

## SLAYING THE BEAUTY OF NAINI LAKE: A GEOGRAPHICAL AND ENVIRONMENTAL PERSPECTIVE

**Manisha Tripathi**

Department Of Geography  
Kumaun University, Nainital-263001  
Uttaranchal, India  
(E-mail: shuchimanisha@rediffmail.com)

### ABSTRACT

Naini Tal the tourist paradise represents the Kumaun hill environment in all its richness and diversity- physical, social, economic and cultural and with all the attending characteristics like the pride of the hill people in being *Kumaunies* the wide gamut of hill fauna and flora as also the natural calamities associated with Himalaya, the young mountain of the world. This popular hill resort of Northern India is the source of attraction due to its natural *Naini Lake* unfortunately its condition is deteriorating every day. The economic and social activities of this area has increased tremendously. Naini Tal has been developed mainly as an Administrative town instead of a major tourist center which it really deserves. Owing to these activities at Naini Tal proper natural environmental balance of the area got disrupted.

There is no denying of the fact that Naini Lake is fallen victim to human greed, as a result of which the entire ecosystem is rapidly changing. With the increase in the tourist influx a large number of residential buildings and hotels have come up along the lake front. Naini Tal lake is the only source of drinking water for the local people. Investigations carried out in the lake area reported that the water quality is harmful for human as well as animal consumption. A number of human activities such as land reclamation, encroachments, growth of authorized, unauthorized and disorderly human habitation and construction of restaurants and guest houses for tourists around the lake periphery have contributed to its pollution and resulted further deterioration of the lake water quality. The thermal behavior of the lake water is also get modified with the raising of the lake bottom. Development of urban activities on the slope and surrounding area have increased the sedimentation rate and lake is under accelerated *silting* and *eutrophication*. If this state of affairs continues the lake may reduce to half of its present status, which is not- too distant future.

This is not an easy task to assess the present stress from Urbanization, so called developmental activities and human interferences in the lake area. An attempt has, therefore, been made in the present paper to record the environmental degradation in and around the lake region. The paper also focuses certain geographical aspects of the Naini Tal and geomorphological evolution of the Naini lake in brief. The situation today is alarming and calls for immediate adoption of an integrated approach to solve the lake problems, so that *Natural Beauty* may remain truly natural.

## **INTRODUCTION**

P. Baron who discovered the Naini Lake in 1839 described the beauty of Lake "A Lake one and a half miles in length and three fourth of a mile breadth wise containing crystal clear water. A beautiful brook joined in after collecting water from hills and another brook rushed out of it from the lower end." Graceful willows encircle the emerald-colored lake. But today there is no brook and the crystal clearness of the water has been swallowed by the effluents of the town turning it into a dull blackish green unattractive pool. The level of the lake has gone a few feet.

The Himalayan region is admitted a fragile zone both from the environment as well as ecological point of view. The region is subject to periodic earthquakes and seismic phenomena. Studies reveal that the forest and vegetation covers have deteriorated, Soil erosion is on the increase, and water regimes are under stress. The process of development itself has unfortunately given rise to a great number of negativities. There has been over exploitation of Natural Resources like land-biomass, water, forest etc., to the detriment of both the people of the region and their resource bases.

## **PURPOSE OF THE STUDY**

The main purpose of this paper is to assess the nature and range of problems associated with the lake and the impact of those burning problems on the mass, who are knowingly or unknowingly dependent on the lake, because the whole phenomena is now in a continued state of stress and degeneration.

## **KUMAUN HIMALAYA**

Kumaun Himalaya stretches between 29<sup>0</sup>5' N to 31<sup>0</sup>25' N latitudes and 77<sup>0</sup>48' to 81<sup>0</sup>0' longitudes. Kumaun derives its name from the word Kurmanchal meaning tortoise mountain. Administratively it comprises of six districts - Nainital, Almora, Pithoragarh, Udham Singh Nagar, Champawat and Bageshwar. The landforms of the Kumaun Region varies from 600m (9.9%) at the hill tract (almost the level of plains) to 7000m (90.1%) along the perpetually snow covered peaks of the high ranges of Himalaya. The Kumaun region is the land of snow clad mountain peaks fast flowing waters, placid lakes terraced fields clinging to steep mountain slopes from small villages. Majority of the hilly areas is clothed with dense forests ranging from sal forests in the south to alpine meadows just below the snow line in the north.

The physical setting of Kumaun region has defined the diverse cultural identity. The Kumaun Himalayan region is divided into the five physiographic divisions viz: Sub Montane Zone (Tarai, Bhabar & Dun), Shiwalik Hills or outer Himalayan Zone, Lower Himalayan Zone, Main Himalayan Zone and Trans Himalayan Zone. The physical setting of Nainital district in the Kumaun region lies in the sub-montane zone and the lower Himalaya Zone. The Geology of this Himalayan Zone is named as Krol formation. This is a well developed rock formation, made of limestone, shales, gypsum etc. A Narrow 25km. long and 4km wide belt in Nainital Distt near the outer fringe of the lesser Himalaya, close to the Main Boundary Thrust (MBT), lie a large number of small lakes of which Nainital Lake is the largest. The Kumaun lakes need

no introduction, much has already been written of their scenic value and their similarity to parts of Scotland and Switzerland. Large number of people got attracted towards this region due to its natural beauty and easy availability of natural resources. This has enforced extra pressures on the natural resources of this region. The Kumaun lakes Nainital, Bhimtal, Naukuchiayatal, Sattal, Punatal, Malwatal, Sariatal, Sukhatal and Khurpatal comprise today a group of lakes laying in the belt 24 km long and 3.2 km broad, in the outer Himalaya. Each year, tourists flock to this area, more so, during the summers to escape the scorching heat of the plains and plateau. Historically the lakes located at various parts of the region were the prime source of water, but gradually the water level of these lakes started falling due to the decreasing rainfall density and increasing water demand by people. The haphazard growth pattern has spoiled the overall character of the site and has caused severe climatic disasters, such as drying and shrinking of the lakes.

### **NAINI TAL: THE LAKE DISTRICT**

Nainital, in many ways, is not a typical hill district in the sense that its area does not include only hilly terrains and valleys. Geographically it is far more complex in as much as it includes distinct and different types of regions, namely the hilly areas, the bhabar, the tarai and the alluvial plains below. It is comparatively much more urbanized than other hill districts of Uttaranchal. Demographically it has become a high growth region with both in-migration and out-migration in different proportions characterizing it. It is a district, where the tourist concentrations are high and growing, and posses seasonally.

The elevation of the region varies from 1073 m to 2626 m. The hill of Naina Peak (Cheena Peak) marks the highest point (2610 m). Other prominent peaks are those of Lariakanta (2481 m), Ayarpata (2352 m) and Deopatha (2434 m). Nainital is situated in a valley running from west to east and bounded by the peak of Cheena (2611metres), continued by Alma (2270m) and Sher-ka-Danda (2217m) to the eastern extremity. On the west, is the rugged hill of Deopata (2273 m) and on the south Ayarpata attains an elevation of 2235 metres diminishing gradually towards the east.

Nainital district lies between latitude 28<sup>o</sup>43' and 29<sup>o</sup> 77' and a longitude of 73<sup>o</sup> 43' and 80<sup>o</sup> 10' E. The northern portion of the district is a part of the outer ranges of Himalaya with slopes towards south and south-west. The hilly portion of the district largely falls in the Middle/Lesser Himalaya, between the valleys and the Shiwalik ranges on the south and the Greater Himalaya in the north separated from the two zones by the Main Boundary Thrust (MBT) and the Main Central Thrust (MCT). The general elevation of the mountainous part of the district has an elevation of 1981 metre. The Kumaun Bhabar is wedged between the foothills on the north and Tarai on the south. About 120 kms long and 13 to 26 kms wide, this tract covers an area of over 2400 sq kms. This area has no major streams or rivers except Kosi and Gaula. The tarai area extends from sharda in the east to tehsil Kashipur in the west with an average width of about 19 kms. - North to south. The south-western portion of the Nainital district mainly Kashipur sub-division is alluvial plain area.

In the entire area the climate is controlled by the diverse topographic features and presence of the lakes. The basic pattern of weather and climate of the lake area is governed by the monsoon. Nainital district can be broadly divided two climatic zones one is the sub-tropical zone (Bhabar and Tarai zone below an altitude of 600m.) and other is the cool temperature

zone between 600-2500m. The areas between 600mt 1200mts are moist in the case of outer hills or sub-tropical valleys. The inner hills between 1000-2500 metres are dry. The mean annual temperature at Nainital ranges between 8°C in January and 20°C in June. June is the hottest month (20.6°C) at Nainital. By mid June generally showers and thunderstorms followed by rainfall and hails bring a temporary relief from the scorching heat while in the month of May, weather is dry with a very low relative humidity. July, August and September are the rainiest month in the year and record a good amount of rainfall. The rainy season receives more than 75% to 80% of the total annual rainfall, which generally ranges between 200cm to 250cm. The main characteristic feature of the weather conditions in the month of October are pleasant breeze and clear sky, with mean monthly temperature 13.9°C which decreases by 2.5°C in the month of Nov. and further fall recorded in December (2.3°C) with less warm day and cooler night. The daily range of temperature begins to rise in February (0.1°C to 2.9°C) and March (2.7°C to 5.8°C). January is the coldest month of the year with 5.7°C temperature. Winter snowfall is common on above 1800m altitude. The hydrology of the area is an integrated three-tire system based on the architecture of the district physiography. In the Middle Himalayan hilly tracts the surplus surface water transported to Shiwalik hills and Bhabar area, which absorbs all the local precipitation due to high porosity and transports the same to be still lower tarai areas by gravity pull. In the bhabar area as the accumulation occurs at great depth it is uneconomic to utilize it.

## **DESCRIPTION OF THE LAKE**

Nainital Lake forms a valley like feature at an altitude of 1934 m. 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 lesser Himalaya. The lake has a catchment area of 5.85 km including Sukhatal. The superficial area of the lake is 120.5 acres and its perimeter is 3560 metres. The greatest length is 1400 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. The surface of the lake is 1938 mts above sea level. In 1871 it had a depth of 29 metres which is now only about 16 metres. Within a span of about 120 years its depth has more or less halved.

## **Evolution of the Lake**

There are numbers of Natural lakes in Kumaun but the chief in size and importance occurs in district Nainital along a Geological formation known as the Krol Nappe. The Nainital massif is a mosaic of blocks that have moved up, down and side ways. No wonders the rocks are in much weakened state, very vulnerable to the onslaughts of rain and human activities (Valdiya 1980). The Sher-ka-danda and Ayarpata ridge are synclinal hills while the Nainital lake occupies the faulted anticline valley thus implying inverted topography as a result of deep erosion. Number of horsts and grabans formed as a result of vertical movement along the transverse faults. Study revealed that the vertical movement was rotational - (20m in the south east to 80-200m in the North West) leading to blocking of the perennial stream and birth of the Naini Lake. Another study revealed that as a result of faulting a number of small scarps and depressions have developed in the lake basin. The Nainital fault is responsible for formation of the Naini Lake.

There are a number of views regarding Kumaun lakes origin; "Strachey" was the first to refer to these Lakes in Geological literature in 1851. H.F. Blanford writing in 1877 and Theobald writing in 1880 favored the glacial theory, while Ball (1878) strongly disagreed with the glacial concept and referred to denudation on and landslip as the possible agencies for the formation of these lakes. Oldham (1880) also favored the land slip theory, which receives some support from the formation of the large Gohna Lake in the Central Garhwal district by a landslip in 1893. While the moraine materials are not available in the area, hence glacial origin of the lake is difficult to conceive. Middlemiss (1890) however suspected differential earth movement along a fault while Griesbach (1891) postulated sagging with contemporaneous folding as the chief causes of the origin of the lakes. The idea of lake origin by Middlemiss was not able to clarify the mechanism. A number of investigations carried out in the lake region reported that the evidences of enlargement and collapse of solution cavities in lime stones are not available in the area, which could give rise to these large lakes, only minor solution cavities are seen near the 'Pashan Devi' area. Investigations further revealed that the large openings are only developed due to slumping of the rock mass along the master joints and the field evidences do not only support the contention of Middlemiss, while the Griesbach's suggestions is also not supported by geological structure of the area. Thomas (1952) took into consideration the fact that the Nainital lake and its ancillary small lakes are the result of very recent earth movements and diversified lithology and the frequency of these lakes in this small region must be converted with a very recent, rapid and irregular local movements. Mathur (1955) believes that these lakes may have been formed along structural valleys, which have subsequently been enlarged by demolition of their floor. A geological study conducted by Hukku et al (1974) indicates the semi-circular configuration of the Nainital-Khurpatal valleys, complete absence of bedrock along the valley floor, and distribution of the quaternary deposits in these valleys, suggest that these valleys may represent an ancient river meanders. Pande (1974) supported that the Nainital Lake is formed as a result of numerous faults in a folded region. Pal and Merh (1975) suggested two factors behind the formation the kumaun lakes one is subsidence of rock fragments along faults, and another is rock slides. Valdiya (1988) pointed out in his research paper that the Naini Lake originated as a result of differential vertical rather rotational movements along the Nainital fault, which caused the impoundment of the water of the stream flowing in the Naini valley.

### **Present Scenario of Naini Lake**

Nainital like other towns of India is getting over crowded due to extensive and unplanned construction. Nainital is getting more and more industrialized. While this is good for the economic well being of its people many pollution problems have cropped up which need to be sorted out. Over the years the local people who compete against each other to obtain maximum gains without realizing the long-term consequences have grossly exploited the lake as a resource common. Urban development is proceeding apace in a haphazard manner. Town planning efforts are dismally poor. Sewerage facilities are most deficient. Recent studies conducted in the lake region give indication that the lakes in Kumaun region are deteriorating, and if appropriate measures are not taken timely it would not be very long when these lakes would be at the point of extinction.

## LAKE WATER QUALITY: DISSOLVED MATERIALS

During recent decades, human population has increased sharply in the lake city, Nainital, which has adversely affected the water quality of the lake. Ever increasing tourist influx has also contributed greatly to the pollution in the lakes. Naini Lake is the only source of drinking water for the local people water is extensively used for recreation. Large numbers of tourists go around the lake on Ponies and Horses. These activities greatly affect the quality of lake water. The lake is now less transparent due to increased quantity of suspended matter. A recent survey has reported that the Nainital Lake has become highly polluted. The Manganese level is ranges between 2 and 1.2mg/lit, while that of lead (Pb) is between .02 and .08mg/lit. The level of dissolved oxygen which fluctuate during summer (5mg/lit) to winter (2.5mg/lit) season has been considered to be very dangerous for fresh water fishes (Ellis et. al. 1946). Lake contains cold water carps, which are sensitive to low oxygen concentration and thus find it difficult to live and a substantial number of them die each year during winter, when the concentration of dissolved oxygen falls below the critical level- i.e. 0.9 mg/lit (Paul and Sharma 1980). Das (1981) reported that Nainital lake water quality is harmful for human as well as animal consumption such as high CO<sub>2</sub>, NH<sub>4</sub>-MPO<sub>4</sub>-BOD, NO<sub>3</sub>N and some metals exceeds the maximum permissible limits of the tolerant. The same constituents are responsible for eutrophication and pollution of the lake, as well as a major factor in winter fish kill in the lake Nainital.

## SEWERAGE DISPOSAL ; A CIVIC DISASTER

The major source of pollution could be attributed to the 50 year old extremely faulty system of sewage disposal, which often bursts and bends, and leaks at places, and the sludge is washed down into the lake. The sewage flows into the lake through "most of the 79 nullahs" that criss cross the hills surrounding it. Incidentally most of these sewers are connected with hotels as well as the authorized and unauthorized colonies that have mushroomed on the hills surrounding the Naini Lake. Naullah No. 21 carries into the Naini lake a huge amount of medical waste daily from the government run B.D. Pande Hospital besides sewage as well as faeces from the make shift toilets that have sprung up in the resort's Ropeway and popular compound areas." A report published in Hindustan times highlighted the fact that the Nullah No. 23, 24, 25 connected with the nullah No. 26 (the biggest nullah in the town) carries into the Naini Lake a huge amount of sewage generated in half of the Mallital area. Similar is the situation of almost all the storms; water drains. Nullah no. 1, which has the Sher-ka-Danda ridge and the Ramsay compound as its catchment areas, "most of the sewage generated by the hotels and houses falling in the twin areas passes directly into the Naini Lake through this nullah" In the western side of the lake there is a nullah which has been the perennial source of water supply for the lake. The other important sources of pollution are household effluent detergents, human and non human excreta, particularly mules and horse excrete, waste from laundries hospitals and studs etc. A colony has been constructed at Sher-ka-Danda but no arrangements have been made for the disposal of the garbage. All the garbage from the colony is dumped into a nullah which opens into the lake thus polluting the water. Moreover the rubble of the newly constructed houses is dumped into the nullahs with the result that silting is an acute problem in the lake.

## **SILTATION AND SEDIMENTATION**

According to De Terra and Paterson (1939) the rate of sedimentation is difficult to determine on account of variability of supply. The insoluble sediments in the form of silt are brought in by the inflow channels. 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. Sharma (1981) calculated in his Doctoral research the sedimentation on rate in Naini Lake which was 0.022 cubic meters per year. At this rate, the lake having the capacity of 6.99 million cubic meters would be filled up with sediments in 314 years. Rawat (1987) predicted in his study that if the physical surrounding of the lake catchment is not further disturbed by tectonic as well as human activities, the Naini Lake will be completely filled up in about 380 years. 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 1988) while Hukku et al.(1974) had given 350 years based on the sediment input into the lake. A study describes the physiographic personality of the Naini lake reported that the Naini Lake is gradually filling up by the debris swept into it during the rains. The rate of its silting is about 0.9144 meter annually. After the great landslides of 1880, when large amount of boulders and debris had fallen into it, the lake has since become comparatively small. Valdiya (1988) estimated the amount of sediment filling 5500 m<sup>3</sup> in 80 years in the Naini Lake and further calculated that the capacity of the lake is progressively shrinking at the rate of 70m<sup>3</sup>/ year. At this rate of debris accumulation, the lake will be completely filled up into a flat tract in 300-400 years.

## **SHRINKAGE OF THE LAKE**

The continuous inflow of inorganic sediments, accumulation of soluble and insoluble materials, encroachment and illegal and unplanned construction of Boat stands/vehicle stands (Jetties), sewer lines etc have all added to the destruction of the lake resulting ultimately in its shrinkage.

The 1880 event is the latest example of mass-movements that have been responsible for progressive shrinkage of the Naini Lake (Valdiya 1988). Practically half the extent of the area of the Naini lake basin is covered with debris generated by mass-movements.

There are many developing fans and cones of stream debris in the lake. Rawat (1982, 1987) reported 23 deltas fans, encompassing 830m<sup>2</sup> area of the lake. Deltas near Naina Devi Temple (N-W), Boat House Club (N-E), Alka Hotel (East), Municipal Library (East) Phansi Gadhara (S-W) and Tallital Rickshaw Stand are quite large in size, while many small fans and cones are still in the developing stage.

The ban imposed on the use of polythene bags five years ago in Nainital has now failed. The throw away mineral water bottles, plastic and polythene bags together with empty *Milk* and *Gutkha pouches*, which remain scattered all over the city are an obnoxious sight. The growing traffic with the growth of town and big turn out to tourist has contributed much to the environmental degradation. The lake is now much smaller in area, it is shallow with much

reduced water volume, its biological population is under stress, the pollution levels are much higher and illegal encroachments continue unabated.

Thus the sedimentation and siltation, release of solid and liquid wastes from human settlements and hotels, faulty planning and the lopsided development of tourism have resulted in environmental issues, which may be difficult to resolve.

### **REMEDIAL STEPS**

The situation today is alarming and calls for immediate adoption of remedial measures to save this beautiful lake from certain depth fortunately the state of degradation of Naini Lake's beauty has not yet reached the point of no return. An integrated approach is needed urgently to solve the problem of Naini Lake and surroundings, steps should be taken to clear the lake by the local authorities. It is seen that Nainital normally attracts more visitors than she can host. It would particularly be very important to plan and correctly organize tourism policy and urban growth within the lake catchment. It is the time for the authorities to revise over and make a thorough reappraisal of the laws, rules and regulations in order to discipline and regulate the morals and methods of the unbridled mass.

A scheme is already underway (as par of the centrally sponsored Nainital Region Lake Conservation Project) to put in place a new network of sewerage in the town. Side by side efforts are also on to de-link the existing sewers from the storm water drains, claim the officials concerned. But that doesn't really show on the ground. The open drains need to be periodically cleaned and an immediate action should be taken regarding sewage overflow at many places. Sewage disposal into the lake should be completely stopped. Land encroachment around the lake should be banned by legislation.

Finally conservation/management can not be achieved by individual efforts; a joint effort initiated by many government and non-government organizations has to be appreciated in this regard.

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