

## *International Journal of Scientific Research and Reviews*

### **Impact Assessment of LULC changes on Local Environment and Livelihood structure of Uttarkashi District of Uttarakhand**

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#### **ABSTRACT**

Land resource is finite but the demands and expectations of the people living on it are infinite. There has always been a conflict between the finite natural resources and infinite human expectations and the result of such conflict is the conversion of the natural scenery from one form to other. The changes of the natural land cover classes are a result of such interactions. In the present study an effort has been made to find out the impact of Landuse Landcover change on local environment. In the present work the landcover changes of the study area was found out between 2000 and 2015 with the help of image classification techniques on GIS platform. As it is known that every effect has got some aftereffect, thus the Landuse Landcover change of Uttarkashi has got some effect on other features too. Similarly the local environment is also getting affected by it. The increase in the built up area and unplanned growth and development of infrastructure are welcoming disasters and disasters creates a snowballing impact on other land cover classes. Thus in this work with the help of the classified images the area facing the major changes were found out moreover the cause and effect of these changes were also traced out.

**KEYWORDS-** Human expectations, Landuse Landcover change, Image classification, GIS platform, Environment.

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## **INTRODUCTION**

The available local resources play a major role in gaining a sustainable rural livelihood. Any change in the existing resources can have a large impact over the livelihood structure of an area. Uttarkashi is considered as the most disaster prone region of Uttarakhand as it lies above the most fragile geological setting. The recurring disasters hamper the day to day lives of the people (*Md Modasser Hossain Khan et.al*)<sup>1</sup>. If natural hazards and constant LULC changes coexist together in fragile Himalayan region then the consequences can be very severe. The Landcover reflects the biophysical state of the earth's surface, thus embracing the soil material, vegetation and water. LULC changes may involve the nature and intensity of changes but may also include spatial and time aspects. LULC changes

also involve the modification either direct or indirect of natural habitats and their impact on the ecology of the area (*Freddy et al*)<sup>2</sup>. The change in any form of Landuse is largely related either with the external forces and the pressure built up within the system (*Bisht and Kothiyal, 2001*)<sup>3</sup>. In the present study LULC changes of Uttarkashi district were analyzed for the year 2000 and 2015 with the help of Landsat TM and Landsat 8 respectively. The images were classified using supervised classification techniques. Slope and elevation maps were prepared using SRTM Dem images in Arc GIS 10.1 software. The villages were located using GPS points. With the help of these maps the location of the villages over different relief were found out. From this analysis it was found that within last 15 years (2000-2015) there has been lots of land cover changes in this place some of these changes are welcoming environmental hazards.

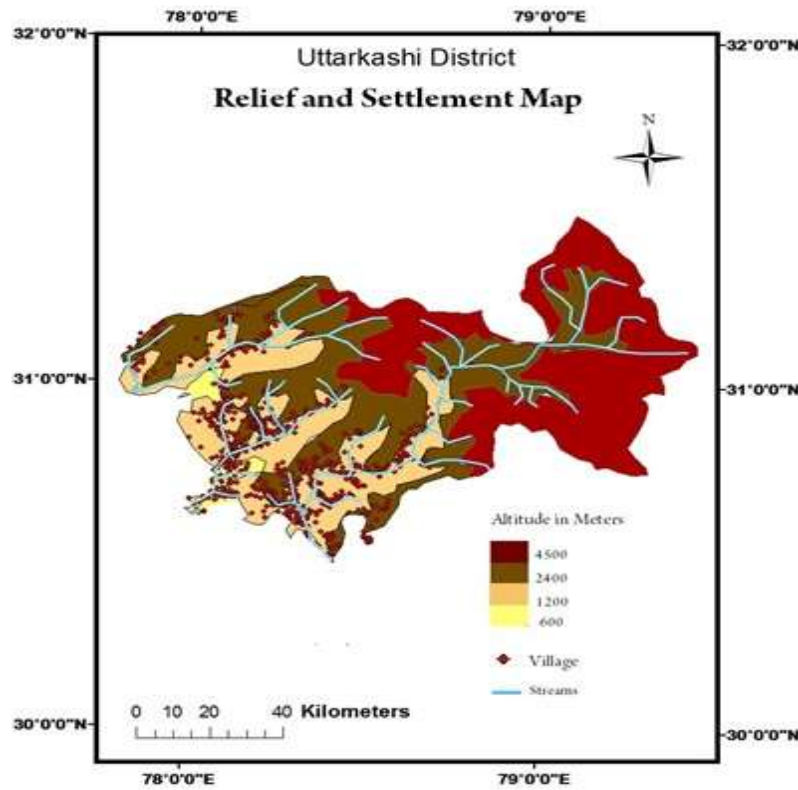
## **RESULT AND DISCUSSION**

The land cover changes have a direct impact on the local environment of Uttarkashi. As already stated the fastest changing Land cover class of Uttarkashi is the snow cover class. The glaciers in the Garhwal Himalaya are already retreating so fast that researchers believe that most central and eastern Himalayan glacier could virtually disappear by 2035 (*Kulkarni*)<sup>4</sup>. Due to melting of glaciers a greater proportion of total precipitation appears to be falling as rain than before. As a result snowmelt begins earlier and winter is shorter; this affects river regime, natural hazards, water supplies and people's livelihoods and infrastructure (*Jianchu Xu et. al*)<sup>5</sup>.

Retreat in glaciers destabilizes surrounding slopes and give rise to catastrophic landslides (*Dadson and Church*)<sup>6</sup>. Changes in precipitation type (rain and snow) and its amount, intensity and distribution over time and space have a direct impact on total and peak river runoff, potential moving it away from agriculture and dry season demands and towards monsoon flash floods. Evapotranspiration rates linked to temperature and effect on the amount of water available for runoff.

The people of the study area have built their houses in ancient time in high altitudinal places mainly due to availability of water in those places but at present due to erratic precipitation pattern accelerated by glacial retreat is making water scarce in those areas. Besides the houses lying in high altitude sloppy areas are now susceptible to landslides.

**Fig 1 Relief and Settlement Map**



*Source-Researcher's own compilation based on Cadastral and Geological maps*

From Fig 1 it is clear that many villages of Uttarkashi district are lying in high altitudinal areas and Fig 2 reveals the location of villages in sloppy areas which are quite hazardous zone. The villages around Uttarkashi town are lying adjacent to the river Bhagirathi; some are even less than a 100 mts away from the river. They are in a high risk of getting washed off even in a small spell of rainfall. Similar situation occurred in June 2013 massive disaster when the impregnated river engulfed many houses lying along the river. Glimpses of such constructions are shown in Plate 1

Fig 2 Slope and Settlement Map

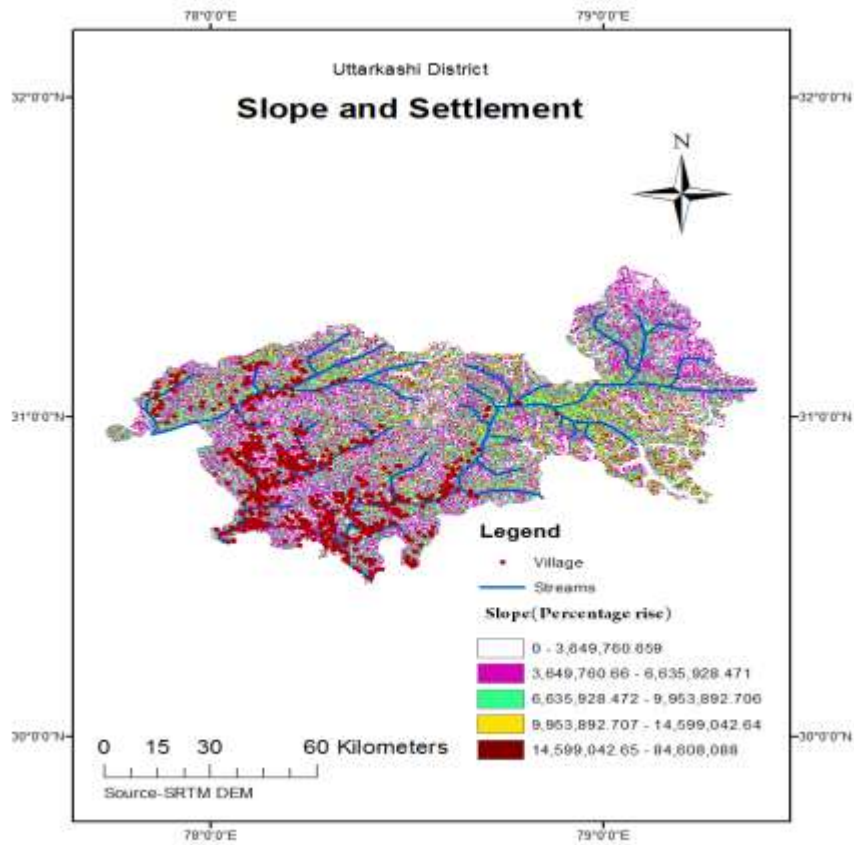


Plate 1 Houses lying near River Bhagirathi





*Source-Researcher's own observation*

Besides, the present housing structures are very prone to disasters. People are using heavy materials in building houses in earthquake prone areas and those houses are in the risk of shattering down even in a small shiver.

The change of the ancient landcover and the rise of disaster occurrences are also welcoming the problem of migration. The people of Uttarkashi are shifting towards Dehradun and Delhi in the hope of getting better economic opportunities as there is very less income source in this place

Disasters and landcover changes are interrelated in Himalayan regions. For example a burst of Glacier Lake will lead to flash flooding the flash flood will ultimately wipe out the areas lying along the river side which will transform the region into a new landcover. The making or broadening of roads will accelerate landslip and landslides. Thus it can be said that disasters and landcover changes are interrelated.

To validate this point a hypothesis was taken as, ***“Natural Hazards affect landuse changes”***. To prove this hypothesis the history of disasters of Uttarkashi as well as Uttarakhand was analysed, from the analysis it can be concluded that the Himalayas are young fold mountains created due to pushing of Indian sub continent against the Asian landmass. The process is still going on which leads to the occurrences of various types of disasters thus Uttarakhand being a Himalayan state have to face disaster every year. The worst disaster seen in the state was in June 2013 where due to heavy rainfall the rivers got impregnated which had snowballing impact in the form of landslides and floods. The lone disaster damaged bridges and roads and left almost 73000 people trapped in various places, many people went missing because of damaged and blocked roads. According to govt. 550

deaths had occurred, 392 people are injured and 334 are missing and more than 60,000 tourists and pilgrimage stranded. Also 1751 houses, 147 bridges and 1307 roads have got damaged, besides affecting the land use land cover structure of the area.

Uttarkashi being situated between sensitive thrust zones has faced many natural calamities. Few of the past deadliest disaster of this region are the Bhagirathi flash

flood(1978) which had a devastating impact, The Gyansu nala landslide(1980) that claimed 24 lives and destroyed several houses. The deadliest 1991 earthquake claimed 653 human lives, injuring about 6000 people and killing around 1300 head of livestock in addition to damage to buildings, other structure and the infrastructure.

A disastrous landslide took place on 24 Sep 2003 in Varunavat hills in Uttarkashi. It destroyed three storey hotels and engulfed many buildings, roads and other infrastructure. On Aug 3 and 4, 2012 night incidence of cloudburst occurred in Uttarkashi area. It was around midnight when the local residents noticed the rise of the water level of the rivers. The township of Bhatwari and Dunda were badly hit by this flood. The major damages were occurred in the Uttarkashi township which is 210 KM from Dehradun. The national highway from Uttarkashi to Gangotri was completely blocked. The bridges connecting Uttarkashi town and Bhatwari block at Gangotri village is collapsed and almost 80 villages got totally cut off.

Few bridges of vehicles and 6 footpath bridges were washed away resulting in no connectivity with Bhatwari area. Almost 60 KM of highway was damaged at many locations. Around 8000 people were affected by this disaster.

But the impact of disaster of June 2013 was the worst in the history of Uttarkashi. It took thousands of lives and damaged property worth of Lakhs.

Thus from the above discussion it is clear that the disasters leads to alterations of land use and land cover and disasters affects the natural land use pattern. Due to disasters many land is being cut down, new roads are being created. Many parts of the floodplain are washed up and in place of it new features are created. Some glimpses of the change in land cover due to disasters are shown in plate 2 and 3.

**Plate 2 Landcover transformation (From agriculture to sand bars)**



*Source-Researcher 's own observation*

**Plate 3- Changes in the area covered by infrastructure (Built Up area)**



*Source-Researcher's own observation*



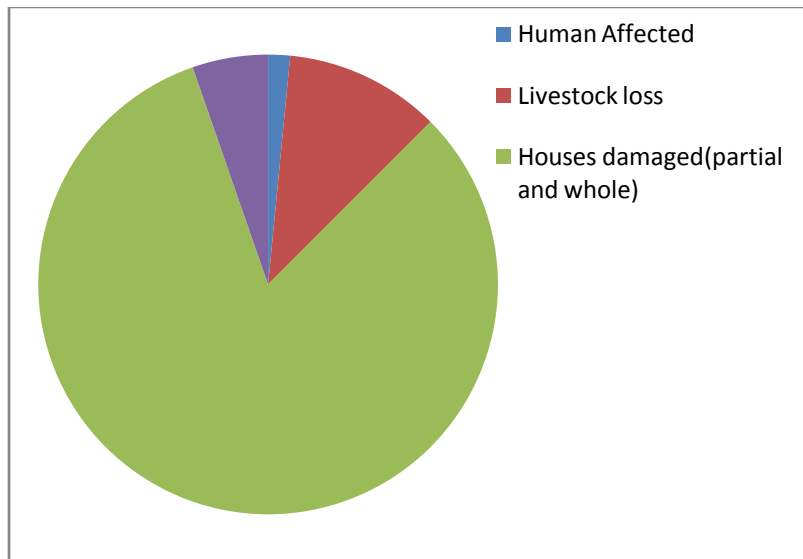
**Table 1 The Impact of Disasters between 2005-2015**

Year	Disasters	Human affected (Injured and Dead)	Livestock loss	Houses damaged (partial and whole)	Agricultural Land Loss (in Hac)
2005	Heavy Rainfall Landslide	01	-	11	157.848
2006	Heavy Rainfall Landslide	-	-	05	-
2007	Heavy Rainfall Landslide	01	17	08	2.52
2008	Heavy Rainfall Landslide	17	-	05	0.400
2009	Heavy Rainfall Landslide	05	-	-	-
2010	Heavy Rainfall Landslide	25	90	410	03
2011	Heavy Rainfall Landslide	11	415	138	-
2012	Heavy Rainfall Landslide	51	118	405	38.54
2013	Heavy Rainfall Landslide	43	477	7401	339
2014	Heavy Rainfall Landslide	03	02	03	02
2015	Heavy Rainfall Landslide	-	-	-	-
		157	1119	8386	543.308

Source-DMMC, Dehradun

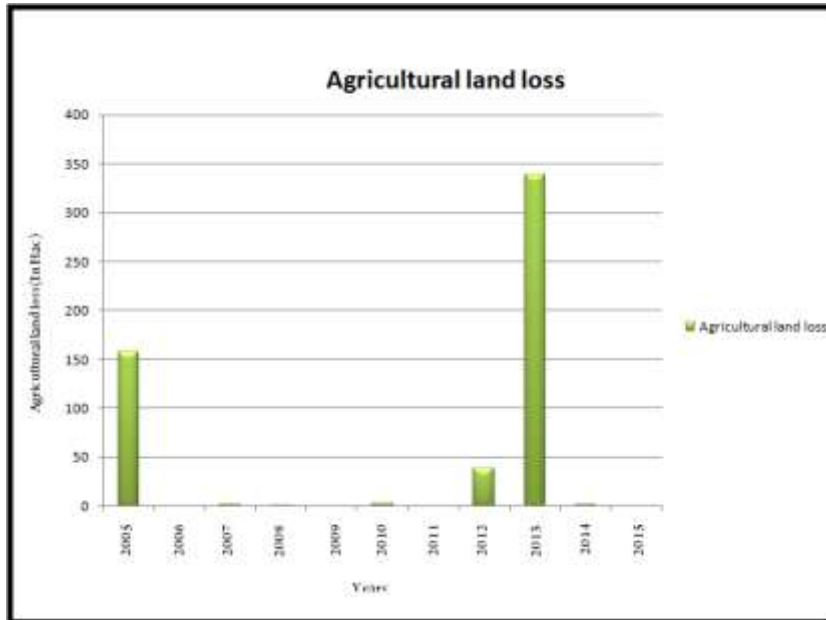
Table 1 reveals that, *“Disasters don’t kill but improper human activity creates all the havoc”*. The improper constructions of houses, improper pattern of agriculture are the main reason behind the huge losses that Uttarkashi faces every year. The impact of the disasters are highlighted in Fig 3,4 and 5

**Fig 3 - Impact of Disasters between 2005-2015**



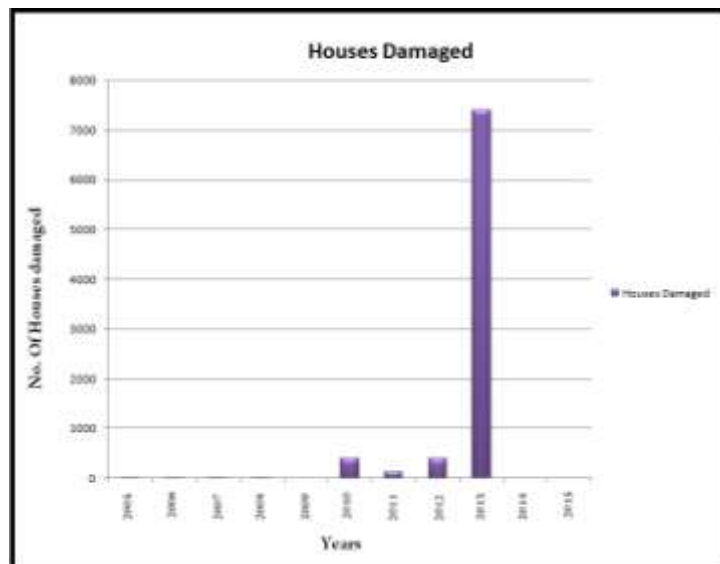
If the impact of disaster on land cover classes be seen then it can be found that the worst sufferer of the disasters are the built up and agricultural areas.

**Fig 4 Agricultural Land Loss due to Disaster**



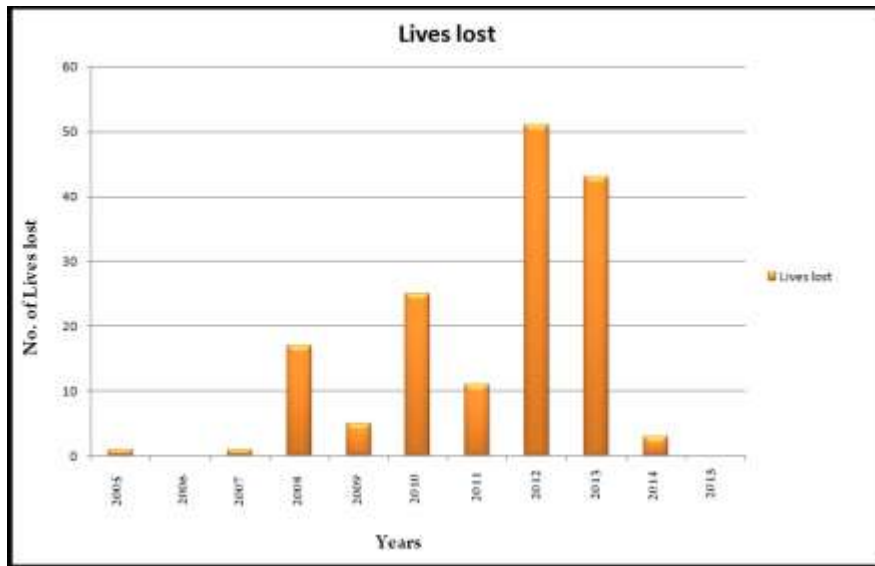
The figure clearly states that in the disasters of 2005,2012 and 2013 there has been a huge loss of agricultural land. The scenario teaches us that agriculture should not be done near the river and river flood plain nor in the sloppy areas reluctant to landslides.

**Fig 5 Houses Damaged due to Disaster**



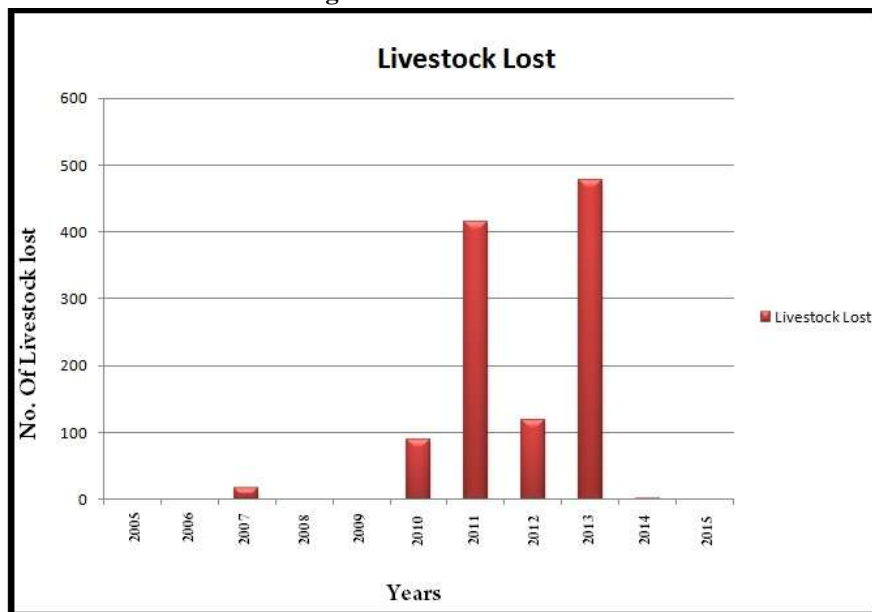
Like wise the above figure states that the people living in disaster prone areas should not build houses in hazardous zone nor should they use low quality construction materials.

Fig 6 Lives Lost due to Disasters



The greatest loss of a disaster is the loss of lives and the present study area is facing this loss every year. The main reason behind this is lack of awareness

Fig 7 Livestock Loss due to Disaster



Loss from disaster can also be seen in the form of loss of livestock, the loss is felt the most by the people who are wholly dependent on them. Such losses make the area more backward as it hampers in the growth and development of the place.

Thus it can be concluded that disasters and land cover changes are interrelated in Uttarkashi. Disasters bring changes on the land cover on the other hand improper land cover welcomes disasters. All these changes have an impact on environment and local livelihood structure.

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