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Urbanization and Anthropogenic Transformation of Hill Slopes in Almora Town of Kumaun Himalaya

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Abstract:

Hill towns of the fragile Himalayas are facing a newly emerged problem of mismanaged and unplanned building construction. Anthropogenic and technogenic activities in the recent past have lead to several geomorphic and environmental problems. This problemhas become more dangerous because of material transformation of the hill slope in the fast growing towns. These materials replaced and transformed in unscientific manner cause environmental hazards. The fast growing towns and cities in Uttarankhand with changing pattern of housing is causing instability in the hill slopes. The geologically active and sensitive mountainous region of Kumaun Himalaya is prone to natural hazards and disaster. Almora town located at 29° 36'N latitude and 79° 39' E longitude lying in Kumaun Himalaya has been selected for the present study. Detailed study of Almora town was conducted to find out the rate of sediment mobilization due to unplanned building construction. Sediment mobilization is accelerating more problems in urban sprawl of Almora town area. Preliminary field investigation indicates that the demographic pressure without proper planning strategies is causing land degradation and socio-economic problems to a great extent. Urbanization in the hill slopes, if not planned properly, result in slope failures and ultimately causes damage to life and property.

Keywords: Sediment Mobilization, Anthropogenic and Technogenic Activities, Environmental Hazards, Transformation, Degradation

1.0 Introduction:

Man has profoundly altered the earth's land surfaces by deforestation, crop cultivation and urbanization (Strahler 1977). Urbanization is the process by which large numbers of people become permanently concentrated in relatively small areas. In this process, the population concentration in town areas is far more when compared with the rural areas. It is also the development in the social, economical as well as behavioral aspects of the people.Urbanization occurs if the population growth in the town in higher than in the rural areas. The urbanization has affected the environment and has increased population growth and pollution. It affects the weather patterns and the runoff patterns for water. Generally there is more rain in urban areas but due to infiltration of water the level of water tables is low. Urbanization of the slope of the Himalayas has accelerated the degradation processes to a great extent. Many of the urban settlement in Himalayas are commonly associated with large destructive slope failure due to Rapid City, expansion with associated destruction of vegetation, building of road and construction of houses and hotels- all on steep slopes (Kale and Gupta , 2001)).

Urban geomorphology is the study of a man as a physical process of change whereby he metamorphoses a more natural terrain to an anthropogene landscape/cityscape (Mariaet al.2006). In such a context urban geomorphology is the surface coponent of urban geology, which is one of the important subfield of environmental geology (Coates 1976). Urban geomorphology examines the changes caused by the requirements of urban residential, economic and traffic function (Cooke

1976, Cooke et at. 1982). Towns are adjusted to the relief and the relief alsoadjusted to the needs of construction and planning (Ahnert 1998). The changes that occur as a result of urban expansion are also influenced by their interaction with the disturbed geomorphological process response systems, such as weathering on building stone resulting from air pollution (Viles 1993) Pareta and Prasad, (2012)).The fast growing towns in Uttarakhand, with changing pattern of houses is causing instability in the hill slopes. Previously the houses constructed with degradable and local materials, which are being, replaced by flats in multistoried building in the unstable slopes in an unplanned manner, which may cause several environmental and socio-economic problems in the near future. The earth surface anthropogenic and technogenic activities in the recent past have led to several geomorphologic and environmental problems. The impact may be short such as waste material or garbage disposal or long terms such as slumping or creeping of land degradation and environmental deterioration. Urban expansion causes problems for the inhabitants. The Almora town of Uttarakhand has a unique geomorphologic and geological setting. It is located on a ridge at the southern edge of the Kumaun hills of the Himalaya range. It is surrounded by thick forests of pine. Flowing alongside the town are rivers of Kosi (Kaushiki), and Suyal (Salmale). The growth of population in the hill town in the past three decades resulting in transformation of natural materials (rocks, soils, vegetation cover etc) into man-smade materials (construction material for houses and roads).due to heavy rainfall in September 2010, the anthropogenic process was carried downslope in the form of slumping, earth flows and debris channels. The crops and field in the nearby villages were damaged, eroded and National Highway connecting the district was destroyed for several days. The villages Bari, Balta and Devli were devastated causing losses to people and properties. Thus, the study highlights the causes and impact of rapid urbanization including the anthropogenic and technogenic processes in Almora town, Kumaun Lesser Himalaya. If not checked properly the situation can worsen in the future and cause a land degradation, environmental hazards and disasters and huge losses to life and property.

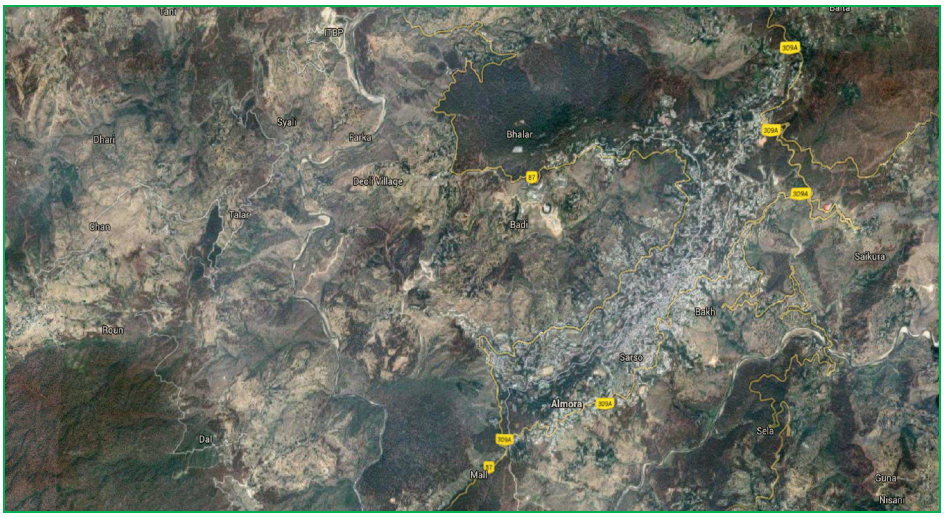

Fig. 1: Google image of Almora Town

1.1 Study Area:

Hill slopes of the Himalayan region are suffering from various degradational processes and environmental problems because of the fast growing town areas. The growth of these towns is mostly unplanned and mismanaged. Keeping in mind the future planning for urban area development, a town from the lesser Himalayan region (i.e. Almora) has been selected for the present study. Almora is a district headquarters in the Kumaun division of Uttarakhand in India. The town falls in the Lesser Himalayan zone of Kumaun Himalaya.

Several attempts have been made to characterize the geological environment of this part of central Himalaya. After the pioneering work of Strachey (1857) and more recently by Valdiya (1979 & 1988) and by Powar (1980) gave a detailed geology of this area.The geological features of the area are presence of Muscovite as dominant clay mineral in the soil. Geologically the town is located on the Almora Nappe of Lesser Himalaya, which is delimited by the north and south Almora thrusts (Pandey, 1985 and Pandey & Rawat, 1990). The rocks are predominantly made up of crystalline rock group and granite rock group (Kumar and Rawat, 1996). It is famous for its cultural heritage, handicraft, nature and wild life. Before its establishment, Katyuri king Baichaldeo possessed the ancient town of Almora. He donated major parts of this land to a Gujarati Brahmin Shri Chand Tiwari. Later on Kalyan Chand founded Chand kingdom at this centrally located place in 1568. During the reign of Chand kings it was known as Rajpur. The name 'Rajpur' is also mentioned over a number of ancient copper plates. Almora town is situated over a horse saddle shaped ridge of a mountain. The eastern portion of ridge is known as 'Talifat' and western one is known as 'Selifat'. The market is at the top of the ridge where these two, Talifat and Selifat jointly terminate. The market is 1.25 miles (2.01 km.) long and covered with stone slabs. The place of the present cantonment was formerly known as Lalmandi. The upper court of Chanda Kings which was known as MallaMahal, presently exists as Collectorate. The site of present district hospital used to be TallaMahal (lower court) of Chand rulers (Pandey, 1993). Major part of the population of the beautiful hill town Almora is situated (lived) in the top of the hill. In the 19th century viewing the beauty of this hill town Mahatma Gandhi said, "In these hills, nature's hospitality eclipses all that man can ever do. The enchanting beauty of the Himalayas, their bracing climate and the soothing green that envelopes you, leave nothing more to be desire the beauty spot of the world. After having been for nearly three weeks in the Almora hills, I am more than ever amazed why our people need to go to Europe in search of health."

Almora town is set on a 6 km. long horse saddle ridge and is extending rapidly in the eastern and western hill slopes. Almora district lies between 29°37′ to 29°62′N and 79°40′ to 79°67′E (Fig. 2). The study town elevated at 1646 meter (5400ft) above the mean sea level. Almora enjoys alpine (BSh) and humid subtropical (Bsh (Koppen)) climatic conditions. The average temperature in summer is 28° -12° centigrade and in winter 15° -2° centigrade. According to census of 2011, total population of Almora town is 33755, while the total population of Almora district is 630567. The density of Almora district was 198 people/ sq. km. as per census 2011 and in 2001 it was 201 people/sq. km. Average literacy rate of Almora in 2011 was 80.47 compared to 73.64 of 2001. According to data for 2001 the ratio was 89.2 and 60.56 respectively male and female. The sex ratio has declined from 1145/1000 to 1139/1000 in between 2001 and 2011.

The objective of the present study is to identify the role of urbanization in transformation of hill slopes. The rapid growth of population in the past two decades resulting in the transformation of natural materials (rocks, soil, vegetation cover etc.,) into man-made materials (construction materials for houses and roads).The rate of input of building material can be estimated through various anthropogenic and technogenic processes in the hill slope of Almora town. The present study aims the Identification and mapping of the area where natural earth surface material is transformed by anthropogenic processes within Almora town. To carryout quantitative assessment of the material removed through different anthropogenic processes (i.e., buildings and roads construction).To analyze the changing patterns of population and environmental problems due to rapid population growth. To find out the impact of anthropogenic transformations of Hill slopes in the selected Ward of Almora town.

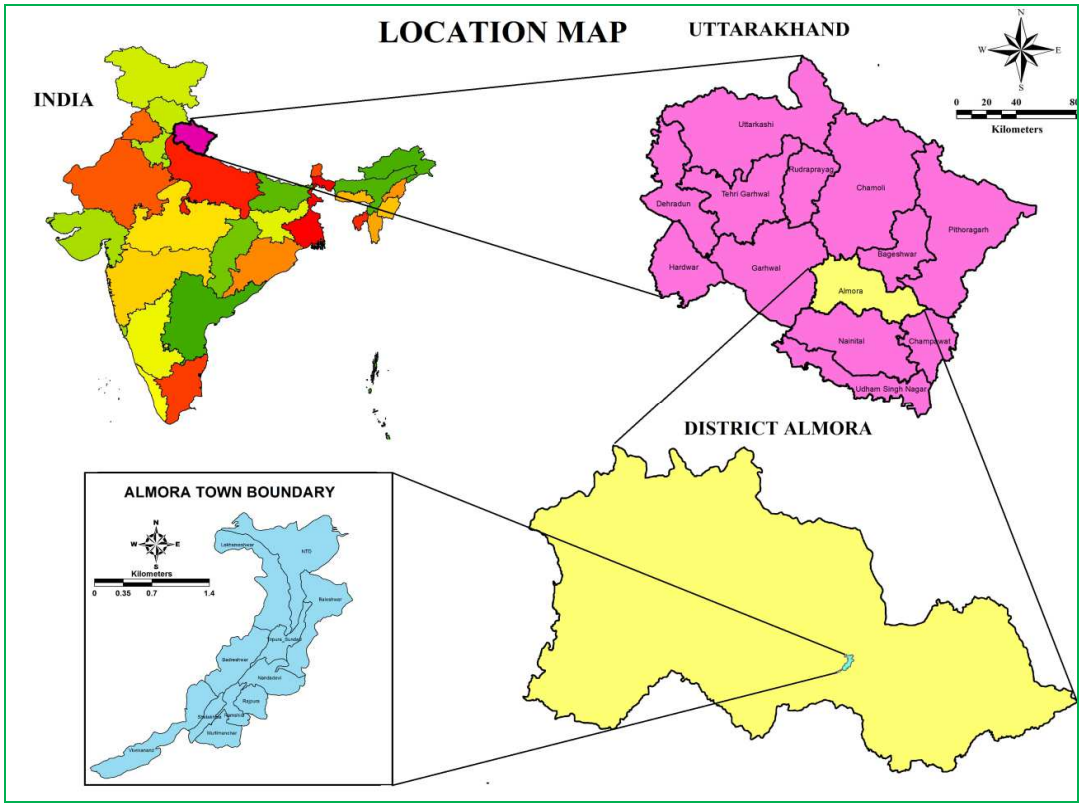

Fig. 2: Location Map of Almora Town

2.0 Materials and Methods:

A survey based study has conducted in Almora town of Uttarakhand. The study has been included both primary and secondary data collection with the help of govt. and non-govt. departments and extensive field observation and measurements. Rajpura Ward was selected as it was the most affected area within Almora town. There are 630 houses in this Ward, out of which around 10% houses have been selected through Random sampling.To find out the impact of the load added through anthropogenic activities carried on in the recent past, detailed field study has been conducted in the study areas. Survey of India topographical sheet (53O/10) was used as base maps for the present study. The construction of houses and road has increase significantly in the past three decades. Data regarding the houses constructed in this period were obtained from Municipality, Almora.Location, extension and detailed information regarding the assessment factors (slopes resistance etc. present and past has been collected through different sources (govt., non-govt., personal contacts)).Preliminary field investigations were complete by selecting the most suitable Ward for the present work.Scheduled method was used for completing the present investigation. Sampling method of data collection was used as required.The output and input of material for the assessment of load added to the slopes was quantified.

3.0 Results and Discussion:

Almora is a hill town of Uttarakhand. The anthropogenic and technogenic activities in the past few decades have changed this beautiful hill town in to a mismanaged urban center. The processes of house and road construction mobilizes large amount of sediment from the slopes and transform the hill slopes (Fig.3, 4). Preliminary field investigation in Almora town indicate that due to the increased phase of human activities (building and road construction) the sediment has been mobilized on

the hill slope in large quantities. The material removed during the process of construction has not been managed properly and may be responsible for the instability of the town area. Almora town has been divided into eleven Ward, which have been listed in table-1. The town area population is not equally distributed among which Baleshwar is the most densely populated ward (i.e., 13.68%) and Sailakhola has the lowest percentage of population (i.e., 4.25%). The population distribution in different wards of the town area suggests that the highly populated wards (i.e., Baleshwar, Rajpura, and Nandadevi) include the oldest settlement area within the town. Vivekenandpuri is the recently developed Ward, represent 7.11 percentage of total population of Almora town (Fig -2). The numbers of houses of Almora town in 1991 was 5198, which increased of 5589 in 2001 and 6171 in 2011 (table 2).

Fig. 3: Building construction and output material (load)

Fig. 4: Building construction and input of materials (load)

Table 1: Population distribution in past three decades (Almora Town)

Sr. No.	Name of Ward	2011	2001	1991
1)	Sailakhola	1437	2655	2128
2)	Ramshila	2259	2667	2224
3)	Badreshwar	3468	2799	2299
4)	N.T.D.	3116	2867	2299
5)	Tripurasundari	2459	2637	2298
6)	Lakshmeshwar	3302	2881	2400
7)	Murlimanohar	2953	2589	2427
8)	Baleshwar	4616	2836	2563
9)	Vivekanandpuri	2401	2666	2411
10)	Rajpura	3907	2733	2446
11)	Nandadevi	3837	2823	2600
Total		33755	30153	26001

Source: municipality of Almora town

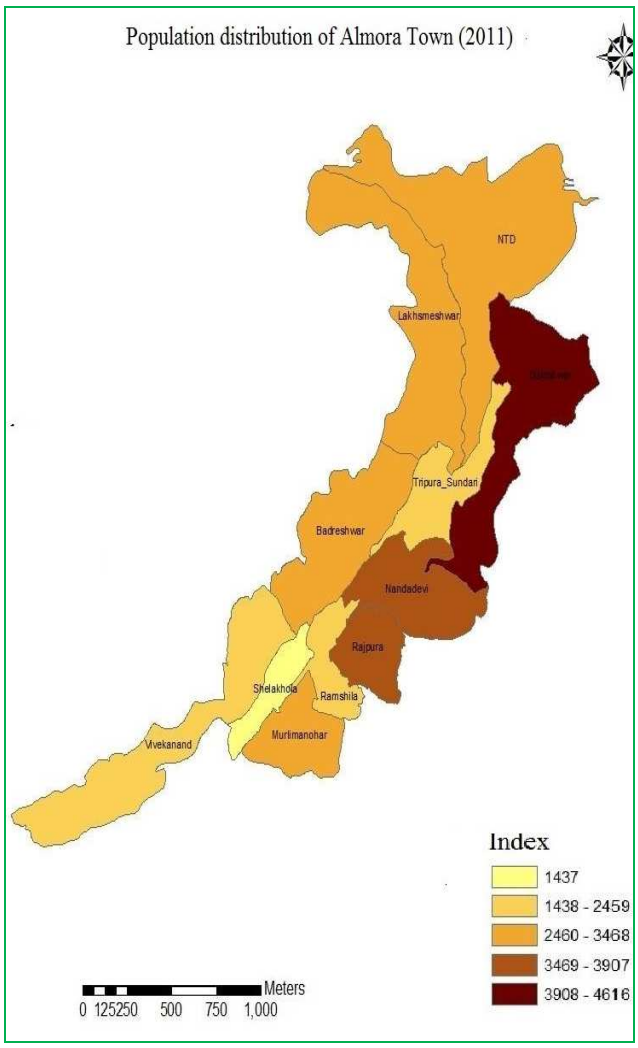

Fig. 5: Population distribution map of Almora Town

Table 2: Total number of houses (Census 2011)

Sr. No.	Name of Ward	Number of Houses
1)	Sailakhola	457
2)	Ramshila	547
3)	Badreshwar	543
4)	N.T.D.	593
5)	Tripurasundari	442
6)	Lakshmeshwar	668
7)	Murlimanohar	475
8)	Baleshwar	616
9)	Vivekanandpuri	539
10.	**Rajpura**	**630**
11.	Nandadevi	661
Total		6171

Source: Municipality of Almora

Table 3: Input and output of material Rajpura ward (Almora town)

Year of Construction	Number of Houses	Output Material (Kg.)	Input Material (Kg.)
1980-1989	4	551960	860500
1990-1999	9	1498680	1575000
2000-2009	22	2256760	2444500
2010-2013	15	2142049	2514550
Total	50	6449449	7394550

Source: Primary data (personal interview)

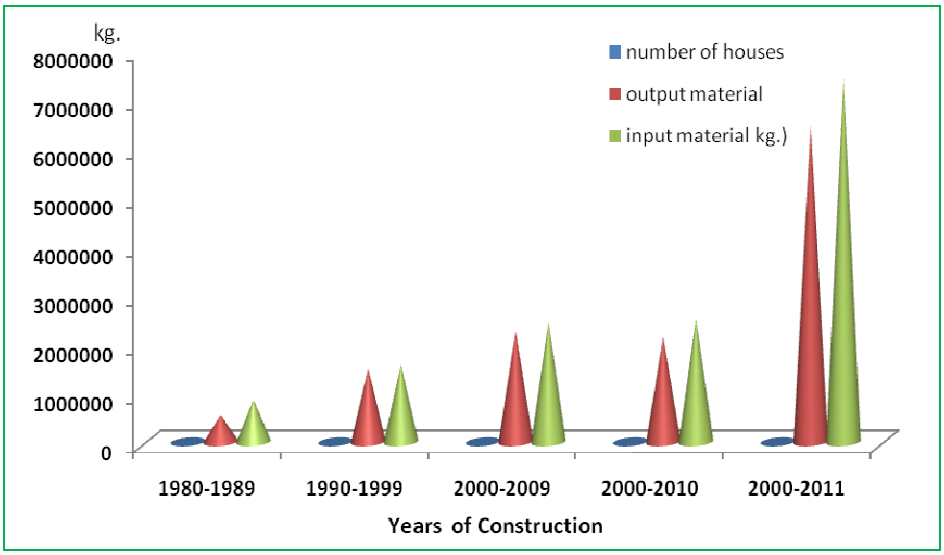

Fig.6: Input and output of material during the construction in Rajpura ward (Almora town)

Fig.7: Mobilized material of building construction (mismanaged)-Karbala

Settlements have increased at rate of 7.52 % in between 2001 to 2011. In the previous two decades, Almora town recorded increase of 18.71% comparedto 1991. Lakshmeshwar, Nandadevi and Rajpura were most affected ward in Almora town. The weight of construction material (output and input material) in the eastern part of the town is lower than the western part of the study area. The difference in between the output material of eastern and western parts is about10 kilogram from 1square feet area.

Rajpura Ward with in town area has been selected for the assessment of the output and input materials of building and house construction. Material removed in the process of building construction has been quantified. The output of material from the selected houses was 50. 6449449 kilogram material has to be mobilized during the construction process in the Rajpura ward. Further, the input (cement, stone, iron, bricks, sand etc.) during the construction process added 7394550 kilogram to the area (table-3). During the process of building construction the material has removed not been managed properly.

Some part of the material has been arranged as kitchen gardens or surroundings of the construction sites, while larger part of this mobilized material has been thrown away in a mismanaged manner in the outskirt of the town areas such Karbala, Falseema and Sikuda band, etc.Fig.-7 shows the material thrown nearby town.

4.0 Conclusion:

In the changing scenario of the fast growing urbanization especially in the developing world, urban landscape and landforms are rapidly being transformed. The transformation has its several aspects, population growth and various degradational processes including anthropogenic and technogenic processes (house and road constructions). Almora town is facing a newly emerged problem of mismanaged and unplanned house construction. This problem has become more dangerous because of material transfer of the hill slope and related environmental hazards. The rapid urbanization in the recent past in the hill towns of Himalayan region is one of the major factors responsible for the accelerated rate of the mobilizing material in the hill slopes of this naturally sensitive region. The polluted urban environment affects the health and quality of life of the urban population. Wherever these transformations are beyond the carrying capacity of land, they become problem for the hill slopes of Almora town. Urbanization has modified the landforms in the selected town in the Himalayas. Building and road construction has played a major role in changing the slope stability and environmental setting of the study area. During the building construction processes the mobilized sediment has been disposed off in the edges of slopes and road sides in an unplanned manner. This material can cause disasters in extreme climatic conditions (i.e. heavy rainstorms) and endogenetic processes (earthquakes of higher magnitudes). Properly planned urbanization can minimize land degradation. Detailed study of such town area (geomorphological and anthropogenic) development can be helpful for future strategy of the urbanization in hill towns.

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