vijay Prakash	Bhadrkot		—do—
37	Ummed Singh	Anal		—do—
38	Praveen Chand	Bhangaon		—do—
39	Bhagwan Singh	Kumrada		—do—
40	Bhag Singh	Khalsi		Khalsi
41	Ram Singh	Gadwalgad		—do—
42	Sohan Singh	Chhoti mani		—do—
43	Kulbeer Chand	Bari Mani		—do—
44	Ummed Lal	Dichli		—do—
45	Summa Devi	Kyari		—do—
46	Sardar Singh	Kyari		—do—

Table 2.37: List of Yuvak Mangal Dal/Mahila Mangal Dal, Block- Naugaon

S	Name of President of Yuvak Mangal Dal / Mahila Mangal Dal	Village	Post Office
1	Meena Devi	Gatu	Gatu
2	Pratima Devi	Chopra	Devel
3	Sushila	Naugaon	Naugaon
4	Palma devi	Bhankoli	Bhankoli
5	Yasoda Devi	Kotiyalgaon	Kotiyalgaon
6	Kiretma Devi	Than	Nagangaon
7	Aya Devi	Mathiyali	Naugaon
8	Savitri Devi	Ponti	Ponti
9	Bchana Devi	Klogee	Klogee
10	Purna Devi	Deval	Deval
11	Lalawati	Muradi	Naugaon
12	Jagdei	Dandagaon	Paunti
13	Sundra Devi	Ranageth	Rana
14	Vanita Devi	Bejlashi	Klogee
15	Subbli Devi	Naugaon	Naugaon
16	Sakla Devi	Kisna	Barkot
17	Rajni Devi	Khansi	Bejladi
18	Revti Devi	Phooldhar	Nagangaon
19	Sunita Devi	Gudkhatal	Devel
20	Vishila	Tirya	Dhari i
21	Shanta	Kotitakral	Gangtari
22	Pavitra	Khamund talli	Sarigad
23	Villa dei	Khandoo	Naugaon
24	Devendri Devi	Bhatiya	Bhatiya
25	Seeta	Bagasu	Bagasu
26	Amardei	Nagangaon	Nagangaon
27	Saduli Devi	Dhari Palli	Dhari
28	Gaura Devi Jayara	Dhakiyat gaon	Rajgarhi
29	Rukmani Balwal	Uprari	Barkot
30	Ajudhi Devi	Masalgaon	Gangtari
31	Punni Devi	Gaul	Nagangaon

32	Sudha Devi	Nandgaon	Gangari
33	Bahgwani Devi	Nishani	Hanuman Chatti
34	Shakuntala Panwar	Kud	Gangtari
35	Vidya devi	Kharsali	Kharsali
36	Rukma Devi	Kandari	Sarigad
37	Ram Pyari	Masu	Rajgarhi
38	Anita Devi	Phiphiyara	Varigad
39	Roshni Devi	Naugaongodar	Naugaongodar
40	Bhima Devi	Dandalgaon	Barkot
41	Meema Devi	Khursil	Mansari
42	Aarti	Kaphnol	Kaphnol
43	Saroj	Syalav	Mansari
44	Vrijmohan	Tiya	Dhari Kalogee
45	Ramanad	Paunti	Paunti
46	Dinesh	Bagasu	Bagasu
47	Kaur Singh	Singuni	Kanva
48	Hardev Singh	Kandoo	Naugaon
49	Chain Singh	Phiphiyara	Singuni
50	Sardar Singh	Diyadi	Diyadi
51	Shailendra Singh	Sarnol	Sarnol
52	Trepan Singh Parmar	Mungra	Naugaon
53	Ramesh Lal	Kud	Gantadi
54	Virendra Singh	Fari	Gantafi
55	Kaur Singh	Singuni	Kanva
56	Dinesh Singh	Bangasu	Bangasu
57	Rukam Singh	Vajri	Kuthnor
58	Teg Singh	Darsu	Darsu

Table 2.38: List of Yuvak Mangal Dal/Mahila Mangal Dal, Block- Purola

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1	Prithvi Singh	Nagjhala	Gundiyatgaon	Gundiyatgaon
2	Ramesh Singh	Kandiyalaon	-do-	-do-
3	Shanti Prasad	Pora	-do-	-do-

4	Yashbeer Singh	Mahargaon	Moltari	-do-
5	Girish Kumar	GundiyatGaon	-do-	-do-
6	Manoj Kumar	Rama	-do-	-do-
7	Jagveer Singh	Paunti	Sarnol	-do-
8	Kamleshwar Prasad	Sukhrala	Moltari	-do-
9	Vijaypal	Dhikalgaon	Gundiyatgaon	-do-
10	Shiveshwar Prasad	Derika	Moltari	-do-
11	Rajan Singh	Sar	Sarnol	-do-
12	Yashveer Singh	Syaluka	Gundiyatgaon	-do-
13	Ranveer Singh	Koti	Moltari	Kharkva Sem
14	Prem Chand	Devdhung	Purola	-do-
15	Moti Ram	Agora	-do-	-do-
16	Malchand	Srikot	-do-	-do-
17	Girveer Singh	Kuroora	-do-	-do-
18	Jayveer Singh	Makhana	-do-	-do-
19	Ramesh Singh	Nauri	-do-	-do-
20	Baldev Singh	Purola	-do-	-do-
21	Ravindra Singh	Kumola	-do-	-do-
22	Chandra Mohan	Math	Moltari	-do-
23	Prem Lal	Sunali	-do-	-do-
24	Jagmohan	Pujeli	Purola	-do-
25	Nagendra Singh	Kharkvasem	Moltari	-do-
26	Ranveer Singhj	Ghundada	Purola	-do-
27	Bharat Lal	Dhampur	-do-	-do-
28	Bhima Lal	Hudoli	Hudoli	Chandeli
29	Kishan Singh	Chandeli	Purola	-do-
30	Jaydev Singh	Sweel	Hudoli	-do-
31	Prem Chand	Kantari	Hudoli	-do-
32	Roshan Singh	Dhakara	Dhakara	-do-
33	Chain Singh	Danvana	-do-	-do-
34	Sovat Singh	Thadung	Hudoli	-do-
35	Shispal Singh	Panigaon	-do-	-do-
36	Sardar Singh	Mairana	Dhakara	-do-
37	Shanti Lal	Sankhal	Bhankoli	-do-

38	Gopal Singh	Karda	Dhakara	-do-
39	Baldev Singh	Khaladi	Purola	-do-
40	Smt. Jeeti Devi	DevDhung	Purola	Kharkva Sem
41	Km. Meena	Dhakara	Dhakara	Chandeli
42	Smt. Vishala devi	Kurda	Purola	Kharkva Sem
43	Smt. Yasoda Devi	UpalaDevra	Moltari	-do-
44	Smt. Tari Devi	Moltari	-do-	-do-
45	Smt. Rajkumari	Nagjhala	Gundiyatgaon	Gundiyatgaon
46	Smt. Jalma Devi	Srikot	Purola	Kharkva Sem
47	Smt. Sovan Dei	Koti	Moltari	-do-
48	Smt. Chandrapati	Hudoli	Hudoli	Chandeli
49	Smt. Veera Devi	KhavliSera	Purola	Kharkva Sem
50	Km. Saroj	Kantari	Hudoli	Chandeli
51	Smt. Purna Dei	Sweel	-do-	-do-
52	Smt. Vimla Devi	Chandeli	Purola	-do-
53	Smt. Kausalya Devi	Makhana	-do-	-do-
54	Smt. Shanti Devi	Pujeli	-do-	Kharkva Sem
55	Smt. Lamviri Devi	Math	Moltari	-do-
56	Smt. Savitri Devi	Sunali	-do-	-do-
57	Smt. Neelavati	Purola	Purola	-do-
58	Smt. Jagdamba Devi	Dhampur	Moltari	-do-
59	Smt. Heema Devi	Mahargaon	-do-	Gundiyatgaon
60	Smt. Kama Devi	Thadung	Hudoli	Chandeli
61	Smt. Sulochna Devi	Chhara	Purola	Kharkva Sem
62	Smt. Chandri Devi	GundiyatGaon	Gundiyatgaon	Gundiyatgaon
63	Smt. KusmaDevi	Karda	Dhakara	Chandeli
64	Smt. Suratama Devi	Rama	Gundiyatgaon	Gundiyatgaon
65	Smt. Uttara Devi	Raun	-do-	-do-
66	Smt. Chandrakala	Kandiyalaon	-do-	-do-
67	Smt. Suratama Devi	Panigaon	Hudoli	Chandeli
68	Smt .Sunni Dei	Paunti	Sarnol	Gundiyatgaon
69	Smt. Kundli Devi	Chhanika	-do-	-do-
70	Smt. Chandni Devi	Derika	Moltari	KharkvaSem
71	Smt. Shila Devi	Sukhrala	-do-	-do-

72	Smt. Asha Devi	Dhakara	Dhakara	Chandeli
73	Smt. Laxmi Devi	Pora	Gundiyatgaon	Gundiyatgaon
74	Smt. Rakhi Devi	Agora	Purola	KharkvaSem
75	Smt. Shanti Devi	Dhundga	Moltari	-do-
76	Smt. Pati Devi	Dukra	-do-	-do-
77	Smt. Kirpali Devi	Dikhalgaon	Gundiyatgaon	Gundiyatgaon
78	Smt. Surpal Devi	Sar	Sarnol	-do-
79	Smt. Narmi Devi	Sankhal	Bhankoli	Chandeli
80	Smt. Atri Devi	Bhadrali	Moltari	KharkvaSem

Table 2.39: List of Memebers of Yuvak Mangal Dal Block – Mori

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1	Sh. Surendra Singh Negi	Kharsadi	Gaddu Gad	Nanai(Mori)
2	Sh. Chandra Singh	Monda	Chinva	Arakot
3	Sh. Mahaveer Singh	Phitadi	Phitadi	Jakhol
4	Sh. Sovat Singh	Danman Gaon	Naitwar	Nanai
5	Sh. Amar Singh	Livadhi	Phitadi	Jakhol
6	Sh. Brijmohan	Nanai	Mori	Nanai
7	Sh. Surat Singh	Pensar	Naitwar	Nanai
8	Sh. Prahlad Singh	Dhara	Jakhol	Jakhol
9	Sh. Rajmohan Singh	Kalap	Naitwar	Nanai
10	Sh. Suvendra Singh	Naitwar	-do-	-do-
11	Sh. Gyan Singh	Hadvadhi	Doni	Doni
12	Sh. Prem Singh	Salra	Mori	Nanai
13	Sh. Layvar Singh	Jakhol	Jakhol	Jakhol
14	Sh. Atul Singh	Bhutanu	Bhutanu	Arakot
15	Sh. Sahab Singh	Gangadh	Gangadh	Jakhol
16	Sh. Chandra Lal	Vinsari	Gadugad	Nanai
17	Sh. Pradip Singh	Makudi	Tikochi	Arakot

18	Sh. Sovendra Singh	Devjani	Devjani	Nanai
19	Sh. Vijendra singh	Odatha	Thadiya	Nanai
20	Sh. Khilanand	Kunara	Mori	Nanai
21	Sh. Darshan Singh	Shringa	Jakhol	Jakhol
22	Sh. Tikam Singh	Kukredha	Thadhiyar	Arakot
23	Sh. Hakam singh	Saur	Sankri	Jakhol
24	Sh. Lakhpatt Singh	Dobhal Gaon	Gaddu Gad	Nanai
25	Sh. Chandan Singh	Sindri(Kotgaon)	Sankri	Jakhol
26	Sh. Chain Singh	Thali	Thadiyar	Nanai
27	Sh. Rajpal Singh	Saransh	Thadiyar	Nanai
28	Sh. Sohan Das	Devra	Naitwar	Nanai
29	Sh. Kailash Singh	Kiranu	Tikochi	Arakot
30	Sh. Subhash Singh	Bari	Masari	Doni
31	Sh. Chaturu Dev	Bhitri	Doni	Doni
32	Sh. Mohan Lal	Maijani	Bhutanu	Arakot
33	Sh. Durga Singh	Gokul	Chinva	Arakot
34	Sh. Raipal Singh	Khanyasani	Doni	Doni
35	Sh. Kailash Singh	Chinva	Chinva	Arakot
36	Sh. Kailash Singh	Chunara	Arakot	Arakot
37	Sh. Narendra Singh	Dhuchanu	Tikochi	Arakot
38	Sh. Mahidhar Singh	Pujeli	Doni	Doni
39	Sh. Sabbal Singh	Bhakvar	Thadiyar	Arakot
40	Sh. Jagmohan Singh	Khanva	Masari	Doni
41	Sh. Prahlad Singh	Dhatmir	Dhatmir	Jakhol
42	Sh. Sardar Singh	Osla	Gangar	Jakhol
43	Sh. Pratap Singh	Doni	Doni	Doni
44	Sh. Hardayal Singh	Masari	Masari	Doni
45	Sh. Ramesh Singh	Arakot	Arakot	Arakot

Table 2.40 : List of Members of Mahila Mangal Dal, Block- Mori

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1	Smt. Sunita	Danman Gaon	Naitwar	Nanai
2	Smt. Kausalya	Doni	Doni	Doni
3	Jagmani Devi	Pensar	Naitwar	Nanai
4	Suman Devi	Livari	Phitari	Jakhhol
5	Visola	kalap	Naitwar	Nanai
6	Mohani	Savara	Mori	Nanai
7	Nirmala	Bhutanu	Bhutanu	Arakot
8	Meenu	Kukredha	Thadiyar	Arakot
9	Sunita	Khitadi	Khitadi	Jakhhol
10	Chandri	Gangar	Gangar	Jakhhol
11	Vrihspati	Vinsari	Gaddu Gad	Nanai
12	Jahari	Kodatha	Thadiyar	Arakot
13	Gyanki	Saur	Sankri	Jakhhol
14	Premlata	Makudi	Tikochi	Arakot
15	Sunita	DobhalGaon	Gaddu Gad	Nanai
16	Hakudi	Shringa	Jakhhol	Jakhhol
17	Ramchandri	Kunara	Mori	Nanai
18	Km. Veervali	Devjani	Devjani	Nanai
19	Smt. Sushila	Kharsadi	Gaddu Gad	Nanai
20	Nirmala	Nanai	Mori	Nanai
21	Surajmani	Sindri(kotgaon)	Sankri	Jakhhol
22	Sakani Devi	Bhitri	Doni	Doni
23	Pavitra	Saransh	Thadiyar	Arakot
24	Urmila	Thali	Thadiyar	Arakot
25	Ishwari	Maijani	Bhutanu	Arakot
26	Chakri	Dhara	Jakhhol	Jakhhol
27	Sheela	Kiranu	Chinva	Arakot
28	Vanmala	Gokul	Chinva	Arakot
29	Sallari	khanyasani	Doni	Doni

30	Rameshwari	Chunara	Arakot	Arakot
31	Gita Devi	Devra	Naitwar	Nanai
32	Vanita	Chinva	Chinva	Arakot
33	Ailasi	Naitwar	Naitwar	Nanai
34	Kapoori Devi	Pujeli	Doni	Doni
35	Sunita	Vankhwar	Thadiyar	Arakot
36	Supari	Sewa	Masari	Doni
37	Km. Kanta	Dhuchanu	Tikochi	Arakot
38	Mamta Rana	Arakot	Arakot	Arakot
39	Virendri	Mohnda	Chinva	Arakot
40	Smt. Phulma	Kosla	Gangar	Jakhol
41	Km. Meena	Khanna	Masari	Doni
42	Smt. Soni	Jakhol	Jakhol	Jakhol
43	Heera Devi	Dhatmir	Jakhol	Jakhol

Table 2.41: List of members of Yuvak Mangal Dal Block- Dunda

S	Name of President of Yuvak Mangal Dal/ Mahila Mangal Dal	Village	Post Office	Nyay Panchayat
1	Sh. Dinesh Prasad	Bagi	Thandi	Bhatiyara
2	Sh. Dhan Singh	Thandi	Thandi	Bhatiyara
3	Sh. Uttam Singh	Kamad	Kamad	Bhatiyara
4	Sh. Nagendra Dutt	Siree	Siree	Bhatiyara
5	Sh. Kamal Singh	Bhatkot	Bhatkot	Bhatiyara
6	Sh. Vinod Kumar	Bhatiyara	Dhauntri	Bhatiyara
7	Sh. Narayan Singh	Bagsari	Bagsari	Pipli
8	Sh. Ramnaresh	Pujargaon	Pujargaon	Pipli
9	Sh. Bachan Singh	Siguni	Singuni	Pipli
10	Sh. Rakesh Singh	Thateti	Thateti	Thateti
11	Sh. Rajkumar	Chakon	Chakon	Thateti
12	Sh. Shashi Bhushan	Astal	Ranadi	Thateti
13	Sh. Dinesh Chandra	gavana	Pujargaon	Thateti

14	Sh. Jotsingh	Pipli	Pipli	Thateti
15	Sh. Mangal Singh	Duglangaon	Vangsari	Thateti
16	Sh. Dharam singh	Singot	New Varsali	Nakuri
17	Sh. Paramveer Singh	Manglisera	New Varsali	Nakuri
18	Sh. Dharam singh	Baun	Baun	Nakuri
19	Sh. Ghanshyam Prasad	Jakhari	Dunda	Nakuri
20	Sh. Balak Singh	Raturisera	Raturisera	Nakuri
21	Sh. Bhadu Lal	Kunsi	New Varsali	Nakuri
22	Sh. Tilakram	Veerpur	Dunda	Nakuri
23	Sh. Chandi Prasad	Matti	Dhaneti	Raimer Bareth
24	Sh. Raghuveer Singh	Garhthati	Raimer	Raimer Bareth
25	Sh. Mohan Singh	Newgaon	Newsari	Raimer Bareth
26	Sh. Dinesh Kumar	Dhaneti	Dhaneti	Raimer Bareth
27	Sh. Vinod Kumar	Gorsada	Raimer	Raimer Bareth
28	Sh. Chandra Mohan	Uprikot	Bharangaon	Barethi
29	Sh. Aalam Singh	Bharangaon	Bharangaon	Barethi
30	Sh. Ram Singh	Matli	Matli	Barethi
31	Sh. Ganesh Parasad	Barethi	Matli	Barethi
32	Sh. Ambika Prasad	Kanwa	Bharangaon	Barethi
33	Sh. Manendra Singh	Panjyala	Baun	Barethi
34	Sh. Bhagwan Singh	Juguldi	Baun	Barethi
35	Sh. Mohan Lal	Gainwla	Gainwla	Gainwla Bhadarsyun
36	Sh. Natthi Lal	Junga	Junga	Gainwla Bhadarsyun
37	Sh. Prem Lal	Mainol	Junga	Gainwla Bhadarsyun
38	Sh. Sundar Lal	Jakhari Patara	Patara	Gainwla Bhadarsyun
39	Sh. Jaiprakash	Olya	Gainwla	Gainwla Bhadarsyun
40	Sh. Susheel Prasad	Pujargaon	Pujargaon	
41	Sh. Sarveer Chand	Kalyani	Kalyani	
42	Sh. Manveer Chand	Naggaon	Mahargaon	
43	Sh. Barfee Lal	Madiasari	Gainwala	
44	Sh. Brijlal	Panoth Painthar	Patara	
45	Sh. Maheshwar prasad	Jaimer	Gainwla	

Table 2.42: List of Villages Vulnerable to Landslide Hazard of Gangotri- Uttarkashi- Nagun Route Source of Information:- RSAC Lucknow, GSI Lucknow, NRSA Hyderabad, DMMC Dehradun

S.	Toposheet No.	Name of village/ town	Hazard class (as per DOS ATLAS)
1.	53 N/1 NW&53 M/4 SW	Gaumukh	High
2.		Bhojbasha	High
3.	53 J/13 NE&53 I/16 SE	Gangotri	High
4.		Bhandar Gaoun	Very High
5.		Khortha	High
6.	53 I/16 SW&53 J/13NE	Lanka	High
7.		Bhaironghati	Moderate & High
8.		Kopang	Moderate & High
9.		Mukhwa	Moderate to low
10.		Dharali	Moderate to low
11.	53 I/12 SE&53 J/9 NE	Bagori	Moderate
12.		Halunga	Moderate
13.		Purga	Moderate
14.		Panchdila	Moderate
15.		Dabrani	Moderate
16.		Jyoti	High
17.		Pala	Moderate
18.	53 J/9 SE	Gangnani	High
19.		Tipru	High
20.		Bhukki	Low to very Low
21.		Tiara	Low
22.		Salang	High
23.	53 J/9 SW	Pokhari	High
24.		Kumalti	High to very Low
25.		Sainj	Closed to very High
26.		Jakhol	Moderate
27.		Saur	Low

28.		Sialu	Very High
29.		Siab	High
30.		Monigaoun	High
31.		Didsari	Low
32.		Pakhoti	Moderate & High
33.		Maneri	Moderate
34.	53 J/10 NW&53 J/9 SW	Varsu	Low
35.		Rathal	Low
36.		Bhatwari	High
37.		Kundara	High
38.		Malla	Moderate to low
39.		Bhela tipri	Low to very low
40.		Gorsali	Low to very low
41.		Junkani	High
42.	53 J/5 SE&53 J/6NE	Netala	High
43.		Simori	Close to high
44.		Nirakot	Moderate
45.		Silyana	Moderate
46.		Jasipur	Moderate
47.		Shanghrali	Moderate
48.		Pata	Moderate
49.		Bagiyalgaoun	Moderate
50.		Varunawat parwat	High
51.		Gyansu nala	Moderate
52.		Chamkot	Moderate
53.		Salra	Moderate
54.	53 J/6 N W	Chandpur	Moderate
55.		Barsali	Moderate
56.		Singot	High
57.		Manjaph	Moderate
58.		Bhalsi	Moderate
		Odalek	Moderate

59.		Singuni	Moderate to low
60.		Dugi	Moderate to low
61.		Samon	Very high to moderate
62.	53 J/6 SW&53 J/6SE	Dharasu	High
63.		Badethi	High to low
64.		Neri	High to moderate
65.		Adni	moderate to Low
66.		Kot	High to low
67.		Kadu	Moderate
68.		Tulyara	Low
69.		Chuphala	Low to moderate
70.		Bagi	Very High
71.		Badsi	Low to moderate
72.		Nagun	High

Table 2.43: Tourist Information, Uttarkashi

S.	Year	Indians	Foreigners	Total No. of Tourists
1.	2001	4,50,634	978	4,51,612
2.	2002	4,51,481	860	4,52,341
3.	2003	6,96,326	1,061	6,97,423
4.	Up to july 2004	5,85,859	826	5,86,689

Table 2.44: List of vulnerable villages under Zone IV and V in District Uttarkashi

S.	Block	Name of village	
1.	Bhatwari	1.	Kishanpur
		2.	Jamak
		3.	Didsari
		4.	Raithal
		5.	Malla
		6.	Sanghrali
		7.	Bhukki
		8.	Mastadi

		9.	Ginda (Manpur)
		10.	Ganeshpur
2.	Naugaoun	11.	Dangud
		12.	Durbil
		13.	Badiya
		14.	Khaneda
		15.	Paali
		16.	Kishala
		17.	Rana
		18.	Ojari
		19.	Dhari/ Devalsari
		20.	Nandgaoun

Annexure-A2 : Proforma for Rapid Damage Assessment Report (Radar) of Landslide

Date of Survey: Local Time: (Hrs) Venue:
 Administrative Set-up of Location: State- District- Block- Tehsil-

A. Event Details: Geographic Location (Longitude, Latitude, Elevation) -

Event Type (Slide/Flow/Fall/Subsidence) –

Landslide Dimension (Length, Width & Depth in metres)

Magnitude of Disaster (Scale & Level)-

Response (Community/Agency)-

Chronology of events – (Time of Initiation, Period/Duration of activity, Sequence of activity, cause of disaster and consequences as well as response); Association with impacts of any other hazard like earthquake, thunderstorm, lightning, flashflood etc., should be mentioned

Total number of villages/towns/ cities affected in the surveyed area:

Total population affected (males/females/children):

Number of Families Affected:

B. Impacts on Life

Humans: Deaths (male/female/children/physically or mentally impaired)-

Injured -

Buried/Missing -

Homeless -

Orphans (male/female) –

Livestocks (Cows/Goats/Sheep/Hens & Chickens/Mules etc.): Deaths - Injured –

C. Impacts on Buildings / Structures:

Residential Buildings: Destroyed - Damaged (kind & extent of damages) -

Cow-Pens/Animal Sheds: Destroyed - Damaged (kind & extent of damage)-

Governmental/Community Buildings (Temples/Community Halls/Educational & Health

Buildings): Destroyed - Damaged (kind & extent) –

Commercial Buildings (Offices/Shops/Industries):

Destroyed - Damaged (kind & extent of damage)-

D. Landscape Changes / Ground Failures / Environmental Impacts:

Agricultural Land Damaged (m²) - Housing Plots Damaged (m²)-

Drainage Disruption (River/Channel blockade) -

Ground Cracks (Dimensions-LxWxD)-

Forest Land affected (no. & types of trees)-

Any other ground changes like river blockade, riverbed upliftment, water pollution etc.-

E. Impacts on Infra-structure:

Transportation (Vehicles/Roads/Bridle path/Bridges/Footpath) –

Communication (Wireless/Phone/Mobile/Internet) –

Drinking Water Supply –

Power Supply -

Sewerage and Sanitation -

F. Projects/Activities affected: Hydel / Power-

Grain Grinders (Gharats)- Other Projects-

Socio-cultural -

Economic/Livelihood-

G. Total Losses (Approx.): Tangible (in Rupees)-

Intangible (brief description)-

H. Additional Information:

Name & Signatures of the Survey Team with Designation & Duties performed

Team Leader (Overall Damage Assessment)

JE/AE PWD (assessed buildings/structures)

AE/JE, Irrigation (Infra-structures)

District Geologist (ground failures)

Section Officer, Revenue (Impacts on life)

Note: A local map, hand-held GPS, measuring tape, digital camera, RADAR Proforma and notebook with pen, pencil & eraser should be carried by the team and data/information may be fed in excel sheet after completion at the NIC Office for use by various authorities and public dissemination on web portal.

Note: A local map, hand-held GPS, measuring tape, digital camera, RADAR Proforma and notebook with pen, pencil & eraser should be carried by the team and data/information may be fed in excel sheet after completion at the NIC Office for use by various authorities and public dissemination on web portal.

Photos/Sketches / Maps showing extent and distribution of damages

Note: North Direction and scale of map should be marked on the map

Annexure - A3 : Proforma for Landslide Database

1. Location of the Slide Site

- i. Name of Road
- ii. Motor Road or bridle road
- iii. Nearest village or town and direction and distance of the slide from it
- iv. Slide developed at km (From — to —)

2. General Description of the Area

- i. Elevation (Height above M.S.L.)
- ii. Slope on Uphill side
- iii. Slope on downhill side
- iv. State of erosion on slope
- v. Density of vegetation (low, medium, high). Give details of trees and vegetations.
- vi. Are trees tilted ?
- vii. Are there cultivated fields ?
- viii. Monthly data for average rainfall for last 3 years. Annual rainfall for last 10 years or as many years as available.
- ix. Name of the nearest observatory.

3. Geological Features of the Area

- i. Type of rock exposed or underlying (thinly bedded, thickly bedded or massive).
- ii. Dip and strike
- iii. Joints, their dip and spacing. State of joint planes - favorable/unfavorable.
- iv. Structural features (fold, faults, conformity)
- v. Stratigraphical position.
- vi. Lithological characteristics of the rock with sequence of formation
- vii. Texture of rocks
- viii. If not rocky to which of the following types it pertains:
Debris (soil to rock pieces)
Soil (almost no rock pieces)

4. Drainage Features

- i. Is there any nala or river flowing at toe of the slide, if so indicate whether it was eroding the toe of the slope.
- ii. Give the position of water accumulation, place of spring water, position of snow accumulation with respect to position of the road.
- iii. Is any pond or lake present on hill slope ?
- iv. Any other remark regarding nature of hill slope affecting the stability of hill slope.

5. History & Description of the Slide during its Development

a. Sketch of Slide

(Please sketch the slide showing relationship with the road and/or other land marks, take photographs from appropriate angles and sufficient in number to be able to generate a panoramic view of the area by joining photographs.

The sketch should show approximate dimensions, boundaries of the slide, position of notable cracks, position of the road, nala and river if any, water path, places of water percolation, spring water, position of road outcrops, big boulders, trees, retaining walls and other prominent structures, position of sinking if any.

- ii. Date of Occurrence of slide.
- iii. No. of times the slide has taken place so far.
- iv. Duration of the road blockage due to slide
- v. Number of casualties or persons injured, if any.
- vi. Damages to the property due to slide (houses, road, fields etc.)
 - a. Number of houses completely damaged
 - b. Number of houses partially damaged
 - c. Number of lives lost
 - d. Nature of Damage
 - e. Occurrence of damage
 - f. Progressive nature of damage - Yes/No
 - g. If extension of damage has any relation with season - Yes/No
 - h. If yes, whom and how observed and their details.
 - i. Period of extension of damage.
- vii. Method of clearance of slide mass by men/by machine or by both.
- viii. Time taken for clearance.
- ix. Condition before occurrence of slide (dry, heavy rains etc.)
- x. Was road sinking noticed ?
- xi. Slope angle.
- xii. Height of crown of the slide from road level.
- xiii. Depth of toe of the slide from road level
- xiv. Any other remarkable point observed during or before slide.
- xv. Rate of movement (cms. per day)

6. Causes of Slide

What you think about the cause of slide?

- i. Whether it was man (such as back cutting, blasting, excavation, changes in nature / artificial drainage etc.)

- ii. Natural cause (such as river erosion, nala erosion, saturation of hill slope mass, cloud burst, unfavourable nature of hill slope mass, earthquake, deforestation, disruption of drainage etc.)
- iii. Any other cause noticed at the site.

Note: Generally more than one cause develop the slide but one cause may be dominating and may precipitate the movement.

7. Remedial Measures

- i. *Whether applied - Yes/No. If yes, please state the measures, viz. :*
 - a. Sealing of cracks.
 - b. Provision of retaining structures.
 - c. Improvement in drainage.
 - d. Measures for protecting river erosion
 - e. Chemical treatment
 - f. Grouting
 - g. Plantation etc.

What is their outcome ?

- ii. Has the slide area been studied for adopting remedial measures by any competent investigator ? If so, give the name of organisation and the summary of the major recommendation.
- iii. Indicate what measures were followed and what is their outcome.

8. Notes:

- i. Please complete separate sheet for important slide site of your region. Mark the location of all slides of your region on the district map.
- ii. Your active feeding of the information is required and will be helpful to the investigator in suggesting the corrective measures to the pertinent landslides and landslides of similar nature.
- iii. The column whose information you find difficult to fill, may be left blank. It may be sent at a later date. Some of the information as e.g. in para (3) may be left for geologist, in case the field engineers are not able to fill it.

Date:

Name & Signature of Reporting Officer with Designation



Towards a disaster free India.....

World Centre of Excellence on Landslide Disaster Reduction

National Institute of Disaster Management

Ministry of Home Affairs, Govt. of India

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