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ENVIRONMENT OF THE UTTARAKHAND DISASTER

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ABSTRACT
Massive floods and landslides in June 2013 led to what most believe to be Uttarakhand's worst disaster in living memory. The devastation was statewide, with estimates of anticipated revenue losses in the tourism sector alone being over Rs. 120 billion for 2013–14 rising to Rs. 200 billion in 2014–15 and an estimated Rs. 250 billion in 2015–16. Uttarakhand's economy may take a few years to recover. The biggest challenge will be to restore the lives and livelihoods of thousands of families who have lost their basic livelihood resources. The disaster led to a nationwide debate on whether anthropogenic activities in the name of economic development aggravated the impact of the disaster. This paper is a comprehensive contribution to the debate. It analyzes Uttarakhand's current development pattern in terms of ecological sustainability and equity.
Key words : Disaster, contribution, development

INTRODUCTION
The origin of the 2013 Uttarakhand floods and landslides disaster can be ascribed to an extreme rainfall event.5 The devastation was statewide though the main death toll occurred between Kedarnath and Gaurikund in the uppermost reach of the Mandakini valley in Rudraprayag district (See Box: The Catastrophe at Kedarnath). The lack of road connectivity and inclement weather made rescue and supply of relief materials very difficult at many places. More than 100,000 pilgrims, tourists and service providers were left marooned near various shrines in the upper reaches of major rivers. The destruction due to the 2013 disaster was multidimensional and continuing. Floods and landslides battered different parts of the state during the entire monsoon season after repeated spells of heavy rainfall.

June 15–17, an Extreme Rainfall Event
Meteorology officials explained that collision of warm moist air from the southeast with cold air from the northwest created a low pressure region above Rajasthan and Haryana. "It sucked in moisture laden monsoon clouds from the Arabian Sea and moved in a northeast direction. When the latter collided with cold air above the mountain ranges in Uttarakhand and eastern Himachal Pradesh, they quickly dumped all their moisture over the region," explained Dr. Anand Sharma, Director, Meteorological Centre, Indian Meteorological Department (IMD) in Uttarakhand. The dynamic monsoon trough in the west also pulled the normal low-pressure southwest monsoon system from eastern India to rapidly traverse the entire state of U.P. in only 24 hours on June 14–15. The monsoon season thus arrived several days early.

On June 14, Dr. Sharma, issued a warning of heavy rainfall in all the agro-meteorological zones of the state. "On June 15th I forecast the possibility of heavy to very heavy rainfall on June 17 and the possibility of rain on June 18 and 19. I informed the state government that char dham pilgrims be advised to postpone their yatra by four days," said Dr. Sharma. Intense rain blanketed almost all of Uttarakhand between June 15 and 17. The Dehradun Meteorological Centre reported 129 and 162 mm

rainfall for 24 hrs ending at 8:30 a.m. on June 16and 17 in Uttarkashi town in the west. The corresponding figures for Dehradun city were 220 and 370 mm, breaking an 88 year-old record. Nainital in the east recorded 176 and 170 mm on June 17 and 18 mornings respectively. Though greater rainfall over a 24-hour period has been recorded in the past in Uttarakhand, sustained heavy rainfall for nearly three days over the entire state is rare.

The maximum rain fell in the Inner Himalayan region, but it varied from sub-basin to sub-basin. The most deluged parts were around Badrinath– Hemkund Sahib–Kedarnath–Gangotri shrines, which are about 60 km apart as the crow flies, and the Gori Ganga and Darma valleys in the eastern Pithoragarh district. The early arrival of the monsoons and the intensity of rain over the mountain region from eastern Himachal Pradesh to western Nepal totally surprised almost everyone. It was the peak of the annual tourist season in Uttarakhand. Well over 100,000 tourists, pilgrims and service providers had ventured into the upper reaches of the major rivers to visit religious shrines.

IMPACT OF THE DISASTER

The ensuing disaster was statewide. Big and small rivers and mountain streams throughout the state burst their banks wreaking havoc in nearby villages. The heavy rains destabilized mountain slopes causing landslides at thousands of locations. The main impact was felt near the more fragile high ranges. Though some of the numbers were not definite, they revealed the scale of the catastrophe. The following paragraphs briefly describe the nature of the impacts.

FLOODS:

Flash floods are a common occurrence in the Himalayas but the destruction at many locations this year was very unusual. Large rivers like the Ganga, Kali, Saryu and Ramganga (E) breached their danger marks. The Ganga inundated Rishikesh and Haridwar. Its tributary, River Bhagirathi, flooded parts of Uttarkashi while the Alaknanda drowned parts of Srinagar under 30 feet of water, mud and silt. The Mandakini.

THE CATASTROPHE AT KEDARNATH

A tragedy of massive proportions took place in the uppermost reach of Mandakini river. Immense destruction occurred all along its length up to its confluence with the Alaknanda at Rudraprayag. Kedarnath town (3,546 m asl) lies less than a kilometer from the origin of the Mandakini river at the snout of the Chorabari glacier (3,895 m asl). The town is built on a terrace on either side of which are Steep Mountain slopes covered with snow and moraines (mud and rocks) left behind by receding glaciers in the past.

A meteorological station established by Wadia Institute of Himalayan Geology (WIHG) at Chorabari glacier camp recorded 325 mm rain in 24 hours from 5 p.m. onwards on June 15. Nearly 210 mm fell in the first 12 hours (Dobhal et al 2013). The combination of intense rainfall and the melting snows opened up a number of landslides on the eastern slopes on June 16th. Rambara village (2740 m asl), downstream, was inundated by the afternoon of June 16 (Petley 2013). Up in Kedarnath the edges of the terrace on which the town stood began to erode causing buildings to collapse.

On the evening of June 16, around 6 p.m. a huge landslide laden with boulders, rocks and mud from the companion glacier to the northeast of Kedarnath slammed into the town with the flood waters. It devastated the upper part of Kedarnath town. The flood water with its bed load then sped down the steep slope and demolished small settlements including Rambara village a few minutes later. Many people lost their lives at Rambara that evening. All night long the valley resounded with the thunderous claps of big boulders and rocks crashing down the slopes.

Meanwhile the Chorabari lake filled up with rain and snow melted from the glacier. On the morning of June 17, swollen waters in Chorabari Lake overtopped its old moraines-filled dam. The barrier

breached catastrophically and a wall of water rushed down the slope collecting more debris and water en route. Soon it hit Kedarnath town, carrying away people, buildings and shops. The rest got buried in several feet of sand. Everywhere there were dead bodies. Lifeless hands and legs stuck out of sand-packed windows and doors.

FURTHER DOWN-SLOPE AT RAMBARA NOTHING REMAINED

level rose 30 to 50 feet in its lower reach, near Rudraprayag. Floods affected every part of the state; rural and urban areas alike. The Yamuna inundated Vikasnagar. The swollen Bindal and Rispana rivers rendered scores of families homeless in Dehradun, the state capital. The usually tranquil Kosi overran the market town of Someshwar in Almora district. Many villages in the Pinder valley were washed away.

Small mountain streams became torrents eroding their banks and causing landslides. A small feeder stream of the Aglar river in Tehri Garhwal district swept away houses, schools, farms and livestock. Heavy floods in the Painagad, a small tributary of the Gori Ganga, destroyed two hydroelectric projects (HEPs) on June 17 evening.

LANDSLIDES:

In a preliminary assessment, Indian Space Research Organization (ISRO) identified 2,395 landslides in various parts of the Mandakini, Alaknanda and Bhagirathi watersheds (www.bhuvan-noeda.nrsc.gov.in). Almost 200 of them were between Kedarnath and Gaurikund. Road and telecommunication links were severely affected.

FATALITIES:

The official human death toll was over 900 and 5748 persons were recorded as missing. Their families became eligible for death compensation. The unofficial estimates were much higher, at above 10,000 fatalities. Survivors described horrific scenes of Kedarnath littered with dead bodies, of arms and limbs sticking out of thick layers of sediments. At Rambara dead bodies were hanging from trees when rescuers reached there.

According to a news report about 12,000 Nepalis were working in the floods affected valleys as porters, palanquin bearers and manual laborers (www.ekantipur.com). Hem Bahadur Khadka, a palanquin bearer, said that around 7,000 Nepalis had permits to work as palanquin bearers this season. Thousands of them may have lost their lives. Another palanquin bearer, Kul Bahadur BK, said "I witnessed many of my villagers and other Nepali friends drown in the floodwaters." The official estimate of about 300 missing Nepalis included about 100 workers only. Deaths due to house collapses or drowning were reported from Uttarkashi, Rudraprayag, Tehri Garhwal, Dehradun, Haridwar, Chamoli, Pithoragarh and Almora districts.

Thousands of mules and ponies were present on the trek routes to Kedarnath and Hemkund Sahib shrines. In addition there were a number of buffaloes and cows. Thousands perished. The Uttarakhand government began to airdrop fodder bundles for them in the second week of July after People for Animals, a voluntary organization, began their rescue.

LOSS OF INFRASTRUCTURE:

Infrastructure in Uttarakhand was badly hit. Roads, bridges, power lines, irrigation canals, drinking water supply systems, telecommunication towers and hotels and houses were destroyed or damaged. Officials valued the lost structures at tens of billion rupees (www.tehelka.com). The consequent business losses were similar. Most of the severe damage was in the northern districts of Uttarkashi, Rudraprayag, Chamoli, Bageshwar and Pithoragarh.

Roads and Bridges: Government data showed that 145 bridges had been swept away and that roads

were damaged at over 2300 locations. Landslides blocked various sections of national highways to Gangotri, Kedarnath, Badrinath and Hemkund Sahib. Toe-cutting also washed away many riverside sections of these highways. In Pithoragarh, Pauri Garhwal, Almora, Bageshwar and Champawat districts state highways and smaller access roads to village were blocked or washed away.
The loss of road connectivity posed problems in providing relief immediately after the disaster. Villages in the upper reaches of the affected river valleys ran out of rations. Injured people in many locations could not get medical attention.

Air force and private helicopters air dropped supplies at Kedarnath, Badrinath, Ghangaria and northeast Pithoragarh. Newspapers reported that disaster victims in the Johar and Darma valleys situated near the Indo–Tibet–Nepal border in Pithoragarh district were on the verge of starvation. Adequate rations and other essential commodities could not be dropped there for the first 10 days due to inclement weather and the collapse of roads and bridges in the area. Flooded rivers washed away many bridges reducing connectivity. A rampaging Mandakini river swept away most bridges across it. The over 100-years old bridge connecting India to Nepal at Jauljibi was washed away by the Kali river. In some places people drowned trying to cross swollen mountain streams on makeshift bridges. Power Supply and Hydroelectric Projects (HEPs): Nineteen small HEPs were destroyed (Basu 2013) Half a dozen large extant or under construction projects suffered severe damage. At several locations the local people held HEPs responsible for severe downstream damages. Electricity supply was hampered to an estimated 3,758 villages. Kedar valley in Rudraprayag district was the worst affected.

Some areas lost power supply due to damage to the distribution system, others suffered due to destruction of HEPs. The Alaknanda river damaged a 400 MW HEP at Lambagad. The Maneri Bhali-I (90 MW) and Maneri Bhali- II (304 MW) projects on the Bhagirathi river in Uttarkashi district had to suspend power generation due to heavy accumulation of silt and debris in their tunnels.
In the east the powerhouse of the 280 MW Dhauliganga project of NHPC in Pithoragarh was submerged on June 16th. It stopped generating power completely. Company officials expect it to resume power production only after six months. The boulder-laden Mandakini buried the 76 MW Phata-Byung dam and severely damaged the 99 MW Singoli-Bhatwari HEP.

Many small hydropower projects were destroyed in the Gori Ganga catchment in Pithoragarh district. Painagad, a tributary of the Gori Ganga, smashed Himalaya Hydro's 5 MW Tanga Phase I HEP. Mudslides damaged the 6 MW and 4 MW Kaliganga I and II HEPs on the Kaliganga, a tributary of the Mandakini river. Irrigation Canals: A total of 1976 canals in the state, built by its Irrigation Department, suffered breaches. Of these 521 canals were in Kumaon division and 1,455 in Garhwal. The official damage estimate was Rs 37.31 crore in Kumaon and Rs 182.29 crore in Garhwal. (Sharma 2013)

Drinking Water: Officials confirmed that 237 drinking water supply schemes had been damaged during the disaster (www.timesofindia. indiatimes.com). They affected supplies to 1418 villages. Drinking water being a basic need, the state government speedily addressed their repair.
Tourist Hotels and Buildings: The floods destroyed tourism infrastructure like hotels, lodges and restaurants and abruptly ended the main annual tourist season. Scores of hotel buildings and residential houses collapsed into the swirling flood waters in Uttarakashi, Rudraprayag and Chamoli districts. GMVN, the state-owned corporation, lost popular tourist rest houses at Syalsaur, Chandrapuri, Birahi and Kaudiyala among other sites. Revenue losses in the tourism sector alone for 2013–14 are estimated at over Rs. 120 billion (PHD Research Bureau 2013). These are expected to rise to about Rs. 200 billion in 2014–15.

In Dhanaulti tehsil of Tehri Garhwal district, landslides destroyed houses in several villages. Livestock died tethered in sheds. The Bhagirathi swept away more than 180 houses, shops and hotels in Uttarkashi. Many buildings collapsed in the swirling waters of the Assi Ganga.

LIFE AND LIVELIHOODS:

The human tragedy resulting from the disaster is grimmer. Without homes, lands and livestock, the basic livelihood assets of thousands of rural families, restoring livelihoods will be a major challenge. The abrupt end of the yatra season and its unlikely resumption on this scale in the near future will impoverish thousands of families whose men service pilgrims and tourists on the yatra routes. They operate taxis, buses, lodges, dhabas and stalls; some guide people who ride their horses or ponies while others are porters carrying the young, old and infirm on their backs or in palanquins on their shoulders. Thousand of these people and the animals were simply swept away by the deluge at Kedarnath.

Manmendra Singh of Mandakini-ki-Awaz, a community radio station in the Mandakini valley, says, "All-women households are numbed by the thoughts of coping with the future."8 Aid agency workers have expressed fears of trafficking of women and children in this region by anti-social elements preying on such vulnerable families. The scheduled resumption of many schools after the summer break was delayed. Many school buildings in the badly affected villages were washed away or damaged beyond immediate use. According to news reports about 100 schools in Uttarkashi and Rudraprayag districts were affected (Trivedi 2013).

Access to medical facilities was significantly cut off in the badly affected districts. Injured people and pregnant women were the worst sufferers. A number of voluntary organizations like Oxfam India, Himalaya Institute Hospital Trust, member organizations of the Uttarakhand Inter Agency Group, Doctors For You, Americares and others were active in providing emergency health care in remote or badly affected locations.

CONTINUING DISASTER

Almost all through the 2013 monsoon season there were several spells of heavy rainfall. Areas where the soil was saturated with water became vulnerable to repeated landslides. The human and animal death toll continued to rise steadily.

In mid-July, six persons lost their lives in Nainital district, when heavy rains in Bhimtal triggered a landslide. A downpour in Kapkot block of Bageshwar district on July 31st killed several members of a family and washed away many homes. Moderate to heavy rains caused landslides and house collapses in Sunali village of Chamoli district.

Continuous rainfall in the second week of August led to a landslide in Kot village, Tehri Garhwal district. The debris demolished a house killing an old woman and her granddaughter. The same rains washed away a large land area near Chinyalisaur in Uttarkashi district. The Pindar river changed its course near Narayanbagar village in Chamoli district and washed away fields, buildings and roads.

Three persons died in separate incidents in Tehri and Chamoli districts after a spell of intense rainfall on August 17th. Seventeen houses collapsed in Tehri district while the Char Dham highways remained blocked due to falling debris at various locations. A flash flood swept away 55-year old Prema Devi and her land in Sensari village, Tehri Garhwal on August 20

CONCLUSION

The monsoon rains arrived a fortnight early in the form of a 48-hour deluge across the state. The ensuing disaster was perhaps the worst in living memory. It also enhanced the instabilities of mountain slopes in many parts of the state. Landslides continued to devastate rural areas during the rest of the monsoon season. Thus the disaster was an extended one. Estimates of anticipated revenue losses in the tourism sector ran to over Rs. 120 billion for 2013–14 and about Rs. 200 billion for 2014–15 (PHD Research Bureau 2013). The state economy may take a few years to recover. The biggest challenge

will be to restore the lives and livelihoods of thousands of families who have lost members, homes, animals and lands – their basic livelihood resources

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