CHAPTER VII

SUMMARY AND CONCLUSION

7.1.. Summary of the Chapters:

In the previous chapters, an attempt was made to give a clear picture about the problems related to the land use and environmental condition of the greater Guwahati area. It is the city area where the capital of Assam is situated. The study area is extended on the both sides of the river Brahmaputra. The area is located almost in the central position of the whole Northeastern region and well connected with every nodal points of the Northeast India. After the problem of research is stated, the objectives and hypothesis was also stated on the base of the study and related literatures. Required data and information are collected from both primary and secondary sources and analysed systematically. For this purpose the whole work has been divided into seven different chapters.

The first chapter is introduction, which includes statement of the problem, objectives of the study, methodology, significance of the study, hypothesis, review of related literatures and organization of the study.

The main objectives of the study covers the expansion pattern of Guwahati, particularly after shifting of the capital from Shillong, the change of land use that taken place in Guwahati in recent past, the nature of environmental problems faced by the city dwellers as well as the users, the socio-economic changes of the people respect of the use of household equipments, occupation, education, energy, health, and public life, the causes of the environmental changes and the impact of such changes also with the prospects for improvement of overall environment in Guwahati.
To show the pattern of land use change three different years have been taken into consideration, i.e. 1967–68, 1990 and 2002. The primary data were collected from both primary and secondary sources based on the objective of the study. To collect the primary data systematically, the whole area has been divided into four different zones namely old residential area (ORA), newly included GMD area (NIGMDA), newly built up area (NBA) and commercial area (COA). As Guwahati is different from other cities, the study about land use, its impact on environment and different socio-economic life needs significant attention and it also carries enormous academic significance.

The second chapter consists of history and geographical setting of the study area, which is again divided into historical, physical and cultural setting of the area. In the history part, evolutionary process of the city was described from ahom period. Under physical setting, the physiography, climate, drainage and water bodies, soil, geology and ground water are described.

The Greater Guwahati covers an area of 354 sq.km lies on both banks of the Brahmaputra river. The study area is situated on a flat plain interrupted by small hillocks rising upto a height of 300 m and large number of wetlands and low lying areas. It is considered as the gateway of the whole Northeast and connected with every corners of the state as well as Northeast India.

Earlier the city Guwahati was known as 'Pragjyotishpur'. The area is famous for astrological and astronomical practices. The name Guwahati is denoted from the betel nut tree found abundantly and betel nut market of Pan bazaar area. The average elevation of the study area is about 52m. from the mean sea level, though there are many high lands as well as low lying pockets within this area. Guwahati has more or less moderate climate
with maximum temperature variation between winter and summer around 20°C. The climate of Guwahati is tropical in nature, which can broadly be divided into three distinct seasons. One of the most striking features of Guwahati is its humidity. The entire northeastern area is known for its humid climate and Guwahati is probably one of the most humid parts of the country.

The natural drainage system of Guwahati is primarily dependent on the river Brahmaputra, which is flowing across the city in east-west direction. The perennial natural streams, which flow across the city, are Vasistha, Bharalu, Bonda in the south bank and Ghoramara in the north bank. Some swamps and wetlands of the city like Silsako beel, Sala beel, Deepar beel etc help in receiving the water of the summer downpour and contribute to the overall drainage system. Except for the heavy downpour, which occur only occasionally, the natural drainage system generally help in draining out the rain water. In hilly areas of the city there are numerous streams flowing along narrow valleys, which are linked to the main natural streams in the foothills.

Based on the rainfall, temperature and hydrology, Guwahati has full growth of natural vegetations. The vegetations are generally deciduous in nature including the heavy growth of herbs, shrubs, climbers, algae, fungi, bryophyta, pteridophyta, gymnosperm etc. The vegetation has been considered under three categories of crown cover density, viz <10 per cent i.e. low density vegetation, 10-40 per cent i.e. medium density vegetation and > 40 per cent i.e. high density vegetation.

At present the Guwahati city is having a population of nearly 12 lakhs, which is increasing day by day. Guwahati has become one of the major hubs of economics activities in the entire Northeast India. It is the main anchor behind the progress and growth of any
city region. The shifting of capital from Shillong to Guwahati and establishment of tea auction center at Dispur has geared up the process of increasing population in the city area.

Guwahati is linked with whole of Assam, head quarters of Northeast as well as with the rest of the country by roadways, railways and airways. Therefore, Guwahati is called the gateway of Assam as well as Northeast India. But a few decades ago there were no modern means of transport in Guwahati. The process was started in the city from 1942 only. The first city bus was placed on the roads of Guwahati in the month of April, 1947. As per the report of the district transport office as many as 2 lakh 48 thousand motor vehicles were registered in Guwahati till 2004. On the other hand 29291 numbers of motor vehicle of different types were registered only in the year of 2008-09. The rate of the increase of the vehicles and the rate of road length increase does not match at all for which city dwellers are facing many problems.

Around 7.64 sq km of the city area is covered by industrial area, where three different types of industries are located i.e. heavy, which covers -1.25 sq km, medium covers- 0.86 sq km, and light covers - 3.05 sq km respectively. From the last part of the twentieth century the industries were established in the northern bank of the river Brahmaputra and southern part of the city that is the adjacent part of the express highway, from Jalukbari to Khanapara. But the processes of distribution of industries are still unsystematic. Large industries like oil refinery, LPG bottling plant, some cement industries, and some highly polluting industries are located in the high density zone like Noonmati, Khanapara, Kalapahar, Basistha, Beltola, Fatasil-Ambari etc., which leads different types of environment related problems in the city area.

According to CDP report 2006, GMCA registered around 9 percent in literacy rate between 1991 and 2001, which may be attributed to the transformation of socio-
cultural importance of education in the society and the growing government emphasis on education. At present there are 388 primary schools and 101 secondary and higher secondary schools including degree colleges with XI and XII in Guwahati. On the other hand 18 higher educational institutions are there, which include Cotton College, Guwahati Medical College and Hospital, Assam Engineering College, Gauhati University and Indian Institute of Technology. Except these, a large number of private educational institutions are established in the city area from pre primary level to master degree level and formal education to some advance professional and IT based education.

Almost all the major government head offices of Northeast India is located at Guwahati beside the state head offices, which provide large employment opportunities. Except these, many educational and health institutions, commercial centers and transport and networking agencies have been providing occupational opportunities and attracting different people of different caste and class towards Guwahati.

The major amenities of the city are medical college and hospitals, nursing homes, Assam secretariat, high court, educational institute etc. Apart from these museum, lanetarium, kalakhetra are also here, which have some public as well as cultural interest.

In the third chapter land use pattern and nature of change have been analyzed. For this, the whole chapter was divided into four different headings, like land use category and change study methodology, spatial and temporal change, pattern of land use change and causes of land use change, where different types of land use categories are analyzed based on both primary and secondary data collected from field visit and from different offices.

Alternatively, use of specific type of land cover refers to land use. Land use and land cover change in urban area is an obvious phenomenon. Rapid urbanization brought
about sudden changes in land use and land cover and created many problems, particularly in geographically congested cities. To study about spatial and temporal land use change of Guwahati, data from 1967-68, 1990 and 2002 were taken into consideration. The land use change from 1967-68 to 1990, the land use categories have been considered are—

(i) Built up land, (ii) Agricultural land, (iii) Forest, (iv) Wetland and (v) Water bodies.

Land use change of Guwahati is clearly shown in urban sprawl map. The sprawling was along the main roads radiated from the core of the city. The map of 1990 covers much larger areas then the area covers in 1967-68. However encroachment on hills and wetlands was negligible till 1990. In spatial contexts, much more changes in land use has been observed in recent years. Hills and wetlands are not spared.

At present the land use within Guwahati can be categorized into seven divisions—(i) residential, (ii) commercial, (iii) industrial, (iv) public and semi public, (v) parks and playground, (vi) transport and (vii) special use.

The land use map prepared under six categories in level one during the year 2002. The categories are—(i) built up, (ii) agriculture, (iii) forest, (iv) waste land, (v) water bodies and (vi) others. At level two built up area has been again divided into four categories—residential, industrial, transport and public and semi public. Various factors, which are responsible for changing land use pattern of Guwahati are its locational advantage, physiographic condition, its historical background and possessing the only metropolitan city status of the entire Northeast India. These factors are also responsible for affecting the temporal land use change because, drastic change has been take place after shifting of capital from Shillong to Dispur in 1971. Growth of different industrial units are also
responsible for changing land use pattern in Guwahati. Different causes of land use are also analyzed in this chapter with supporting diagrams.

Fourth chapter is on land use change and environmental problems. There is close relationship between land use change and environmental condition. In this chapter, it is tried to analyse the relationship between land use change and its impact on wetlands, hills and residential areas. Water logging, traffic related problems and different types of pollution occuring as a result of encroaching both hill slopes and wetlands are highlighted, based on both primary and secondary data illustration and supplemented by suitable diagrams.

The beels and other wetlands are the temporary reservoirs, which maintain the storm water level and reduce water-logging problem. But this category of land is haphazardly encroached by the people in the name of development activities. The construction of multistoried residential buildings, institutions, industries and roads and railways are not only responsible for water logging problem in the city but also cause severe damage to the aquatic flora and fauna species and ultimately affect the ecosystem.

The natural slope of the hills has been disturbed by human interferences which cause landslides in different hills almost every year in the city. This is also responsible for siltation and creation of dusty atmosphere in the city specially after every shower. The general tempature of built up areas increased by more then 3° C compared to the surrouding rural areas.

The city is bounded by hills in all three sides. Therefore its horizontal expansion is restricted, which cause more congestion in high density zone. Insufficient drainage system, traffic congestion, noise pollution, disposing household waste and shortage of power are
the common problems faced by the city dwellers. Of all four areas the problems are more prominent in old residential and commercial areas.

Physiographic condition, unsystematic drainage network, blocking the drains by throwing waste materials, construction of broad gauge railway lines are the main causative factors that affect water logging in the city.

Traffic related problems are caused by increasing number of vehicles, narrow roads, shortage of parking places, attitudes of some drivers and the road side locations of some schools. Having the central location of whole Northeast, the city generates a large volume of passenger and goods traffic to and from the city.

Land pollution in urban area is basically related with disposal of solid waste, from household, municipal and industrial units. Removing green coverage is also responsible for degrading the soil texture and fertility.

Different types of pollution like water, air and noise are analysed in this chapter based on both primary and secondary data. The natural streams like Bharalu, Bondajan and Khonajan flow across the thickly populated area and carry waste materials, both liquid and solid from residential, commercial and industrial areas and cause water pollution. A major source of pollutants of Bharalu river is the oily effluents derived through a channel from the Noonmati refinery. On the other hand drinking water is also not safe. It is seen that the network of pipes for water supply passes through the roadside drains. The leakage and faults in this system allow the treated water to be polluted by drain water. Moreover, water treatment plants are also not sufficient to fulfill the demand of city dwellers, which causes different types of water borne diseases in the city area.
Overcrowding, excessive hill cutting, unplanned growth of residential, commercial and industrial areas, different constructional works, increase of automobiles etc are most responsible factors of air pollution in the city area. The physiographic conditions has also nurtured the rate of increasing air pollution in the recent years.

Using different types of automobile vehicles as a mode of transportation, burning woods and other materials as fuel by the low income group people and slum dwellers, burning of solid waste are also responsible for increase of air pollution.

A healthy man can tolerate intensity of sound up to 85 decibel (db) level. The sound intensity level has exceeded that limit in some areas of the city. The primary data also show it clearly that in all four zones, the people have the experience of high noise pollution. More then 30 per cent respondents state the high noise effect throughout the day. However, the highest level is shown mostly in the commercial areas. Silpukhuri records highest of 90 db in day time because of its thick population, market and traffic congestion. This is followed by the other areas like Guwahati Club, Chandmari, Ganeshguri, Fancybazar, Adabari, Beltola Chariali etc.

In the fifth chapter environmental change and its impact on human health is analyzed. For this purpose living environment of the people of slums and hills analyzed based on both primary and secondary data. Different types of diseases like water borne, air borne and mental stress are analyzed to find out the relationship between environmental change and human health.

Increasing movement of people from villages to towns and cities causes vast changes in the socio-economic conditions of urban areas. The rapid rate of population growth and lack of proper land use plan have created several problems including growth
of slum areas in almost all the large towns. The development of slums have brought many inconveniences in large area, degrade the aesthetic value and create pathetic environment of a locality. The existence of slums indicates prevalence of social inequality and economic deprivation. It is a real challenge for the planners and policy makers to bring about a development process that uplifts all sections of the society.

The city Guwahati has been experiencing very high growth rate since 1971, which indicates large inwards population migration. According to 1991 census, 57.8 per cent of total migrants to the city were rural of which 27.3 per cent were illiterate. These illiterate rural migrants definitely settled in slums and create pathetic, unhygienic living condition and leads to some anti-social activities in the nearby areas.

According to census of India, there is only 8,547 slum population in 2001. Guwahati Municipal Corporation enlists that more than 56 thousand slum population are there in 26 slum pockets in Guwahati. On the other hand Town and Country Planning Organization records more than 65 thousand slum population. Moreover, according to Guwahati Municipal Administration there are more than 1 lakh urban poor in Guwahati.

Among the 26 slums of the city area, renowned permanent slums are Bamunimoidam, that extend from Bamunimoidam railway colony in the east to Bhaskar Nagar in the west. It occupies a low lying areas adjacent to a swampy land. Maximum number of people living here are engaged in some low ranked jobs like rickshaw and handcart puller, mechanic and household worker, engaged in unorganized sector, collection of waste materials and engaged in some small business like vegetable vendor and wage labour.
Housing condition, bathroom and sanitation, water supply, solid waste disposal and sewage system and fuel use are the main drawbacks, which affect the environmental condition of the slums. Housing condition includes types and size of houses and crowding status etc. Availability of the water supply in the slums of Guwahati, found to be very poor. They generally collect water from broken points of municipal pipes and river Brahmaputra. Air and water pollution and preponderance of flies, mosquitoes and rodents are very common in these areas.

Use of dry leaves or wood, paper, plastic etc as their fuel along with kerosene has negative impact on environment because these create large amounts of smoke and carbon monoxide.

As many as 14 hilly areas are there in Guwahati. Hill settlement in Guwahati is not very old. Due to over congestion in the built up areas hill settlement started in the city. Some hill settlements were there in the early days by tribal people coming from different parts of Northeast. Another type of hill settlement seen in Guwahati is associated with temples. For example Kamakhya temple on Nilachal hill led to hill settlement in the said hill, which is at present very thick. Even Kamakhya was treated as separated township before 1970s. Initially hill settlement was there in foothill areas. But with the progress of time it extended to the high slope zones and at present even the steep slope peak areas of the hills are not spared.

Guwahati is prone to all sorts of water borne diseases. Slums and people belonging to poor living conditions become more prone to such water borne diseases. Dysentery, gastroenteritis, jaundice are more common water borne diseases. Unsafe drinking water associated with poor sanitation are responsible for such water borne diseases. Most part of Guwahati becomes vulnerable to such diseases mainly because of frequent water logging.
During rainy days the septic tanks, roadside drain etc get connected with the drinking water sources particularly who have shallow tube well and well water.

The most critical components included in the air mass are sulphur dioxide originating from the burning of fossil fuel and high-sulfur coal, particulate matter created by domestic fires, power and industrial plants and diesel engines etc. Serious air pollution has carcinogenic properties, which cause lung cancer. Some school buses, public motor transport, growth of industries etc. are responsible for creating air pollution.

Dusty and smoky atmosphere of Guwahati lead to air borne diseases. Except automobile and industrial effect, constructional works and water logging are also responsible for air pollution in the city area because at the time of water logging drain soil and mud come to the roads. These muds get dry as soon as water gets drained out. The motor tyres spread the dirty dry mud into the atmosphere and make the city environment dusty.

With the introduction of different advanced occupational opportunities, people are engaged in more than one occupational activity, which causes the shortage of free time and reduce social and public relationship. They are always under compulsion to follow a strict time schedule. Especially the dual career couples are constantly worried about their home affairs, children, elderly parents, education of their children, health related problems and some other official duties, which ultimately leads to the mental stress.

On the other hand, noise from various sources puts great strain on nervous system of city dwellers. Noise cause some kinds of physical, physiological and psychological harm or stress to human beings and cause severe health hazards.
In the sixth chapter, environmental change and socio economic issues have been interpreted, which included environment and population, education and occupation, awareness on land use and environment, land use change and impact on economy, impact on socio cultural life and remedial measures to minimized the problems created by changing land use pattern to make Guwahati a better livable city.

There is a close relationship between population and environment. Moreover, it can be said that human activities totally depend on environmental factors. Therefore, it is very essential to study the population pattern to find out the man land relationship and its impact on environment. The population of Guwahati city is increasing day by day with a very fast rate, which is responsible for increasing population pressure on land. Population growth in Guwahati in first 30 years from 1901 to 1931 was less then two times i.e. 11.6 lakh to 21.6 lakh. But from 1951 to 1961 i.e. only in 10 years population increased in the city more then 2.3 times (43.6 L in 1961 and 100.7 L in 1961). Significantly from 1971 when capital was shifted to Guwahati till 1991 population of the city increased by more then 4.5 times (123.7 L in 1971 to 557.6 L in 1991)

The family pattern is acting as most effective criteria to know the land use pattern. In Guwahati, individual families are more common then joint families. On the other hand, in commercial zone the number of joint families found to be more in number. One of the important points is that in commercial area like Fancy bazaar, Pan bazaar etc some male persons of different families are living in the same building leaving their family at their native places so that they can concentrate only on earning.
Large number of people migrated to the city which increased population pressure in Guwahati. The maximum numbers of people who migrated to Guwahati are from other towns of the state. One of the most effective points of pressure on land in Guwahati is migration of large numbers of people from their original places to newly built up areas for better opportunities and to enjoy better standard of living.

Occupation and education are the main reasons behind the migration of the people towards Guwahati. Except these two main causes some other causes of migration are identified which are social, political, marriage and cosmopolitan nature of the society in the city.

The maximum number of population found between the age group of 26 to 60 years, which indicate a strong work force is there in the city. The children of lower age groups are comparatively less in all four areas. In addition, the population growth seems to have a declining trend in the city. It may be due to individual small family system and adoption of one child concept.

The environmental change and its impact on the city environment are associated with the land use and land use changes. The proper built up area is highly congested, which is responsible for various environmental problems. The dense forest areas have decreasing substantially whereas built up areas are increasing at a very high rate. It is due to the growing congestion of human settlement particularly after the shifting of capital from Shillong to Guwahati. There are some other causes, which are directly related to changing land use pattern of the Guwahati as well as its environmental degradation in the recent years. These causes are population pressure, land use change, occupational opportunities, competitive and professional educational facilities with national and international level institutions,
economic set up with fast changing economic activities, advanced household amenities and cosmopolitan nature of society.

Land use change has occurred mainly due to residential, commercial, transport, recreational, garbage dumping, industrial and public amenity development. The consequence of such activities on the city environment reflected on various aspects. Congestion in residential areas, unsystematic growth of various infrastructure, traffic congestion, accident, pollution at various spheres, ugly look of some parts of the city and many inconveniences are the consequence or impact of such land use changes.

With the implementation of advanced modern technology, man is able to live at any place of the world irrespective of the physical or natural phenomena. But it has some negative impacts on natural environment, which cause different types of environmental problems and also create some environmental hazards. Therefore, environmental awareness is very essential to overcome the problem of environmental degradation. The subject environmental education is newly introduced in our curriculum to develop environmental awareness and to improve the quality of environment for desirable modification of behaviour.

Undoubtedly the environment of Guwahati is deteriorating in the recent years, which is clearly reflected on increasing traffic congestion, pollution and water logging and related issues. Under such conditions to keep the Guwahati a liveable city, general awareness in regard to settlement sites, pollution control, garbage disposal etc are highly essential.

Occupation and land use are directly related with one another and also have direct impact on environment. Occupation like agriculture, industry and mining are directly related to land use pattern, which leads to different environmental problems. Except these,
movement of people from one place to another and living near by locality for occupational purpose is also responsible for changing land use pattern and environment related problem.

It has been scientifically proved that due to hill cutting and encroaching wetlands hazards like water logging have occurred. The landslide frequency has increased in the recent years mainly due to human interference on hills. In spite of that, people in general are not aware of such cause and effect relationship. The people of Guwahati have used their occupied or owned land for constructing not only residential buildings but also for car parking, constructing rented houses, garden and lawn making, seasonal flowers and vegetable raising etc. Some of such activities like garden making, vegetable raising etc are environment friendly while the land use for car parking rented house constructing are against environment. As a result of the changing land use pattern, whole habitat lands are badly affected. Hill cutting, lowland encroaching and forest destruction, slum growth are some of the major environmental problems in Guwahati caused by changing land use pattern.

Economic status of the city area is also changing with the changing land use pattern. With the establishment of different industries and business organizations, the income level of city dwellers is increasing day by day, which also upgrade the standard of living of the city dwellers. With the upgradation of economic standard and availability of advanced house hold and technological equipments, people are kept busy with their own interest ignoring the social relationship and responsibility. There is shortage of open space for playing and other outdoor activities and therefore, children and elderly people are also under compulsion to be busy with computer, T.V. etc, which affect the socio cultural affairs of the city dwellers.
Shortage of land for residential houses has brought about changes in the house types. The beautiful and comfortable Assam type houses have losing its position, as it is not sufficient to fulfill the requirement of the increasing population of Guwahati.

7.2. FINDINGS:

The study investigates the changing land use pattern and environmental problems of Greater Guwahati area, Assam. The problem includes the land use pattern, factors behind the land use change and its effects on environment, different environmental problems, and their impact on human health as well as socio-cultural aspects of the society.

The study area has been divided into four different zones; (i) old residential area, (ii) newly included GMD area, (iii) newly built up area and (iv) commercial area, which have some specific characteristics related to is house type, roads and drainage network, urban function etc.

The major findings of the study are :-

Taking the advantage of convenient location, Guwahati grows as the main center of trade and commerce of entire Northeast. It is well connected with each and every urban centers of the whole region and becomes a point of attraction for the people of different corners of the state as well as whole Northeast India. The location of Guwahati is such that horizontal expansion is not possible in all directions. The horizontal expansion is possible only through narrow corridors towards east and west.

Population pressure is the main reason behind rapid changes of the city in every aspect. It has increased substantially after 1971, just after the shifting of state capital from Shillong to Dispur. Fast growth of population is mainly responsible for land use change.
Conversion of dense forest to open forest is seen, as the forest got destructed for timbers which were also used for residential purposes. Agricultural land is decreasing as dwelling houses, different institutions and industries have occupied the agricultural fields. The wastelands and water bodies are changed, mainly because of conversion of wasteland to built up land. The changes also observed in the same way in case of rivers, tanks and lakes and also riverine sands.

Built up areas are increasing day by day while other types of land use gradually decreasing. Residential area increased more then other categories. The trend is same in case of public and semi public built up land categories also. Older built up area is highly congested of which 52.28 sq. km. (14.76% of total land) area falls under high-density residential area in 2002.

Initially hill settlement was there in foot hill areas but at present even the steep sloped peaks of the hills are not spared. For the changing settlement pattern almost all the trees on the hill slopes have been removed, for which the consequences are water logging, massive siltation in the foot hill areas. All the hill slopes are haphazardly terraced and used for constructing dwelling houses.

The construction of houses in the hill slopes without considering ecological implications led to the instability of the hills slopes resulting in manifold increase in the occurrence of landslides. Removal of vegetation cover, terracing in the hill slopes, construction of residential buildings and roads are mainly responsible for the landslides in the city. Landslides occur frequently during the monsoon season. About 90 per cent of landslides occur during the first three months of the monsoon.
The wetlands are gradually decreasing as more and more areas are encroached for constructing multi storied residential flats, industries and institutions of different levels in the name of development.

The congestion in residential areas lead to many environmental problems and inconveniences in Guwahati. The run off erosion causes drainage problem and nurtured the problems of siltation, flash flood, water logging in many residential and commercial areas.

The city is slopping towards west direction. The natural drainage system of the area is totally controlled by the general slope of the city area. Many of the drains have been relentlessly constructed against the natural direction of flow. The mushrooming of settlements on either side of the perennial drains restrict easy flow of water. Drain-cum-footpaths are also not adequate to carry storm water from the busy area of the city. Construction of the broad gauge railway lines through the heart of the city by ignoring the master plan recommendation is also responsible for the existing inadequate drainage system of Guwahati. Drains are comparatively narrow and not sufficient to carry wastewater of the locality. Drains are blocked by boundary walls, solid wastes, mud flow and sometimes for some constructional wastes, which are not cleared regularly. As a result they remain stagnant almost through out the year. The presence of depressed areas, usually promote the tendency of collection of water in scattered areas after every heavy showers. Construction of residential flats and pulling of ground water caused lowering of under ground water day by day.

The industrial area, which was only 1.8 sq km in 1967 has increased to 4.3 sq km in 2002. Little variation has been observed in case of built up land category under transportation head. The land use for transportation has not been sufficient to fulfill the
demand of increasing number of vehicles. The roads are squeezing and land kept for transportation and communication have been used for other purposes. The number of vehicles of all kinds increased many fold with a fast rate. On one hand shortage of parking places and on the other narrow roads cause traffic related problems. Traffic congestion problem is common at school and office hours in all four areas, but it is more acute at evening time particularly in old residential and commercial areas. The number of bicycles and other non-polluting vehicles are very few in all the areas of the city.

Solid waste management has been an issue of major concern since the last two decades. Land pollution in Guwahati is basically related to disposal of solid and liquid wastes from both industrial and municipal areas. The dustbins are provided by GMCA but it is not sufficient for which some people have throw the household wastes in the drains and roadsides.

Scarcity of drinking water has emerged as a major problem in the city. With the increase of population at a very fast rate the shortage of drinking water is increasing day by day. At present only one-third of the population have been able to avail the drinking water facility from Guwahati Municipal Corporation and others through water supply pipes. Polluted water at the source is responsible for occurrences of different water borne diseases like typhoid, hepatitis, gastro-enteritis, skin diseases etc. The man made drainage system of the city also acts as a major source of water pollution. The mixing of wastewater from households, industries, commercial and business establishments etc. have contaminated the surface water. The Noonmati refinery releases its oily effluents in the natural stream which cause major water pollution in the river Bharalu joins at down stream areas.

The toxic materials, which are found available in the lower level of atmosphere in the city area are fine clay particles, dry organic matters of municipal waste, sulphur dioxide,
carbon monoxide, unburnt hydrocarbon mixed with water vapour, a noxious mixture of 
fog and smoke. Uses of wood, kerosene etc create large smoke, which is dangerous to 
city environment. Overcrowding, indiscriminate hill cutting, unplanned growth of residential, 
commercial and industrial areas, different constructional works, water logging, burning of 
fossil fuel by large number of motor vehicles lead the air pollution of the city area. The 
uneven topography, the geographical conditions and climatic factors and elements like 
circulation of air temperature, radiation level etc aggravate the air pollution problems in 
different localities.

The noise pollution level of Guwahati has been crossing comfortable levels with 
times, which makes Guwahati as one of the noisiest cities of the country. The main sources 
of noise in Guwahati are automobile engines, construction equipments, industrial activities, 
loud speakers, bursting crackers etc. Silpukhuri records highest of 90 db in day time because 
of its thick population, market and traffic congestion which is followed by the other areas.

There are 26 slum pockets in Guwahati. The Town and Country Planning 
Organization records shows that slum population is more than 65 thousand. On the other 
hand according to Guwahati Municipal Administration Department there are more than 1 
lakh urban poor in Guwahati. The riverside slum is a temporary one that grows usually in 
winter season, which spreads over the southern bank of the Brahmaputra river from 
Fancybazar to Machkhowa. The economic conditions of the people of riverside slums are 
very poor. The slums of Guwahati specially in Lakhtokia and riverside slum areas have no 
bathroom facility. Only in Dhirenpara area both toilet and bathroom are available.

Changes occurs in case of house types, house hold equipments and standerd of 
living. Guwahati is prone to all sorts of water borne diseases. Dysentery, gastroenteritis, 
jaundice are more common water borne diseases. During rainy days the septic tanks,
roadside drain etc get connected with the drinking water sources particularly who have used shallow tube well and well waters. Serious air pollution has carcinogenic properties causing lung cancer. Some school buses, public motor transports are responsible for creating air pollution, which may contribute to such diseases. The people who are engaged in transport and networking like rickshaw pullers, hand carters, city bus drivers and conductors, traffic police personal, vendors and also school going children are affected by air pollution, which causes dry cough, allergy, eye infection, poor visibility, influenza and skin diseases etc. The pollutants which are responsible for such diseases are in brief the fine clay particle, dry organic matters of municipal wastes, sulfur dioxide, carbon monoxide, unburnt hydrocarbon mix with the water vapour and a noxious mixture of fog and smoke.

The increase of mental stress among city dwellers is emarge as a problem in recent years. Following a strict time schedule to maintain the balance between occupation and domestic affairs cause the mantel stress. It is more acute among the dual carrier couples. The noise from various sources put great strain on nervous system of city dweller, which is responsible for some kind of physical, physiological and psychological harm or stress to human beings and cause severe health hazards. Loud and continuous noise reduces the working efficiency, interference with communication, increases the frequency of errors, reduced the mental capability, interferes with deep sleep and interrupts sleep, which are also responsible for hearing damage, rise of blood pressure and some other cardiovascular disorders. Lack of proper housing facility, traffic congestion, noisy road, pollution and improper civic amenities brought lot of mental stress to the city dwellers as well as city users who are remain busy throughout the day. Shortage of open space has made the people to stay at home and with computer and T.V. under compulsion particularly the elderly people and small children, which bring the feeling of isolation and make them unsocial.
7.3. SUGGESTION:

With the increase of population at very fast rate and with fast land use change, the problems of the city are increasing day by day. Therefore, to minimize the existing problems some remedial measures are required, which can make Guwahati a better liveable city.

Some remedial measures, which have been identified in course of the study are:

i. Land use should be done in a planed manner.

ii. Urban amenities, particularly education and medical facilities should be improved in other towns of Assam, so that migration to Guwahati could be minimized.

iii. Better occupational opportunities in other places of the state should be ensured, which may help in minimizing the population pressure in the city.

iv. Indiscriminate earth cutting should be stopped at any cost.

v. Hill settlement should be strictly prohibited.

vi. Wherever possible aforestation programme must be undertaken on the hill slopes to prevent siltation, mud flow and land slide problems.

vii. Encroachment of low-lying areas should prevent and water bodies should be preserved to overcome the water logging problem.

viii. Implementation of advanced, up-to-date plan to preserve and manage Guwahati for our future generation is of umpteen needs at this moment.

ix. The proper parking places should be arranged and footpaths should be cleared for walking people to minimise the problem of traffic obstruction.

x. The drainage system of the city should not be connected directly to the Brahmaputra river just to save the river from water pollution.

xi. To avoid slum and squatter settlements basic facilities to be provided for the poor and newly migrated people to the city.
The slums, which have already been developed should be given priority to provide required facilities so that the city environment could be made better.

Restrictions to be imposed in addition of motorised vehicles and existing laws to be enforced to minimise pollution.

Adoption of different social awareness programmes may be helpful for developing a strong social relationship and preventing the anti social activities.

Introduction of appropriate technology and enforcement of law are also found to be essential to keep discipline and provide better living environment in the city.

7.4. CONCLUSION:

Undoubtedly, the land use pattern of Guwahati has a drastic change with the rapid increase of population, which cause a major impact on its environmental conditions. As it is the only metropolitan city of the whole Northeast and the capital city of the state it has some advanced amenities and administrative importance. Its locational advantages and well networking system with every urban centers of the state, other Northern states as well as countries by different means of transportation make Guwahati the point of attraction of different groups of people belonging to different corners, for which now Guwahati has become overcrowded. Haphazard growth of built up areas, encroachment of hills and wetlands, destruction of forest cover in the name of development leads to different types environment related problems. Air, water, land and noise pollution are not only affecting the human health but also affect the whole ecological set up the city. Therefore, time has come now to think deeply and to adopt some scientific measures for proper land use and to protect Guwahati from different environmental problems, so that it could be kept a better liveable place for our future generations.