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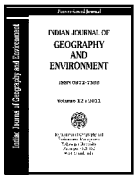

An assessment of anthropogenic impact on natural landscape –The case of Kurseong Town, Darjeeling, West Bengal

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KEY WORDS

Anthropogenic impact
Fragile environment
Vulnerability
Man-made drain density
Environmental consequence

A B S T R A C T

The high altitude mountain ecosystems are very fragile and sensitive to any sort of changes introduced by human being. The critical balance of such ecosystem has largely been offset by the landuse / landcover changes for development purposes. The natural processes are accelerated out of proportion by strong anthropogenic modifications of landscape through clearance of forest for agriculture, settlement, pasturing, mining and quarrying, water resource capturing, road construction etc. to invite hazardous events which have dramatic impact on human property and lives. Thus humans have been instrumental for significant increase in the frequency and magnitude of these hazardous events. An assessment of anthropogenic impact on the natural landscape is necessary for sustainability of the mountainous landscape, particularly in those urban areas where large volume of population throng together for livelihood. The Kurseong Town occupies the east facing cliff like slope of Senchal- Mahaldiram ridge of the Darjeeling Himalayas that rises steeply from Rinchengtong Khola River Valley (a tributary of the Balason River) from an altitude of 800m, in the east, to an altitude of 2200m to the west.

The present study is a humble attempt to assess the extent of human impacts in causing physical hazards like landslide, flash flood, soil erosion and social hazards like water scarcity, building congestion, traffic congestion, road accident etc. This study is based on household survey and Global Positioning System aided survey. Dumpy level survey has been carried out for drawing topographic profiles. Satellite images (Wikimapia and LISS-III) have been used to detect the changes in landuse pattern. Finally, GIS is used for data analyses and preparation of maps.

1. Introduction

The role of human being in creating and modifying landform is a theme of great importance (Goudie, 1993). The range of human impact on both forms and processes is considerable, especially in case of fragile environment. The present study has been conducted in one of such sensitive mountain terrains of the Darjeeling Himalayas. Kurseong is a Sub-Divisional town in the Darjeeling district of West Bengal (fig. 1). It lies between 26°51´40´´ to 26°53´35´´ North latitudes and 88°15´25´´ to 88°17´45´´ East longitudes along the left valley side slope of Balason River and adjoining spur of the Senchal -Mahaldiram

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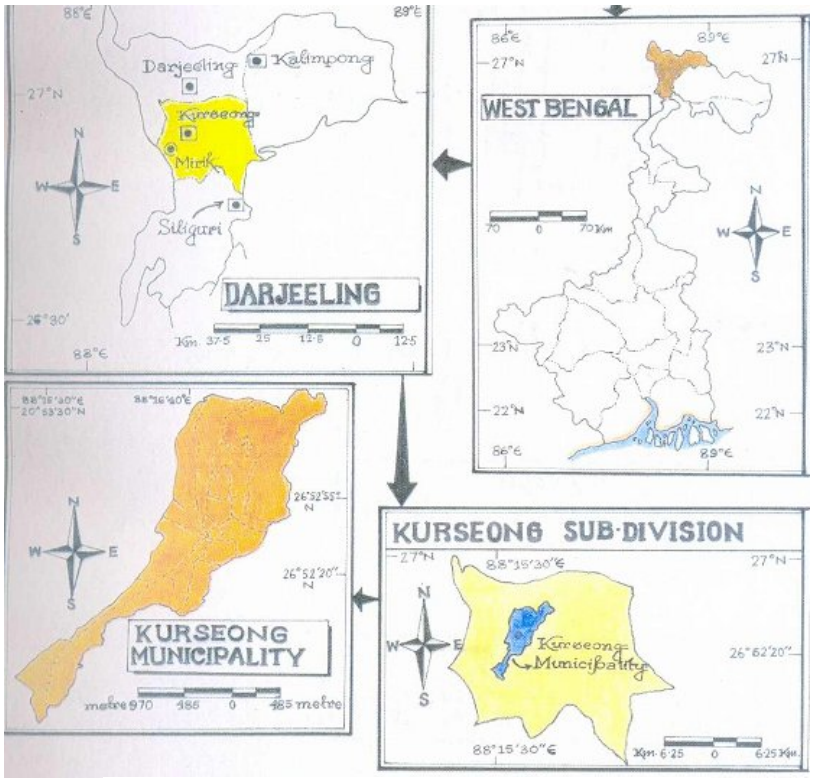

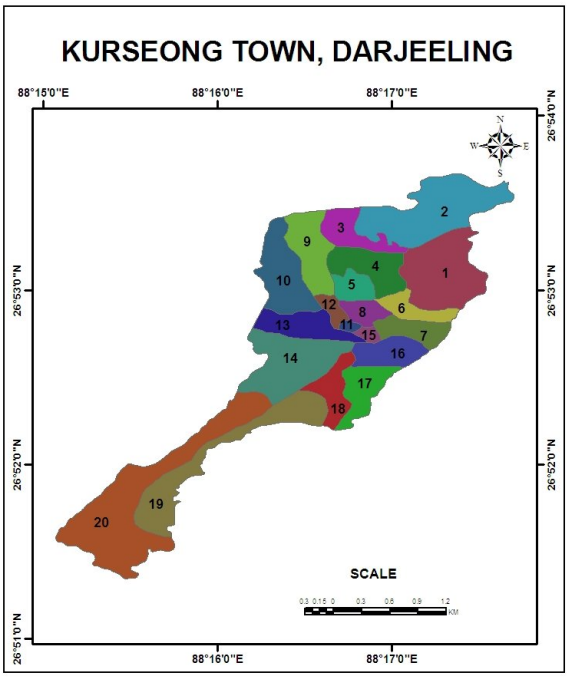

Figure : 1 Location map of the study area

range. It is one of the oldest urban centres and was originated way back in 1835 when the British Government of India took this town on lease from Sikkim kingship. Kurseong Municipality came as a separate administrative unit in 1878. It began to develop as a resort town and became centre of attraction after the construction of Siliguri – Darjeeling Road (1880) and laying of narrow-gauge railway line. Along with extension of transport facilities and its connectivity with the plains, economic potentiality began to sprawl and multifaceted commercial activities like tea gardening, trade and tourism began to flourish which lured a mass of population towards it. Migrants from the neighbouring districts, states and countries converged upon this hilly urban centre causing population to grow. According to the Census of India, Kurseong town had a population of 40,019 in 2001 but in only six years, the number increased to 61,416. This dramatic change in population has great impact on natural environment. The study area is surrounded by steep slopes of mountain spurs and therefore, aerial expansion of the urban centre has been restricted which results in very high concentration of population within limited space. This has created undesirable impacts on offered environment. Construction of high rise buildings along highly vulnerable mountain slopes has led to the problem of slope instability while indiscriminate forest felling adds fuel in offsetting the harmony among environmental systems. Being located in a mountain setting, the nature of problems in kurseong is different from the general problems of an urban area on plains. The present treatise aims to assess-

- Intensity of urban uses of land
- Nature, degree and types of land transformation and their bearing on the fragile natural systems
- Social outcomes of the urbanization process
- Potentiality of the management alternatives

2. Methodology

This work is based on deductive methodology of investigation. Primary data have been collected through field survey. Secondary data have been collected from different books, journals, published and unpublished reports of official sources. Remote sensing data have also been used to support the field observations. SOI topographic sheet (78B/9) and satellite imageries are used to analyze the landuse/ landcover pattern of the study area. Finally, GIS techniques have been used for preparing diagrams and maps.

3. Results :

Anthropogenic Activities

An Urban centre or area is the manifestation of concentration of population and diverse economic activities. These are the areas of strong socio-economic interactions as well as rapid development. Development has its consequences on space. As a result, every urban area is affected by environmental problems. So is the case of Kurseong.

Unplanned Urbanization

Kurseong town has a long history of urban growth since 1835. The valley side slopes in and around the town have long been chosen for tea plantation and tea processing which formed the economic bases of the study area. Its importance as a growth centre flourished when it was connected toDarjeeling and Siliguri by regular transport in 1864 and 1869 respectively, along the older Military Road and newly constructed Hill Cart Road (Tenzing Norgey Road, NH55). Tenzing Norgey Road connects the hill area to the plains of Bengal via Tindharia, Kurseong, Sonada and Ghoom. The population of this hill town increased due to immigration from neighbouring areas. Britishers also set up many educational institutes of national and international repute which also contributes to attract population. Furthermore, the enchanting beauty of the natural landscape of Kurseong (meaning 'the land of white orchid') have attracted tourists. The places of tourist interest within and around Kurseong town are Bordung Busty, Giddhar

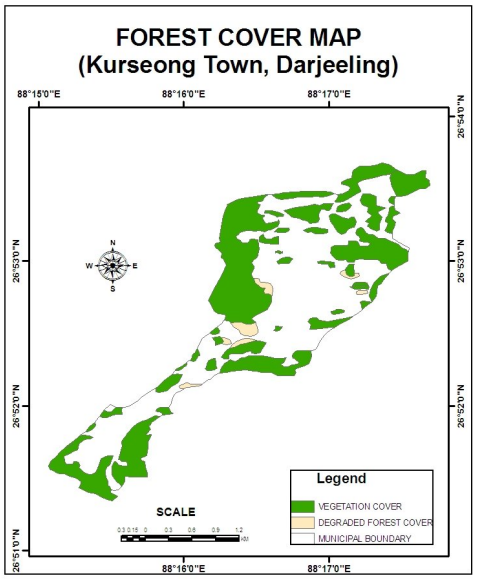

Figure : 2

Pahar, Rohini, Sittong, Latpacnchar, Dowhill, Durpin Dara, deer park etc. The town has a good market of retailing foreign consumer goods, imported from Nepal, China, Japan, Korea, Hong Kong and other South East Asian countries. All the above factors have long been instrumental for the growth of population in Kurseong town.

Urban development has caused population pressure to increase over limited space which in turn has given rise to a number of urban problems like congestion in dwelling places and traffic routes, irrational construction on steep slopes, slope failure, deforestation, shortage of drinking water, unmanaged disposal of waste etc. Exceedingly high growth is observed in the market areas where percentages of Bengali and Nepali population are rapidly rising. Due to shortage of land for construction on hilly ridges, new buildings and roads are being constructed undermining the slopes which are susceptible to land slides.

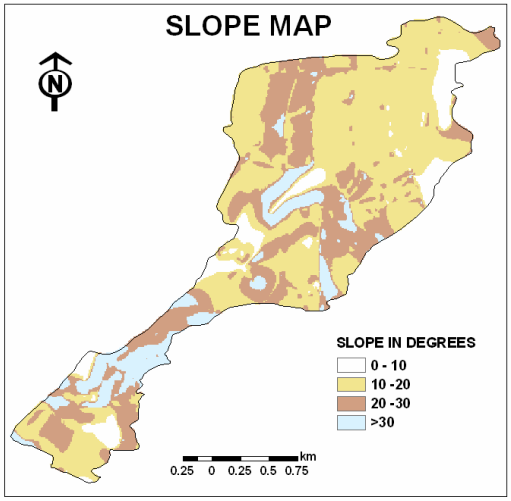

Figure : 3

Changing vegetal cover

Kurseong is richly endowed with natural vegetation, the floristic composition of which varies perceptibly with altitude. The upper portion of the hill town has a distinct forest cover of temperate nature. The important species found are Alder, Cryptomenia, Walnut and Poplar. The northern part (Ward no. 1 & 2) is dominated by this kind of vegetation. Other than trees different kinds of herbs, shrubs and Orchids also characterize the natural vegetation of this part. Along with natural vegetation, tea gardens also represent a considerable part of green cover. The Forest Department's data it reveal that there has been a dramatic reduction in vegetal cover during the last few decades. Plantation of tea gardens also results fragmentation of vegetation cover. Urban sprawling in the forms of expansion of- township, residential complexes, tourist complexes, commercial centres, industrial establishments, hotels, restaurants and recreational centers is responsible for such kind of de-vegetation in Kurseong (fig.-2). In 1901, about 51.54% of the total land of Darjeeling district was covered by forest. In 1921, it reduced to 49.14%, in 1931 to 45.46%, in 1941 to 45.08% and in 1981 the figure decreased to 38.26%.

Slope Modification

The topography of the study area exhibits a high relative relief of (more than 500 m.) and with steep slope ranging between 15^0 and 45^0(fig.-3). Number of cross sections have been drawn on the basis of dumpy level survey with GPS to assess the spatial association of geomorphic units and their relation to landslide sites. The Southern part of the urban area (Ward Nos. 19 & 20) is elongated towards south west along the old Pankha Bari Road. The section is situated over a gradually descending spur that has separated the upper catchment of Rohini from the Balasan basin. The NH 55 along with the heritage narrow gauge railway line approximately follows the 1450 m contour. The regional morphometric setup of this part of Darjeeling Himalayas involves ridge that runs in a north south fashion and flanked in both sides by number of first order basins, each of which is separated from the adjoining basin by a spur that radiates from the aforesaid ridge. All these small rivers like Babu Khola, Paglajhora etc have contributed to the formation of major rivers. The northern part of the Kurseong town has a considerable width in east west direction which lies along the east

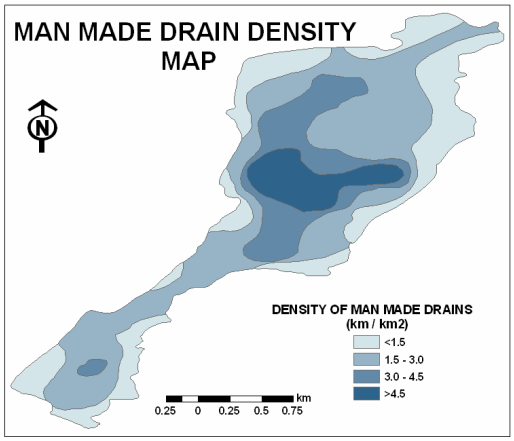

Figure : 4

facing cliff of Mahaldiram – Senchal ridge that steeply descends to Rinchengtong Khola. The whole area is covered by gneiss dominated metamorphic rocks of Darjeeling formation. So geomorphologically and geologically this zone is very fragile and prone to soil erosion and land slides. The landslide sites are closely associated with streams. The slope failure events have been found to be more probable along the valley side slopes. Another problem of the area is flash flood during high intensity rain fall which causes scouring along the base of the valley side slope.

Expansion of settled area

From the field data analysis it has been found that the settlements are more concentrated towards the central the market area of Kurseong town (Ward nos.

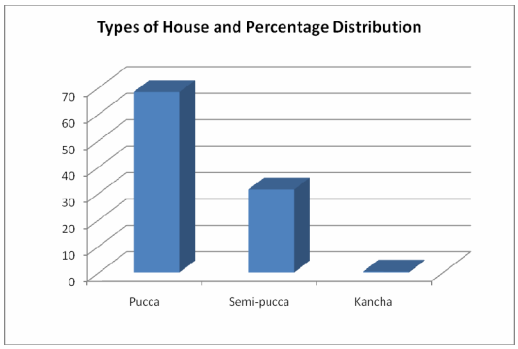

Figure : 5

1, 2, 9,10,17,18 & 19).Spatial variability in availability of transport facilities and other urban amenities has caused uneven distribution of settlement over the urban space(fig-4). The density of settlement in the central part is 1050 per Sq Km. Immigrants in Kurseong has created excessive pressure on land and burgeoning population prefer lands in the fringe areas or in the congested areas which results in expansion of settlement in vulnerable zones.

Construction of multistoried buildings

House types and pattern of their distribution indicate the economic condition and reflect the social status of the owner. Kurseong town presents an interesting scenario in this regard. From the household survey it is found that most of the housing units are either pucca or semi – pucca. Only 1% of the houses are kuccha (Fig. 5). Owing to scarcity of space, multistoried buildings of concrete structure have been constructed to house a large population within the town. But it may be pointed out that Kurseong is a hill town and concrete construction is environmentally not preferable. Besides this, unscientific utilization of space have also yielded hazardous results.

Intensification of settlement

Employment opportunity in the urban centre attracts the rural people. Excess population needs land for

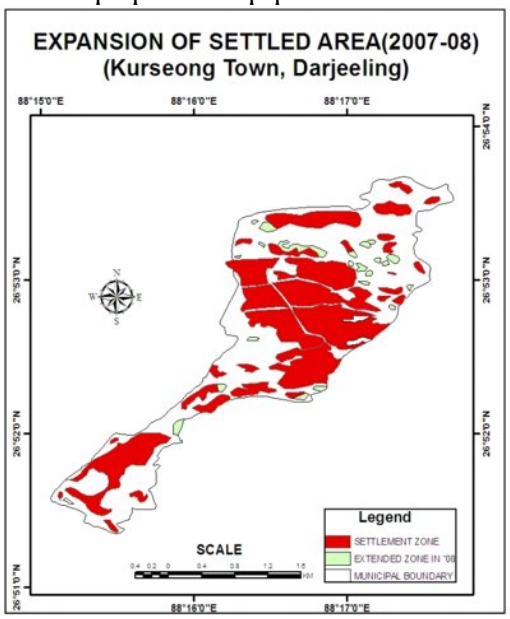

Figure : 6

settlement causing intensification of settlement in the core areas. Buildings have been constructed without plans violating rules and regulations in many cases. From the settlement density map, it is evident that higher concentration of settlement is found in Ward nos. 1, 2,9,10,17,18,19 and 20, where density is 200 dwelling units per km^2. As the distance increases from the heart of the town, density of settlement becomes thinner. Accessibility is a major problem in any mountainous terrain and the poor are unable to afford personal means of transport. Therefore, they concentrate in and around the centre which is one of the major causes of housing congestion in the urban core.

Man made drains

Man made drains and sewerages are very important urban features. Density of manmade drains (Fig. - 6) is highest along the central tracts. In Ward nos. 6,7,11,12 13 and 15 the density is more than 9km/ km^2 where as lower density is found in Ward nos. 1,2, 3, 4,8, 14, 17,19 and20. Very low density is observed in the parts of Ward nos. 1,2,10, 19 and 20. From the field observation it can be said that marginal parts of the fringe wards are having least drainage density.

Waste disposal

A major problem faced by the people of Kurseong town is disposal of wastes. There is no proper disposal

site with advanced management technology in the municipal area. Volume of waste generated daily is 6 MT. and these wastes are directly thrown to the jhoras without grading and treatment. These are mainly responsible for blockage of Jhora. The road side dustbins are not adequate to hold domestic and municipal garbage. Very limited number of dustbins in the marginal wards is also a problem. Along with solid waste problem, sewerage system is also poor in the study area. A partial sewerage system was developed in kurseong town in1918 to serve 10 community latrines and a few houses in the market area. More than 736 low cost sanitary latrines were made to eliminate the system of removal of night soil by head load. Recently one centralized septic tank has been constructed in ward no.14 for proper treatment and discharge of sewerage.

Impact of anthropogenic activity on environment

Development and environmental problems are two facets of a single process. With the fast growth of kurseong as an urban centre, impact of human beings on natural environment increased with time. As a result, the urban centre is now facing some environmental problems.

Along with the physical environmental problems, the Kurseong dwellers are also experiencing deterioration of the living condition and health problems caused by inadequate and contaminated water, poor sanitation and drainage, absence of solid waste management, improper sewerage system, air pollution, deficient public transport, unhealthy public housing, precarious housing, road congestion etc.

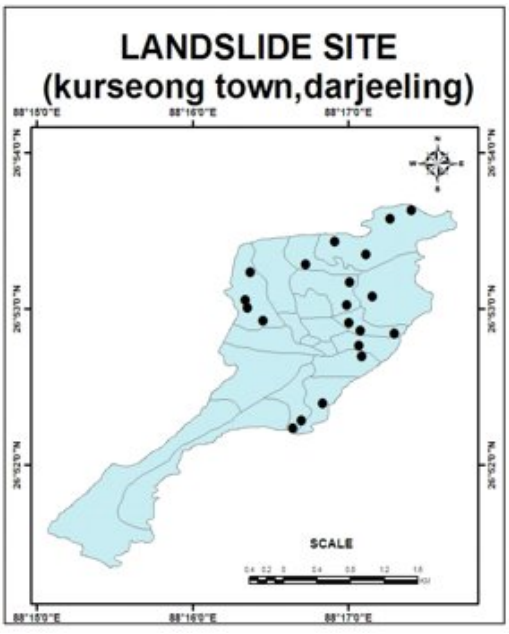

Figure : 7

Landslide and soil erosion

Landslide is one of the most important problems of Kurseong having higher probability to appear in more destructive way in future. But the local authority has not yet seriously addressed the issue in any of their planning programmes. Indiscriminate replacement of forest cover by dwelling units or other constructions ignoring the natural drainage and other environmental systems along the steep mountain slopes of Kurseong urban area has aggravated the problem to the hazardous extent. There are at least 20 landslide sites within this municipal area (Fig. 7). The incidences of landslide mostly occur during monsoon. Observation and enquiries in regard to the landslide events reveal the following important points.

Landslide phenomena are particularly associated with high energy mountainous environment having moderate to high relief and subject to period of high rainfall. Complex sets of physical factors are responsible for slope instability e.g. geology (rock type, structure, joint and crack etc.); hydrology (surface runoff, through flow, drainage network etc.); geomorphology (nature of terrain, landform character and association, degree and aspect of slope, intensity of weathering and types of other geomorphological processes involved etc.); climate (intensity and amount of precipitation, temperature etc.) and above all the characteristics of surface materials (texture, porosity, moisture transfer and holding capacity, shear strength etc.).The natural processes of slope failure have largely been magnified by strong anthropogenic modifications of landscape through agriculture, settlement, pasturing, mining, water resource capturing, road construction etc.

Drinking water scarcity

Scarcity of drinking water is a serious problem in Kurseong town that culminates in a crisis during the dry months. The situation becomes so worse that people of some localities are compelled even to purchase water. Impervious nature of the country rocks and very high degree of slope are the two important factors, that pose restriction to recharging processes. The terrain being composed of gneiss and other equivalent metamorphites of various mineralogical compositions does not allow rainwater percolation to greater depth. As such, surface run off constitutes the major output component of the local hydrology.

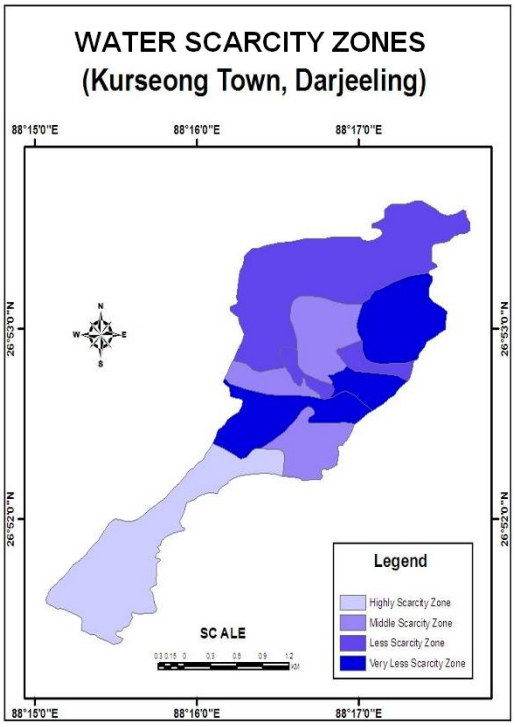

Figure : 8

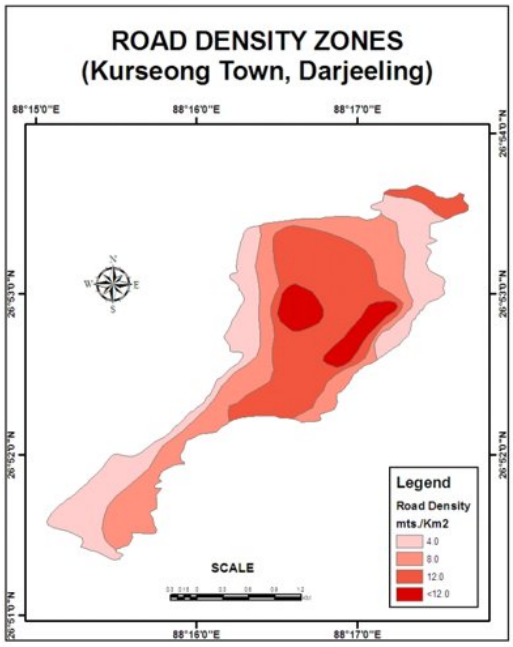

Figure : 9

This portion of the basin thus experiences negative water budget temporarily during lean season. The higher degree of slope is also responsible for ready drainage of rainwater as surface run-off leaving very short period of time for recharging, and whatever amount of water is recharged, a major share of it is drained quickly as through flow. Furthermore, indiscriminate forest felling, concretization of slope surfaces etc. play additive roles to hinder recharging processes. Increase in the use of water for various commercial activities is another major factor leading to water scarcity in the town.

Survey reveals that the problem of water scarcity is not equally suffered in all the municipal wards (Fig. 8)). In many cases, natural scarcity has been supplemented by municipal water supply that has lessened the degree of suffering. But in general the areas of steeper slope, lower drainage density, and higher concentration of population, the scarcity of water is much higher.

Traffic Congestion

Unplanned growth of Kurseong Township in a situation of acute land scarcity, has led to the problem of traffic congestion along most of the major motorable roads. Rapid increase in the number of vehicles, plying between Siliguri and Darjeeling, and expansion of commercial activities in Kurseong and consequent extension of transport both in terms of connectivity and frequency, are responsible for large-scale congestion within Kurseong town(Fig. 10). The major arterial roads have been constructed parallel to the contours across the cliff slope. As such, there is little or no opportunity to expand the roads in their width. Moreover, the buildings and dwelling units have been constructed closely to the roads without leaving any space for road expansion.

It has been tried to manage the congestion problem by construction of parallel roads which are still far behind the requirement. The down flow of vehicles towards Siliguri from Darjeeling are diverted along Pankhabari Road to release pressure on NH-55 along which only upward flow to Darjeeling is allowed. Though, this has significantly reduced congestion along NH-55 within the market area, but in other major roads like Dowhill Road, portion of the Hill Cart Road away from the Kurseong Railway Station (towards Siliguri) etc. are still facing serious traffic congestion problem. Siliguri bound vehicle flows from different directions and converge at the central transport node near Railway station and create congestion. It has been found from the flow count survey along the major roads of the town that number of Darjeeling bound vehicles along Hill Cart Road remains considerably high all the day after 9 AM and

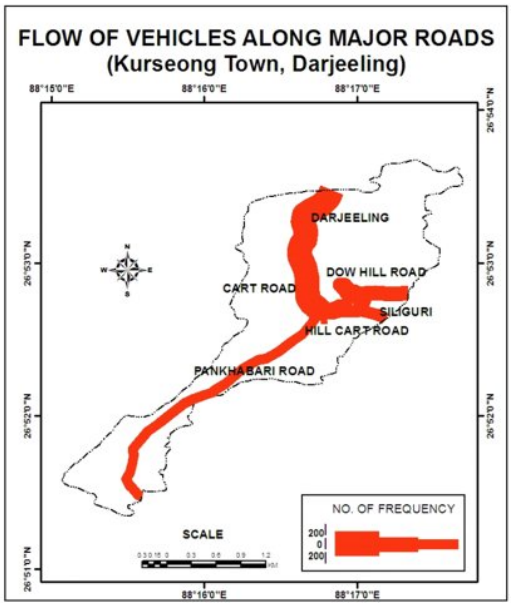

Figure : 10

create congestion. Sometimes the flow comes to a halt during the peak hours. Dowhill Road is another channel of flow that remains busy throughout the day and congestion problems are faced in every now and then.

From survey and post field data analyses it has been found that the areas under Ward Nos..-5,6,7,11 are more facilitated by good transport while in Ward Nos.-1,2,10,19 and 20 road density is moderate and less density is found in Ward nos.-4,8,15,16,17 and 18.So this may be said that more transport facility as well as road density found in the market centre of town while the marginal wards are suffering from lack of transport facility (Fig. 9).

Population Congestion

Kurseong town has a population of 40,019 according to the census of 2001. Out of this, 20,410 are male and 19,609 are female. There is highest number of population in Ward No-4 (4,043) when the lowest is in Ward No-11 (1,018). More than 2000 population is found in Ward Nos.-2, 4, 5, 7, 8, 9, 13, 14 and 17. Moderate range of population (1500-2000) is present in Ward Nos. - 1, 10 16, 18, 19 and 20. Relatively lower population (1000-1500) exists in Ward Nos.-3, 6, 11, 12 and 15. According to 2001 census, total population of Kurseong town was 40,019 but within only 6 years the number of population reached to 61,416 (Fig. 11).

Building Congestion

Frequency of houses and buildings used for other

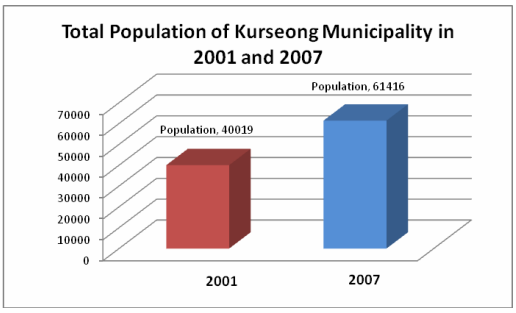

Figure : 11

purposes (shops, hotels, service centres etc.) have been studies all across the municipal wards using grid method. Maps have been prepared on the basis of data thus colleted. Concentration of houses / buildings has attained maximum value around the market and circular zones (elongated along NH-55) of diminishing house frequency surround that central high-density core. It is interesting to note further that, though the market hub having an area of only 0.75 km^2 approximately, has house / building density as high as 1800 units per km^2 while the density diminishes dramatically away from NH-55 on its both sides. In the peripheral areas of the municipality house frequency has reduced to values between 100 and 200 units / km^2. Accessibility to the market and availability of regular transport facility can be considered as the factors that have played dominant role in choosing dwelling sites. Physically this area is more vulnerable to slope failure. Unregulated and irrational constructions in this area provide impetus to landslide phenomena. Number and frequency of landslide events have gone up during the last few years.

Health Hazards

Increasing trend of diseases like T.B., Hepatitis, Diarrhoea, liver diseases, heart diseases, Cirrhosis of liver, Anemia, stomach disease etc. has worsened the health scenario of Kurseong town. Inadequate treatment facility, non availability of modern instruments technology and lack of adequate expert medical officers etc are the principal hindrances in extending health services.

Feature of AIDS

AIDS has become an alarming threat to the inhabitants of Kurseong town where the incidence of AIDS is increasing at high rate. The disease is mostly prevalent among the transport workers. 83% of AIDS patients are drivers, 9% are helpers (Khalasi) and 2-3% are the students(Table-1). The youths of 20-45 years age group are the poor victims of this disease.

TABLE-1: Occupation wise Distribution of AIDS affected people(April 07-March 08):

Months	Occupation wise AIDS affected Number of patients						Total
	Drivers	Khalasi	Laborers	Student	Business man	Others	
April-'07	7	-	-	1	-	-	8
May-07	7	-	-	-	-	-	7
June-07	9	-	-	-	-	-	9
July-07	5	-	-	1	-	1	7
August-07	5	2	1	-	-	-	8
September-07	3	1	-	-	1	-	5
October-07	3	-	-	-	-	-	3
November-07	5	-	-	-	-	-	5
December-07	6	-	-	-	-	-	6
January-08	4	3	-	-	-	-	7
February-08	3	-	1	-	1	-	5
March-08	6	-	-	-	-	-	6
Total	63	6	2	2	2	1	76

Lack of hospitals, lower number of doctors per head, insufficient hospital beds, lack of medicines, private clinic, nursing home, health centers and specialist doctors, lack of awareness about HIV & AIDS- all these problems are instrumental in recent spread of HIV and AIDS. Following table (Table-2) depicts the prevalence of other communicable and non-communicable diseases in the area.

TABLE- 2: Average number of reported cases of major Diseases (April 07-March 08)

Communicable disease:

Sl no.	Type of Disease	March		November			
		Discharge	Death	Sl No.	Disease	Discharge	Death
1	T.B.	41	2	1	T.B.	15	2
2	Hepatitis	7	2	2	Hepatitis	10	0
3	Diarrhoea	51	2	3	Diarrhoea	26	0

Non communicable-diseases:

Sl No.	Type of Disease	March		November			
		Discharge	Death	Sl No.	Disease	Discharge	Death
1	Liver	5	0	1	Liver	12	1
2	Heart diseases	12	5	2	Heart diseases	9	2
3	Cerebro vascular	9	2	3	Cerebro vascular	5	2
4	Cirrhosis of liver	1	0	4	Cirrhosis of liver	5	2
5	Anemia	11	0	5	Anemia	2	0
6	Stomach	29	0	6	Stomach	28	0

Source : Kurseong Sub-divisional Hospital

4. Discussion

The present study pursues the out balanced urbanization in Kurseong town and its consequences in terms of physical and socio-economic stresses on the urban landscape. Increase in population beyond the sustainable limit is the most important concern that has exposed the urban dwellers to all kinds of vulnerabilities imposed. Limited scope for the local economy to flourish and restriction imposed by non-availability of space to accommodate increasing population are the roots of every hazard experienced in this age-old town. In spite of sufferings of the people from all such problems, no significant long term management strategy has been taken up by the administrative authorities. This has aggravated the problems to the serious extent.

Following are the major findings of this research -

Population of the town is growing at very high rate, which has apparently attained an alarming level. Population of Kurseong increased from only about 10,000 in 1901 to about 30,000 in 1991. But during the next 7 years Total population of the urban centre has doubled. In 2007, total population reached 62,000.

In spite of fabulous increase in population, the territorial domain of the urban area could not expand as it is surrounded by steep slopes of mountain ridges and spurs leaving the urban area with only possibility to sprawl in the form of narrow strip along the main road. This has led the population density to increase. Currently population density has attained a value as high as 10,000 person /km^2 in many of the municipal wards.

Increasing population within a limited space has compelled the economically marginalized people to be pushed in environmentally marginalized areas. Thus the ecologically fragile areas have been irrationally occupied that has triggered many environmental hazards, like- landslide, flash flood, scarcity of water etc.

Irrationally designed constructions have been built up on irrationally chosen vulnerable sites. Steeper mountain slopes have been indiscriminately de-vegetated for constructional purposes; natural drainage lines have been either blocked or diverted without considering the local slope; construction of road obliterating local hydro-geological setting etc. have been instrumental in causing physical hazards. As such, the numbers of landslide sties have gone up. Most of them are occurring within the zone of high landslide susceptibility. Currently certain areas within the municipal area have become highly vulnerable to landslide.

The economy of the town is not competent to absorb its total population. Closure of many tea gardens has posed serious threats to the economic potentiality of the area. More than 45% of the households fail to earn only Rs. 6000/- per month. More than 10% of the total populations are living a miserable life in the slums.

Urban dwellers in Kurseong are maintaining a poor health status. They have been found to suffer from Tuberculosis, hepatitis, Cirrhosis of Liver etc. Number of HIV positive patients (currently 76) exhibits a rising trend.

Tremendous pressure of vehicles on the main and arterial roads within the town and consequent congestion is another problem faced by the local inhabitants.

Population pressure within the municipal area has gone up to such an extent that it has become very difficult for the municipal authority to provide basic services to the urban dwellers. Inefficient drainage and sewerage system, solid waste collection and disposal insufficient supply of drinking water etc. have crippled the urban life. Strategies to manage landslide problem, fulfill the demand for water, mange the solid waste are to be formulated immediately and to be implemented without further delay.

5. Conclusion

Management of urban problem is a way in which urban potentiality is well saved and effected as well as the urban infrastructure and all of the facilities will be defined in a positive way along with the reduction and mitigation of urban problems. Some important strategies may be taken up for sustainable growth of Kurseong town.

(i) The micro level Integrated Resources Planning.
(ii) Conservation oriented planning of the resources;
(iii) The environmentally sustainable farming techniques
(iv) Integrated Man Biosphere Programme implementation
(v) Active involvement of the local people in the urban management process.
(vi) Integrated forest and Watershed Management;
(vii) Sustainable eco-tourism Industry;
(viii) Large-scale 'orchid' culture and floriculture may be developed on a cooperative basis;
(ix) Animal husbandry should largely be extended;
(x) Dairy industry is to be developed on commercial basis;
(xi) Extension of mushroom culture and development of mushroom industry;
(xii) The environmental impact assessment has to be done before development planning;
(xiii) Transformation of marginal and undeveloped habitats through educational improvement, health care, transport improvement, credit and marketing etc.

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