

## **HAPHAZARD GROWTH OF HUMAN HABITATION IN AND AROUND NAINITAL, UTTARAKHAND, INDIA : ECOLOGICALLY UNBALANCED MAN-ENVIRONMENT RELATIONSHIP SCENARIO**

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### **ABSTRACT**

The most recent and visible possible reason for the alarming situation in Nainital and its neighboring areas are; rapidly growing uncontrolled human habitation, haphazard settlement pattern and its continuous expansion and unplanned road construction. The growing population and frequent influx of people from surrounding areas are having potentially serious consequences on the lake. Until recently, one of the main damages caused by haphazard human settlement in the lake area has been illegal deforestation in the densely forested surrounding areas. Illegal encroachment and construction of houses, hotels and shops on large tracts of land around the lake area is damaging the vital elements of the lake. Due to unplanned settlement patterns and land-use modification, the lake has not only been recorded shrinking in its surface area, but its condition has also become eutrophic to a great extent because of the haphazard development of human settlements, more human settlements around the lake. Waste is generated, which eventually finds its way into the lake water. The continuous environmental degradation in the lake area has increased the intensity of environmental stress. The objective of this paper is to assess the past and present settlements in Nainital with respect to the nature of environmental degradation and to evaluate the human activities that are the possible causes of environmental changes in the Nainital lake region. In addition, some remedial measures for city and lake watershed management have also been proposed.

**Key words;** Haphazard Human Habitation, Landscape Transformation, Tourist Influx, Traffic Pressure, Environmental Stress.

### **INTRODUCTION**

Lakes are one of humanity's most important resources especially in the hills where they are often viewed as highly productive biological systems. They provide water for consumption, fishing, irrigation, power generation, transportation, recreation, disposal of wastes, and a variety of other domestic, agricultural, and industrial purposes. Many of the old lakes, described in the Indian records, were developed during the British rule in India. Some of them attracted thousands of

visitors on important religious days. Many of them also had a specific economic significance in the past. All these natural lakes are now facing new challenges because of the fast changes, which are taking place in the surrounding areas and in the society itself. Chemically active runoff from the agricultural fields, unchecked erosion of hillsides in the watershed by encroachment or deforestation, industrial effluents, and city wastes, are causing increased silting and loading of nutrients in the otherwise stable old water bodies, which fared well for a long time in the earlier settings. In spite of the fact that freshwater bodies are very sensitive resources that need proper care and management, they are probably the most abused of resources. Therefore, accelerated degradation of lake environment because of human activity is a concern throughout the world.

In the Himalayan region, human factors, in combination with the physical conditions of climate and geology, may influence water quality to a large extent. Fortunately, Nainital city does not have the industry that flourished in the major developed urban centers and pollutants are not produced in large quantity. However, pollution resulting from human activities, such as land use modification causing environmental degradation, change in lifestyle and other practices associated with rapid population increase, has caused or accelerated many negative changes in and around the Naini Lake. Pressure of the human settlements along its shore and surrounding the lake is one of the main factors contributing to the environmental deterioration of the lake.

In recent years lot of information on the ecology and environment of Kumaun lakes has been obtained which amply support the view that these ecosystems are getting polluted as a result of undesirable human impact (Pande and Singh,1980; Rao et.al.,1982; Pant et. al.,1979,1980; Sharma and Pant, 1979; Sharma et.al.,1982). Nainital Lake is surrounded by a substantial amount of human settlements undoubtedly resulting into relatively more organic and inorganic pollution in this lake. Das (1978,1981) reported Nainital lake to be highly polluted as a result of the release of sewage and human waste in the lake water. The problem of pollution has further aggravated by the seasonal tourist influx. The unchecked growth of urban amenities in the name of development reached on peak since 1950 coupled with a lack of awareness of the relationship between human activities and land use modifications led to the rapid degradation of Lake Environment. However, the considerable achievements in tourism and the rise in life-style of the population were not matched by concern for environmental management.

## **MATERIALS and METHODS**

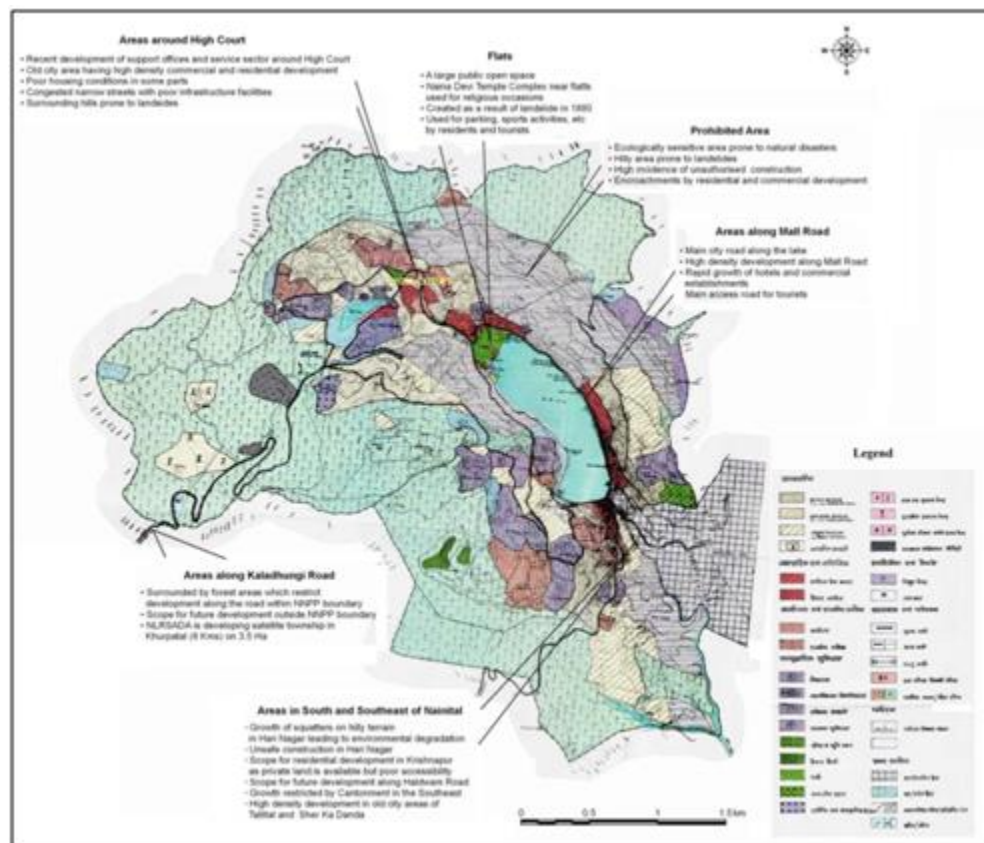
This paper has two major objectives. First, to assess the environmental stress and risk and understand the causes and consequences of degraded environment in and around Nainital regard to haphazard growth of human habitation and suggest conservative measures the local stakeholders can sustain that, and second to underline the changes in physical as well as social

environment due to rapid increase in flow of tourist and heavy traffic, responsible for the degradation of natural and ecological environment in and around Nainital.

Based on observations and data available, this paper tries to evaluate the human activities that are the possible causes of the environmental changes in the lake city Nainital, and to propose some corrective measures of management. Data from recent studies made on this and other lakes as well as recent observations have been used in this paper to evaluate the human activities through supportive figures. Field data is most important part in this study.

### STUDY AREA

Figure 1 Nainital Resource Map (modified from Urban Development Directorate)



Nainital lake region is gifted with a variety of aquatic ecosystems, especially a number of lakes that are of great scientific interest and economic importance in which Lake Nainital is one among the groups of lakes occurring in the southern fringe of the Kumaun lesser Himalaya. Lake Nainital forms a valley like feature at an altitude of 1934m asl extended in 29° 24' N latitude and 78° 28' E longitude. It is a 1.5 Km long crescent-shaped water body located along with the

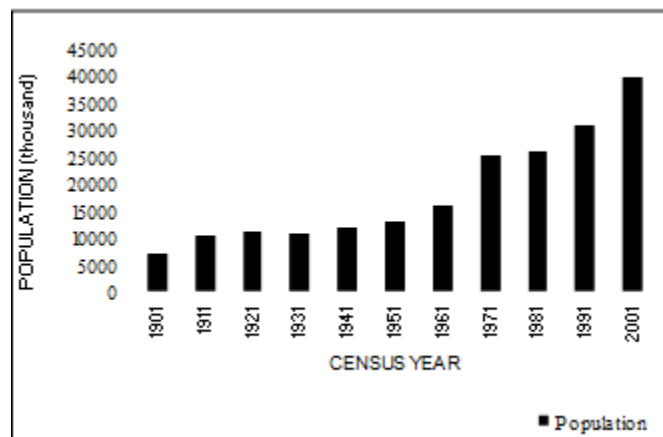
Nainital lake fault. In fact, it lies in a fault line valley. It is the second biggest natural water body of the Kumaun Lesser Himalaya. The surface area of the lake is 120.5 acres and its perimeter is 3560 meters. The greatest length is 1430 mts. and the greatest breadth is 551 mts. Its maximum depth is 28 mts but there is a ridge running across the centre of the lake where the depth is actually 18 metres. In 1871, it had a depth of 29 meters. Within a span of about 120 years, its depth has more or less halved. The lake has a maximum capacity of 1735.60 thousand cubic meters of water (Tripathi, 2005). The hills are unstable and many landslides have caused havoc in the past. New constructions in most of the hills are prohibited yet unauthorized commercial as well as residential construction continued posing danger to the natural environment and the stability of the slopes.

## RESULTS AND DISCUSSIONS

### RAPID EXPANSION AFTER 1950

Almost after the one century in 1960, the Uttar Pradesh government decided not to shift the capital to Nainital during summers, which affected the whole economic structure of the town. In 1965 and 1971, Indo-Pak and Pak-Bangladesh war played a significant role to develop Nainital as major tourist place and regain its economic base as the maximum number of tourists heading to Kashmir shifted Nainital due to the safety purpose.

**Figure 2 Decadal increase in population of Nainital**



Population of Nainital town has tremendously increased during the past few decades. From 1961 to 2001 the population growth rate increased by 22.8 to 28.72. In last five census years the population is almost doubled from 16080 in 1961 to 39840 in 2001 shows the rapid growth of the town (the number temporarily swells during the summer months due to tourist influx). With the growth in population, particularly the municipal population (14995 in 1961 to 38559 in

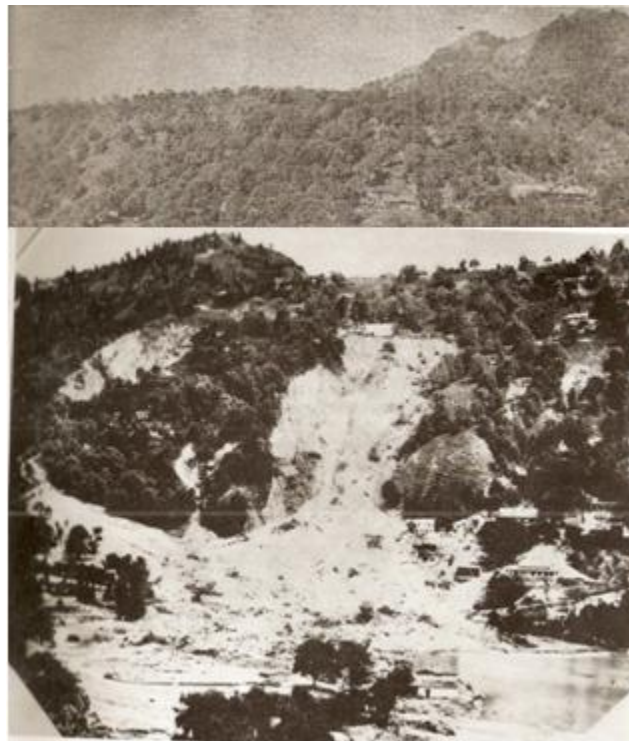
2001), the pressure on the lake and its surroundings as potential settlement areas, has increased. It is assumed that the population will grow at higher rates during 2005 to 2010 due to the initiatives taken for the development of infrastructure of this hill town. In 2003, the floating population (mostly tourist) of Nainital was 4.24 lakhs, which increased to 5.18 lakhs by 2005 recording an increase of 22% over a period of three years.

### **HUMAN INTERFERENCE INDUCED NATURAL DISASTERS**

Whenever human interference reached its peak nature always alarmed the future hazards in form of much catastrophic destruction. *“Any environment under heavy human influence is nevertheless under control of natural structures and process”* (Rapp 1972). As in the case of Nainital during the nineteenth century three diabolic landslides wrecked havoc here. The first landslide occurred in July 1867, when above the west end of mallital market a huge part of the hillside came down.

**Plate 1 (up) Virgin land before 1880 landslide.**

**Plate 2 (down) Nainital 1880 landslide**



The second catastrophe landslide occurred in 18<sup>th</sup> September 1880 which was most tragic and destructive in the entire history of this region when the entire hillside of the Alma Dhar on the

sher-ka-danda ridge collapsed. More than a hundred and 26 years have passed since the major catastrophe of 18<sup>th</sup> September 1880 but no lessons have been taken from it. The cutting of trees and hillside continues unabated and they seem to forget that history can repeat itself as it happened in case of Gohna Lake. This lake is completely wiped out by a landslide. Nature again warned Nainital in 1898 and this time it was in the form of Baliya ravine landslide, a massive part of Kailakhan ridge slid down into the Balia ravine causing temporary choking of the bed of the ravine. The major cause behind this landslide was the percolation of water into the surface layer as very huge amount of seasonal rains fell down during a very short span of time from 9<sup>th</sup> to 17<sup>th</sup> august 1898. A study (Sah and Sah 2011) reveals that presently Cheena peak has perennial source of landslides threatening the very existence of Nainital, due to indiscriminate forest felling. The hill has started caving in and there is a crack about 70 meters in length, 1.5 meters in breadth and 2.5 meters deep on the south-west of the Naina ridge. Today there lurks the danger of a landslide, which may engulf the houses down below.

## **PART II : SITUATION ANALYSIS**

**Plate3 Heavy built up area along the hill side showing change in natural landscape**



**Plate4 Uncontrolled haphazard development towards higher altitude**



Man has been the most active agents in modifying the face of the earth and transforming the landscape according to their own interests into human conditions. The diverse human activities results into the transformation of the natural landscape into cultural environment. The dominant feature of cultural landscape i.e. human habitation is the physical expansion of man's presence.

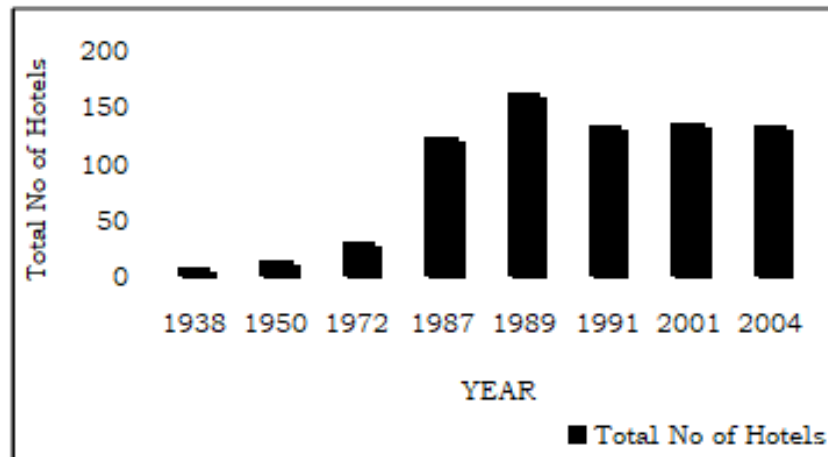
The topography of the Nainital town has defined the different stages of living conditions. People first settled around lake, and then extended their habitat towards hills. Earlier very few peoples were inhabited in this area due to the different topography and varied landform, which have developed the conditions and environment for the sustainability of the traditional living pattern. The present landscape are in fact , the product of constantly changing process which is conditioned and modified by the ever changing natural, socio-economic, cultural and ecological circumstances of the area. The formation of markets has developed squares at the junction; streets have been built. Al these morphological changes have attracted more number of people to settle in the area as it provided the economic base. The regular increase in population has led to the transformation of the area into settlement. Many buildings were constructed in different parts of Nainital to accommodate various kinds of administrative, recreational and religious activities besides residential colonies. People started occupying all type of land and converted them into livable areas haphazardly. These haphazard growth patterns has spoiled the overall character of the site and caused severe environmental degradations. This process of habitation was preceded further and in the first priority the lake surroundings and the lower parts of the hills was occupied for the construction of more number of dwelling units. This process was further expanded and it led to the transformation of lower area of the hills in dense human habitation. This has directed the growth of the habitation area in the upward direction (plate 3 and 4). Many new stone houses and modern hotels are coming up and constructed along the lake periphery, which has changed the landscape and environment of the area. Such stone houses hotels, lodges and resorts are replacing the once verdant forest and fertile land.

Human settlement in close proximity to the Nainital Lake is among the greatest potential causes of changes in water quality and quantity. The growing population and haphazard human habitation in the town can have potentially serious consequence on the lake. Domestic and industrial wastes may find ways into the lakes.

The illegal encroachment and reclamation of huge tracts surrounding the lake area in the form of houses, hotels and shop site constructions are eating the vitals of the lake itself. Pressure of the human settlements along its shore and surrounding the lake is one of the main factors contributing to the environmental deterioration of the lake. The lake is dying under the increased human impacts in its drainage basin. The condition of the lake in the immediate vicinity of sewage out falls, because of human habitation, has reached a critical stage from the point of existence of the lake. This lake is a hotspot of biodiversity and a unique ecosystem, which shall

be reduced to a shambles if heavy, and unplanned construction of private, government buildings, resorts and roads etc. are implemented on the eco-fragile ridges and forested slopes. The damage will be permanent and a renewable natural resources base will be lost forever.

**Figure 3 Increases in the total no of hotels in Nainital**



In recent years, the great rush of migrated and floating population to Nainital and heavy urbanization along with the burden of local residents has experienced the rise of multistoried hotels almost after two three buildings , particularly on mall road and on the Sher-Ka-Danda ridge. A huge government complex is under construction on the way of Hanumangarh area and other is in the premises of Uttarakhand High Court. It is not a proper decision because the entire area is situated on the most effective seismic zone where heavy constructions are not permitted. The Nainital hill encompasses a rock succession that includes granites and the sediments and have thrust over shivaliks along the main boundary thrust (MBT). The MBT is tectonically very active and is manifested in large-scale hillside instability in the region (Valdiya 1988).

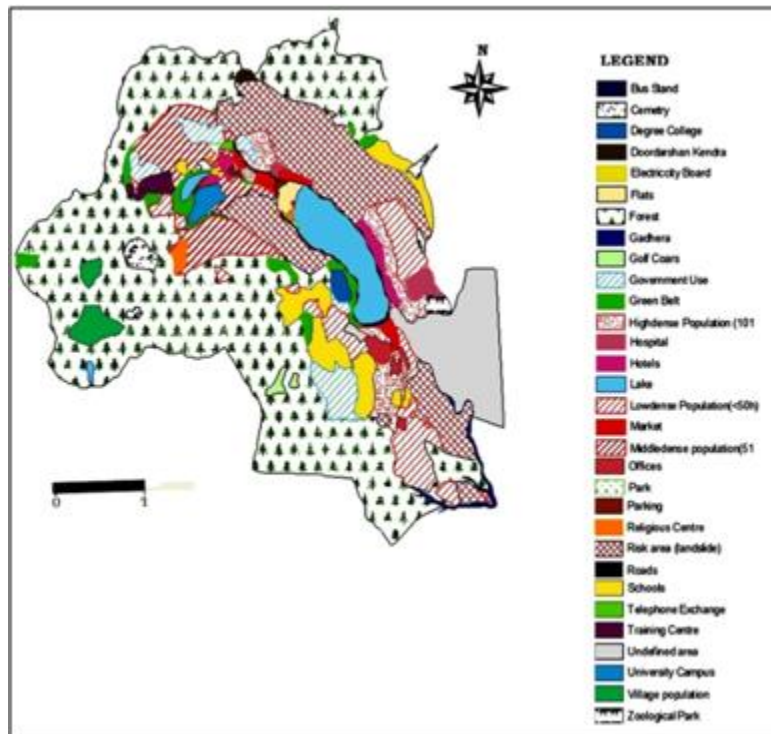
Building contractors in an attempt to make quick profits are violating the norms, rules and regulations by erecting multistoried apartments and people are investing money to purchase flats besides thinking of the future risk of subsidence of the area. Due to such activities, Nainital town is becoming overcrowded, facing acute environmental problems. With the growth of tourism, the number of hotels, restaurants and cafeterias are undergone a phenomenal increase.

Due to overcrowding and poor sanitation facilities, garbage spread laterally on the east and west end of the lake and pollutes the natural lake water (plate 5 and 6).Individually, waste discharges may appear insignificant, certainly in comparison with the volume of the lake , but the cumulative effects must be appreciated. The haphazard growth of dwellings on the unstable slopes has resulted into rapid soil erosion, many noticeable ravines and gullies are developed



during rainy season, and erosion is found to be severe. The eroded materials are finally deposited in lake. Thus, the capacity of the lake is getting/being gradually reduced.

**Figure 4 Nainital urban land-use (modified from Nainital Development Authority)**



### VEGETATION REMOVAL AND LAKE LEVEL VARIATION

The area of today's Nainital was covered with dense forests in the past (plate 1). This has protected the underground water level of the area. In addition, the overall ecological balance was maintained due to this dense forest cover. Often the previously peripheral, forested areas became parts of holiday homes, resorts, rest houses and an urbanized holiday belt was developed around the lake. The rapid increase in land demand for human habitation and developmental process has caused severe changes in the landform of this area. The average rainfall density of the area got reduced due to the deforestation in the hill slopes and surrounding the lake. Gradually the water level of the lake started falling due to the decreasing rain fall density and increasing water demand due to increase in human resources.

Due to various construction activities in the town for accommodating increasing population, a vast area of forest has been cleared off. The forest areas were converted into the habitation lands (plate 3 and 4 ). Peoples', Builders and contractors have felled numerous trees and leveled the earth for the construction of township and resort, on the hill slopes surrounding the Nainital lake

and thus threatening the ecological balance necessary for the survival of the human beings, animals and other organisms. The rich forested slopes have been converted into barren rocks in the name of developmental activities like the construction of roads, hotels, tourist rest centers etc. Multistoried concrete buildings for hotels, is a common sight in Nainital. The buildings and hotels emerging rapidly on the fringe of lake are increasingly polluting them. The hill slopes encircling lakes were earlier densely forested but are now barren. The increase in forest felling has furthermore increased the risks for soil erosion and land degradation. The surrounding barren hills are reducing their water holding capacity through accelerated silt loads. Thus, the catchment area is also being destroyed reducing annual recharging capacity. The increased demand for timber for building tourist as well as private and government complexes and fitting them out with furniture also makes huge demands on the already depleted forest resources of the area, thereby accelerating the deforestation and its related soil erosion and water shortage problems.

**Plate 5 All the tourist and shop waste are dumped directly in the lake and finally find their way into the lake waters**



The land use changes can, however favour more rapid sediment and silt flow during the rainy season and increase the filling rate of the lake, especially after heavy rainfall and a recharge of the ground water resources. The bathymetrical analysis of the Naini Tal (Khanka and Jalal 1984, Rawat 1987) reveals that its capacity has considerably decreased in the last 84 years from 31,699m<sup>3</sup> in 1895 to 26,205m<sup>3</sup> in 1979. Thus a reduction of 5494m<sup>3</sup> in 84 years, attributable to being filled with silt and mud. At an average rate of 65.37m<sup>3</sup>/year the sediment load is accumulated in the lake since 1895 (Rawat, 1987) while Hukku et al. (1974) had given 350 years based on the sediment input into the lake. Pande et al. (1980) discussed the bathymetric

characteristics of Naini lake in his paper, which indicates that the greatest depth of Naini Lake was 27.45m in 1889 and 26.75m in 1979. He further calculated the lake capacity which has been reduced to 6808.40 thousand cubic meters in 1969 from 7425.20 thousand cubic meters in 1889.

The major cause behind this drastic reduction in the axial extent of deeper part is mainly due to the constant filling by silt in the lake bottom and secondly development of lake fans at the mouth of streams draining from the surrounding slopes. An another study reveals the average sedimentation rate in Nainital lake which is around 0.75 cm/yr and further calculated the area weighted average rate of sediment accumulation in Nainital lake which is approximately  $3715 \pm 400 \text{ m}^3/\text{yr}$  (Kumar et al. 2005). The result reveals that the maximum rate of sedimentation is found near the entrance of main drain of the Lake Catchment and minimum rate in the middle zone of the lake. The variation in sedimentation rate within the lake depends upon the inflow from the different parts of the lake. A recent study (Rai et al. 2005) carried out in the Kumaun lakes indicates that the increasing population in the Naini lake catchment has accelerated the nutrient loading in the lake and thus the lake has reached in hyper eutrophic stage in past few decades. Once eutrophication has taken place in a lake, recovery requires a long period of time because nutrient levels are maintained by internal recycling and despite the lowering of nutrient concentrations, increasing water consumption means that limits on the total volume of pollutants may need to be introduced.

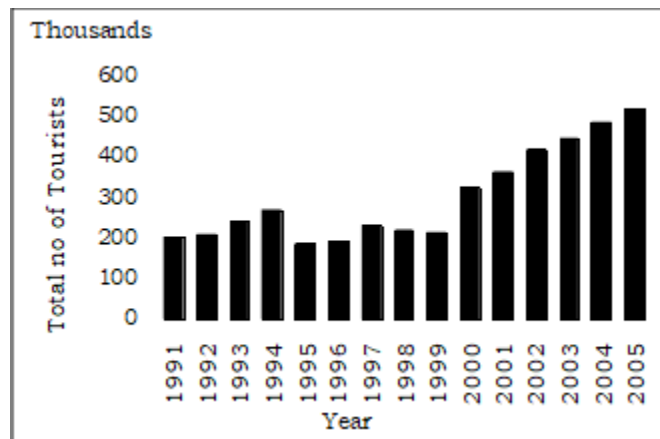
**Plate 6 Mouth of a major untreated drain discharged effluents into the lake directly;**



Over the last 25 years or so alarm bells has been sounding over the looming water shortage in the lake region of Nainital and surrounding east and west areas (Ranibagh/Kathgodam/Haldwani). Studies have proved constantly that the ground water levels have fallen very sharply in the lake

region and many springs, streams (all tributaries to the Gaula River) have dried up or have been reduced to mere trickles. The situation is worsening and will soon reach a point of no return.

**Figure 5 Total tourist arrivals in Nainital**



The Nainital lake has acted as a sedimentation basin as indicated by the large debris fans and growing deltas (Plate 5) the town site were planned without taking the environmental hazards into account in spite of the clear geomorphic indicators of past landslides. Due to the removing of the earth, various deltas have been formed in the lake as the earth is flowing from the hills to the lakes (plate5 and 6). No attempt whatsoever has been made to stop the causes of siltation and now human and organic pollution, the latter due to open bazaar drains and uncontrollable garbage and waste from the roadside mushrooming shops, restaurants, recreation centers and hotels. Sewage systems are still not installed widely over here and untreated and partially treated effluents are discharged into the lake directly. Filthy row of shops and eating-houses right above the slope along the right side of the lake ensures that all the tourist and shop waste goes directly into the lake waters.

### **SEASONAL TOURIST INFLUX**

Lake Nainital is of high importance in Uttarakhand tourism. With the development of tourism as the point of business, unauthorized hotels have flourished which ironically posing damages, particularly to the lake situated within the city. Number of tourists visiting Nainital has tremendously increased in last few years (Figure 5). With the increasing tourist inflow, the number of hotels restaurants has increased which is greatly adding to the environmental destruction around lake area. They are major pollutants as they directly let out their refuse together with human waste into the lake. Figure 5 gives important information regarding the seasonal tourist influx flooding Nainital. Approximately, during the last 10 years, some of 3.34 million tourist visited Nainital.

It has been observed that with the exception of 1995, 1996, 1998 and 1999, all the years registered increase in the number of tourists. In reality the number of visitors has been growing uncontrollably and the development of the infrastructure has not been able to keep up with the growing popularity of the lake, leading to crowd and traffic problems in the season as well as otherwise, and a deteriorating image in general. Taking the tourist population of 2005 (5.18 lakhs) as the base, the average days of stay per tourist as 15 the average tourist load per day works out to 34,533. The educational institutions, training institutions and the university together account for approximately 16,000 population. The estimated number of population visits the town for official business is around 5000. Thus, the total number of floating population in Nainital town works out to 56,000 in 2005 (CDP, 2007).

### **ROAD CONSTRUCTION and TRAFFIC PRESSURE**

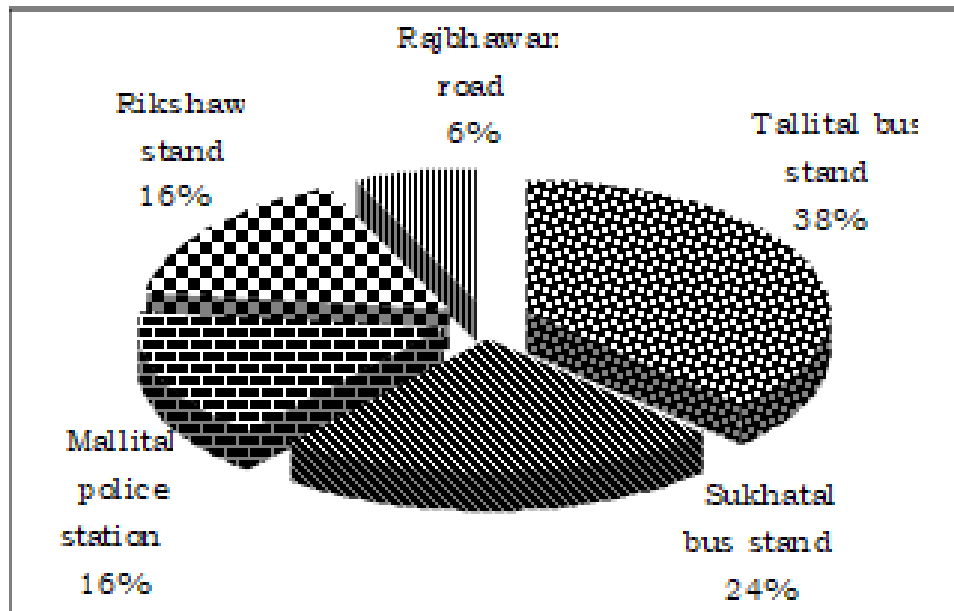
Inadequate existing road infrastructure to carry heavy vehicles, traffic congestion, lack of adequate parking areas, insufficient space for parking of government and private buses in bus stand and lack of public transport facilities are the major problems faced by Nainital. Construction of roads has obstructed the free flow of water, causing the lake to stagnate. The Road that have come along the periphery of the lake to meet the ever increasing number of tourist visiting Nainital, has led to an alarming increase in the amount of silt that flows into the lake. The unplanned road construction and excessive movement of automobiles are addictive factors to the problem of environmental degradation, which cause insurmountable damage especially to the roadside vegetation and silt and sediment flow direct into the lake.

**Plate 7 Traffic congestion during peak summer season in Nainital**



The main road of small-township is highly congested during the main tourist season, and opening of the schools and the number of vehicles passed through the main roads (mall road and governor’s house road) varies from 314 to 502 a day (Figure 6).

**Figure 6 Traffic density on major routes in nainital**

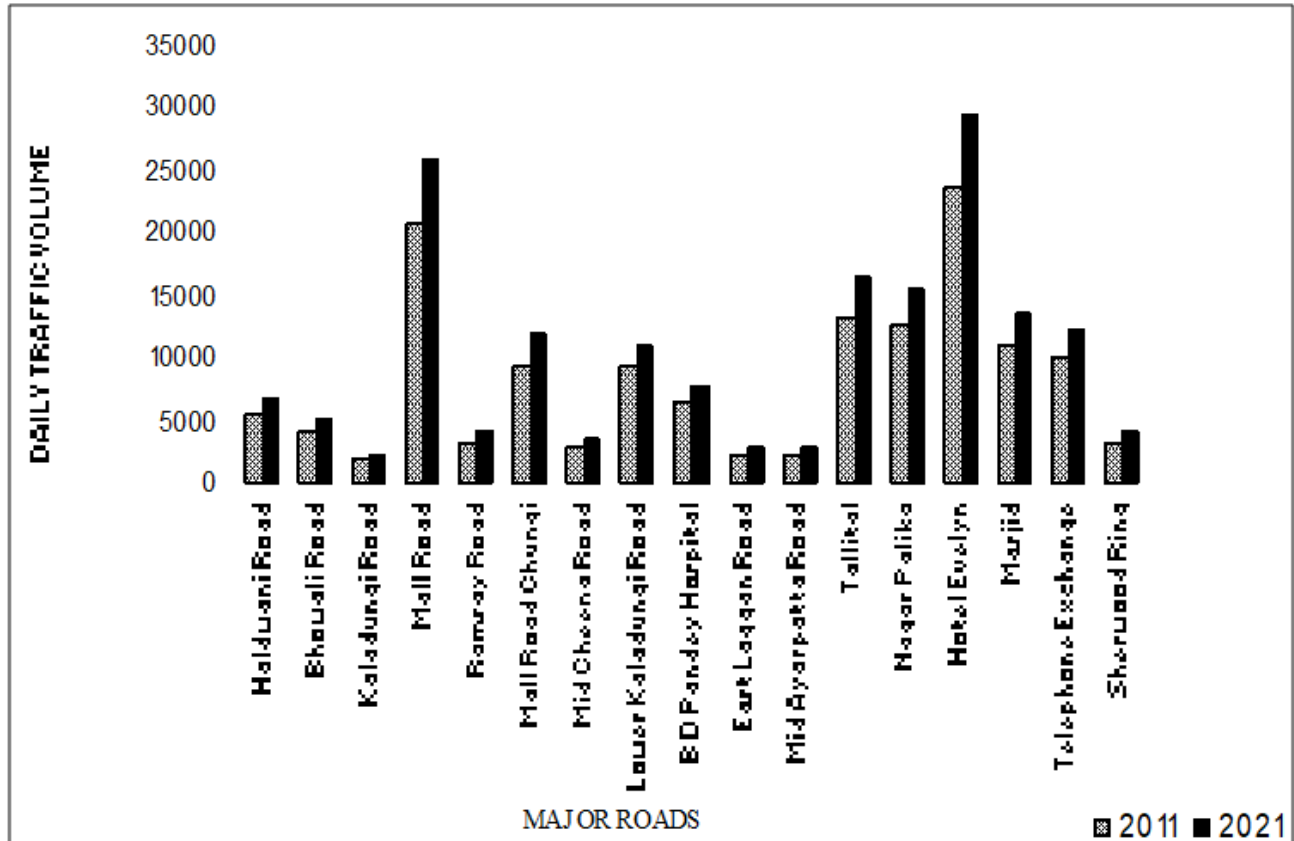


The location of the bus stand just the entrance of the town also creates problems for the local and tourist population. However, the space cannot be extended due to haphazard mushrooming of shops, buildings, and gutakha–pan–tobacco dhables (modern kind of thatched roofing of small shopping huts) around it, but the site could be shifted outside the township to minimize congestion and pollution near lake.

The road going to High-Court from Mallital Fields has witnessed unprecedented slummification despite the State Government laws. With the increase in tourist and local population, the number of vehicles is increasing year by year. In 2001 the estimated motor vehicles in Nainital was 3,650. The floating population in the town in comparison to its population is very high. Same in the case of vehicular traffic flow, which is also very high (Plate7), and so the congestion and traffic pressure will become a very big problem in near future (Figure 7).

Inadequate width of the road, encroachments, unplanned on-street parking, traffic heterogeneity, pedestrian flow, lack of traffic signals, improper turning of traffic, road making, lack of enforcement of traffic rules, poor road geometrics, inadequate side protection barriers are all present there in the Nainital.

**Figure 7 Decadal differences in existing and projected traffic volumes in Nainital**



### REMEDIAL STEPS

In the face of the growing population, intensified land use, and the associated settlement network discussed in this paper, immediate actions have to be taken to change the present approach of land utilization and mismanagement. Serious ecological crisis is inevitable if corrective measures are not taken to reduce lake erosion. It is clear that many environmental problems arise from the process of development itself. Therefore, although all the development programs that the country is planning to carry out appear to be indispensable, their ecological impacts should be considered before any of the development programs are launched; and their negative impacts should be minimized where and when possible. Increased emphasis should be placed on preventive planning based on environmental impact assessment.

- i. The need is only for a careful environmental management.
- ii. Some hard decisions at government level should be taken up to achieve the real objective of a healthy and protected environment.

- iii. A few other spots may be developed for alternative tourist resort, providing better amenities in less developed tourist spot to reduce the concentration of tourists in the peak tourist season.
- iv. Any development plan particularly for hill stations should be adopted an eye on the security and safety of the entire landscape.
- v. The hill slopes facing the lake should be reforested if Nainital has to really survive as tourist centre for long, in future. The lake, also the source of drinking water for city inhabitants are already falling short to meet the domestic as well as seasonal extra needs and in near future water will become a big problem , if not a rare commodity .
- vi. Parking facilities near the main tourist spots need improvement.
- vii. To preserve the environment, if some restrictions are not imposed on the construction of buildings at the cost of forest –land, the whole area is likely to be transformed into small cement concrete jungle.
- viii. Efforts should now be made not to increase the volume of tourist traffic but to improve the quality of environment so that it does not lose its charm any further.
- ix. There is a need to take necessary precautions to check the entry of sediments into the lake by putting some suitable barriers at the inflow points and then regular removal of the sediment deposited at the barrier sites.
- x. The mushrooming growth of restaurants and hotels has to be checked.
- xi. The human settlements need to be planned.
- xii. The construction of transport routes, particularly in the ecologically fragile hilly areas, should be carefully planned.
- xiii. Both the inhabitants and the government establishments should be equally concerned for lake management. Active participation of the inhabitants who contribute to the damage of the catchments is especially desirable in lake management.
- xiv. Enforcing compliance with environmental and economic regulation would limit the personal freedom of residents as well as hotelier’s in many ways: e.g. when building a house, hotel, shop, or resorts, they should meet the existing rules concerning the size, height, style, structure of new buildings.



## **CONCLUSIONS**

The increasing unauthorized encroachments of settlements, hotels, rest houses etc. during recent past might have encouraged land use modification, which, from an environmental point of view, have been disastrous. The recent changes of land use to uncontrolled unplanned settlement construction may have changed the runoff and sediment production. Cutting down the lake and hillside forests has reduced the natural sedimentation trap for the lake as well as the water retention capacity for the region. Man-induced changes are often slow to become detectable and when these changes are not anticipated once the problem has become apparent, the costs of management are often very large: the restoration of the damaged ecosystem to its former natural state may be impossible. From this discussion, following conclusion can be drawn regarding man-environment impact within the lake area of Nainital.

First haphazard human habitation initiated environmental degradation within the study region. The control of waste discharges required land-use controls and, most importantly, the participation of an informed people to undertake individual and community actions to mitigate immediate problems. Local opinion favored the idea that the land use modification and an increased siltation have reduced the Naini lake storage capacity and caused the water shortage in the study region. In order to obtain a sustainable development of an area like Nainital there is certainly a need for an understanding of natural structures and processes.

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