INDIA

Uttarakhand Disaster
June 2013





Joint Rapid Damage and Needs Assessment Report

The World Bank

Government of Uttarakhand

Asian Development Bank

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Report

August 2013

Foreword

The State of Uttarakhand experienced an unprecedented high rainfall between June 15 and 17, 2013 that resulted in flash floods and landslides within the State. The continuous rain disrupted normal life resulting in a total of 580 human lives being lost, over 4,083 persons missing and over hundred thousand pilgrims being stranded. This event has affected over 900,000 people in Uttarakhand this year. The numerous landslides and toe erosion by the sediment loaded rivers caused breaching of roads / highways at many locations and washed away several bridges; disrupting traffic and telecommunication links within the State.

The Government of Uttarakhand (GoUK) launched a massive emergency rescue and evacuation operation with assistance from the Indian Army, Indian Air Force (IAF), Indo-Tibetan Border Police (ITBP), the Naitonal Disaster Response Force (NDRF) and the local Police evacuating more than 110,000 people from these flood affected areas. The State Government continues to ensure that there is no shortage of food and other essential supplies, especially for communities in areas with connectivity problems. Additionally, doctors and paramedics were deployed in the disaster affected areas to provide medical services.

The need to immediately start the recovery and reconstruction work, especially in the most affected areas prompted the need for a rapid assessment to understand the nature of damages post-disaster. The GoUK, in collaboration with the World Bank and the Asian Development Bank initiated an exercise to assess the damages and prepare a recovery framework. This "Uttarakhand disaster June 2013, Joint Rapid Damage and Needs Assessment" report is the result of this exercise which took place between July 29 and August 7, 2013.

The Uttarakhand Government is committed to ensure the safety and well-being of its people and recognizes the necessity to continuously improve disaster risk reduction and management within the State.

This report is a forward looking report incorporating a post-disaster recovery framework that proposes immediate measures of 'building-back-smarter' to improve the resilience of the State's infrastructure and its communities from impacts of future disasters and climate change(s).

Vijay Bahuguna,
Chief Minister
Uttarakhand

Acknowledgement

This Joint Rapid Damage and Needs Assessment (JRDNA) report was prepared in response to a request from the Department of Economic Affairs (DEA), Government of India (GoI) and the Government of Uttarakhand (GoU) and was undertaken jointly by the GoU, the World Bank (WB) and the Asian Development Bank (ADB). The JRDNA team visited Dehradun (Uttarakhand) from July 29 and August 07, 2013, and worked with the GoU on assessing damages due to the disaster and formulating a recovery framework.

The JRDNA team met with various line departments in different sectors within the GoU that have been involved in the emergency relief and recovery operations. The team extends its appreciation to the national and state authorities for their support and assistance in terms of access to information and their availability for discussions. Meetings were held with Mr. Subhash Kumar, Chief Secretary of State and the relevant department officials. A special note of gratitude is expressed to Mr. Rakesh Sharma, Additional Chief Secretary, the Principal Secretaries, the Secretaries of State and all Government officials for meeting with the JRDNA team and sharing valuable information.

The report would like to acknowledge the many Government officials from line departments that participated in this assessment team. The Wadia Institute of Himalayan Geology (WIHG) and the Uttarakhand Space Application Centre (USAC) also contributed their expertise to this report and their efforts are duly acknowledged. The team would also like to express thanks to G. Padmanabhan, Emergency Analyst, United Nations Development Program (UNDP) and Puthumai Nazarene, United Nations Disaster Management Team (UNDMT) for sharing their valuable inputs towards recovery planning and the UNDMT for sharing data from a rapid assessment undertaken by them following the disaster, in the five worst affected districts of Uttarakhand.

The team would also like to acknowledge the financial support provided by the Global Facility for Disaster Reduction and Recovery (GFDRR) which contributed to the assessment and the preparation of this report and, Raja Rehan Arshad and Ayaz Parvez (GFDRR) for their guidance in helping develop the assessment methodology.

The JRDNA Team[1]

[1] The JRDNA team was led by Saurabh Dani (World Bank) and Anil Motwani (ADB). The team members from the World Bank included: Deepak Singh, Smita Misra, Dechen Tshering, Suranga Sorriya Kumara Kahandawa, Augustin Maria, Keiko Saito, Hemang Karelia, S Krishnamurthy, B.K.D. Raja, Manu Prakash, Anupam Joshi, Gaurav Joshi, Jurminla Jurminla, Vinayak N. Ghatate, Roshin Mathai Joseph, Deepak Malik, Vidya Mahesh, Peeyush Sekhsaria, D.C. Saha and Malini Nambiar. The ADB team was comprised of: V.S. Rekha, Ashok Srivastava, Saugata Dasgupta, Vallabha Karbar, Tika Limbu and Prabhash Sahu.
Title and inside photos courtesy: Government of Uttarakhand

Table of Contents

LIST OF TABLES

LIST OF FIGURES

BOXES

Abbreviations & Acronyms

ADB	Asian Development Bank
BRO	Border Roads Organization
CWR	Centre for Water Resources
DEA	Department of Economic Affairs
DMMC	Disaster Mitigation and Management Centre
DoT	Department of Tourism
GFDRR	Global Facility for Disaster Reduction and Recovery
GoI	Government of India
GoU	Government of Uttarakhand
GSDP	Gross State Domestic Product
HEPs	Hydro Electric Projects
HH	Households
IAF	Indian Air Force
IEC	Information, Education and Communication
ITBP	Indo-Tibetan Border Police
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
JRDNA	Joint Rapid Damage and Needs Assessment
MDR	Major District Roads
MoDWS	Ministry of Drinking Water Supply
MSME	Micro, Small and Medium Enterprises
NBA	Nirmal Bharat Abhiyan
NDRF	National Disaster Response Force
NGOs	Non-Governmental Organization
NRDWP	National Rural Drinking Water Program
ODR	Other District Roads
PMU	Project Management Unit
PWD	Public Works Department
RCC	Reinforced Cement and Concrete
SH	State Highways
SRTC	State Road Transport Corporation
SWAp	Sector- Wide Approach program
SWM	Solid Waste Management
UJS	Uttarakhand Jal Sansthan
UJVNL	Uttarakhand Jal Vidyut Nigam Limited
UK RWSS	Uttarakhand Rural Water Supply and Sanitation
ULBs	Urban Local Bodies
UN	United Nations
UNDMT	United Nations Disaster Management Team
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UPCL	Uttarakhand Power Corporation Limited
UPJN	Uttarakhand Pey Jal Nigam
UREDA	Uttarakhand Renewable Energy Development Agency
USAC	Uttarakhand Satellite Application Center
VR	Village Roads
WB	World Bank
WIHG	Wadia Institute of Himalayan Geology
WSS	Water Supply and Sewerage

Executive Summary

1. The monsoon in June 2013 arrived almost two weeks earlier than expected in Uttarakhand. During June 15 to 17, 2013, cloud bursts and heavy (64.5 - 124.4 mm) to very heavy rainfall (124.5 – 244.4 mm) hit several parts of the higher reaches of the Himalayas in the State of Uttarakhand. This unprecedented rainfall resulted in a sudden increase in water levels giving rise to flash floods in the Mandakini, Alakananda, Bhagirathi and other river basins and also caused extensive landslides at various locations. According to official sources, over 900,000 people have been affected by the floods in Uttarakhand this year.

2. The districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were among those most affected by this disaster. Some of these regions are among the country's most important pilgrimage centres and the calamity occurred during the peak pilgrimage season. As stated by the State Government of Uttarakhand (GoU), a total of 580 human lives have been lost, over 5,400 people[2] are still reported as missing, 4,200 villages affected, 9,200 cattle/livestock lost and 3,320 houses fully damaged. This event also left over 70,000 tourists and 100,000 local inhabitants stranded in the upper reaches of the mountain terrain.

3. The GoU was extremely proactive with relief operations in the immediate aftermath of the flood. A massive emergency rescue and evacuation operation was initiated by the State Government with assistance from the Indian Army, Indian Air Force (IAF), Indo-Tibetan Border Police (ITBP) and the National Disaster Response Force (NDRF). This rescue operation was hampered by heavy rains and landslides causing delays and complicating the operations in this difficult terrain. The IAF, the Indian Army, the Paramilitary Troops, civilian helicopters, along with road vehicles have evacuated more than 110,000 people from these flood affected areas.

4. The Floods impacted all the communities that are scattered in the mountainous terrain. Uttarakhand is primarily a mountainous state, as the plains constitute only about 10% of its total geographical area. The terrain further compounds the difficulty of connectivity, a characteristic of hill economies around the world. Due to its peculiar geographical setting, Uttarakhand is vulnerable to natural disasters. This makes the state disaster prone in terms of landslides, forest fires, cloud bursts, flash floods, and earthquakes.

5. The World Bank (WB) and the Asian Development Bank (ADB) received a request from the Department of Economic Affairs (DEA), (GoI), to field a Joint Damage and Needs Assessment Mission within the State. A Joint Rapid Damage and Needs Assessment (JRDNA) mission comprising of members from the World Bank (WB) and the Asian Development Bank (ADB) visited the State between July 29 and August 07, 2013, initiating discussions with the GoU for a multi-sectoral assessment of the damages and needs arising after the disaster.

6. The GoU's institutional capacity to manage the disaster was challenged with the large scale and sudden onset of floods and landslides in the region. In addition, a high percentage of precipitation coupled with the large influx of tourists and pilgrims around the same time of the disaster stretched the existing public infrastructure and public services beyond its limits.

7. The objective of the exercise is to undertake a joint rapid damage and needs assessment and lays the ground for a recovery and reconstruction framework.

[2]UN Sitrep "Uttarakhand Flood" No. 10. UNDMT July 10, 2013.

Methodology and Limitations

8. The main focus of the assessment has been to assess the damages to physical assets, corresponding needs and prepare preliminary estimates. The JRDNA team conducted detailed interviews with the sectoral counterparts within the respective line departments of the GoU in order to understand the data collection methodologies and to fill in any gaps that may exist. The data used in this report was collected by government officials based in the field from the five worst affected districts - Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi - and the other lesser affected downstream districts and was subsequently collated at the state level.

9. Due to bad weather, continued flooding and landslides in some areas and the affected areas being largely inaccessible, the team was unable to undertake independent on-site missions. In the circumstances the damage assessment carried out by the State government of Uttarakhand has been relied upon. It is also relevant to note that the State government estimates in this regard are also preliminary in nature as the State machinery is currently focused on the immediate humanitarian relief operations and emergency restoration and connectivity works.

10. This report presents an assessment of the physical damages with a sector-wise impact of the disaster, reconstruction needs and preliminary estimates specifically with regards to infrastructure, housing, services and livelihood. The sectors that were covered in the JRDNA are given below:

- Housing
- Public Buildings
- Roads and Bridges
- Urban Infrastructure (Water Supply, Roads, Drains and Sewerage)
- Rural Water Supply and Sanitation
- Irrigation
- Livelihoods (Agriculture, Livestock, Fisheries, Tourism linked Livelihoods and Micro, Small and Medium Enterprises (MSME))
- Tourism Infrastructure
- Energy
- Forests and Biodiversity

11. The WB and ADB team coordinated the damage assessment with the different Heads of Department within the GoU and the Disaster Mitigation and Management Centre (DMMC). The team presents a consolidated view, in assessing the damages of the disaster, and provides a first attempt at identifying immediate and medium term recovery, rehabilitation and reconstruction needs on the basis of relevant information received and the expertise of the multi-institutional and interdisciplinary assessment team.

Disaster Damage and Needs Assessment Overview

12. The overview of the Damage and Needs Assessment has been provided in Table 1.

Table 1 : Summary of Damages and Preliminary Estimates of Reconstruction Cost

Sectors	Cost (INR million)	Cost (US$ million)
Housing	1505	25.08
Public Buildings	1029	17.15
Roads and Bridges	27103	451.71
Urban Infrastructure (Water Supply, Roads, Drains and Sewerage)	1268	21.13
Rural (Water Supply and Sanitation)	1305	21.75
Livelihoods(Agriculture, Livestock, Fisheries,Tourism linked livelihoods, Micro enterprises and other)	1668	27.80
Irrigation	1393	23.22
Tourism Infrastructure	1166	19.44
Energy/Power	2662	44.37
Forests and Biodiversity	542	9.03
Grand Total	**39,641**	**661**

Note: The total value has been rounded off. Currency Conversion rate US$=INR 60.

13. Chapter 3 gives a sector-wise description of the damage and needs assessment.

14. While serving as a wakeup call, this disaster also provides a window of opportunity to address several underlying developmental and risk reduction issues. The government has responded well to the recent disaster. However, addressing the immediate and longer term recovery and reconstruction needs and putting into place appropriate mitigation and risk reduction measures towards building resilience is important. Moving ahead, there are several interventions that must be undertaken in order to reconstruct the damaged assets and to restore the economy of the affected areas. For example, restoration of connectivity and urban infrastructure will help bring back economic activity in tourism and help restore livelihoods. The assessment team has identified several preliminary needs in each of the sectors in Chapters 3. All interventions need to be undertaken in a sustainable and eco-friendly manner taking into consideration the environment and the use of modern technology. It is also critical that aspects such as transparency, accountability, proper integrated planning and other cross cutting issues such as gender, climate change etc. are given due attention. Chapter 4 of this report discusses the above factors that must be taken into consideration to inform the design of a comprehensive recovery and reconstruction framework which would not only help the State recover from this disaster but also help towards building a resilient Uttarakhand.

Chapter One

Introduction

1. Introduction

1.1 Overview of the State

1. Uttarakhand was formed on November 9, 2000 as the 27th State of India, after it was carved out of northern Uttar Pradesh. Located at the foothills of the Himalayan mountain ranges, it is predominantly a hilly State, having international boundaries with the People's Republic of China in the north and Nepal in the east. On its north-west border lies the State of Himachal Pradesh, while on the south it is bounded by Uttar Pradesh. The high Himalayan ranges and glaciers form most of the northern parts of the state while the lower reaches are densely forested (covering about 60%[3] of the state)with rich natural resources and wildlife habitats. Two of India's major rivers, the Ganga and the Yamuna originate from Uttarakhand.

1.2 Uttarakhand Social and Economic Context

2. The State of Uttarakhand comprises of 13 districts that are grouped into two regions (Kumaon and Garhwal) and has a total geographical area of 53,484 sq. km. The State has a population of 10,116,752 (Census of India, 2011) of which the rural population at about 7,025,583[4] constitutes about 70% of the total. Uttarakhand is the 20th most populous state of the country. As per the 2011 census the gender ratio was 963 females per 1000 males which is higher than the national average of 940, however the child gender ratio[5] at 890 females per 1000 males is lower than the national average of 914. The literacy rate in the state was nearly 80% with 88.33% literacy for males and 70.70% literacy for females.

3. The economy of the State primarily depends on agriculture and tourism. About 70% of the population is engaged in agriculture. Out of the total reported area, only 14% is under cultivation. More than 55% of the cultivated land in the State is rain-fed. The landholdings are small and scattered. The average land holding is around 0.7 ha (divided into small holdings) in the hills and 1.8 ha in the plains[65].The State has been one of the fastest growing economies in India. Its Gross State Domestic Product (GSDP) (at constant prices) more than doubled from INR 248 billion (US$ 4.13 billion) in FY2005 to INR 585 billion (US$ 9.75 billion) in FY2012. Per capita income at constant (2004-05) prices for FY2012 at INR 50,303 (US$ 838) is higher than the national average of INR 38,037 (US$ 634)[7].

4. The State is home to some of the most important pilgrimage centres known as the "*Char-Dham*", i.e. the Gangotri, Yamunotri, Kedarnath and Badrinath, all of which are situated in the northern region. The state receives over 32 million tourists annually, a majority of whom visit the state during the peak summer season (May-July) for pilgrimage and recreation. The region is also a well-known tourist destination and has many trekking trails. In the past years, tourism has contributed in a major way to the economy of the State.

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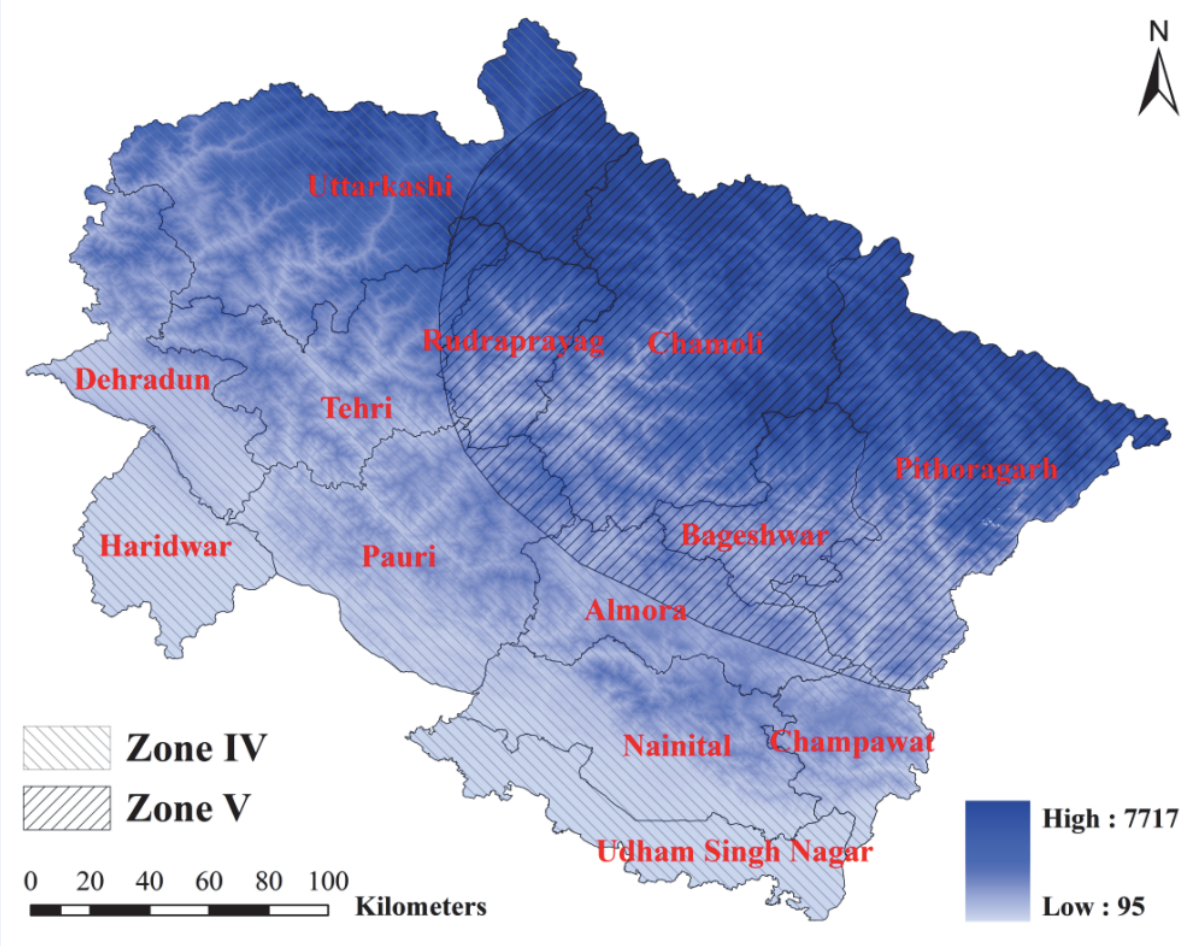
[3] India: Uttarakhand Economic Assessment; November 16, 2012, Poverty Reduction and Economic Management Unit, South Asia Region, World Bank.
[4] Statistical handbook and Census of 2011
[5] Number of females per 1000 males in the age group 0 – 6 years in human population
[6] Uttarakhand State: Perspective and Strategic Plan 2009-2027 (WMD) http://gramya.in/Perspective_Plan_2009-2027.pdf
[7] Ministry of Statistics and Programme Implementation. 1 August 2012. http://mospi.nic.in/Mospi_New/site/inner.aspx?status=3&menu_id=8

1.3 Natural Hazard and Vulnerability Profile

5. The State is primarily a mountainous region which constitutes about 90% of its total geographical area. The State has a very fragile terrain that, by virtue of its very origin, is prone to natural disasters. The entire State falls within Zone IV and Zone V (Zone V represents the highest level of seismicity)of the Earthquake Zoning Map of India. The districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi all fall within the Seismic Zone V.In the recent past the State has witnessed two major earthquakes (Uttarkashi 1991 and Chamoli 1999).

Figure 1[8]: Earthquake Zoning Map of Uttarakhand



6. Every year, the state faces massive losses, particularly during the monsoon season, due to rains, cloudbursts, flash floods, landslides, floods, hailstorms and water logging events. Small and marginal farmers in the hills lose a substantial portion of their agricultural produce and sometimes permanently lose their agricultural lands due to these events. In addition, Uttarakhand is also prone to forest fires, avalanches and droughts.

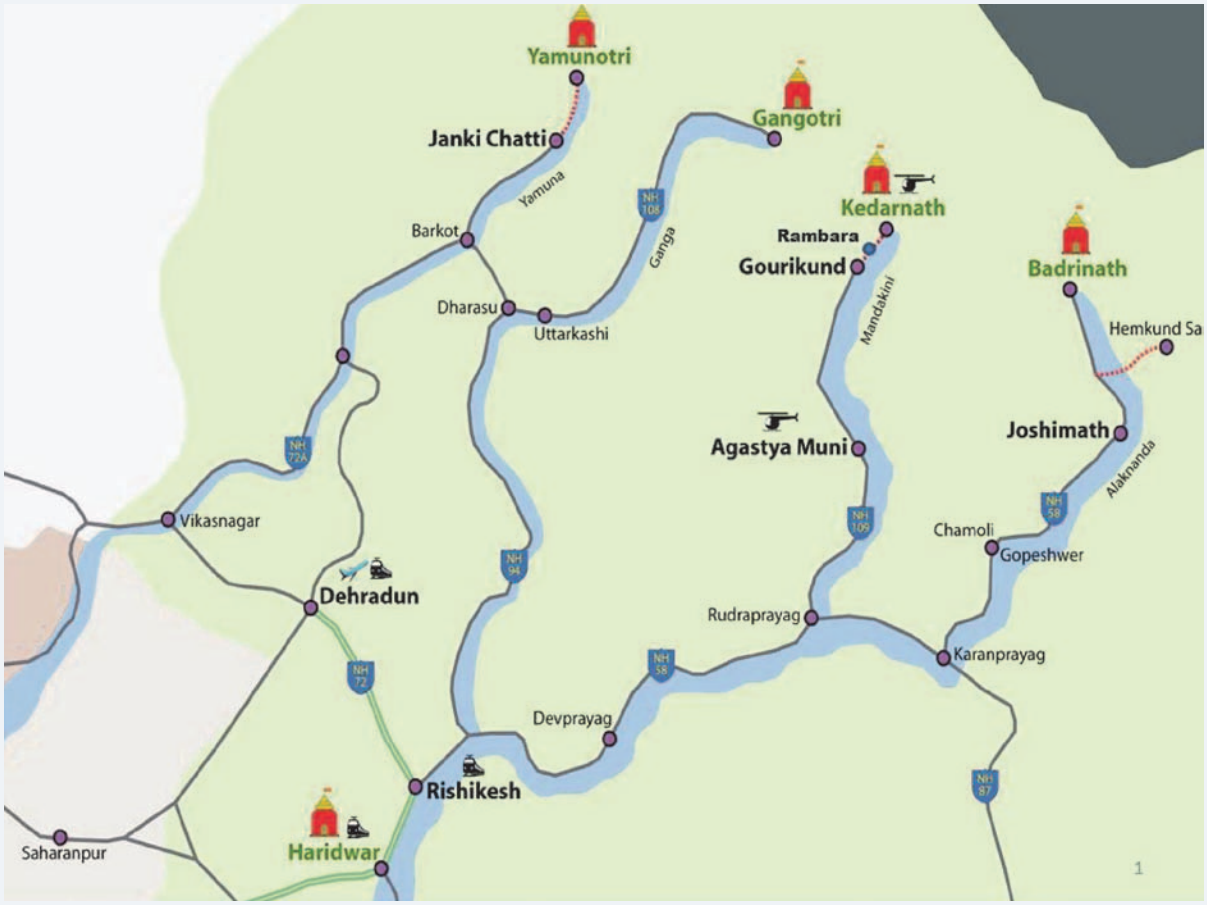
1.4 The Uttarakhand Disaster

7. During June 15 to 17, 2013, cloud bursts and heavy (64.5 - 124.4 mm) to very heavy rainfall (124.5 – 244.4 mm) hit several parts of the higher reaches within the State. This unprecedented rainfall resulted in a sudden increase in water levels giving rise to flash floods in the Mandakini, Alakananda,

[8] Disaster Relief Memorandum; Department of Disaster Management, GoU

Bhagirathi and other river basins and also caused extensive river bed and toe erosion, and landslides at various locations. The worst impact happened in the Mandakini river valley around the Kedarnath shrine region (Rudraprayag district) and its downstream areas. Rock falls resulted in the partial blockade and impoundment on the river channel to the left of Kedarnath. The embankment on the left bank of the channel soon gave way and the abandoned channel to the east of Kedarnath became active. Adding to this, continuous rains and melting of the Chorabari glacier[9] (that feeds the Gandhi Sarovar Lake or Chorbari Lake) caused waters in the Chorabari Lake to rise. The lake's weak moraine barrier gave way and a huge volume of water along with large glacial boulders came down the channel to the east, devastating Kedarnath town, Rambara, Gaurikund and other places in its wake.

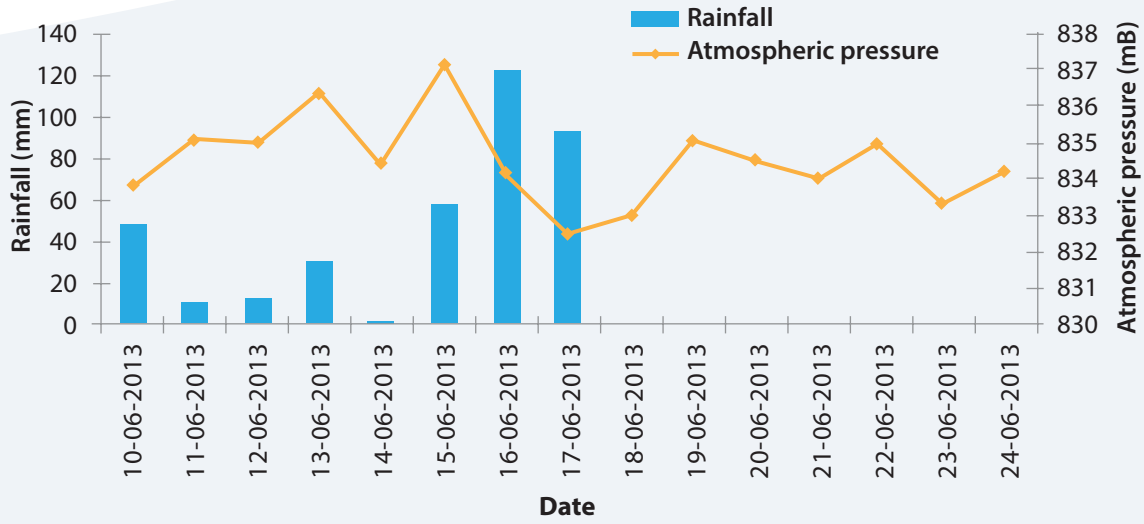
Figure 2 : Important Pilgrimage Centres "Char-Dham"



8. The heavy rainfall across the upper reaches of the Himalayan terrain spread through Yamunotri, Gangotri, Badrinath, Hemkund Sahib and other mountains along the Kailash Mansarovar route. The districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were among those most affected by this disaster. The flooded rivers reaching downstream carrying heavy amount of debris and sediment caused further devastation in the lower districts, though to a lesser extent, when compared to the higher Himalayan districts of Uttarakhand. The Wadia Institute of Himalayan Geology's (WIHG) meteorological observatory located at the Chorabari Glacier camp recorded a record rainfall of 115mm on June 16, 2013 alone (from 5:00 a.m. to 5:00 p.m.).

[9] The glacier lies close to Kedarnath, an important destination for Hindu pilgrims. One of the glacier's two snouts is the source for the Mandakini River, a tributary of the Alaknanda River.

Figure 3: Rainfall and atmospheric pressure recorded at Kopardhar Observatory
(Near Ghuttu (WIHG) that is approximately 38 km (aerial distance) from Kedarnath)



9. This event coincided with the peak tourist and pilgrimage season, within the State, thus significantly increasing the number of causalities, missing, and affected populace, thereby compounding the impact of the disaster. The continuous rain disrupted normal life resulting in a total of 580 human lives being lost, over 5400 persons missing and left over 70,000 tourists and 100,000 local inhabitants stranded in the upper reaches of the mountain terrain. The numerous landslides and toe erosion by the sediment loaded rivers caused breaching of roads / highways at many locations and washed away several bridges (steel girder bridges, beam bridges, suspension/cable bridges). Traffic was also disrupted along all national highways and link roads,along with the disruption of telecommunication lines, all adding to the impact of the disaster.

10. The northern region of the State was severely impacted by the disaster. Reports of entire villages and settlements such as Gaurikund and the market town of Rambara, a transition point to Kedarnath, being obliterated, while the market town of Sonprayag suffered heavy damage and loss of lives. Although the Kedarnath Temple itself has not been damaged, its base was inundated with water, mud and boulders from the landslides, damaging its perimeter. Many hotels, rest houses and shops around the temple in Kedarnath Township were completely destroyed.

1.5 State Government and Development Partners Response

11. The GoU with the support of the Government of India (GoI) and other institutions including the Indian Army, Indian Air Force (IAF), Indo-Tibetan Border Police (ITBP), and the National Disaster Rescue Force (NDRF) launched one of the largest ever evacuation and rescue operations in the immediate aftermath of the disaster.

12. About 20 civil and 59 military air crafts were used for air evacuation. In all 72 permanent and temporary helipads were mobilized for evacuation and dropping of relief material. The IAF carried out 2,616 sorties evacuating around 21,961 persons. The GoU hired civilian helicopters which undertook over 2,000 sorties evacuating nearly 12,000 persons. All the persons evacuated by air were brought to the nearest towns with road connectivity, from where safe transportation of these persons was arranged by the State Government. More than 5,000 vehicles were arranged and approximately 90,000 persons were evacuated by road. A total of about more than 110,000 persons were evacuated despite the hostile terrain and weather conditions. During the evacuation operations the GoU also catered to the food, health and other requirements of the stranded persons.

13. The GoU also provided all evacuated persons with cash assistance of INR 2,000 (US$ 33) to take care of their routine requirements while in transit. The State Government continues to keep in service 10 civilian helicopters to ensure that there is no shortage of food and other essential supplies in the State, especially for those communities in areas with connectivity problems. Additionally, 313 doctors along with 4,977 paramedics were deployed in the disaster affected areas to provide medical services. Medical teams were also deployed for DNA sampling of dead bodies in the Kedarnath valley to help identify the remains. Despite the gigantic magnitude of the disaster the State Government has ensured that there has been no outbreak of any disease or epidemic during this period.

14. Civil Society institutions including Local, National and International NGOs responded immediately to the disaster and continue their operations in all affected districts. Multiple United Nations (UN) agencies through the United Nations Disaster Management Team (UNDMT) prepared periodic 'Situation Reports' that collated information on the damage rescue and relief efforts. UNDMT teams undertook field work in the five worst affected districts and continue working with the GoU and respective district authorities to put out Rapid Assessment Reports. The Central Government and various State Governments have also extended support, and the private and public sector have also been active on the field.

Chapter Two

Process and Methodology of the Joint Rapid Damage and Needs Assessment

2. Process and Methodology of the Joint Rapid Damage and Needs Assessment

1. This JRDNA report is a joint collaborative effort of the GoU, the WB and the ADB in response to a request from GoU and the Government of India (GoI). The objective of the exercise is to undertake a joint rapid damage and needs assessment and lay the ground for a recovery and reconstruction framework.

2. The need to quickly start the reconstruction and rehabilitation, coupled with the continued incessant rainfall, the limited accessibility and remote locations of the affected areas has prompted the need for a rapid assessment to understand the nature of the damages and to inform immediate recovery and reconstruction planning.

2.1 Assessment Process

3. A joint assessment team was fielded by the WB and ADB and a mission visited the state of Uttarakhand between July 29 and August 07, 2013. The mission team,in partnership with GoU, comprised of experts from different sectors in order to be able to produce a multi-sectoral assessment of the damages and needs. A sector-by-sector analysis of the damage was undertaken, utilizing specific templates for information recording and gathering in order to ensure consistency of information, non-duplication and comparability of the data.

4. The mission team was briefed by the GoU on July 29, 2013 where the scope of the assessment was agreed upon with the GoU. A wrap up session was held on August 07, where the mission team shared the assessment findings with the GoU. During the mission, meetings were held with the Chief Secretary, Additional Chief Secretary, Principal Secretaries/ Secretaries, departmental heads and their staff. Several technical and scientific institutions were also contacted. Table 2 shows the time frame for the assessment.

Table 2: Assessment Time frame

Time Period	Activity
July 22-26	Mobilize sector teams and coordination with GoU
July 29	Kick off meeting with the GoU (presentation to the mission team by GoU and sharing of information by officers from all line agencies and their contact details for further discussions)
July 30 - 31	Sector-wise meeting with line agencies – data collection
August 01 - 04	Preparation of draft assessment report
August 05 - 06	Filling up data gaps and updating of the report
August 07	Wrap-up – presentation of report by the Mission to the Chief Secretary, Additional Chief Secretary, Principal Secretaries/ Secretaries, Department heads and other heads of departments

5. Standard Damage and Needs Assessment data collection and aggregation templates were distributed to the sector teams who customized these templates to their specific context. Given the climatic and logistical considerations (most of the affected areas are remote and difficult to access due

to ongoing rainfall and landslides), the team was unable to conduct field visits for the assessment. The team conducted detailed interviews with sectoral counterparts from the respective line departments to understand their data collection methodologies and to fill any gaps that may exist. The data used in this report was collected by government officials based in the field in the affected districts and collated at the state level. Data was also taken from the rapid assessment conducted by the UNDMT. An analysis based on remote sensing data was also conducted for the transport, housing and agriculture sectors in one district (Rudraprayag) to understand the extent of the affected areas. Furthermore, given the continued rainfall and the nature of data availability, a cut-off date of July 29, 2013 has been used for the data incorporated in this assessment. A currency conversion rate of US$ 1= INR 60 has been used.

2.2 Assessment Scope

6. While the disaster and subsequent rainfall affected almost all districts within the state, the main focus of the assessment was on five districts that were most affected by the cloud burst and heavy rainfall – Bageshwar, Chamoli, Pithoragarh, Rudraprayagand Uttarkashi. Please note that where available and pertinent, the team has also taken into account findings from other districts. The following sectors were included in the assessment:

- Housing
- Public Buildings
- Roads and Bridges
- Urban Infrastructure (Water Supply, Roads, Drains and Sewerage)
- Rural Water Supply and Sanitation
- Irrigation
- Livelihoods (Agriculture, Livestock, Fisheries, Tourism linked Livelihoods and MSME)
- Tourism Infrastructure
- Energy
- Forests and Biodiversity

2.3 Assessment Methodology

7. While the main focus of the assessment has been to estimate the damages to physical assets and the corresponding needs, this rapid assessment is broadly based on the Damage and Loss Assessment (DaLA) methodology developed by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) and further updated and expanded by the World Bank's GFDRR. It provides a preliminary estimate of the total cost of damages and identifies the needs for reconstruction. It is envisaged that detailed sectoral analyses would inform project design and implementation. Under the DaLA methodology conceptual framework, the damage is the value of physical, durable assets that may be destroyed due to the action of the natural hazard that caused the disaster, expressed in terms of the replacement value of the assets assuming the same characteristics that they had prior to the disaster. Where available, the corresponding needs figures typically include a "build back smarter" factor to consider quality improvements.

8. The JRDNA team reviewed several existing assessments and situation reports. This assessment is informed by these prior assessments conducted by government, NGOs, local and UN agencies such as the UNDMT Situation Reports and the Rapid Needs Assessments. The UNDMT undertook rapid needs assessments for the GoU. The mission took place between July 2 and 12, 2013. Teams visited the five

most severely affected districts for primary data collection between July 3 and 8, 2013. Secondary data was also collected from the District Magistrate's office. Standard formats were used for data collection on emergency food, health, water, sanitation, hygiene, shelter and livelihoods whose findings were then collated to put the assessment together. It must be noted that there are several similar on-going and detailed assessment efforts (e.g. shelter cluster teams) from various government, UN and NGO entities that would inform early recovery planning. The team's estimates of damages neither supersede nor disregard assessments of damage and needs made by other entities. It presents a consolidated view, on the basis of relevant information received and the expertise of a multi- institutional and interdisciplinary assessment team.

2.4 Limitations and Caveats

9. The findings of the joint rapid assessment, which was conducted from July 29 to August 7, 2013, are presented in this report. The assessment is intended to quantify the consequences of the disaster, and to provide a first attempt at identifying immediate and longer term recovery and reconstruction needs. The team's analysis is based on discussions with the state government, and relies on information (through assessments carried out by the GoU) available at the time of the mission and the information is based on data up to July 29, 2013. As large parts of affected areas are still cut-off and the monsoon is ongoing, it is not possible to make a complete assessment at this stage. As accessibility increases, more damage information may come in and thus the final damages numbers may be much higher than what is assessed in this report.

10. Since many assessments, surveys and specific sectoral analyses are still ongoing, the figures should be considered as the best estimate possible given available data and time constraints. The massive and continued rainfall as a result of an early monsoon may further saturate the soil. The continuing heavy rains are thus causing more damages and the region is susceptible to further damages, as the full rainy season still lies ahead.

11. While damages have been estimated for some of the districts, this does not mean that other districts were affected less, nor does it imply that some districts/areas must be prioritized over others. The estimates are also a function of the level of data availability in these regions.

12. The damage and needs assessment is derived from figures provided by the state government and incorporated into the analysis by the sector teams following discussions with the government and on the basis of strategic interviews, expert opinions, feasibility considerations and other implementation considerations. Detailed project formulation and project needs may be predicated on pending policy decisions, and subsequent detailed assessments as well as consultation and participation of the affected population.

13. Given the short time available for this rapid assessment, and the focus of local authorities on rapid emergency response in terms of reconstruction needs, the figures presented here should not be considered definitive, but rather a preliminary understanding to guide the recovery and reconstruction efforts.

14. The report was discussed amongst WB, ADB and the GoU and the finds were accepted on August 7, 2013.

Chapter Three

Damage and Needs Assessment by Sector

3. Damage and Needs Assessment by Sector

1. This Chapter provides the damage and need assessment on a sector-by-sector basis.

3.1 Housing

2. The State has a population of 10,116,752 (Census of India, 2011) of which the rural population constitutes about 70% of the total (7,025,583)[10]. Building Typologies in the disaster-affected areas include (i) *kutcha* structures (i.e. semi-permanent houses made in stone walls and with roofs of slate or other local materials); (ii) *pucca* structures (i.e. houses made with Reinforced Cement Concrete (RCC) structure with RCC roof or in brick/stone masonry with RCC roofs), and (iii) multi-storeyed structures. The settlement in the northern districts of the State are mostly along the river and overtime as the number of pilgrims have increased the settlements on the pilgrimage route and have at times encroached into the river valleys.

3. Many buildings were washed away either due to rising water levels or due to erosion of the foundations and slopes caused by high speed currents. At many locations entire settlements have been washed away, while many buildings that were partially damaged are now unsafe for habitation and may require total rebuilding.

4. The other challenges include finding suitable lands for the reconstruction of houses for which land has been lost due to widening of valleys, erosion of slopes or due to generated landslides. In the post disaster scenario there are a large number of women survivors who would now lead the households.

[10] Statistical handbook and Census of 2011

5. Based on the information provided by the GoU about 3,077 units were damaged in both the urban and rural areas. In addition there were losses of personal property;however, those have not been quantified due to lack of relevant data available at the time of this report. A snapshot of the damages is given in the following Tables 3 and 4.

Table 3: Damages to Urban Housing

District	Building Typology	Number of Units		
		Total	Partially Damaged	Fully Damaged
Bageshwar	*Pucca*	5	-	5
Chamoli	*Pucca*	132	118	14
Pithoragarh	*Pucca*	-	-	-
Rudraprayag	*Pucca*	382	88	294
Uttarkashi	*Pucca*	150	117	33
Total		**669**	**323**	**346**

Table 4: Damages to Rural Housing

District	Building Typology	Number of Units		
		Total	Partially Damaged	Fully Damaged
Bageshwar	Pucca	145	135	10
	Kutcha	1	-	1
	Total	**146**	**135**	**11**
Chamoli	Pucca	511	-	511
	Kutcha	47	-	47
	Total	**558**	**-**	**558**
Pithoragarh	Pucca	477	37	440
	Kutcha	-	-	-
	Total	**477**	**37**	**440**
Rudraprayag	Pucca	386	56	330
	Kutcha	-	-	-
	Total	**386**	**56**	**330**
Uttarkashi	Pucca	841	533	308
	Kutcha	-	-	-
	Total	**841**	**533**	**308**
Grand Total		**2,408**	**761**	**1,647**

Reconstruction Needs

6. The discussions with the GoU have helped crystalize the area requirements and unit cost of construction. The challenges due to connectivity, extreme climatic conditions and expected strain on the natural and human resources have been considered while costing the recovery needs.

7. As per estimates, the reconstruction needs amounts to about INR 1,278 million (US$ 21.3 millions). Table 5 below provides the details.

Table 5: Reconstruction Cost for Houses (Urban and Rural)

District	Urban			Rural			Total Cost for Reconstruction	
	No. of Units	INR million	US$ million	No. of Units	INR million	US$ million	INR million	US$ million
Bageshwar	5	2.80	0.05	146	38.47	0.64	41.27	0.69
Chamoli	132	40.88	0.68	558	273.42	4.56	314.30	5.24
Pithoragarh	0	-	-	477	224.67	3.74	224.67	3.74
Rudraprayag	382	189.28	3.15	386	175.42	2.92	364.70	6.08
Uttarkashi	150	51.24	0.85	841	281.51	4.69	332.75	5.55
Total	**669**	**284.20**	**4.74**	**2,408**	**993.48**	**16.56**	**1,277.68**	**21.29**

Note:
a) The reconstruction cost for partially damaged houses has been taken as 50% of the reconstruction cost.
b) Unit cost of construction is taken as INR. 0.56 million (US$9300) (400 square feet built-up area for urban houses)
c) Unit cost of construction is taken as INR 0.49 million (US$8160) (350 square feet built-up area for rural houses)

8. The total reconstruction cost including the cost of relocations and temporary shelters has been worked out and amounts to INR 1504.8 million (US$ 25.08 million) provided in the Table 6 below:

Table 6: Total Reconstruction Cost of Housing (Urban and Rural)

Category	Housing	Temporary Shelters	Land	Utilities	Total
Urban	4.74	0.45	0.13	0.28	5.60
Rural	16.56	1.61	0.32	0.99	19.48
Total					**25.08**

Note:
a) Temporary shelters have been assessed for 20% of the reconstruction costs of the affected houses @ INR 200,000 (US$ 3330) per unit.
b) 20% of the affected houses have also been considered for relocation
c) Cost of land for relocation has been taken as INR 60,000 (US$ 1000) in urban area and INR 40,000 (US$666) in rural areas
d) Cost of utilities = 30% of total cost of construction in relocation areas.

3.2 Public Buildings

9. The flood damaged the infrastructure including equipment and amenities which led to the disruption of the routine functioning of these facilities in the affected areas. Several of the public buildings which were damaged during the disaster, have also lost connectivity and are inaccessible due to damages to roads and bridges.

10. As per the information obtained from the GoU, a total of about 995 Public Buildings are damaged which includes Education, Health, Women & Child Development Centres, Block Offices and Other Residential Buildings. The detail of the damages to the public buildings categorized as partially and fully damaged are given in the Tables 7 to 10 below:

Table 7: Damages to Educational Buildings

Description	Bageshwar	Chamoli	Pithoragarh	Rudraprayag	Uttarkashi	Other districts	Total
Partially Damaged							
Primary	49	60	13	30	63	217	432
U. Primary	15	22	3	7	30	67	144
Sec./Sr. Sec	15	26	8	7	3	53	112
Block/Cluster Res.	0	0	0	0	0	4	4
Higher/ Vocational Inst.	0	1	0	0	1	3	5
Total	**79**	**109**	**24**	**44**	**97**	**344**	**697**
Fully Damaged							
Primary	3	38	5	4	57	28	135
U. Primary	0	5	0	4	12	9	30
Sec./Sr. Sec	0	0	1	2	1	0	4
Block/ Cluster Res.	0	2	2	0	0	1	5
Higher/ Vocational Inst.	0	0	0	0	0	2	2
Total	**3**	**45**	**8**	**10**	**70**	**40**	**176**
Grand Total	**82**	**154**	**32**	**54**	**167**	**384**	**873**

Note: (1) The schools are classified as: (i) Primary School – Class 1 to 5; (ii) Upper Primary School – Class 6 to 8; (iii) Secondary Schools /Sr. Secondary Schools – Class 6 to 12.

Table 8: Damages to Buildings for Health Services

Description	Bageshwar	Chamoli	Pithoragarh	Rudraprayag	Uttarkashi	Other districts	Total
Partially Damaged							
CHC	1	0	0	0	1	9	11
Sub centre	0	0	0	0	2	6	8
PHC	0	1	0	0	1	10	12
SAD	0	3	0	2	1	6	12
Other facilities	0	0	1	2	0	4	7
Total	**1**	**4**	**1**	**4**	**5**	**35**	**50**
Fully Damaged							
CHC	0	0	0	0	0	0	0
Sub centre	0	0	0	0	0	1	1
PHC	0	0	0	0	0	0	0
SAD	0	1	0	1	0	2	4
Other facilities	0	1	0	0	0	0	1
Total	**0**	**2**	**0**	**1**	**0**	**3**	**6**
Grand Total	**1**	**6**	**1**	**5**	**5**	**38**	**56**

Note: The other facilities include administrative buildings for the health facilities and hospitals. Child Health Centre (CHC), Primary Health Centres (PHC); State Allopathic Dispensary (SAD).

11. The Women and Children Centres include Office Buildings and *Anganwadis*.

Table 9: Damages to Women & Children Centres

Description	Bageshwar	Chamoli	Pithoragarh	Rudraprayag	Uttarkashi	Other districts	Total
Partially Damaged							
Office Bldg.	0	0	0	0	0	1	1
Anganwadi	0	2	5	0	8	7	22
Total	**0**	**2**	**5**	**0**	**8**	**8**	**23**
Fully Damaged							
Office Bldg.	0	1	0	0	0	0	1
Anganwadi	0	3	0	4	6	12	25
Total	**0**	**4**	**0**	**4**	**6**	**12**	**26**
Grand Total	**0**	**6**	**5**	**4**	**14**	**20**	**49**

Table 10: Damages to Block Offices and Residences

Description	Chamoli	Other Districts*	Total
Partially Damaged			
Block Office	4	3	7
Residential	4	2	6
Total	**8**	**5**	**13**
Fully Damaged			
Block Office	0	0	0
Residential	1	3	4
Total	**1**	**3**	**4**
Grand Total	**9**	**8**	**17**

Note: *Damage details for the other four districts of Bageshwar, Pithoragarh, Rudraprayag and Uttarkashi are not available. Therefore, it has been extrapolated from the figures for Chamoli.

Reconstruction Needs

12. The GoU has provided cost estimates for the restoration of partially damaged structures as well as the cost for reconstruction of fully damaged structures. The assessment includes an additional 10% to account for furniture and other equipment and another 10 % as the cost for additional complexities on top of the estimate provided by the GoU.

13. Total reconstruction needs for public buildings amount to about INR 1028.79 million (US$ 17.15 million). The detail of the number of units damaged and the cost of reconstruction in Rupee million as well as US$ million is provided in the Tables 11 to 14 below.

Table 11: The Needs Assessment for Educational Buildings

Districts	Primary & Secondary			Higher education / vocational institutes			Total Cost for Reconstruction	
	No. of Units	INR million	US$ million	No. of Units	INR million	US$ million	INR million	US$ million
Bageshwar	82	35.94	0.60	0	-	-	35.94	0.60
Chamoli	153	134.18	2.24	1	2.04	0.03	136.22	2.27
Pithoragarh	32	39.76	0.66	0	-	-	39.76	0.66
Rudraprayag	54	69.50	1.16	0	-	-	69.50	1.16
Uttarkashi	166	189.42	3.16	1	0.50	0.01	189.92	3.17
Other Districts	379	180.62	3.01	5	196.80	3.28	377.42	6.29
Total	**866**	**649.43**	**10.82**	**7**	**199.34**	**3.32**	**848.77**	**14.15**

Table 12: The Needs Assessment for Health Services

Districts	Number of Units	INR million	US$ million
Bageshwar	1	1.44	0.02
Chamoli	6	25.80	0.43
Pithoragarh	1	0.12	0.00
Rudraprayag	5	40.44	0.67
Uttarkashi	5	19.20	0.32
Other Districts	38	44.35	0.74
Total	**56**	**131.35**	**2.18**

Table 13: The Needs Assessment for Women & Children Centres

Districts	Office Buildings			Anganwadi			Total Cost for Reconstruction	
	No. of Units	INR million	US$ million	No. of Units	INR million	US$ million	INR million	US$ million
Bageshwar	0	0	0	0	0	0	0	0
Chamoli	1	1.20	0.02	5	2.22	0.04	3.42	0.06
Pithoragarh	0	0	0.00	5	0.03	0.00	0.03	0.00
Rudraprayag	0	0	0.00	4	2.40	0.04	2.40	0.04
Uttarkashi	0	0	0	14	1.67	0.03	1.67	0.03
Other Districts	1	3.00	0.05	19	4.31	0.07	7.31	0.12
Total	**2**	**4.20**	**0.07**	**47.00**	**10.63**	**0.18**	**14.83**	**0.25**

Table 14: The Needs Assessment for Block Offices and Residences

Districts	Block Office			Residential			Total Cost for Reconstruction	
	No. of Units	INR million	US$ million	No. of Units	INR million	US$ million	INR million	US$ million
Chamoli	4	2.16	0.04	5	3.12	0.05	5.28	0.09
4 Districts*							21.12	0.35
Other Districts	3	2.70	0.05	5	4.74	0.08	7.44	0.12
Total	**7**	**4.86**	**0.08**	**10**	**7.86**	**0.13**	**33.84**	**0.56**

Note: *Damage details for the other four districts of Bageshwar, Pithoragarh, Rudraprayag and Uttarkashi are not available. Therefore, it has been extrapolated from the figures for Chamoli.

14. An abstract of the total cost of construction for all the public buildings is provided in the Table 15 below:

Table 15: Total Reconstruction Cost of Public Infrastructure

S.No.	Sectors	No. of Units damaged	Total Cost for Reconstruction	
			INR million	US$ million
1	Education	873	848.77	14.15
2	Health	56	131.35	2.19
3	Women & Child Development Center	49	14.83	0.25
4	Other Public Buildings - Rural	17	33.84	0.56
	Total	**995**	**1028.79**	**17.15**

3.3 Roads and Bridges

15. About 90% of passenger and freight traffic in the State of Uttarakhand moves by road. Rail services offer freight and passenger connections to the neighboring states through four rail heads in the State's southern low-lying plain region. The hilly and mountainous terrain that covers more than 90% of the State's land area would preclude the development of railway infrastructure catering to intrastate services.

16. The roads subsector in the State comprises of road infrastructure, which is primarily administered by the Public Works Department (PWD); and transport services, which are overseen by the Transport Department. The PWD is responsible for planning, financing, constructing, and maintaining roads, bridges, and related government buildings.

17. The overall road network in the State is 31,929 km. The road network is administered by the PWD and comprises of 1,151 km of national highways (NH)[11], 3,788 km of State Highways (SH), 3,290 km of Major District Roads (MDR), 2,945 km of Other District Roads (ODR), 15,402 km of Village Roads (VR), and 1773 km of Motor Bridges. Additionally, the PWD also administers 3,736 km of bridle roads/ tracks and 1,073 bridle bridges. The Border Roads Organization manages about 1,623 km of NHs, SHs, MDRs, and ODRs.

18. The Transport Department is responsible for issuing licenses for vehicles and operators, operating permits for private freight and passenger service operators, and managing the State Road Transport Corporation (SRTC). Private operators provide the bulk of the freight and passenger services under permits issued by the State transport authorities. Privately operated passenger transport predominates in the rural hill areas.

19. Roads are the lifeline of the State. However, the quality of the road network in Uttarakhand has been poor and constraints the economy of the State. The mountainous terrain, rivers that are prone to flash floods, fragile geology and ecology and lack of adequate funding for development and maintenance, is further aggravated by flash floods, massive landslides, erosion and caving of roads caused by cloud bursts and heavy rains during the monsoon period. The PWD faces a major challenge in the opening of disrupted roads during the monsoon season every year.

20. The cloud burst and torrential rains during June 15 -17, 2013, has resulted in erosion of long stretches of roads, major landslides and caving of roads and pathways, and complete disruption of vehicular movement and road connectivity. A few rivers in the region have changed course significantly at many places and the unprecedented river flows with heavy sediment and floods have caused total erosion of the river banks, and has washed away large sections of roads and a significant number of bridges. The impact of the calamity has reached far downstream areas throughout the State, where the damage to roads has been caused by inundation and overtopping of roads due to downstream floods. Damaged roads would require realignment at a number of locations and the widened rivers would require longer bridges.

[11]Ministry of Road Transport and Highways has delegated the responsibility of National Highways to PWD.

21. The disaster has caused damages to about 2,174 roads, 85 motor bridges and 140 bridle bridges and connectivity to about 4,200 villages have been affected. A large number of vehicles have been washed away, buried under debris, fallen off the hill, or stranded at cut-off locations. Large areas in Uttarakhand had been completely cut-off and over 70,000 tourists and 100,000 local inhabitants were stranded in the upper reaches of the mountain terrain. The impact on the affected population due to the loss of connectivity has been manifold. The food supply, healthcare, education and the livelihood of the affected population has been completely disrupted. Food and essential supplies to the cut-off areas are being undertaken through the landing of helicopters at makeshift helipads.

Table 16: Summary of Roads with BRO, National Highways and State Highways Affected by the Disaster

Districts	Roads with Border Road Organisation (BRO) in km	National Highway (NH) in km	State Highway (SH) in km
Part A-Worst affected Districts			
Bageshwar	0.00	0.00	101.00
Chamoli	280.00	7.00	50.00
Rudraprayag	100.00	0.00	19.00
Uttarkashi	175.00	54.18	10.00
Pithoragarh	380.00	0.00	73.00
Total	**935.00**	**61.18**	**253.00**
Part B-The other Eight Districts			
Almora	0.00	73.00	294.40
Champawat	50.00	0.45	0.00
Dehradun	0.00	29.00	135.00
Haridwar	0.00	31.80	11.00
Nainital	0.00	53.00	121.00
Pauri	15.00	21.00	106.00
Tehri	96.00	15.00	93.00
Udham Singh Nagar	0.00	25.00	27.00
Total	**161.00**	**248.25**	**787.40**
Grand Total- A and B	**1096.00**	**309.43**	**1040.40**

22. The region of the disaster includes the holy pilgrimage circuit constituting Kedarnath, Badrinath, Gangotri, and Yamunotri, and the road connectivity to these places has been the worst affected which has completely disrupted the pilgrimage. Some of the popular trekking routes in the higher ranges of the Himalayas have also been affected and these trekking destinations have been cut off. Besides the physical damages, the calamity has also severely affected the livelihood of the people dependent solely on the flow of pilgrims and tourists.

23. Out of the total number of 2,174 closed roads, 1,784 roads have been restored and the connectivity to 3,771 villages out of the total number of 4,200 cut-off villages has also been restored. However, the current restoration of connectivity is only through temporary measures so as to facilitate the movement of vehicles, people and animals. These locations are still susceptible to further damages and the risk of these areas being cut-off again continues to remain.

Table 17: Summary of Other Roads Affected by the Disaster

Districts	MDR (km)	ODR (km)	Village Roads PWD (km)	Village Roads – PMGSY (km)	Bridle Roads (km)	Motor bridges (nos)	Bridle Bridges (nos)
Part A-Worst affected Districts							
Bageshwar	75.00	55.00	79.09	25.50	6.00	1	18
Chamoli	86.00	124.00	253.61	69.86	76.40	1	26
Rudraprayag	27.00	24.00	143.38	81.47	31.15	4	25
Uttarkashi	81.00	12.00	389.91	49.33	49.30	7	12
Pithoragarh	17.00	-	250.61	20.77	108.50	2	26
Total	**286.00**	**215.00**	**1116.60**	**246.93**	**271.35**	**15**	**107**
Part B-The other Eight Districts							
Almora	169.00	178.50	66.91	23.56	-	-	3
Champawat	12.00	7.00	261.38	20.65	-	-	-
Dehradun	79.60	47.60	439.52	30.02	-	31	2
Haridwar	47.00	17.30	49.00	-	-	2	-
Nainital	37.00	6.00	180.48	22.51	27.00	-	-
Pauri	88.00	120.00	964.14	101.57	5.6	2	7
Tehri	82.00	79.00	769.39	40.39	132.4	35	21
Udham Singh Nagar	6.00	1.00	215.55	-	-	-	-
Total	**520.60**	**456.40**	**2946.37**	**238.70**	**165.00**	**70**	**33**
Grand Total- A and B	**806.60**	**671.40**	**4062.97**	**485.63**	**436.35**	**85**	**140**

Reconstruction Needs

24. The preliminary assessment of the needs reflect the cost of rehabilitation and reconstruction of the affected road stretches. The preliminary estimate of needs for the roads with the Border Roads Organization (BRO) and the National Highways (NHs) are based on the proposals submitted by the

BRO, the NH Division, and PWD respectively to Ministry of Road Transport and Highways. These estimates include a provision for protection works, river training works and resurfacing of the roads. The preliminary assessment of the damage on roads under the jurisdiction of the PWD is based on a preliminary visual assessment to the extent possible. In order to ensure sustainability, a provision for protection works and selective resurfacing has been kept in the preliminary needs estimate.

Table 18: The Needs Assessment for Roads and Bridges

A	Category of Road			
		Needs Estimate for Roads		
		Affected Length[1] (In km)	Preliminary Needs Estimation	
			(INR million)	(US$million)
A1	Roads with Border Roads Organization	1096.00	5850.00	97.50
A2	National Highway	309.43	4173.37	69.56
A3	State Highway	1,040.40	3453.02	57.55
A4	Major District Roads	806.60	1387.98	23.13
A5	Other District Roads	671.40	707.74	11.80
A6	Village Roads	4062.97	5461.59	91.03
A7	Village Roads-PMGSY	485.63	1088.30	18.14
A8	Bridle Roads	436.35	171.04	2.85
Sub Total Roads		**8908.78**	**22293.04**	**371.56**
B	**Needs Estimate for Bridges**			
Category of Bridge		**No of Affected Bridges**	**Preliminary Needs Estimation**	
			(INR million)	**(US$million)**
B1	Motor Bridges (1675 nos.)	85	271.82	4.53
B2	Bridle Bridges (1019 nos.)	140	1002.62	16.71
Sub TotalBridges		**225**	**1274.44**	**21.24**
Total A + B			**23567.48**	**392.80**
Additional cost on account for poor connectivity & remoteness @ 15 %			**3535.12**	**58.92**
Total (including contingency)			**27102.60**	**451.71**

[1] Overall length of roads, which have been affected due to severe damages including landslides, slips, potholes, breach of retaining walls and breast walls.

25. Preliminary analysis of damage and loss statistics indicates that major damages have happened beyond the 5 stated districts, due to the cloud burst and very heavy rainfall. The remaining 8 districts have also been affected in varying degrees. The water in the torrential mountain rivers with very high velocities has been reported to have caused river bed erosion even in the downstream reaches in other districts. Similarly, flooding of these rivers has taken place even in the downstream reaches and inundated the roads causing damages in all districts in varying degrees.

3.4 Urban Infrastructure (Water Supply, Roads, Drains and Sewerage)

26. Nearly a third of the state's population lives in urban areas. As per the census 2011, the state's urban population is 3.05 million out of a total population of 10.1 million. Uttarakhand's urban settlements include 75 statutory towns with a total population of 2.56 million. These include the

Municipal Corporation of Dehradun, 32 Nagar Palika Parishads, 31 Nagar Panchayats, 9 Cantonment Boards, and 2 Industrial Townships. In addition the census 2011 identified 41 census towns[12] with a total population of 0.49 million.

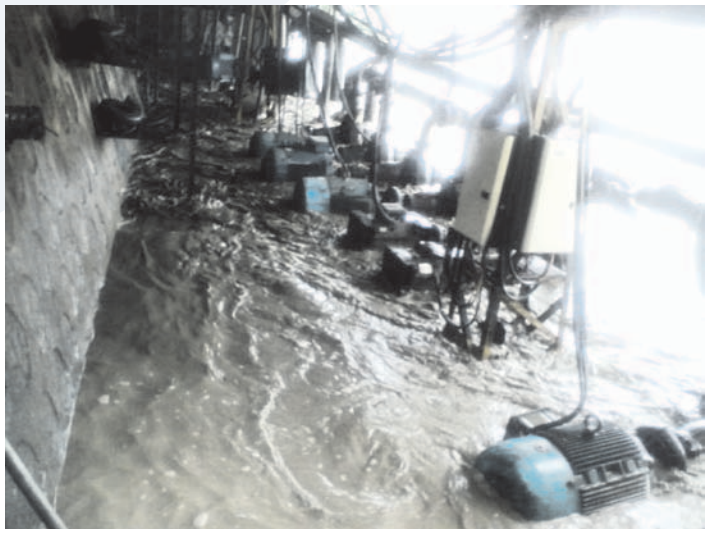
27. 74% of the State's urban population lives in the plains of southern Uttarakhand including Dehradun, the capital. Majority of the towns and cities of the plains and the hills are popular tourist destinations or gateways to other tourism spots.

28. Haridwar, Pantnagar, and Sitarganj are the key industrial urban hubs of the State. These industrial hubs and tourism provide the main opportunities for economic development in the urban centres of Uttarakhand. However, the basic infrastructure of these urban centres has not kept pace with the rapid growth in population, tourist traffic, and the construction boom, all of which has put the fragile ecosystem of the State under pressure.

29. About 80% of the urban population of Uttarakhand has access to piped water supply. While the state enjoys abundant water resources, service levels are low (average supply hours varies from 1 to 4 per day) due to improper planning, difficult terrain, capacity issues and resource constraints. Sewerage coverage in the towns is limited. Only 25 towns have a centralized sewerage system with partial coverage while the other towns rely on individual septic tanks. None of the urban centres in the State has landfill sites of the quality mandated by the Municipal Solid Waste (MSW), 2000 Act. Due to land constraints, the internal roads in most of the hilly towns are narrow with insufficient parking space. To meet the challenges of urbanization, the GoU is implementing a number of urban infrastructure schemes with the assistance of the GoI, the WB and the ADB.

30. Urban Local Bodies (ULBs) are primarily responsible for providing urban infrastructure and services (except water supply and sewerage) including on-site sanitation, solid waste management, drainage, road maintenance, street lighting, and slum improvement. Water Supply and Sewerage (WSS) service provision is the responsibility of the State water utilities i.e., Uttarakhand Pey Jal Nigam (UPJN) for capital works and Uttarakhand Jal Sansthan (UJS) for operation and maintenance, both of which operate under the Drinking Water Department.

31. The urban infrastructure in 41 of the 75 towns has been seriously affected by the floods. It has caused damages to the intake wells and the treatment plants of the water supply schemes in the mountainous districts of Chamoli, Rudraprayag, Pauri, Tehri, and Uttarkashi as a result of scouring and heavy deposition of silts. The per capita water supply in the urban areas of these districts has been reduced by 20 to 50 litres per capita per day (lpcd). It is estimated that about 112,000 people have been directly affected in terms of reduced coverage of municipal water supply systems due to the damage caused by the floods. In total, 50 raw water intake stations and tube wells and 40 km of pipelines have been severely damaged. The damage to the sewerage schemes is relatively minor, except



[12] Census towns are areas which are categorized as urban following criteria or population, density and occupation. These areas are however still administered by rural local governance structures (Gram Panchayats).

some losses in the 16 on-going works under the National Mission for Clean Ganga (14 programs) and the Jawaharlal Nehru National Urban Renewal Mission (2 programs). District wise figures of damages of urban water supply schemes are summarised in Table 19 below.

Table 19 : Summary of Damages to Urban Water Supply Infrastructure

Districts	Number of affected towns	People directly affected	% urban population of the district	Average reduction in level of supply (in lpcd)	Potable water production capacity reduced (in MLD)	Number of intakes/ tube-wells damaged	Pipeline damaged (in km)
Bageshwar	1	2,000	8%	20	0.50	1	0.2
Chamoli	9	26,900	23%	20	2.20	24	12.5
Pithoragarh	2						0.3
Rudraprayag	2	2,900	10%	27	1.00	8	9.1
Uttarkashi	2	9,900	13%	55	3.60		3.5
Almora	1	-	-	-	0.30		
Champawat	2						0.1
Dehradun	4				6.00	4	1.0
Haridwar	3	42,535	5%	3	10.50	4	0.2
Nainital	6	-	-	1	0.80		0.4
Pauri	4	14,440	12%	40	6.60	8	7.65
Tehri	5	13,430	16%	17	1.20	1	5.5
Total	**41**	**112,105**				**50**	**40.45**

32. Besides damaging the water supply network, the floods have also washed away or destroyed about 21 km of urban roads and 24 km of roadside drains. However the impact of the damages to urban roads and road side drains are not significant and have not disrupted the regular traffic. The district-wise break up of damages are given in Table 20 below:

Table 20: Summary of Damages to Urban Roads and Drains

Districts	Number of affected towns	Road length damaged (in km)	Drains damaged (in km)
Chamoli	5	2.20	9.80
Pithoragarh	2	0.20	0.10
Rudraprayag	1	-	0.05
Uttarkashi	4	11.00	7.20
Almora	1	0.60	1.00
Champawat	2	1.40	0.30
Pauri	2	3.30	-
Tehri	6	-	2.00
Haridwar	3	0.90	2.10
Dehradun	2	1.20	1.70
Total	**28**	**20.80**	**24.25**

Reconstruction Needs

33. In the current conditions, undertaking an independent on-site assessment in the remote, vast and completely cutoff areas was not possible due to the fact that the incessant rains and flash floods are continuing to date in the current monsoon period. Under the circumstances, the damage and loss assessment carried out by the GoU has been relied upon. It is also relevant to note that the State government estimates in this regard are also preliminary in nature as the State machinery is currently focused on the immediate humanitarian relief operations and emergency restoration and connectivity works. As large parts of the affected areas are still cutoff and the monsoon is ongoing, it is not possible to make a complete assessment. The continuing heavy rains are causing more damages and the region is susceptible to further damages, as the full rainy season still lies ahead. Moreover, a realistic and engineering assessment would require preliminary field surveys and investigations.

34. While estimating the need for the rehabilitation of the water supply component of individual towns, the following basic service standards have been considered, keeping the network coverage the same.

Table 21: Summary of Per capita Water Supply based on Population

Town Population	Per capita water supply (lpcd)
Up to 10,000	70
Above 10,000 to 50,000	100
Above 50,000	135

35. For the assessment of damages to urban roads,drainages and (on-going projects with water supply and sanitation components, the estimate provided by agencies of the GoU, based on applicable standard rates, have been used. As relevant data and information were not available for Solid Waste Management (SWM) and Street Lighting, it is not possible to estimate losses for those components.

36. Restoration needs were estimated by the State assuming the reconstruction cost of the damaged assets and provisioning of services as per standards, with a 10 year planning horizon. The estimated needs for urban infrastructure amounts to INR 1,268 million (US$ 21.13 million), including INR 707 million (US$ 11.78 million) for water supply infrastructure, INR 236 million (US$ 3.94 million) for urban roads, INR 145 million (US$ 2.42 million) for drains, and INR 180 million (US$ 3 million) for sewerage.

Table 22: Summary of Preliminary Estimation of Damagesto Urban Infrastructure

Districts	Water Supply		Urban Roads and Drains			Sewerage		Total	
			No. of affected towns	Damage (US$ million)				Damages	
	No. of affected towns	Damage (US$ million)		Road	Drains	No of Schemes	Damage (US$ million)	INR million	US$ million
Bageshwar	1	0.32	-	-	-	-	-	19.20	0.32
Chamoli	9	3.41	5	0.45	0.70	5	1.10	339.60	5.66
Pithoragarh	2	0.03	2	0.05	0.06	-		8.40	0.14
Rudraprayag	2	0.70	1	0.35	0.10	1	0.83	118.80	1.98
Uttarkashi	2	1.70	4	0.46	0.17	5	0.73	183.60	3.06
Almora	1	0.04	1	0.08	0.16	-	-	10.20	0.17
Champawat	2	0.02	2	0.07	0.03	-	-	7.20	0.12
Dehradun	4	0.59	2	0.67	0.43	1	0.01	102.00	1.70
Haridwar	3	0.43	3	0.09	0.23	-	-	45.00	0.75
Nainital	6	0.10	-	-	-	1	0.04	15.00	0.25
Pauri	4	4.06	2	0.25	0.13	1	0.03	268.20	4.47
Tehri	5	0.38	6	1.47	0.41	2	0.25	150.60	2.51
Total	**41**	**11.78**	**28**	**3.94**	**2.42**	**16**	**3.00**	**1267.80**	**21.13**

37. Preliminary cost analysis indicates that the expenditure required for restoring the damaged urban infrastructure in Chamoli, Rudraprayag, Uttarkashi and Pauri districts will account for 80% of the overall reconstruction cost of the sector, of which major share will be required for rehabilitation the water supply systems.

3.5 Rural Water Supply and Sanitation

38. Ensuring safe drinking water is a major challenge for Uttarakhand where almost 90% of the territory falls within the Himalayan region. Three out of four of the state's 10 million people live in rural areas with densities varying from around 40 people per sq. km to over 800, spread over the 7,562 Gram Panchayats (GPs), 16,623 villages and 39,967 habitations[13]. The State was doing well on providing water supply and sanitation services to rural communities however; the recent floods particularly in the five worst affected districts like Bageshwar, Chamoli, Pithoragarh Rudraprayag and Uttarkashi have significantly washed out the gains. Even the remaining eight districts (Almora, Champawat, Dehradun, Haridwar, Nainital, Pauri, Tehri and Udham Singh Nagar) have suffered massive losses due to the spiral downstream floods and heavy rains which damaged the assets in large numbers. In the area of rural water supply and sanitation, the damages and losses are state-wide with catastrophic impact on communities and families.

39. The recent cloud bursts, heavy rains, landslides and floods in Uttarakhand have severely affected the existing rural infrastructure crippling access to basic services, particularly water supply and sanitation. In a disaster-hit situation, the lack of potable drinking water adds to the crisis, impacts the health of communities, women and children suffer the most as they have to spend hours trying to collect the water. Lack of sanitation further aggravates it, by polluting the environment that can breed many diseases. Disruption in water supply and sanitation services overall compromises the coping mechanism of communities and families and prolongs the recovery period after a disaster.

[13] GoU, 2012

40. The Nodal Department, the three implementing agencies (Swajal PMU, Uttarakhand Pey Jal Nigam (UPJN), and Uttarakhand Jal Sansthan (UJS)) and the district teams have responded quickly and effectively to the crisis. As a part of the immediate step, they have been able to restore the water services in a majority of the villages by carrying out temporary repair works in the water supply systems. For example, structures were connected temporarily by locally available materials like plastic pipes, making by-pass at damaged structures like CWR, temporary Random Rubble (RR) masonry works for protection & at source point by making local site specific arrangements to divert the water into temporarily restored supply distribution pipelines and other works. The State has also used tankers to supply water to villages facing water scarcity.

41. In the worst affected areas, 873 schemes (84%)were temporarily restored while in less affected districts, 1,214 schemes (73%) were restored. Providing safe water still remains a major issue in the affected areas which can be addressed if the permanent restoration and reconstruction of the schemes are completed.

42. The agencies have prepared a plan categorized into two sub-plans –1) Short term plan where all the temporary works will be completed by August 2013, and 2) Medium and Long term plan in which all the permanent restoration and reconstruction works will be completed within two years.

43. In Uttarakhand, the coverage of water supply and sanitation in rural areas has been impressive with over 80% of the inhabitants were either fully or partially covered either with piped water or hand pump schemes. The State has performed well in ensuring sanitation access to more than 80% of the households[14]. With a supportive centrally sponsored National Rural Drinking Water Program (NRDWP), the Nirmal Bharat Abhiyan[15] (NBA) and the World Bank assisted Uttarakhand Rural Water Supply and Sanitation Project (URWSS Project), the State has been successful in improving the service delivery of water supply and sanitation in rural areas by improving its infrastructure, IEC, and program management systems. The World Bank assisted on-going URWSS Project (2006-2014) has successfully implemented the Sector-Wide Approach program (SWAp), including RWSS schemes in more than 6100 habitations across all 13 districts.

44. The Uttarakhand RWSS Project played a major role in achieving improved service delivery by developing the institutions, capacities, and policies. The three implementing agencies (Swajal PMU, Uttarakhand Pey Jal Nigam (UPJN), and Uttarakhand Jal Sansthan (UJS)) have made significant progress under the leadership of the Drinking Water Department in adopting and implementing the decentralization program and policies[16].The project has also focused on improving governance and accountability systems.

45. Before being hit by the disaster , the State had 12,182 well functioning piped water schemes (5,193 in the five worst affected and 6,989 in the other eight districts) providing access as per existing norms to more than 32,000 habitations (12,000 in the five worst affected districts and 20,000 in the

[14] MoDWS and GoU, 2013
[15] Clean India Campaign
[16]The decentralization program and processes allows community participation and ownership in planning, implementation and operation & maintenance of integrated water and sanitation schemes.

other eight districts) and benefiting 5.9 million people (1.3 million in the five worst affected districts and 4.6 million in the other eight districts). The State has also taken several catchment and protection works along with source for better sustainability of the schemes. Most of the water supply schemes are gravity based single village schemes. More than 820,156 households (236,257 in the five worst affected districts and 583,899 in the other eight districts) were able to access sanitation facilities across the State. The success in sanitation has motivated the State to set the goal of achieving state wide 'open defecation free' status by 2017.

46. In the five worst affected districts, 20%, i.e. more than 1041 schemes were damaged either fully or partially affecting 1,780 habitations. It is estimated that more than 362,143 people and 72,429 households were affected by it. Among all the districts, Uttarkashi with 43% of its schemes being washed away is the worst affected.

47. Similarly in the remaining eight districts, 24% (i.e., 1,662 schemes) were damaged. This affected more than 928,071 people and 185,614 households. Dehradun has faced severe damages with 41% of its schemes being washed away. Covering the entire State, more than 2,703 piped water schemes were damaged affecting more than 8,728 habitations and 1.29 million people.

Table 23: District wise Status and Impact of Damaged Piped Water Supply Schemes

Districts	Total no. of existing schemes	No. of damaged schemes			Affected habitation/population/ Household		
		Fully	Partially	Total	Habitation	Population	Household
Part A-Worst five affected Districts							
Bageshwar	658	2	61	63	199	29296	5859
Chamoli	955	7	239	246	445	83274	16655
Rudraprayag	604	8	127	135	317	72913	14583
Uttarkashi	1068	52	407	459	515	140887	28177
Pithoragarh	1908	8	130	138	304	35773	7155
Sub Total : A	**5193**	**77**	**964**	**1041**	**1780**	**362143**	**72429**
Part B-Other eight affected Districts							
Almora	1583	1	251	252	767	141435	28287
Champawat	676	5	57	62	185	21770	4354
Dehradun	947	45	340	385	728	177130	35426
Haridwar	106	0	3	3	55	133761	26752
Nainital	816	0	179	179	572	34081	6816
Pauri	1185	0	288	288	867	152486	30497
Tehri	1641	212	281	493	3774	267408	53482
Udham Singh Nagar	35	0	0	0	0	0	0
Sub Total : B	**6,989**	**263**	**1,399**	**1,662**	**6,948**	**9,28,071**	**1,85,614**
Grand Total A+B	**12,182**	**340**	**2,363**	**2,703**	**8,728**	**12,90,214**	**2,58,043**

48. The excessive rains severely damaged most of the gravity schemes and a few of the pumping schemes. The heavy discharge in springs, *nalas (gadheras),* streams, and rivers have caused havoc on the infrastructure especially in the areas of the source, intake/filtration chambers, river intake wells, gravity pipelines, pump houses, protections works along the sources, etc.

49. There are variations reported in the nature of the damage to the schemes. In the worst affected

districts, more than 77 schemes are fully damaged[17], while 964 are partially damaged. Estimations indicate that more than 347 km of pipe line, 1,054 sources, 1,045 civil works, 766 house connections, 496 stand posts and 86 hand pumps were damaged. The damages are also reported in the other eight districts where more than 1,399 schemes are fully damaged. The preliminary analysis suggest that more than 440 km of pipe line; 1,327 sources; 1,217 civil works; 30 house connections; 355 stand posts and 352 hand pumps were damaged.

50. More than 291 under-construction schemes have been washed away out of which 95 schemes were in the five worst affected districts. Both multi-village (246 in five worst affected districts and 570 in other eight affected districts) and single-village (795 in five worst affected districts and 1,092 in other eight affected districts) schemes were damaged.

Damages in Sanitation

51. The damages in sanitation are comparatively less than the water supply schemes but potentially it can bring greater health hazards especially in villages where the piles of waste in the form of debris, boulders, stones, mud, sand, etc. have accumulated. In many villages, the toilets have been washed away and as result people have had to resort to open defecation contributing to the pollution of the water and overall environment. About 930 household toilets have been washed away in the worst affected districts including 893 soak pits and 14,526 meters of drains.

52. In the other eight districts 2,408 toilets, 2,435 soak pits and 27,244 meters of drains have washed away.

Table 24: District-wise Sanitation Damages Assessment

Districts	Total no. of HHs accessing toilets before calamity	Total no. of damaged HH toilets	Damaged SLWM infrastructure	
			Soak Pit	Drains (m)
Part A- Worst five affected Districts				
Bageshwar	37138	45	60	3080
Chamoli	53047	398	369	5080
Rudraprayag	31760	296	224	1332
Uttarkashi	46920	51	110	1454
Pithoragarh	67392	140	130	3580
Total	**2,36,257**	**930**	**893**	**14,526**
Part B- Other eight affected Districts				
Almora	72126	229	260	3910
Champawat	33513	863	765	3507
Dehradun	57866	84	90	2509
Haridwar	117706	69	70	4312
Nainital	48001	164	170	2503
Pauri	81089	185	205	5511
Tehri	82084	165	185	2112
Udham Singh Nagar	91514	649	690	2880
Total	**5,83,899**	**2,408**	**2,435**	**27,244**
Grand Total- A and B	**8,20,156**	**3,338**	**3,328**	**41,770**

[17] Fully damaged schemes includes all components of the scheme including damaged source, intake, storage, pipe distribution, civil works, connections, etc., while partially damaged schemes include some of the above listed components.

Reconstruction Needs

53. More than 1.29 million people have been affected due to disruption in the water and sanitation services, caused by the recent disaster across the State. In order to provide improved quality services to the affected population, a well-planned permanent restoration and reconstruction program needs to be initiated which may need about INR 1,304 million (US$ 21.7 million)[18]financing over the next two years. The estimates take into account that damaged assets need to be replaced with new ones (in some cases), not only of equal value, but with upgrades to services and infrastructure in order to reduce the previous inherent vulnerability or change in alignments. The inflation and design period horizon have also been factored in the estimation.

54. In the five worst affected districts, the reconstruction needs are estimated at INR 571.2 million (US$ 9.52 million).

55. In the other eight districts the reconstruction needs are estimated at INR 733.5 million (US$ 12.22 million).

Table 25: Reconstruction Needs forRural Water Supply and Sanitation

Districts	Water Supply		Sanitation		Hand-pumps		Total (Water Supply & Sanitation)	
	INR million	US$ million	INR million	US$ million	INR million	US$ million	INR million	US$ million
Part A- Worst five affected Districts								
Bageshwar	23.90	0.40	3.80	0.10			27.70	0.50
Chamoli	139.20	2.30	11.40	0.20			150.60	2.51
Rudraprayag	122.40	2.00	6.00	0.10	8.60	0.14	128.40	2.14
Uttarkashi	215.40	3.60	2.30	0.00			217.80	3.63
Pithoragarh	32.30	0.50	5.80	0.10			38.10	0.64
Sub Total : A	**533.20**	**8.90**	**29.400**	**0.50**	**8.60**	**0.14**	**571.20**	**9.52**
Part B- Other eight affected Districts								
Almora	54.30	0.90	7.60	0.10			61.90	1.00
Champawat	19.80	0.30	17.20	0.30			37.10	0.60
Dehradun	143.70	2.40	3.90	0.10			147.60	2.50
Haridwar	2.20	0.00	5.40	0.10			7.60	0.10
Nainital	56.50	0.90	5.10	0.10	34.60	0.58	61.60	1.00
Pauri	135.40	2.30	8.50	0.10			143.90	2.40
Tehri	221.20	3.70	4.80	0.10			226.00	3.80
Udham Singh Nagar	0.00	0.00	13.30	0.20			13.30	0.22
Sub Total : B	**633.10**	**10.60**	**65.80**	**1.10**	**34.60**	**0.58**	**733.50**	**12.22**
Grand Total A+B	**1,166.30**	**19.40**	**95.20**	**1.60**	**43.20**	**0.72**	**1,304.70**	**21.74**

3.6 Irrigation Infrastructure

56. The Uttarakhand Irrigation department is involved in the construction and maintenance of irrigation channels and tube wells in hilly regions. In addition, it is also involved in flood protection

[18] Includes the repair and re-installation needs of hand pumps estimated at INR 43.2 million or US $ 0.72 million as sum for all 13 districts

and drainage works. To support irrigation, the department has constructed and is managing 2,740 canals (small and big), 1,248 tube wells and 166 lift canals. The department has also constructed 891 flood protection walls with a length of 394 km. Simultaneously, it also manages 9 lakes and 2 barrages. The total command area under irrigation is 333,800 ha.

57. The disaster caused damages to 495 km length of canal works out of the total length of 11,702 km. In the five affected districts, the total damage to the canal works is 205 km.

58. Out of 394 km of flood protection works, 74 km has washed away with the flood waters in Uttarakhand. In the five target districts, from a total 45 km of flood protection works, 25 km has washed away. The total command area under irrigation is 333,800 ha and due to the damages sustained by the irrigation infrastructure, 38,330 ha have been affected in the State. The detailed assessment on the actual damage in the worst affected areas is still in progress and will take time as some of the areas are still inaccessible, especially in the Kedarnath valley.

59. The Department of Irrigation is in the process of restoring the irrigation network with temporary measures such as stacking of sand bags and connecting the damaged stretches with pipes, but given the nature of the disaster, it has been rather challenging. The continued rains and difficult terrain has hindered the immediate restoration work and a detailed investigation of the damages in order to design the recovery interventions.

Table 26: Details of the Damages to Irrigation Infrastructure

Name of works	Total No. of Works	Damaged No.	Total Length (km)	Damaged Length (km)	Total Command Area (ha)	Affected Command Area (ha)
Canals	2,740	1,542	11,702	495	209,502	33,181
Flood Protection Works	891	508	394	74	-	-
Lift Canals	166	60	-	-	5,041	1,999
Lakes	9	2	-	-	-	-
Barrages	5	1	-	-	-	-
Tube Wells	1,248	53	-	-	30,683	3,151
Buildings	-	12	-	-	-	-

Source: Department of Irrigation, Uttarakhand

Reconstruction Needs

60. The total estimated cost of rehabilitation of irrigation infrastructure in the five districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi is INR 1,393 million (US$ 23.22 million). The rehabilitation cost for the district of Uttarkashi alone, which sustained the highest damage is estimated at INR 690 million (US$ 11.5 million).

61. In the irrigation subsector, all damaged schemes and infrastructure identified were public investments. During the upcoming season, the flood protection structures and diversion bunds should be rehabilitated on a priority basis to avert further losses and damages.

Table 27: Estimated Damages to Irrigation Infrastructure in the Five Districts

Districts	Estimated Needs	
	INR million	US$ million
Bageshwar	57.60	0.96
Chamoli	168.00	2.80
Rudraprayag	307.00	5.12
Pithoragarh	170.40	2.84
Uttarkashi	690.00	11.50
Total	**1,393.00**	**23.22**

Source: Department of Irrigation, Uttarakhand

3.7 Livelihoods

62. The Uttarakhand economy mainly relies on the Tourism industry. The tourism sector makes up about 25% of Uttarakhand's GDP and the livelihood of about 100,000 people depends on it. Agriculture is also a key sector in the State economy which contributes around 23.4% to the State Gross Domestic Product and about 75% of the State's population depends on agriculture.

63. Substantial investments have been made through several programs and projects that had built social capital and provided training on improved agriculture and livestock management. However, the disasters have eroded the income gains made by these programs and projects.

64. Although data is still being compiled, close to 200,000 people engaged in agriculture, horticulture and livestock management are now reported to have lost their livelihood as a result of this disaster.

Table 28: Summarized Damages to Livelihoods

Sector	Damages (Area / length)	Livelihoods affected
Agriculture	20,401 ha of cultivable land eroded, washed away, or inundated	Data not available
Horticulture	15,536 ha affected	50,000 farmers
Fisheries	42 fish ponds affected	
Livestock	17,700 animals (cows, buffaloes, bullocks, equines, sheep, goats, poultry etc.) killed	
Tourism linked Livelihoods	Hotels, restaurants assets washed away. Taxis, small traders out of business, Youth unemployed.	83,320 HH affected
Small and micro-enterprises	80% of the 80,000 registered and unregistered enterprises affected	

65. The direct damages were mainly in the form of perished or lost livestock, un-harvested standing crops in the field, damaged fishery ponds, machineries and other Government infrastructures. The direct damage to the livestock was the loss of about 680 large animals (cattle, buffaloes), 1,532 Equines (horses, mules) and 8,446 small animals (sheep, goat). The direct damage of the agriculture crop sector was in the form of un-harvested standing crops including horticulture produce.

66. In the tourism and MSME sector, the losses are estimated on the number of livelihoods affected.

Reconstruction Needs

Table 29: Estimated Damages (by Sector) to Livelihood

Sectors	Financial losses		Livelihoods affected
	US$ million	INR million	
Agriculture	4.25	255.00	Data not available
Horticulture	21.02	1,393.20	50,000 farmers
Fisheries	0.13	7.50	
Livestock	2.40	144.00	
Tourism linked livelihoods			83,320 HH affected
Micro, Small and Medium-enterprises			

67. The total losses of the agriculture sector are estimated at INR 1,668 million (US$ 27.80 million) which includes INR 1,261 million (US$ 21.02 million) in Horticulture, INR 255 million (US$ 4.25 million) in Agriculture INR 144 million (US$ 2.4 million) in Livestock and INR 7.5 million (US$ 0.125 million) in Fisheries.

68. The overall costs for early and medium-term recovery of the agriculture sector (Agriculture, Livestock and Fisheries) were estimated at US$ 5.4 million. The largest financial losses to the affected population were the losses caused by loss of land and death of livestock. Hence, one of the key reconstruction efforts should be re-allocating land to the farmers, de-silting covered land (in the plains), lining or flood protection of river beds for protection from further land degradation and providing animals to the farmers who have lost them. Given the extent of losses, their impact on the poor and vulnerable population, as well as the financial implications, the need is to provide full compensation of lost animals to vulnerable affected population.

69. The indirect losses were mainly in the form of lost milk production which was estimated at INR 4.50 million (US$ 0.75 million). Indirect losses were not calculated for fisheries subsectors.

3.7.1 Agriculture

70. 75% of Uttarakhand's population depends on Agriculture[19]. Out of the total reported area of 5.67 million ha, 723,000 ha (13%) is under cultivation. The net irrigated area of the state is 340,000

[19] Uttarakhand State Profile 2011

ha, which is mostly confined to the plains while most of the cultivated area in the hills is rainfed. Land holdings in the hilly areas are small and scattered, and productivity of subsistence cereals is low (12-14 quintal/ha in the hills, against 32-35 quintals/ha in the plains) and consequently the corresponding agriculture income is low. The incidence of poverty at about 40%, is higher in Uttarakhand than the national average.

71. The State produces more cereals than its requirement but there is a deficiency of pulses and oil seeds. Wheat and Rice are the main crops of the State, and covers 30.8% and 23.9% of the total cropped area respectively. Rest of the arable area is covered by Millet (10.9%), Sugarcane (9.1%), Sawan (5.4%), Maize (2.7%), Pulses (2.5%), Oil seed (1.9%) and others (12.8%).

Table 30: Total Production by Crop Type and Area

Crop Type	Area (ha)	Production (MT)
Sugarcane	109,897	6,715,969
Cereals	896,774	1,803,736
Pulses	55,690	47,465
Oil seeds	30,881	32,264

Source: Agriculture Census 2010 – 2011

72. The impact of the disaster on the agricultural sector has been severe. Heavy rains have severely eroded the agricultural land in many villages, while in the plains, crops have been damaged due to inundation. Given that agriculture is the main livelihood for most of the population in the affected areas and most of the farmers in Uttarakhand come under the small and marginal category of land holdings, the disaster has severely impacted their livelihoods.

73. While detailed assessments are yet to be undertaken, as of July 29, 2013, the total crop area affected by the disaster in the State was estimated as 20,401 ha, out of which 14,800 ha accounts for the sugarcane crop in the district of Haridwar. The damage to the agriculture sector consists of one or more of the following, damage due to the total wash away of lands, damage to the agriculture infrastructure, losses due to the damaged crops and losses due to the siltation of lands that need to be cleared at a cost.

74. In the five districts concerned, the total crop area affected was reported as 2,010 ha, whereas 1,206 ha of lands have been completely washed away. The total land area silted has been reported as 944 ha.

Table 31: Agricultural Lands affected in the Five Districts

Districts	Total Affected Crop Area (ha)	Total Area Silted (ha)	Total Area Washed Away (ha)
Bageshwar	6	7	5
Chamoli	445	314	205
Pithoragarh	364	173	190
Rudraprayag	1,040	450	650
Uttarkashi	155	-	155
Total	**2,010**	**944**	**1,206**

Source: Department of Agriculture

Reconstruction Needs

75. Based on the reported damages as of July 29, 2013, total damages and direct losses in the five districts were estimated at INR 255 million (US$ 4.25 million). The Uttarakhand Agriculture Department is in the process of carrying out detailed assessments in the field and more precise data will be available once these assessments are completed. According to the estimates, the main damage is due to the wash away of lands and the worst affected district in terms of agriculture is Rudraprayag.

76. While the detailed assessments are in progress, the state government has initiated provisional relief for the farmers. The Government is planning to distribute seed mini kits to the affected farmers during the next cultivation period.

Table 32: District-wise Estimated Damages and Losses to Agricultural Land

Districts	Estimated Damages in US$				Total US$ million
	Lands lost	Lands silted	Crop losses	Damages to Infrastructure	
Bageshwar	0.01				0.01
Chamoli	0.43	0.08	0.06		0.57
Pithoragarh	0.40	0.05	0.12	0.99	0.56
Rudraprayag	1.35	0.11	0.27		1.73
Uttarkashi	0.32		0.06		0.39
Total	**2.5**	**0.24**	**0.52**	**0.99**	**4.25**

Table 33: District-wise Estimated Direct Losses

Districts	Agricultural Crop Production US$ million	Horticultural Crop Production US$ million	Livestock US$ million	Fisheries US$ million	Total US$ million
Bageshwar	0.01	0.20	0.07	0.00	0.28
Chamoli	0.57	4.40	0.20	0.01	5.18
Pithoragarh	0.56	4.20	0.87	0.03	5.66
Rudraprayag	1.73	2.90	1.29	0.00	5.92
Uttarkashi	0.39	8.10	0.16	0.09	8.73
Total	**4.25[20]**	**19.80**	**2.59**	**0.13**	**26.77**

3.7.2 Horticulture

77. Out of a total geographical area of 5.35 million hectares, about 750,000 ha come under agriculture, of which horticulture accounts for 300,000 hectares, with about 120,000 farmers attached to it. 88% of these are small and medium farmers. The total revenue of the horticulture sector is around INR 20,000 million (US$333.3 million) per annum[21].

78. The main categories of horticultural crops grown in Uttarakhand include: fruits, vegetables, potato, spices, medicinal plants and aromatic plants. The colder climate of the State's hilly terrain is suitable for fruit crops such as apples, almonds, plums, pears, apricots, peaches, and walnuts, whereas the plain areas of the State are suitable for mangoes, guavas, strawberries, lychees, melons, etc. The

[20] This includes US$ 0.98 million damage to the Agriculture Department infrastructure
[21] Horticulture Department Annual Report 2012-2013

state's climate is also suitable for lemons and has the potential for the production of mushrooms, honey, silk and tea. The State government, through various schemes, is in the process of tapping into this potential.

Table 34: Horticultural Crop Production Details

S. No.	Crop	Year 2011-12	
		Area (Ha)	Production (Metric tons)
1	Fruits	200,727	802,124
2	Vegetables	62,956	624,121
3	Potato	25,034	433,821
4	Spices	10,459	75,447
5	Flowers	1,544	1,841

Source: Horticulture Department Annual Report 2012-2013

79. The disaster has caused widespread devastation to this sector; the fruit and vegetable cultivations have been severely affected. An estimated 15,537 ha in total have been affected.

Table 35: Horticultural Crop Area Damaged in All Districts

Category of Horticultural Crop	Area Affected (ha)
Fruits	5,692.00
Vegetables & Spices	7,289.00
Aromatic Plants	2,518.00
Medicinal Plants	38.00
Tea cultivation	0.30
Total	**15,537.30**

Source: Horticulture Department

Recovery Needs

80. The crop loss is estimated to be as high as INR 1,260 million(US$ 21 million). These figures are preliminary estimates, as detailed field assessments are still being conducted. In addition to the crop losses, the disaster caused damages to the horticulture department's infrastructure including nurseries and buildings - the estimated damages are to the tune of INR 40 million (US$ 0.67 million).

81. In the horticulture subsector, provision of essential farm inputs and land preparation support to farmers could be provided as a subsidy to purchased inputs and should be given to small and poor farmers on a preferential basis. Since market routes have been damaged, there is a critical need to support the farmers to re-build market routes so that they are able to take their produce to the market. This includes putting up rope ways.

Table 36: Estimated Loss of Horticultural Crop in All Districts

Category of Horticultural Crop	US$ million	INR million
Fruits	19.74	1,188.00
Vegetables& Spices		
Aromatic Plants	1.00	60.00
Medicinal Plants	0.25	15.00
Tea cultivation	0.03	1.80
Total	**21.02**	**1,261.80**

82. The total estimated damages and losses in the five affected districts are INR 1,188 million (US$19.8 million) with Uttarkashi being the worst affected with estimated losses of INR 486 million (US$8.1 million). The districts of Chamoli and Pithoragarh reported estimated losses of INR 264 million (US$ 4.4 million) and INR 252 million (US$ 4.2 million) respectively.

Table 37: Impact on Horticulture in the Five Districts

Districts	Total Damages and Losses	
	US$ million	INR million
Bageshwar	0.2	12
Chamoli	4.4	264
Uttarkashi	8.1	486
Rudraprayag	2.9	174
Pithoragarh	4.2	252
Total	**19.80**	**1188**

Source: Horticulture Department

83. The government is planning a compensation scheme for the estimated 50,000 farmers involved in horticulture who have been directly affected by this disaster. A sum of INR 15,000 (US$250) per hectare of the affected crop land i.e., for washed away lands and for lands covered with silt and boulders is being planned to be handed out to these farmers. The government has also identified the need to grant a grace period of one year for the farmers who have obtained bank loans.

84. Removal of debris and boulders from the affected lands, construction of protection walls for the landslide affected lands and setting up new nurseries to produce quality planting materials have been identified as medium term interventions towards recovery.

3.7.3 Livestock

85. The rearing of livestock is an integral part of the farming system in the hills and it is carried out in more than 70% of rural households of the State, supporting the livelihoods of these farmers in part or in full. Farmers are dependent on livestock for milk, meat, eggs, wool, skins, manure for fertilizer and the draught power for all agricultural operations in the hills.

86. As discussed under the tourism section, mules play a very critical role in the tourism sector for transporting people and goods to the three pilgrimage sites of Kedarnath, Yamunotri and Hemkund that are inaccessible by road.

87. Livestock production in Uttarakhand is mainly carried out by the small and marginal farmers

and takes place in small holdings scattered across the state. The predominant farming system in the state is a mixed crop-livestock farming system, most of it being rain fed. Stock holdings are small, often made up of a mix of several species, except in the case of nomadic pastoralists herding sheeps and goats. Over 80% of all the species are owned by marginal and small farmers, along with some by the landless.

Table 38: Estimated Annual Production Livestock Products 2012-13

Livestock Produce	Unit	Estimated Quantity
Milk	MT	1,478.40
Meat	MT	21.60
Eggs	Million	307.92
Wool	kg	399.90

Source: Department of Animal Husbandry

88. Floods and landslides have caused a significant impact on livestock in Uttarakhand and seem to have a serious impact on the food security of the affected households. The reported number of livestock deaths in the State as of July 29, 2013 exceeded 17,700. The animals killed include; cows, buffaloes, mules, sheep, goats and poultry.

89. The total number of animals that died in the five worst affected districts, reported as of July 29, 2013 is 11,047 which are 62% of the total animals dead in the State and the estimated value of the dead animals is INR 144 million (US$ 2.4 million). The production losses associated with the livestock damage are significant and have not been estimated here as they depend on the time taken to restore infrastructure and provide the new animals and required inputs to the farmers.

Table 39: Number of Dead Animals and the Estimated Damages in the Five Districts

Districts	Cow	Buffalo	Bullock	Sheep/ Goat	Poultry	Other	Total
Bageshwar	4	3	3	440	-	1	454
Chamoli	12	26	23	743	-	-	932
Pithoragarh	290	61	94	3,459	-	88	4,226
Rudraprayag	19	57	24	2,741	300	-	4,301
Uttarkashi	34	21	9	1,063	-	-	1,134
Total	**359**	**168**	**153**	**8,446**	**300**	**89**	**11,047**

Table 40: Number of Dead Horses, Mules, Donkeys in the Five Districts

Districts	Equines
Bageshwar	3
Chamoli	128
Pithoragarh	234
Rudraprayag	1,160
Uttarkashi	7
Total	**1,532**

Recovery Needs

90. The livestock survey of 2007 estimates that the total asset value of livestock in the state is INR 81,060 million (US$1,351 million) and the estimated value of the annual livestock produce is INR 34,200 million (US$570 million)[22].

Table 41: Estimated losses due to loss of Cattle, Buffalo, Small Animals and Poultry

Districts	(US$ million)[23]	(INR million)
Bageshwar	0.04	2.40
Chamoli	0.10	6.00
Pithoragarh	0.58	34.80
Rudraprayag	0.28	16.80
Uttarkashi	0.13	7.80
Total	**1.13**	**67.80**

Table 42: Estimated Losses due to Loss of Mules, Horses, Donkeys

Districts	(US$ Million)[24]	(INR Million)
Bageshwar	0.003	0.18
Chamoli	0.11	6.60
Pithoragarh	0.20	12.00
Rudraprayag	0.97	58.20
Uttarkashi	0.01	0.60
Total	**1.29**	**77.58**

91. The government took immediate measures to rescue farm animals and more than 2,000 animals have been rescued. Special emphasis was paid to provide animal feed and fodder and the Department of Animal Husbandry has so far distributed more than 100 MT of animal feed. The Department has deployed 108 veterinary relief teams in affected areas. Also, 82 veterinary officers, 53 veterinary pharmacists, and 131 livestock extension officers have been deployed in Rudraprayag, Chamoli, Uttarkashi and Pithoragarh. The burying of the dead animals has been almost completed in the affected districts and more than 115,000 animals have been vaccinated against potential diseases.

[22] Livestock Census 2011, Department of Animal Husbandry

[23] Estimations by the Department of Animal Husbandry based on NABARD Norms

[24] Estimations by the Department of Animal Husbandry based on NABARD Norms

3.7.4 Fisheries

92. The Fisheries resources of Uttarakhand comprise of fast flowing rivers and tributaries and high and low altitude natural lakes and ponds. Out of the total stream length of approximately 2,600 km, 725 km is suitable for fish production. The area of natural lakes available in the State is 297 ha. The private sector owns around 700 ha of ponds in both the hilly and plains regions. Apart from this, there are several man-made reservoirs covering an area of more than 20,000 ha. The estimated annual fish production in Uttarakhand is around 3,900 metric tonnes, and the estimated value of the produce is INR 350 million (US$ 5.83 million)[25].

93. Due to the disaster, the fisheries activities in Chamoli, Uttarkashi, Rudraprayag, Bageshwar and Pithoragarh districts have been severely affected. Both the departmental fish farms in the districts of Chamoli and Uttarkashi have been affected. Especially, the fish farm at Gangori in Uttarkashi has been severely affected. This farm breeds more than 200,000 fish fingerlings every year with most of the farmers in this region dependent on the farm for their fish fingerlings.

94. The Department of Fisheries is in the process of carrying out a detailed assessment of the damage; the final figures are thus yet to be finalised. As of July 29, 2013, out of a total of 1,013 fishponds in the five affected districts, 42 ponds have been damaged.

Table 43: Damages and Losses to Fisheries in the Five Districts

Districts	No. of Available Ponds	No. of Damaged Ponds
Bageshwar	217	-
Chamoli	202	10
Pithoragarh	313	29
Rudraprayag	80	-
Uttarkashi	201	3
Total	**1,013**	**42**

Source: Department of Fisheries

Recovery Needs

95. The damage to the fish farm at Gangori in Uttarkashi has been estimated at INR 5.0 million (US$0.08 million). Correspondingly the damage to the ponds has resulted in an estimated loss of INR 2.5 million (US$ 0.04 million).

Table 44: Estimated Cost of Fisheries

Districts	US$ million	INR million
Bageshwar	-	-
Pithoragarh	0.03	1.74
Chamoli	0.01	0.10
Rudraprayag	-	
Uttarkashi	0.09	5.16
Total	**0.13**	**7.50**

96. Detailed assessments are being carried out to estimate the total impact on the sector. In many farms, fish ponds have overflown and the fish have been washed away, although the ponds are not

[25] Uttarakhand at a Glance, Directorate of Statistics and Economics, 2012

damaged. These losses are not yet estimated. Steps have been taken to increase the fish seed production in the other, non-damaged farms to their maximum capacity so that the fingerlings can be provided to the farmers as early as possible.

3.7.5 Tourism Linked Livelihoods

97. The tourism sector makes up about 25% of Uttarakhand's GDP. The total number of tourists in Uttarakhand per year as per the census of 2011 were 32.0 million of which the pilgrimage circuit, commonly called as the "*Char dham"* (four pilgrimage sites) circuit accounted for 2.2 to 2.4 million. The circuit takes about 9-10 days to cover all four pilgrimage sites. Majority of the tourists in 2011 were from Gujarat, Bengal, Rajasthan and Uttar Pradesh. A small proportion of tourists were from Punjab, visiting Hemkund. It is estimated that about 60% of the pilgrims covered the entire circuit of the four *dhams*, 30% visited only two *dhams* and the remaining 10% visited only one of the two *dhams* of Gangotri or Badrinath. The peak tourist season falls between April-July, with the main influx during the school holiday period from mid-May to end June.

98. The Livelihoods of 83,320 households from the affected five districts depend on the tourism sector[26]. This includes small businesses such as hotels and restaurants (6,500), petty traders (23,000) such as road side tea stalls and roadside eateries (*dhabas*), fruit and vegetable vendors, handicraft vendors, taxi and bus drivers, palanquin bearers (*dandi kathi*) who carry pilgrims and goods up the steep slopes of the two *dhams*, and the priests. It is estimated that the people working in the hotels and restaurants earn an average income between INR 7,000-15,000 (US$ 115 –250) whereas the petty shop owners earn between INR 4,000-8,000 (US$ 66 – 132) per month.

99. There are 4 major bus operators that ply on this circuit, with a total fleet of 326 buses. In the four districts of Chamoli, Uttarkashi, Rudraprayag and Bageshwar, 3,134 MUV taxisand 947 sedan taxis were registered. It is estimated that about 8,000 people were directly employed in the commercial transport sector in these districts, each earning between INR 15,000-40,000(US$ 250 –US$ 666) per month during the season. Due to the loss of livelihoods that are dependent on this sector, there is a threat of forced migration.

100. As per estimates, all the petty traders, hotels and restaurants, bus operators and taxis have lost their livelihoods as a result of the disaster. Almost all the petty shop owners' businesses have been hit and the ones located in the Kedarnath valley routes have seen their physical infrastructural assets washed away. The impact is expected to be especially worse on those petty traders who are in debt – traders typically take loans from money lenders at interest rate of 4-5% per month. Hotels and restaurants have suffered damages to their assets, and many of them face significant business losses. It is estimated that around 80% of all livelihood losses as a result of the disaster has been in this sector. According to available data, 1,994 buses and 2,205 taxis were plying on the pilgrimage routes on June 15 to 17, 2013.

101. The government response comprises of a structured three layered program consisting of an (i) immediate (ii) medium, and (iii) long term plan.

Immediate plan:

a. Provide relief to totally/partially damaged tourism assets en route to the *Char dham* sites.
b. Restore livelihoods: Training and capacity building programs for youth rendered unemployed.
c. Exemption on certain taxes and fees

[26] Bageshwar (5224), Chamoli (6879), Pithoragarh (19505), Rudraprayag (18949), Uttarkashi (32763)

Medium plan

a. Media campaigns to rebuild the state's image as a safe destination for tourism

Long term plan

a. Develop "village/ rural tourism" to provide sustainable livelihoods.
b. Create new points/avenues in the gateway cities to increase their potential for tourist halting, and thereby regulate the tourist flow of the *yatra* as well.

3.7.6 Micro, Small and Medium Enterprises

102. The small scale industries play a crucial role in Uttarakhand's economy. While they do not bring high revenues to the state, Uttarakhand's 0.223 million enterprises employ about 0.442 million individuals. The market value of fixed assets of these enterprises are worth INR 60,000 million (US$1, 000 million) and the annual gross output totals to INR 1,61,880 million[27] (US$2,698 million). The Fourth All India Census of Micro, Small and Medium Enterprises (MSMEs) in India (2007/08) revealed that of the total 226,513 units that are in working condition, 202,746 are unregistered and 23,767 are registered; nearly half the total number of enterprises are in the rural areas; and about 192,321 in the unregistered category are self-financed. Recent data from the Ministry shows that there are a total of 42,340 MSME's in the State, employing an estimated 700,000 youth.

Table 45: Industrial Scenario in the most affected Districts

	Unit	Bageshwar	Chamoli	Pithoragarh	Rudra-prayag	Uttarkashi	Total
Registered Industrial Unit	No.	1092	1229	2158	1214	2268	10,171
Total Investment	INR Million	199	489	374	425	449	1936 (US$ 32.6 million)
Bank financing	No of Units taking loans (INR Million)	3585 (714)	2852 (1106)	3625 (51.8)	3396 (513)	952 (736)	14410 (3587) (US$ 59.8 million)
Registered Medium and Large Unit	No.		Nil		Nil	-	
Estimated Avg. No. of Daily Worker Employed in Small Scale Industries	No.	2093	2527	4700	2852	5367	19,546
No. of Industrial Area	No.		02		01	04	08

Source: MSME Department.

103. Most of the registered micro and small enterprises in the five districts are largely engaged in the manufacture of food products, furniture, paper, or are engaged in services such as hotels and restaurants, repair and maintenance services. These enterprises also include artisan units and those engaged in agro

[27] Annual Report 2012-13, Government of India Ministry of Micro, Small and Medium Enterprises, http://www.dcmsme.gov.in/ANNUALREPORT-MSME-2012-13P.pdf (Pg 24)

based activities, wool, silk and artificial thread based clothes, ready-made garments and embroidery, wooden furniture, leather products, paper products, metal based fabrications etc. As mentioned, a large majority of the MSMEs in the region are unregistered and cater to the tourism sector; the impact on these livelihoods has been covered in the section on Tourism linked livelihoods.

104. Out of a total of 42,340 registered micro, small and medium enterprises in the State as of March 31, 2013, 10,171 micro and small enterprises registered are situated in the five majorly affected districts, employing about 20,000 people, with assets totaling to INR 1,932 million (US$32.2 million). It is estimated that there were about 60,000 unregistered enterprises in these areas. Although the damage to these enterprises is still being assessed, it is estimated that around 80% of them (including the unregistered units) have been adversely affected and have lost their stocks.

105. Infrastructural losses are primarily confined to the Kedarnath valley; an estimated 100 registered units have been completely washed away. Since many of the unregistered enterprises were self-financed, they will have a hard time to recoup the losses caused by the disaster. The government has announced compensatory packages, but at a fraction of the total value of the loss. These lists are also being currently compiled.

106. In the five most affected districts, about ten government buildings owned by the Khadi Gramodyog Board and the Directorate of Industries have been damaged as well.

107. The Department of MSME has focused on designing a package only for the registered units who have suffered losses. While the exact damage and losses are still being assessed, the department has developed a three pronged strategy-

- Relief and compensation to MSMEs for their losses
- Facilitate entrepreneurs to restart their enterprises
- Facilitate setting up and growth of MSMEs.

108. Summary of the support being ironed out by the ministry includes:

- Creation of the MSME relief, revival and reconstruction Fund
- Support for repayment of existing bank loans of affected MSMEs estimated at INR 300 million (US$ 5 million)
- Support towards interest payment on existing loans to MSMEs for two years in the affected are as estimated at INR 702 million (US$ 11.7 million)
- Fresh loans to MSMEs (incl. affected enterprises) for setting up new or reviving existing enterprises with no interest for two years estimated at INR 498 million (US$ 8.3 million)
- Support for payment of stamp duty on loan agreements/mortgage of land and VAT/Entertainment/ Luxury tax in the affected areas estimated at INR 150 million (US$ 2.5 million)
- Special skill development and EDP programs including from Uttarakhand Skill Development Society (USDS) for regenerating livelihoods by training 76,290 youth and achieving at least a 70% placement (one from each affected household) estimated at INR 1566 million (US$ 26.1 million)
- Infrastructure development: Development of new industrial areas and upgradation of existing industrial areas estimated at INR 500 million (US$ 8.33 million)
- Handloom and Handicraft: Special package for handloom and handicraft development council estimated at INR 60 million (US$ 1 million)
- Khadi and Village Industries estimated at INR 18 million (US$ 0.3 million)
- Margin money targets under this scheme for the state be doubled to INR 360 million (US$ 6 million)

Recovery Needs

109. The overall costs for early and medium-term recovery of the livelihoods of the people depending on the Tourism and MSME sector is estimated at INR 4,500 million (US$ 75 million)[28]

110. Reconstruction of pilgrimage routes and re-building the confidence of the tourists that Uttarakhand is a safe destination is necessary to re-build the livelihoods of those whose lives depend on the sector.

111. Focused skill development and EDP programs for regenerating livelihoods (especially youth, women headed households and the disabled)

112. Providing support through the entire craft value chain (including design, product development, marketing and brand development) for the handloom and handicraft industry.

3.8 Tourism Infrastructure

113. The State of Uttarakhand with holy shrines, rivers, the Himalayas and stunning landscapes, is popularly called the *Devbhumi* i.e. the Land of Gods and is an important destination for pilgrims and tourists from all over the world. Two of the most revered rivers of the country, the Ganga and the Yamuna, originate from Gaumukh (Gangotri) and Yamunotri. Shri Badrinath and Shri Kedarnath, the holy places of Lord Vishnu and Lord Shiva respectively are an important part of the pilgrimage circuit. Another prominent pilgrimage destination in the State is the holy town of Haridwar, where the prestigious Kumbh Mela is held every twelve years, attracting millions of pilgrims from all over the world. Apart from religious/ pilgrimage tourism, Uttarakhand also provides great opportunities for nature based tourism and adventure sports like mountaineering, trekking, skiing and water sports.

114. Tourism is a one of the fastest growing industries and a major driver of economic growth and livelihood promotion in Uttarakhand. The contribution of tourism to the State Gross Domestic Product is about 22.48%[29]. The policy of the state has a vision of placing Uttarakhand on the tourism map of the world as one of the leading tourist destinations. The sector witnesses active participation of the private sector and the local host communities and is a major source of employment and income/revenue generation.

115. The disaster affected region includes the holy pilgrimage circuit of the *Char Dham Yatra* with the road connectivity to these places being the worst affected, which has completely disrupted the visit of pilgrims to these holy places[30]. The damage is extensive and multi-fold. Tourism is the largest provider of livelihood in Uttarakhand and this disaster that hit during the peak tourist season has had a devastating impact on the sector. The tragedy besides impacting thousands of lives, has badly hit the industry stakeholders especially, those involved in religious tourism. The state does not have a proper statistical system on tourism, and no scientific study of the carrying capacity of the different areas has been carried out. With the roads and bridges being washed away and landslides occurring in several places, over 70,000 tourists and 100,000 local inhabitants stranded in the upper reaches of the mountain terrain. It took a massive effort on the part of the State Government to undertake immediate and large scale rescue operations. Owing to the treacherous mountainous terrain, incessant rains, zero or low visibility, unpredictable weather conditions, severely affected connectivity and communication systems and lack of proper helipads/landing facilities, it was reported to be the most difficult air and ground rescue operation in the world[31].

[28] Since data was not available on the extent of private assets such as petty shops, restaurants, taxis the recovery needs for these were considered through a mix of subsidies, investment and restocking

[29] Economic and Statistics Department, GoU.

[30] The Four pilgrimage destinations namely Yamunotri, Gangotri, Kedarnath and Badrinath, collectively known as the Char Dham, draw's large numbers of pilgrims each year, becoming an important hub of religious travel in Northern India.

[31] 20 civil and 59 military air crafts were used for air evacuation. In all 72 permanent and temporary helipads were mobilized for evacuation and dropping of relief material. Approximately 34,000 people were rescued by air and 90,000 were moved through 6,000 vehicles mobilized to facilitate evacuation, a total of around 110,000 people were evacuated

Besides the physical damages, the disaster has also severely affected the livelihood of the people dependent solely on the flow of pilgrims and tourists. With the destruction of infrastructure on one hand and the loss of livelihoods on the other, the image of tourism in the state has taken a severe beating and the tragedy has cascaded down to other tourism destinations in the State as well. The hospitality industry suffered a great set back due to massive cancellations of earlier bookings after the disaster, even in the unaffected popular destinations of the State.

116. The damage and loss could be broadly classified as:

- Loss of Infrastructure - (Government and Private)
- Direct Loss to stakeholders: hotel and other service industries related to tourism (tour operators, travel agents, taxi drivers, guides, shop keepers etc.)
- Loss of Livelihoods along the entire chain dependent on the pilgrimage and adventure tourism in the impacted areas.
- Revenue and Tax Losses
- Loss to Tourism repute of the State as a whole

Table 46: District and Category-wise Damages to Government Tourism Infrastructure

	Districts	Destination Development/ Site and Services	Ghat Development	Night shelters	Misc.	Tourism Information/ Convenience Centre	Toilets Blocks/ Complexes	Tourist Rest Houses	Grand Total
		Nos	Nos	Nos	Nos	Nos	Nos	Nos	Nos
1	Bageshwar	1							**1**
2	Chamoli	1	2			4	7	6	**20**
3	Pithoragarh	1				1		5	**7**
4	Rudraprayag	3	1	4			10	9	**27**
5	Uttarkashi				1	2	7	16	**26**
6	Almora				2	1		3	**6**
7	Dehradun	2					2		**4**
8	Haridwar				1				**1**
9	Nanital						1	2	**3**
10	New Tehri	3	4				4	1	**12**
11	Pauri Garhwal		1	4	1		1		**7**
12	General				1				**1**
Total		**11**	**8**	**8**	**6**	**8**	**32**	**42**	**115**

Reconstruction Needs

117. The estimated loss of prospective earnings in the tourism sector has also been made by the DoT. As per the estimate, the loss of the tourism related earnings in the present calendar year is INR 62,801 million (US$1,047 million). With an assumption that it will take 3 years for a full recovery from the impacts of the disaster, the total estimated notional loss figure is INR 228,223 million (US$3,804 million)

118. The DoT has estimated the physical losses to the government's tourism assets[32] to be US$19.44 million (INR 1166 million) for the entire state and INR 853 million (US$14.2 million) for the five most affected districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi. A preliminary assessment of the losses to tourism infrastructure in the private sector has been provided by the DoT based on an initial compilation from the field offices. The losses to the private sector are estimated at INR 880.87 Million (US$ 14.68 million). DoT estimates that this could go up to INR 480 Million (US$ 80 Million) once details from inaccessible locations are compiled. The summary of tourism infrastructure needs on a sector- wise basis is provided in Table 47 below and the details of district-wise damage to the tourism infrastructure is noted in Table 48.

Table 47: Summary of Estimated Needs for Government Tourism Infrastructure

S. No	Category	Preliminary Needs Estimates	
		(INR million)	(US$ million)
1	Destination Development/ Site and Services	158.50	2.64
2	*Ghat* Development	88.00	1.47
3	Night shelters	117.50	1.96
4	Tourist Information /Convenience Centre	31.50	0.53
5	Toilet Blocks/Complexes	97.60	1.63
6	Tourist Rest Houses	568.50	9.47
7	Miscellaneous	104.50	1.74
Total		**1,166.10**	**19.44**

119. The State is developing a framework for promoting climatically resilient tourism. Existing infrastructure of helipads will be strengthened and new helipads, ropeways and other supporting structures and multi-purpose shelters are proposed to be constructed. Village and community based tourism is proposed to be promoted to reduce the need for huge investment on hotels etc., and also provide sustainable livelihoods. The State proposes the development of Tourist Bio-metrics & Regulation software at various entry points for knowing and regulating the numbers tourists. The State also proposes to conduct studies to (i) define the carrying and absorption capacities of the higher reaches destinations; (ii) develop micro plans for the middle reaches destinations to convert them into base camps for the higher reach destinations in order to stagger the number of tourists,and (iii) enhance the facilities in surrounding towns and villages near the Gateways to major destinations. These would require detailed multidisciplinary studies and larger fund allocations. A comprehensive media campaign is also planned to revive the image of tourism in the State. The Government of Uttarakhand requires enhancement of its planning, funding and implementation capacity to undertake such projects for which significant funding, technical assistance and capacity building support would be required by the State.

Table 48: Summary of District-wise Estimate of Needs for Government Tourism Infrastructure**

S. No	Districts	Destination Development/ Site and Services	*Ghat* Development	Night shelters	Tourist Information/ Convenience Centre	Toilets Blocks/ Complexes	Tourist Rest Houses	Misc*	Grand Total	
		US$ M	US$ M	US$ M	US$ M	US$ M	US$ M	US$ M	INR M	US$ M
1	Bageshwar	0.33							**20.0**	**0.33**
2	Chamoli	0.07	0.31		0.23	0.37	1.56		**152.00**	**2.53**
3	Pithoragarh	0.29			0.08		0.38		**45.50**	**0.76**
4	Rudraprayag	1.11	0.21	1.58		0.78	4.99		**520.00**	**8.67**
5	Uttarkashi				0.08	0.23	1.58	0.04	**115.50**	**1.93**
6	Almora				0.13		0.83	0.12	**64.50**	**1.08**
7	Dehradun	0.13				0.06			**11.60**	**0.19**
8	Haridwar							0.17	**10.00**	**0.17**
9	Nanital					0.03	0.09		**7.50**	**0.13**
10	New Tehri	0.71	0.92			0.15	0.04		**109.00**	**1.82**
11	Pauri Garhwal		0.03	0.38		0.02		0.08	**30.50**	**0.51**
12	General							1.33	**80.00**	**1.33**
Total		**2.64**	**1.47**	**1.96**	**0.53**	**1.63**	**9.47**	**1.74**	**1166.10**	**19.44**

*Miscellaneous: Trek Routes, Parking,Replacement of damaged and washed away assets and fixtures, Retaining walls etc.
**Note: Detail table in Annexure 2.

3.9 Energy

120. Uttarakhand has hydropower potential estimated at 20,000 megawatts (Mw) against which only about 3,164 Mw (16% of the estimated potential) has been harnessed so far through 45 Hydro Electric Projects (HEPs) of varying capacities implemented by the State and Central government agencies and public and private sectors. Hydropower is vital to meet the in-state demand and export power to surrounding states, and support investment in rural and other productive sectors. The State plans to expand its hydropower generation and high-voltage transmission capacity to become self-reliant and

also become a net exporter of surplus power. During the year 2012-13, the peak electricity demand of Uttarakhand stood at 1,759 Mw which was deficit by 4.8%.

121. The Uttaranchal Jal Vidyut Nigam Limited (UJVNL), a State government enterprise, constructs, operates and maintains small, medium & large Hydro Electric Projects in the State. It is developing 32 HEPs with an aggregate installed capacity of around 2,815 Mw; the Central Utilities are developing 25 HEPs with an aggregate installed capacity of around 7,300 MW and Independent power producers (IPPs) are developing another 38 HEPs with an aggregate installed capacity of around 2,118 Mw.

122. The Uttarakhand Power Corporation Limited (UPCL) functions as a distribution licensee for the entire State. It is committed to providing good quality power supply to the consumers by constructing, maintaining and operating the distribution network.

123. The Uttarakhand Renewable Energy Development Agency (UREDA), the Department of Renewable Energy, is the nodal agency for providing electricity to the remotely located villages and hamlets where the National/State grid cannot reach due to the hilly terrain and dense forest. UREDA has electrified 113 Villages and 71 Hamlets through 41 Decentralized Distributed Generation Micro/ Small Hydro Projects.

124. The major cloudbursts,incessant rains and floods in the upper valleys during June ,15-17, 2013, resulted in heavy damages to the on-going HEPs and the existing Power distribution system in the state including UJVNL's 17 small hydro projects under operation and construction. Majority of the access roads to these HEP sites were also washed away. Major parts of the distribution systems, owned and operated by the UPCL in the flood affected areas of Rudraprayag, Uttarkashi, Chamoli and Bageshwar were also damaged. All the 33/11 kilovolts (kV) substations, 33 kV lines, 11 kV lines, LT lines & distribution substations were operational before 16 June 2013. However, after the calamity, the distribution systems were damaged resulting in the disruption of power supply to about 3,758 villages in the State. Apart from these, one Solar Power Plant (at Kedarnath) by UREDA was also damaged during this period.

Table 49: Brief Summary of Utility-wise Damages (Preliminary Estimates)

Utility	Description
UJVNL	17 small hydro projects with an aggregate installed capacity of 66.1 Mw (UJVNL has also included 3 more HEPs namely Chilla, Maneri Bhali Stage – I and Stage –II with installed capacity of 144 MW, 90 MW and 304 MW respectively as part of the rehabilitation program). The details are in Annexure-I
UREDA	41 small hydro projects with an aggregate installed capacity of 5,294 kW
UCPL	Damages to 33kV, 11kV and LT lines with aggregate length of 60.92 km, 195.53 km and 220.18 km respectively. No. of distribution transformers affected are 377

Reconstruction Needs

125. A summary of the preliminary needs assessed by the State utilities based on the data and estimates from their field divisions is summarized in Table 50 given below.

Table 50: Preliminary Estimates of Energy Needs

S.No.	Agencies	Preliminary Estimates of Needs	
		INR million	US$ million
1	UJVN Ltd.	2191.9	36.53
2	UREDA	108.3	1.81
3	UPCL	362.4	6.04
Total		**2,662.6**	**44.38**

126. Some of the measures taken by the State government are as follows:

- UJVNL has proposed a project wise rehabilitation initiative for the damaged projects. The details of cost estimate are in Annexure 1 Section 1. The implementation period for UJVNL shall be 3 years and 6 months (from 2013-17).
- UREDA has proposed a project wise rehabilitation initiative for the damaged projects. The details of cost estimate are in Annexure 1 Section 2. The implementation period for UREDA shall be 2 years (from 2013-15).
- UPCL has proposed to repair/reconstruct the damaged distribution network, and strengthen the distribution network to provide reliable power supply to the affected families. Construction of 33/11 kV substations and associated 33 kV lines shall be done by the secondary works division of UPCL. The implementation period for UPCL shall be 18 months (from 2013-15). A brief summary of the damaged network which is proposed to be repaired/ reconstructed is shown in Table 51 below:

Table 51: Proposed Repairs/Reconstruction Works by UPCL

S.No.	Work	Unit	Quantity
1.	Repair /Re-construction of 33 kV line	km	60.92
2.	Repair/Re-construction of 11 kV line	km	195.53
3.	Repair/Re-construction LT line	km	220.18
4.	Replacement of Distribution Transformer	no	377

- To provide reliable power supply to the affected areas UPCL has proposed to construct/upgrade the following infrastructure in the various districts.

Table 52: Proposed UPCL Works in Affected Districts

S.No.	Districts	Description of Work
1.	Bageshwar	• Replacement of 3 MVA transformer at 33/11kV substation Garur by 5 MVA
2.	Chamoli	• Construction of 33 kV Substation at Pandukeshwar and associated 33 kV & 11 kV lines. • Installation of additional 5 MVA transformer at 33/11 kV substation Pokhari • Installation of additional 3 MVA transformer at 33/11 kV substation Deval
3.	Rudraprayag	• Shifting of 33 kV Substation at Ukhimath and construction of associated 33 kV & 11 kV lines. • Construction of 33/11 kV substation at Agastmuni (1x5 MVA) and associated 33 kV & 11 kV lines
4.	Uttarkashi	• Construction of 33 kV Substation at Gangotri, Sayanachatti and Harshil (2x3 MVA) and associated 33 kV & 11 kV lines.

3.10 Forests and Biodiversity

127. The recent extreme weather events marked by excessive rains and cloud bursts resulted in landslides and land slips and other associated incidents leading to damage and loss of natural infrastructure including forests and the associated Non Timber Forest Products (NTFP), primarily characterized by firewood, thatch grass, fodder, local fruits, medicinal plants and other extractable forest resources. Such losses, in the short term, has affected the resilience of people to manage their daily needs of cooking, heating and lighting, and in the medium to long term will impact the livelihood of those that depend on these resources, particularly on the pilgrim circuit.

128. An accurate assessment of such damage and loss is therefore a pre-requisite to plan immediate investments under the project. At the same time, it is recognized that accurate assessments would be difficult within this mission, as clear post-disaster satellite images are not available due to constant cloud cover and with most affected areas remaining inaccessible due to broken and washed away roads, mule paths and bridle paths.

129. The losses assessed during this mission are primarily based on estimates provided by the State Forest Department. These need to be further finalized as and when some ground truthing is possible.

This is critical, as the forests of Uttarakhand are socially and economically interlinked with the people and their livelihood in the hills playing an important role in the general economy and development of the region.

130. The recorded forest area of the State is 34,651 sq.km., which constitutes 64.79%[33] of its geographical area. The actual forest area administered by the State Forest Department is approximately 70%, spread across a wide altitudinal range from 300m to 3,500m. The remaining is under the administrative control of the Revenue Department and the *Van Panchayats*. The forests are categorized into Reserved Forests (68.74%), Protected Forests (0.36%) and Un-classified Forests (30.9%). The actual forest cover is 45.8%, the rest being alpine meadows, rock and snow covered areas. District-wise forest cover baselines are given in Table 53.

Table 53: District-wise Forest Cover in Uttarakhand

Districts	Geographical Area (GA), sq.km.	Very Dense Forest, sq.km.	Moderate Dense Forest, sq.km.	Open Forest, sq.km.	Total, sq.km.	Percent of GA	Scrub, sq.km.
Bageshwar	2,246	194	883	304	1,381	61.49	4
Chamoli	8,030	427	1,586	682	2,695	33.56	6
Pithoragarh	7,090	567	1,115	412	2,094	29.53	32
Rudraprayag	1,984	246	581	298	1,125	56.70	5
Uttarkashi	8,016	567	1,959	619	3,145	39.23	21
Almora	3,139	222	928	427	1,577	50.24	10
Champawat	1,766	336	571	274	1,181	66.87	8
Dehradun	3,088	584	695	328	1,607	52.04	24
Pauri Garhwal	5,329	523	2,094	672	3,289	61.72	59
Haridwar	2,360	26	353	240	619	26.23	0
Nainital	4,251	601	1,923	566	3,090	72.69	13
Tehri Garhwal	3,642	298	1,232	617	2,147	58.95	89
Udham Singh Nagar	2,542	171	247	128	546	21.48	0
Total	**53,483**	**4,762**	**14,167**	**5,567**	**24,496**	**45.80**	**271**

131. Reports confirm that some forest areas, including tree cover, grasslands and high altitude pastures have been washed away and there are intermittent losses to forest patches in the worst-hit districts of Uttarakhand. For reasons mentioned earlier, accurate assessments are unavailable. Estimates shared by the Forest Department indicate a loss of forest area of about 80 Ha along river courses. However, as more information comes in covering a wider geographic area in the worst-hit districts, these estimates are likely to increase significantly.

132. Many remote villages, pilgrim sites and other trekking destinations, where several people were stranded and several dead bodies are yet to be recovered, remain inaccessible due to such damage. Several alternate paths and trek routes may need to be urgently developed, primarily to restore connectivity and ensure relief supplies can reach the worst affected communities. The preliminary damage to this physical infrastructure, as estimated by the State Forest Department is presented in Table 54. Almost 1,000 km length of forest road (inside forests) and about 2,500 km of bridle paths are reported to be damaged that require urgent reconstruction.

[33] Recently, the forest area increased to 37,999 sq.km., (71.04%) on account of declaration of previously unclassified areas as forests.

133. Several residential and office buildings/ structures (about 200), log bridges, other temporary bridges and culverts (totaling about 76), soil and moisture conservation structures like check dams, retaining walls, gully plugs, river training works, etc. and nurseries (63 Ha) and plantations (247 Ha), have been damaged and need to be reconstructed and/or repaired urgently. The cost of reconstruction of this physical infrastructure, as estimated by the State Forest Department is presented in Table 55.

134. The State is well endowed with faunal and floristic diversity which is conserved across a network of Protected Area (PA) covering 14.4% of its geographical area as against the national average of 4.8%. There are six National Parks (NP), 7 Wildlife Sanctuaries (WLS), 1 Biosphere Reserve, and 3 Conservation Reserves. The Nanda Devi and the Valley of Flowers NPs have been inscribed on the UNESCO World Heritage List and the area falling in the buffer of the latter is reported to have suffered heavy damage. In terms of floral wealth, the State harbours about 4,500 species of vascular plants, of which 29 species are endemic. Almost 51% of India's avifauna is found in the State. The entire run of the Himalayas in the State are part of the Himalayan Biodiversity Hotspot. The State also harbors a number of endangered species, including the Tigers, Snow leopards and the Gangetic *Gharial*.

135. No loss estimates are currently available for endangered/threatened fauna and flora, as well as losses to the potential ecosystem goods and services.

Table 54: Damages Incurred to the Forest Infrastructure

S. No	Districts	Residential Bldgs. (no.)	Non-Residential Bldgs. (no.)	Forest Motor Roads (km.)	Bridle paths (km.)	Bridge/ Culverts (no.)	Nurseries (Ha.)	Planta-tions (ha.)	Other Works (Soil & Water Conservation) (no.)
1	Bageshwar				2.00			7.00	
2	Chamoli	24	12	-	434.40	5	17	4.00	209
3	Pithoragarh	5		18.93	77.01			9.50	
4	Rudraprayag	18	0	5.15	229.50	3	0	-	4
5	Uttarkashi	35	10	93.00	1308.30	47	28	43.00	44
6	Almora			24.50	9.00			2.50	
7	Champawat			28.00	121.00				
8	Dehradun	37	4	271.50	28.00	4	0	85.50	500
9	Haridwar	13	0	137.60	0	4	2	13.00	492
10	Nainital	0	0	150.00	0	0	0	-	0
11	Pauri	4	9	198.10	111.50	0	4	-	450
12	Tehri	12	15	26.00	223.90	12	12	83.00	88
13	Udham Singh Nagar	1		45.50		1		-	-
	Total	**149**	**50**	**998.28**	**2,544.61**	**76**	**63**	**247.50**	**1,787**

Reconstruction Needs

136. Based on the preliminary estimates, the total cost of reconstruction and repair due to losses in the forests and the biodiversity sector is about INR 542 million (approx. US$ 9.03 million). However, this cost is likely to increase significantly once estimates are refined in the wake of updating the damage and loss assessments when these areas are accessible and clear satellite images are available.

137. Restoration of connectivity, through reconstructing the forest roads (inside forests), bridle and foot paths will cost approximately INR 214 million (US$ 3.57 million). This can only be accomplished when the log bridges, other temporary bridges and culverts are also repaired on the way, which would cost an additional INR 71 million (US$ 1.18 million). Reconstruction and restoration of nurseries and plantations to their earlier status would cost about INR 26 million (US$ 0.43 million). Repair or reconstruction of soil and water conservation structures would cost about INR 154 million (US$ 2.57 million).

Table 55: The Needs Estimate for Forest Infrastructure

S. No	Districts	Res. Building	Non-Res. Buildings	Forest Motor Roads (km.)	Bridle paths (km.)	Bridge/ Culvert	Nurseries (ha.)	Planta-tions (ha.)	Other Works*	Total Cost of Reconstruction	
		INR M	INR M	INRM	INRM	INRM	INRM	INRM	INR M	INRM	US$ M
1	Bageshwar				0.10			0.10	0.50	**0.64**	0.10
2	Chamoli	11.40	2.30	0	13.60	1.90	0.60	0.20	20.40	**50.40**	0.80
3	Pithoragarh	6.10		0.80	2.00			0.10	1.30	**10.30**	0.20
4	Rudraprayag	5.70		2.20	10.80	1.20			1.20	**21.10**	0.40
5	Uttarkashi	15.90	4.50	20.10	92.70	60.80	2.90	5.20	12.30	**214.40**	3.60
6	Almora	-	-	0.50	0.60			0.10	2.40	**3.50**	0.10
7	Champawat	-	-	1.00	3.00				5.00	**9.00**	0.20
8	Dehradun	10.40	1.80	22.20	0.40	1.40	0	1.50	28.80	**66.50**	1.10
9	Haridwar	4.30	0	13.50	0.60	2.60	0.20	0.90	11.40	**33.30**	0.60
10	Nainital	-	-	6.40	-	-	-	3.00	9.00	**18.40**	0.30
11	Pauri	1	2.10	10.30	2.20		0.90	-	57.40	**73.90**	1.20
12	Tehri	4.00	6.90	1.80	4.20	2.80	1.20	3.50	2.80	**27.20**	0.50
13	Udham Singh Nagar	0.60		5.40		0.40		6.40	1.10	**13.80**	0.20
	Total	**59.40**	**17.60**	**84.10**	**130.20**	**71.10**	**5.70**	**20.70**	**153.60**	**542.40**	9.00

*Soil & Water Conservation

138. An urgent action for this would be to clear the debris and muck/silt. However, that cost has not been estimated, as no information on the amount to be cleared is available.

- Earmark a fund of INR 60 million (approx. US$ 1 million) for refining the damage and loss assessment through ground truthing and clear weather satellite imagery of the worst affected areas.

- The State Government should undertake a detailed study covering the losses incurred due to erosion of ecosystem goods and services (going beyond the physical losses), that are critical for sustaining the State's economy.

- There is an urgent need to start restoring lost livelihoods that are directly linked with the forests and biodiversity in the most affected districts. A detailed analysis of such losses should be undertaken for allocating sufficient funds for livelihood restoration.

- Devise a strategy and develop guidelines for impact absorbing buffers based on the bioshield approach for reducing the vulnerability of frequently visited areas, such as the pilgrim routes.

- The recent extreme weather events have clearly indicated a need to undertake thorough assessments prior to the siting of physical infrastructure, including road alignments and disposal of debris and muck generated during large-scale infrastructure development. The State should develop an environment strategy and environment management plans/frameworks for infrastructure development planned in the river valleys, silt disposal and deposits in the rivers, extractive policy on river bed materials etc.

Chapter Four

Laying the ground for Recovery and the Way Forward

4. Laying the ground for Recovery and the Way Forward

1. Uttarakhand's recent disaster while serving as a wake up call, also provides a window of opportunity to address several underlying developmental and risk reduction issues. The government has responded well to the recent disaster, however, in addition to addressing the immediate and longer term recovery and reconstruction needs, it is important to put into place appropriate mitigation and risk reduction measures towards building resilience.

2. This chapter summarizes some of the assessment team's preliminary findings for needs to recover from the disaster and then elaborates on some of the guiding principles and other key considerations that should inform the design of the Recovery and Reconstruction Framework (RRF).The objective of this section is to lay the ground for the RRF noting that several important aspects pertaining to detailed recovery and reconstruction planning - such as detailed costing; prioritization and sequencing; ascertaining institutional, implementation and financing arrangements; monitoring and evaluation of recovery etc., are still being finalized by the GoU.

4.1 Overview of Recovery Needs

3. The Table 56 below summarizes the key needs with details specified in the relevant sections. While not all needs have been quantified at this time, it is important to note that higher damages or needs for certain sectors or districts do not mean that the needs in those sectors or districts have higher priority. Each sector and district has critical needs that need to be addressed in a parallel or prioritized manner. Where available, the costing for the needs and recommendations is provided as the replacement value of the damaged assets, and may not take into consideration any detailed reconstruction and recovery strategies (e.g. relocation) which will have a bearing on the actual costs, these may thus require a more in-depth recovery and reconstruction analysis. These needs include both those activities already initiated by the government in addition to those that may need to be undertaken.

Table 56: Sector-wise Overview of Recovery Needs

Sector	Needs
1. Housing	• The immediate recovery needs include creation of temporary shelters for the affected population. • The medium term needs include reconstruction of damaged houses and the long term needs include relocation of houses/villages/localities to suitable locations. • Assessment of long term needs involving relocation would require much more detailed investigations of safe locations and willingness of communities for relocation. Such plans would also require careful consideration from town and country planning professional, statutory clearances, geological investigations, land acquisitions etc. • Temporary shelters will need to be provided for beneficiaries who have now been accommodated in schools and other public buildings. Efforts will need to be made to minimize the need by quickly putting up the permanent shelters except those requiring relocation. However, completing these before the onset of winter is challenging and therefore the use of prefabricated materials will need to be examined. Together with this an effective coordination and consultation

		mechanism will need to be created by involving community and non-government organizations. Government may also need to evolve a mechanism for providing rental relief to minimize the need for temporary shelters. • In order to identify safe relocation sites, multi-hazard vulnerability assessments will need to be carried out considering the hydro-metrological and geophysical hazards. In addition proper settlement planning for both rural and urban areas would be required to provide proper amenities and finalize the siting for the settlement, amenities, planning for infrastructure etc. • While taking up the reconstruction, the GoU will need to put in a proper regulatory framework in order to not further increase the vulnerabilities as the area is prone to frequent floods, landslides, earthquakes etc. Proper structural designs, material specifications and construction techniques will need to be followed and the process will need to be supervised by communities, technocrats and civil society organizations. • Measures will need to be identified for slope stabilization to safeguard the locations for in-situ construction and also proposed relocation sites which will have a bearing on the cost of reconstruction. • The debris removal from residential locations would also be required in certain cases. While a part of the material might be useful for construction purposes, a major part will need to be removed and safely deposited at identified sites.
2.	**Public Infrastructure**	• The immediate recovery needs include the creation of temporary setups for schools and to bring the health facilities back into a functioning status especially to provide basic medical care including medicines and vaccines and to resume the schools. • Temporary Arrangements: While the recovery and reconstruction program is being structured, it is required to identify temporary accommodation for schools and other health services buildings. This could be through the provision of temporary facilities including on a rental basis and also through sharing of existing facilities. For schools even a shift system can be used to house two schools in one building. • Restoration of partially damaged buildings should be immediately started to restore the education system, health facilities and other functions. • Medium term needs include the reconstruction of damaged infrastructure and the long term needs include the relocation of public buildings depending on the vulnerability assessments and relocation plan of affected settlements.
3.	**Transport**	• To complete where necessary, the temporary restoration of roads. • In order to create sustainable roads and bridges infrastructure, requisite geological and geo-technical studies, adequate provision of protection and river training works, use of appropriate, sustainable, low cost road building technologies in the region, and disaster resilient structures will have to be adopted. • In the longer term, the GoU is also contemplating the relocation of endangered habitations, adopting a multi-modal transport system, ropeways tunnels and viaducts. These would require detailed multidisciplinary studies and larger fund allocations. • The GoU would require enhancement of its planning, funding and implementation capacity to undertake sustainable redevelopment and reconstruction for which significant technical assistance and capacity building support would be required by the State.

4.	**Urban Infrastructure (Water Supply and Sanitation)**	• Temporary restoration of the piped water supply system in the affected towns. • Provision of water through tankers or other means where necessary • Upgrade water supply systems as per the service level standards, with a reasonable planning horizon. • Rebuilding of damages suffered by the ongoing sewerage schemes under the Jawaharlal Nehru National Urban Renewal Mission and the National Mission for Clean Ganga. • Temporary restoration of urban roads and firming up the strategy for complete reconstruction and up-gradation of those are yet to be firmed up.
5.	**Rural Water Supply and Sanitation**	• Providing safe water still remains a major issue in the affected habitations. • Replace/rehabilitate damaged water systems (pipe lines, sources, civil works, house connections, stand posts, hand pumps etc.). • Replace/rehabilitate damaged sanitation systems (toilets, soak pits, drains, etc.). • Given the geo-physical condition of the State, it is prudent to have an emergency plan for uninterrupted water supply and sanitation services. • The State has provision for insurance of under-construction water supply schemes. Such good practices should be encouraged. A regular premium should be paid to avoid any pre-mature closure. In addition, a detailed disaster preparedness plan should be developed for the RWSS sector in Uttarakhand. • If the re-location of some of the villages are planned, the water supply and sanitation component should also accordingly be planned for those villages to provide integrated services. • The water supply and sanitation infrastructure to be constructed as part of restoration and reconstruction should ensure its safety, quality and sustainability, and adherence to environmental norms. In addition, it will be important to ensure that future efforts are built to resilience standards, given the recurrent floods and landslides in the mountains. • The water supply and sanitation infrastructure to be rebuilt should have a cost-effective time bound program, with sustainable outcomes addressing the needs of the communities. The involvement of communities is critical for ensuring a demand responsive reconstruction of the facilities, sustainable operations and maintenance of the schemes.
6.	**Productive Sectors and Livelihoods**	• Build capacity for developing non-farm livelihoods and focus on skill development for quick employability. • Support is needed for land preparation, construction/repair of animal shelters and of irrigation canals and watersheds. • Seeds and fertilizer should be provided, and lost or destroyed tools, machinery and equipment, and livestock and fodder stocks/banks, would need to be replaced. • There is a key need to establish market links through flexible temporary bridges. • Concept of conditional cash transfers can be piloted - this system can be refined to ensure a Gender Sensitive Design of Cash Transfers. • Cash for work could be initiated to help both in building the infrastructure and providing immediate support to the affected communities. • Counselling services, for those who may have lost some family members. • Community institutions need to be supported in forming their own agri-business institutions for providing training. • Micro-planning for livelihood rehabilitation for land based and other activities.

		• Re-allocating land to the farmers, de-silting covered land (in the plains), lining or flood protection of river beds for protection of further land degradation and providing animals to the farmers who have lost them • Provide compensation of lost animals to affected vulnerable population. • Provision of essential farm inputs and land preparation support to farmers for the upcoming Rabi season and extending a credit line to the farmers. • Fertilizer, seeds and land preparation support. • Support to purchase inputs should be given to small and poor farmers on a preferential basis. • Support the farmers to re-build market routes so that they are able to take their produce to the market. • Flood protection structures and diversion bunds should be rehabilitated on a priority basis to avert further losses and damages • Reconstruction of the pilgrimage routes and re-building the confidence of the tourists that Uttarakhand is a safe destination is necessary to re-build the livelihoods of those whose lives depend on the sector. • Alternative employment through skill training for youth from affected households. • Creation of a MSME relief, revival and reconstruction fund. • Focused skill development and EDP programs for regenerating livelihoods (especially for the youth, women headed households and the disabled). • Providing support through the entire craft value chain (including- design, product development, marketing and brand development) for handloom and handicraft industry.
7.	**Tourism Infrastructure**	• Promotion of climatically resilient tourism. • Strengthening of existing infrastructure of helipads and construction of new helipads, ropeways and other supporting structures and multi-purpose shelters. • Promotion of village and community based tourism. • Development of Tourist Bio-metrics & Regulation software at various entry points for knowing and regulating the numbers of tourists. • Conduct studies to (i) define the carrying and absorption capacities of higher reaches destinations; (ii) develop micro plans for the middle reaches destinations to convert them into base camps for the higher reaches destinations to stagger the number of tourists, and (iii) enhance the facilities in surrounding towns and villages near the Gateways to major destinations. • Comprehensive media campaign to revive the image of tourism in the State. • Enhancement of planning, funding and implementation capacity to undertake projects.
8.	**Energy**	• UJVNL and UREDA - Project wise rehabilitation initiative for the damaged projects • UPCL - Repair/reconstruct the damaged distribution network, strengthen the distribution network to provide reliable power supply • Repair /Re-construction of 33 kV line, 11 kV line, LT line • Replacement of Distribution Transformer • Construct/upgrade infrastructure to provide reliable power supply to the affected

9. Forests and Biodiversity	• Restoration of connectivity, through reconstructing the bridle paths and foot paths. • Repair or reconstruction of bridges and culverts must be the prime focus. • Repair or reconstruction of motorable roads and their maintenance on a regular basis. • Reconstruction and restoration of nurseries and plantations to their earlier status. • Muck removal and disposal. • Repair or reconstruction of soil and water conservation structures. • An assessment of damages caused by this calamity and its ecological impacts need to be done through ground truthing, especially in important areas not currently accessible, such as the Valley of Flowers. • A study on hydrology of rivers, the changes in the course of these rivers, silt deposits in the rivers, River Bed Material removal and disposal, etc., need to be conducted. • Increase investments on restoring lost livelihoods that are linked/based on forests and biodiversity. • As the present Sewage Treatment Plant capacity along the rivers is not meeting the demand, Sewage Treatment Plants need to be built commensurate with the demand. • For effective erosion and landslide control there is a need to prepare integrated Catchment Area Treatment Plans.
10. Urban disaster risk reduction and response preparedness	Carry out a detailed vulnerability analysis of the cities and model various risks for effective mitigation planning and disaster response preparedness. This may include: • Assessment of existing compliance and enforcement mechanism. • Consultation workshop for policy makers/ decision makers on techno-legal regime and amendments to existing bye-laws. • Workshop for Engineers/ Town Planners/ Municipal Corporations on Urban Risk Reduction. • Establishment of City EOCs and regular city preparedness drills. • Preparation of City/ Ward level DRM Plans including evacuation routes and identification of safe shelters and disaster resources. • Advocacy workshops on mainstreaming/ integrating urban risk reduction in development plans. • Awareness for the community on safer construction practices and disaster preparedness.
11. Cross cutting theme	• Take into consideration cross cutting issues such as DRR, gender and climate change while planning and implementing the recovery. • Setup a coordination and M&E mechanism for the reconstruction program. • Establish an MIS that will help longer term development planning. • Data preparedness and remote sensing capacity for damage assessment. • Better preparedness for disaster situations including early warning systems • Full-fledged mitigation program for landslides, cloudbursts, floods, avalanches, earthquakes; including safe shelters in disaster prone areas. • Development of a detailed Uttarakhand Recovery and Reconstruction Framework that will include aspects such as detailed costing, prioritization, sequencing, ascertaining institutional and implementation arrangements, monitoring and evaluation of recovery etc.

4.2 Guiding Principles for Recovery and the Way Forward

4. Going forward, recovering from the disaster and building longer term resilience in Uttarakhand would require a comprehensive recovery and reconstruction framework – the RRF. The RRF would provide a sequenced, prioritized, programmatic, yet flexible (living) action plan to guide the recovery and reconstruction process. It would help to: a) maintain a cohesive and flexible structure for managing the overall recovery and reconstruction process, including communication flows and information feedback loops; b) clarify roles, responsibilities, and institutional arrangements to capitalize on the strengths of each stakeholder, and augment capacity where needed; c) effectively prioritize, sequence, and drive multi-sectoral and cross-cutting recovery decisions, activities, and allocation of resources; d) systematically integrate disaster risk reduction in reconstruction and recovery and formalize policy and strategic linkages across recovery and regular development processes; e) implement recommendations and strategies outlined in the assessment; f) assist in establishing robust and criteria-based monitoring and evaluation systems for recovery; and e) apply lessons learned from other countries and adapt them to national contexts.

5. The following are the guiding principles which should form the basis of a robust framework for recovery to be developed by the government. A consultative process will be needed to fine tune and adapt the principles to the Uttarakhand context.

Strategy

6. The RRF should be based on a clear understanding of the damages, losses and needs based on assessments undertaken by the GoU in collaboration with other key partners that can bring in the requisite expertise. In order to design interventions that address the local requirements, keeping in mind larger considerations of sustainability and economy, area specific studies/surveys would be required. Such studies/assessments should capture the destruction of assets (public and private), livelihood losses, and disruption of access to services. Assessments that are being carried out by civil society organizations could also be referred to in order to corroborate the findings of government assessments, especially to capture the damages and requirements in villages that are cut off.

7. A multi-sector assessment should thus form the basis for formulation of the RRF for the physical, socio-cultural, and economic recovery of the people affected, based on sustainable development and disaster risk reduction principles, taking into account the potential climate change impacts. The strategy to be adopted should be to develop a comprehensive RRF on the basis of recovery needs and disaster risk reduction priorities and building on lessons learnt from national examples of post-disaster recovery and reconstruction programs. The state government may therefore invite the relevant stakeholders (especially key government officers who played a significant role) to share their experiences and lessons learnt/challenges faced in the implementation of the recovery and reconstruction programs in Maharashtra, Orissa, Gujarat, and Sikkim. In addition, it may be prudent to learn from global recovery experiences (as indicated in Box 1). Uttarakhand's recovery program should be conceived in accordance with the ecology and development plans for the state bearing in mind the fact that the processes and systems followed by other states could provide useful learning to design interventions and establish appropriate implementation arrangements.

BOX 1: LESSONS LEARNT FROM PRIOR RECOVERY EFFORTS

Globally, there is evidence that some flood response programs have focused too heavily on rebuilding infrastructure and not enough on better adaptation and preparedness for the future in complementary investments, such as water and flood management, cropping pattern adjustment, rural finance, enhancing capacities of water users groups, and early warning systems.

For example, in Bangladesh there was a gradual, significant shift in thinking about floods and flood management by government, donors and nongovernmental organizations (NGOs) starting in the late 1980s. Disasters increasingly came to be seen as part of the development continuum, to be expected and prepared for. Greater attention was placed on mitigation, preparedness, coping strategies for the poor, flood proofing rather than flood control, and socio-economic and political factors (WHO 2000, Beck 2005).

Looking at the earliest phase of action, successful damage assessments are quick, detailed, and focused, but are not one-off efforts. They are updated as the situation unfolds and are not abandoned after the initial effort (IEG 2006a, Box 4.7). Quick initial actions and a realistic schedule were major success factors in the Mexico Earthquake Project. One factor in this success was that temporary reinforcement of dwellings in low income neighbourhoods was done within the first month.

A report by the Independent Evaluation Group (IEG) Haiti Earthquake finds that, "There is no emergency period where anything goes. Every response is either developmental or counter-developmental; every decision affects everything else." In a similar vein, "The actions of the first few days affect all future decisions" (IEG 2006a). Realism in planning longer-term action is also important. Many project designs have been unrealistic. Across some 60 disaster activities reviewed in the IEG Hazards of Nature study (2006), most required extensions of about a year and a half on 3- to 6-year projects, and by no means did all of the extended projects achieve their original targets.

Source: Extracted from Response to Pakistan's Floods: Evaluative Lessons and Opportunity, 2010, IEG, The World Bank.

8. Focus on the most vulnerable and socially disadvantaged groups, such as children, women, and the disabled. Disasters increase the vulnerability of all, but especially of those who are already disadvantaged. Recovery programming should give priority to the most vulnerable groups, including female-headed households, children and orphans, and the poor, and take into account those with special needs, to avoid them being overlooked.

9. While this assessment provides a preliminary estimate of the damages and corresponding needs, a thorough review of existing and proposed sector strategies must be undertaken to help prioritize and sequence the needs. The GoU must also develop and enforce quality standards to ensure that the underlying vulnerability of the affected communities diminishes with recovery. It would be critical to take into consideration cross cutting issues such as gender and climate change while planning and implementing the recovery.

10. There is a need to move from a culture of response to one of long-term resilience to address long-term vulnerability and risks. To help prepare effectively to reduce future disaster risks, recovery interventions should be designed to promote resilience to future shocks by utilizing this window of opportunity to bring attention to the importance of the DRR and the need to integrate risk reduction at both policy and sector levels in national, state, and local development. Particular care must be taken to ensure that disaster risk reduction is a key cross cutting consideration across all sectors in the

recovery. In addition to 'hard' infrastructural investments for risk mitigation and reduction, appropriate 'soft' interventions such as risk awareness, strengthening early warning, risk transfer etc. must also be undertaken.

11. Urban disaster risk reduction and response preparedness: Considering the multiple hazard risks in Uttarakhand's urban areas where almost 30% of its population lives, it is imperative to carry out a detailed vulnerability analysis of the cities and model various risks for effective mitigation planning and disaster response preparedness. This may include: assessment of existing compliance and enforcement mechanism; consultation workshop for policy makers/ decision makers on the techno-legal regime and amendments to existing bye-laws; workshop for engineers/ town planners/ municipal corporations on urban risk reduction, establishment of city EOCs and regular city preparedness drills; preparation of city/ ward level DRM plans including evacuation routes and identification of safe shelters, disaster resources, advocacy workshops on mainstreaming/ integrating urban risk reduction in development plans, and awareness for communities on safer construction practices and disaster preparedness.

12. Recovery and Reconstruction Policy: The reconstruction and recovery process in the state should be guided by a well-formulated policy. This policy should clearly articulate the principles to be followed and prescribe the entitlements for the people affected by the disaster event and establishment of enabling mechanisms for participation of donors, corporate sector, and NGOs in the recovery and reconstruction program. Since the state has active Panchayati Raj Institutions (PRIs), it would be useful to involve these institutions and the communities in the reconstruction processes along with the involvement of NGOs. The policy should also mention the role of various agencies at the state and district levels.

13. Since the state has a highly fragile eco-system with acute pressure on safe land, the plans and policies should be able to promote sustainable reconstruction technologies using local resources and capacities to promote the 'build back smarter' concept with appropriate technical assistance.

Financing

14. A detailed financing plan and resource mobilization strategy based on assessment of resource requirements should be prepared. The resource requirement should be on the basis of a more development-oriented recovery plan for the region (with adequate provision of disaster risk reduction).The resource mobilization strategy will identify potential sources of funding including budgetary support, central assistance, insurance pay out, resources from bilateral donors, multilateral credit, etc. There should be proper linkages between recovery and reconstruction programs and development programs which could serve as a vehicle for implementing specific aspects of the recovery program.

Implementation

15. The government many need to adopt a phased approach to recovery involving shorter and longer-term interventions. Prioritize immediate service delivery support to local governments in affected areas directly in the short-term and a program of capacity building over the long-term. The government could consider instituting a two tier implementation and monitoring system. At the state level the functions could include oversight, monitoring and evaluation and technical, financial and administrative clearances. At the district level the actual execution could take place with the involvement of the line ministries and district authorities.

Governance, Monitoring and Evaluation

16. Developing a strong Monitoring and Evaluation (M&E) mechanism to ensure that the course of recovery, reconstruction, and DRR activities get completed in a timely manner. Efforts must be made to maximize credibility through independent oversight mechanisms, third party monitoring and

community-based grievance redressal mechanisms while leveraging existing capacities. In order to track financial and physical progress towards achievement of the targets set, an IT based Tracking and Accounting system could be established. The monitoring mechanism in the districts and blocks should have systems to receive feedback on progress and grievances through PRIs. In order to ensure adequate participation of the communities, program committee of citizens, advisory bodies, village-level committees, panchayati raj institutions, etc. could be established

Coordination

17. The need for a coordinated effort towards recovery: Several government ministries, international organizations and NGOs, will be working on recovery interventions. Going forward, it will be imperative to ensure harmonization between the various agencies involved in planning and execution. The Government should establish a platform to channelize and coordinate the support from non-government agencies (private, trusts, NGOs, academic/technical institutions). The strategy should be to facilitate the participation of all stakeholders in the recovery and reconstruction program under a common umbrella, making them adopt the policies, designs, standards, and practices which are approved at the program level. It is important to ensure that NGOs participate in the program in an open and transparent way, and subject themselves to the same standards of accountability as the government. The process would involve identifying NGOs willing to participate in the recovery and reconstruction program based on their commitment to the recovery and reconstruction interventions, specialization (education, health, shelter, livelihoods, advocacy, etc.) and time-frame of typical interventions (short or long-term). Accordingly, sectors / geographical areas for their functioning could be allocated. This would also help the departments to develop the terms of their participation for each of these components. Similar structures should be established in each of the five districts.

Chapter Five

Science and Technology for Better Disaster Management

5. Science and Technology for Better Disaster Management

1. Uttarakhand is a state severely vulnerable to multiple natural hazards. Floods, landslides and earthquakes have been recurrent phenomena with concomitant loss of lives, properties, infrastructure and public utilities. The aftermath of the cascading disaster of June 15-17 has again underscored the state's vulnerabilities and has called for a comprehensive approach to manage and mitigate disaster risks. A comprehensive vulnerability analysis and risk assessment, a fail-safe early warning and communication system, and a strong disaster response mechanism play a crucial role in not only saving lives and livelihoods but also for achieving sustainable recovery and long-term disaster risk reduction. Science and technology can play a crucial role in this endeavour and contribute to building the resilience of the state of Uttarakhand and its people.

5.1 Risk Identification and Modelling

2. While the current disaster at hand is a hydro/meteorological disaster by nature, it should also be noted that Uttarakhand sits in a highly seismically active zone. According to the Seismic hazard zone map of India by BMTPC, the whole state falls within Seismic Zone IV and V, which are the two highest earthquake risk levels for India. Even a medium size seismic event in this region could cause huge devastation, with earthquake induced landslides potentially destroying assets and affecting human life within its reach. Seismic events can also trigger the failure of glacial lakes / moraine dams which can cause massive flash floods downstream.

3. Given the potential for large-scale cascading disasters in the region from a host of hazards, a comprehensive risk identification program through risk modelling and simulations is of paramount importance. Several risk assessments for select parts of Uttarakhand have been carried out in the past for some types of hazards with varied purposes. Unlike deterministic risk assessments, or assessments based only on past recorded events where only one or a few event scenarios are looked at, probabilistic assessments is a well-established technique that provides an opportunity to look at a wide range of possible consequences from all probable events. Given the potential for a wide range of future hazard events, the probabilistic approach to risk assessment can help the State in identifying the range of consequences and contingency planning.

4. The scientific information derived from these risk identification programs should be converted into easy to understand and actionable information for the state decision-making authorities and housed within the GoU. Customized information platforms could be developed to share the risk information for various planning and early warning purpose. An example of such a system is InaSAFE that was developed for the Indonesian capital of Jakarta (estimated metro population of 2.8 million), based on the probabilistic flood and earthquake risk assessment carried out.

5.2 Early Warning and Decision Support System

Improving Hydromet Systems

5. The lack of an effective early warning system for flash floods and landslides in the region has been highlighted in the aftermath of the recent event. An effective early warning system necessitates that various hydromet data inputs are seamlessly available for accurate modelling of the flash floods

or rain induced landslides. The underlying data and information needed for an early warning system typically come from a wide range of sources which are often not shared or integrated in a way that facilitates timely and accurate decision-making. This situation is exacerbated by the lack of common standards for data collection and dissemination, resulting in difficulties for the end-users, typically the authorities responsible for disaster warning and response. In light of this, a review of the existing weather forecasting and information systems, critical gaps therein along with establishing a data coordination mechanism is necessary. Accuracy of the disaster warnings, communications with local authorities, hydromet data collection and sharing capabilities should also be targeted for improvement.

Decision Support System

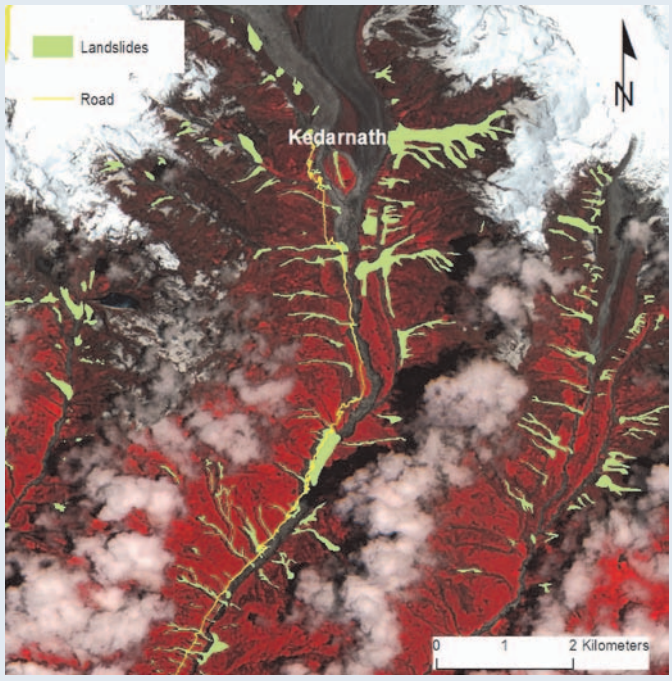
6. Given the massive scale of the required recovery, rehabilitation and reconstruction and the planning for disaster-sensitive development activities in Uttarakhand, it is important to put in place a decision support system (DSS) for aiding the decision-makers and ensuring coordination among various stakeholders and implementing departments. Such a DSS integrates and analyses vast amounts of data and displays it in user-friendly ways for consumption by various stakeholders for their decision making. Use of geographic information system (GIS) in the DSS helps assimilate multiple layers of spatial and statistical databases, historical and real-time, and represent them through map-based decision tools. A DSS can help i) tracking and reporting of financial and physical progress towards achievement of the targets set, ii) enabling citizen feedback and grievance redressal mechanisms for the active participation of communities in the recovery and reconstruction program. Dedicated helpline, social media channels and mobile applications can also be considered for collecting feedback; iii) improve response planning in areas such as determining evacuation routes, locating vulnerable infrastructure and vital lifelines, and estimating the relief and response supplies, and iv) maintaining an inventory of the state's disaster preparedness and response resources. Ideally, such a DSS should be web-based and make optimum use of the existing networks and facilities such as NICNET, POLNET, and ISRO DMS Network.

5.3 Spatial and Satellite Data Applications

7. Data for post-event damage and loss assessments are traditionally collected by the government departments leading the assessment. With rapid advances in the field of remote sensing, the increase in the number of earth observation satellites, the spatial, temporal and radiometric resolution of the images as well as computing power in the recent years, the use of such techniques for rapid assessment purposes are becoming increasingly realistic and reliable (as indicated in Box 2). Some of the conditions for a good spatial data-based assessments are i) a strategy in place before an event happens that ensures the rapid acquisition of the post-event satellite images that covers the entire affected area, ii) pre-event images ideally from the same season in the immediate previous years or immediately prior to the event, iii) highly detailed spatial baseline data sets that show the location of the key assets on the ground as well as the population distribution, and iv) dedicated manpower for the duration of the assessment to be able to process the large amount of data, as well as an impact assessment methodology. In view of the changing climate and sensitive ecosystem of the Himalayas, the spatial data preparedness can also aid proactive monitoring of glacial lakes which compound the vulnerability of the downstream regions. High-resolution satellite data, complemented by aerial or close-range photographs, can also help monitoring the rehabilitation and reconstruction works.

BOX 2: PRELIMINARY LANDSLIDE MAPPING RESULTS BY UTTARAKHAND SPACE APPLICATION CENTRE (USAC). THE LANDSLIDE VECTORS ARE OVERLAID ON A FALSE COLOUR LISS VI IMAGE.

For the 2013 Uttarakhand (India) cloud burst event, the Joint Rapid Damage and Needs Assessment (JRDNA) assessment team collaborated with Uttarakhand Space Application Centre (USAC) in Dehradun, Uttarakhand to apply the Indian satellite data for the purpose of assessing the suitability of these data for a rough but rapid estimate of the damage. Using the Indian satellite data such as LISS IV, the hazard (landslide, debris flow and flood extents) footprints were extracted from LISS VI. The hazard footprint was overlaid on baseline data produced at 1:50,000 scale by USAC for agriculture, transportation, forestry and village locations to estimate the distribution of damage.



Though damage information produced using baseline data at 1:50,000 is good enough to provide an overview of the damage distribution, had highly detailed spatial baseline data of the affected areas been available, it would have increased the accuracy, effectiveness and the usefulness of the damage assessment derived using satellite images.

8. The methodology was developed using the information pertaining to the Mandakini valley in the district of Rudraprayag. Following the completion of this work, the methodology will be extended to the other affected valleys. At the same time, arrangements to work on more high resolution data, both in terms of the baseline data as well as the satellite images are being planned. When the affected areas are inaccessible due to rough terrains as it was the case with the Uttarakhand floods, remote sensing can provide reliable means to assess the situation on the ground. High resolution data, both in terms of the satellite images (pre- and post-event) and the baseline spatial data are needed for effective and rapid assessment of the damage that is usable and reliable both for damage assessment and recovery planning.

5.4 Coordination amongst Science & Technology Agencies

9. In Uttarakhand state, capabilities to carry out risk identification activities, and indeed many other technical capacities related to natural hazard risk identification and management exist in a fragmented manner in various national and state agencies. Due to the multi-faceted and multi-dimensional nature of the hazard events likely to occur, coordination and data/knowledge exchange amongst these agencies, both national and state, is imperative. In particular, increased coordination and information sharing among the government's science, technology and disaster management institutions such as Uttarakhand Space Application Center (USAC), Disaster Management and Mitigation Center (DMMC), Wadia

Institute for Himalayan Geology (WIHG), Indian Institute of Remote Sensing (IIRS), and National Remote Sensing Center (NRSC) is of utmost importance.

10. The state can also benefit immensely from technical collaboration and knowledge exchange with the national institutions such as the Survey of India (SOI), Geological Survey of India (GSI), India Meteorology Department (IMD), Central Water Commission (CWC), Forest Research Institute (FRI) and Forest Survey of India (FSI). This collaborative environment could be initiated and coordinated under the guidance of the Uttarakhand state secretariat. Coordination should extend to items such as the sharing of existing resources and data sets including the Automatic Weather Station data that the various agencies maintain, databases such as the National Natural Resource Management System (NNRMS) and various sectoral databases for development planning. High priority should be accorded to sharing of scientific information among various actors and finding ways to mainstream science and technology inputs into policies, regulations and implementation plans.

ANNEXURES

Annexure 1: Energy Sector: Summary of Preliminary Damages Estimated for UJVNL, UREDA and UPCL

Section 1: UJVNL Estimated District-wise Damages

S. No.	Districts	Name of HEPs	(MW)	Description of Rehabilitation Works	Estimated Damages	
					(INR Million)	(US$ Million)
1	Chamoli	Badrinath – II	1.25	Trench weir, Intake and Power channel	0.90	0.02
2	Chamoli	Pandukeshwar	0.75	Diversion structure, power channel, escape channel, TRC, store and Residential building 04 nos.	15.00	0.25
3	Chamoli	Tharali	0.4	(a) Trench weir partially damage; and (b) Trench weir, intake, Desilting tank, power channel filled with River Bed Material	0.80	0.01
4	Chamoli	Urgam	3	(a) Trench weir, intake,Desilting tank, power duct	40.00	0.67
				(b) Power channel 150m, TRC and power house protection works ; and (c) Power house building partially damaged		
5	Pithoragarh	Kanchauti	2	(a) Head diversion works and power channel; (b) Penstock partially; (c) Power house building and switchyard washout and (d) Residential building 08 nos. guest house and store	120.00	2.00
6	Pithoragarh	Relagad	3	(a) Diversion works and power channel;(b) Power house building, switchyard and power house protection building and (c)Power house about to fall	170.00	2.83
7	Pithoragarh	Chirkkila	1.5	(a) Head diversion work and power channel; and (b) Power house building switchyard safe	30.00	0.50
8	Pithoragarh	Kulagad	1.2	(a) Switchyard, colony head works and transmission line; (b) 33 kV double circuit line approximately 9 km line damage; (c) 11kV and LT line about 15 km; and (d) 1.5 MVA 33/11 kV substation, Kanchauti 11kV switch room damage	83.00	1.38
				Rural electrification Border area development plan 2012-13.		
				(a) 1 village sobla tok Jhimir supply material washed away		
				(b) 1 village sobla tok Yaldaj supply material washed away		
9	Pithoragarh	Sobla – I	8	Power house site, penstock, head works, E&M equipments, residential building 09 nos., store, steel LT lines	250.00	4.17

S. No.	Districts	Name of HEPs	(MW)	Description of Rehabilitation Works	Estimated Damages	
					(INR Million)	(US$ Million)
10	Rudraprayag	Kaliganga - I	4	(a) Power house, building, Penstock, protection works, Switchyard, residential building 8 nos. and other structures; (b) Associated Electromechanical Equipments; and (c)Transmission line	183.20	3.05
11	Rudraprayag	Kaliganga - II	6	(a) Tunnel, Desilting Tank, Residential building 12 nos ;and (b) Electromechanical Equipment's	199.10	3.32
12	Rudraprayag	Madyamaheshwar	15	Weir, Desilting Tank, Residential building 08 nos.	56.00	0.93
13	Rudraprayag	Sonprayag	0.5	(a) Trench weir, intake, Power channel; (b) Intake, Desilting tank, power channel filled with River Bed Material; (c) Power house building entirely drowned inside river' and (d) Power house, TRC and Switchyard equipment	22.00	0.37
14	Uttarkashi	Maneri Bhali Stage – I	90	(a) Protection Wall along both side of TRC, Power house and Switchyard; (b) 33 kV Tiloth-Heena Feeder; and (c) 11 kV three feeders from Heena to Maneri substations.	43.70	0.73
15	Uttarkashi	Maneri Bhali Stage – II	304	(a) Protection Wall along reservoir, both side of TRC and Power house; (b) 33 kV Tiloth-DPH Dharasu feeder; and (c) 11 kV Tiloth- Joshiyara feeder.	71.50	1.19
16	Uttarkashi	Pilangand	2.25	Diversion ,Intake, Desilting tank, Power Channel, TRC and Residential Colony	13.00	0.22
17	Uttarkashi	Asiganga – I	4.5	Power house building, Weir, and Power Channel	9.00	0.15
18	Uttarkashi	Asiganga - II	4.5	Weir and Desilting tank	8.00	0.13
19	Uttarkashi	Kaldigad	9	Tiloth Kaldigad transmission line	1.10	0.02
20	Pauri	Chilla HEP	144	33 kV lines from Bhupatwala to Hardwar (Chilla)	1.50	0.03
Total			**604.85**		**1317.80***	**21.96***

***** This is only the estimate of damages. However to rehabilitate the entire HEPs affected in the flood, it is estimated to cost INR. 2,191.2 million (US$36.52 million).

Section 2: UREDA Estimated District-wise Damages

S.No.	Rehabilitation of Projects	Estimated Damage	
		(INR million)	(US$ million)
1	Bageshwar {1x25+7x50+4x100+1x500=1275 kilowatts (kW)}	7.30	0.12
3	Chamoli (1x25+2x50+6x100+2x200 =1125 kW)	12.80	0.21
2	Rudraprayag (1x14+1x100 =114 kW)	5.20	0.09
4	Pithrogarh (1x500+1x800= 1300 kW)	69.10	1.15
5	Uttarkashi (2x20+1x40+1x100+1x150+3x200=930 kW)	11.50	0.19
6	Almora (1x100 kW)	0.20	0.003
7	Nainital (1x100=100 kW)	0.40	0.01
8	Tehri (1x50+1x100+1x200=350 kW)	1.80	0.03
Total		**108.30**	**1.81**

Section 3: UPCL Estimated District-wise Damages

S.No.	Rehabilitation of Projects	Estimated Cost	
		(INR million)	(US$ million)
1	Bageshwar	7.90	0.13
2	Chamoli	59.60	0.99
3	Pithoragarh	12.00	0.20
4	Rudraprayag	65.20	1.09
5	Uttarkashi	119.70	2.00
6	Almora	6.00	0.10
7	Champawat	3.90	0.07
8	Dehradun	9.80	0.16
9	Haridwar	16.40	0.27
10	Nainital	8.30	0.14
11	Pauri	18.90	0.32
12	Tehri	27.30	0.46
13	U.S.Nagar	7.40	0.12
A	**Sub Total**	362.40	6.04
B	Cost of providing free electricity to victims (Lump sum)**	142.50	2.38
Total		**504.90**	**8.42**

** This cost for providing free electricity is not included in the needs

Annexure 2: Summary of District- wise Damage to Government Tourism Infrastructure

Amount in million

SN	District	Destination Development	*Ghat* Development	Night Shelters	Others	Parking	TCC	Tourism Information Centre	Toilets	Trek Route	Tourist Rest Houses	Grand Total	
		US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	INR	US$
1	Rudraprayag	1.0	0.2	1.6	0.1	-	-	-	0.8	-	5.0	520.0	8.7
2	Uttarkashi	-	-	-	0.0	-	0.1	0.0	0.2	-	1.6	115.5	1.9
3	Chamoli	-	0.3	-	0.1	-	-	0.2	0.4	-	1.6	152.0	2.5
4	New Tehri	0.4	0.9	-	0.3	-	-	-	0.2	-	0.0	109.0	1.8
5	Pauri Garhwal	-	0.0	0.4	0.1	-	-	-	0.0	-	-	30.5	0.5
6	Almora	-	-	-	0.2	-	-	-	-	0.1	0.8	64.5	1.1
7	Bageshwar	0.3	-	-	-	-	-	-	-	-	-	20.0	0.3
8	Haridwar	-	-	-	0.1	0.2	-	-	0.1	-	-	21.6	0.4
9	Nainital	-	-	-	-	-	-	-	0.0	-	0.1	7.5	0.1
10	Pithoragarh	0.3	-	-	-	-	-	0.1	-	-	0.4	45.5	0.8
11	Other Districts	-	-	-	1.3	-	-	-	-	-	-	80.0	1.3
	Total	**2.0**	**1.5**	**2.0**	**2.3**	**0.2**	**0.1**	**0.3**	**1.6**	**0.1**	**9.5**	**1,166.1**	**19.4**

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