

Degradation of Natural Resources and its Impact on Environment: a Study in Guwahati City, Assam, India

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Abstract- Degradation of natural resources and environmental pollutions are most concerning subject in present day context among the social scientist as well as the environmentalist. As the population increase day by day the amenities are not improve simultaneously. With the advancement of science and technologies the needs of human beings has been changing rapidly. As a result different types of environmental problems have been arising. Guwahati the capital city and the gate way of north east India is also not exceptional on it. After the shifting of the state capital from Shillong to Dispur, the city has been faced lots of problems which impact on the degradation of environment and poses as a threat to the biodiversity. In the present study, an attempt has been made to provide a comprehensive study of the degradation of natural resources in Guwahati city and its impact on the environment. The study is based on primary and secondary data which has been collected from the field and different sources. The findings reveal that the mushroom growth of multistoried buildings, encroachment of hillside and wetlands, improper disposal of municipal solid waste makes the city environment worsen. The only river Bharalu converted as a most polluted river in India. Deeparbeel, only world ramsarsite of Assam has lost it's water quality. The study is concluded with a few fruitful suggestions, which may be beneficial to encourage the competent authorities/ researchers to work towards to stop further degradation of environment pollution.

Index Terms- Flash flood, Natural resource, Pollution, Solid waste, Water body

I. INTRODUCTION

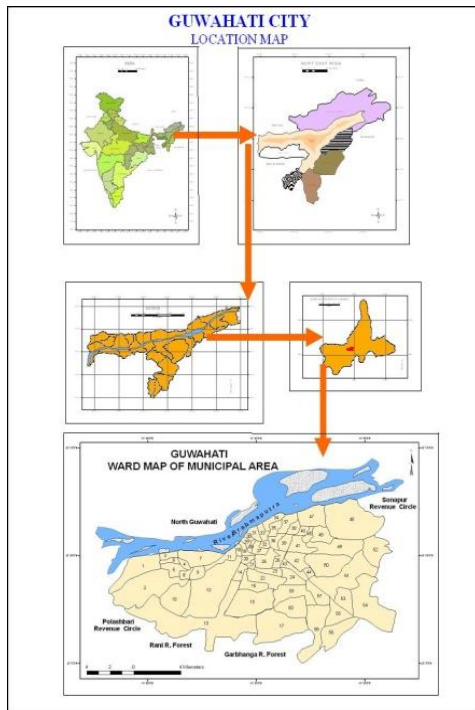
Degradation of natural resources can also mean a loss of biodiversity and a loss of environment in an area. Natural resource degradation is not a new thing, it has been happening all over the world for centuries. The problem is that it is now occurring at a much faster rate, therefore not leaving enough time for the environment to recover and regenerate. The greater demands placed on the environment by an ever increasing human population is putting a great strain and drain on the earth's limited natural resources. Gradually it effect on natural environment and polluted it.

Guwahati, the capital city of Assam is one of the fast growing urban centres of India. Due to rapid growth of population, transport network, trade and commerce and industrial activities, the flow of labour group of people to the city is increasing tremendously. They are creating unauthorized settlements affecting the existing as well as proposed land use pattern of the city. Moreover, these unauthorized or squatter

settlements are not confined to existing or proposed residential areas. Rather, these develop in the areas are not suitable for habitation, like hill slopes, swampy lands, areas by the side of the railway track and riversides. Growth of settlement in these areas has negative impacts on the environment in the form of loss of vegetation cover and biodiversity, soil loss, land slide, flood, etc. The location and distribution of these settlements in a city may influence the degradation of natural resources.

Guwahati is said to be the legendary Pragjyotishpur, the city of Eastern Light. The city has a rich historical past and finds frequent mention in medieval historical sources. The city is lying at the south bank of mighty river Brahmaputra is bounded by 91°38'E and 91° 51'E longitude and 26°5'N and 26°12'N latitude (Map-1). The whole city region is an undulating plain interspersed with a number of hills and wet lands.

The emergence of modern Guwahati started in 1826. The town was connected by railway line with rest of India in 1890. Guwahati experienced phenomenal growth after independence of the country following the establishment of major institutions of higher education. Guwahati is situated on the bank of river Brahmaputra. It is located towards the south eastern side of Kamrup district, which is surrounded by Nalbari district in the north, Darrang and Morigaon district in the east, Meghalaya state in the south and Goalpara and Barpeta districts in the west. The physical feature of the city is an undulating plain with varying altitudes of 49.5 meter to 55.5meter above mean sea level. The southern and eastern sides of the city are surrounded by hillocks. Apart from the hilly tracts, swamps, marshes, water bodies like Deepar beel, Borsola beel & Silasakoo beel, Silpukhuri, Dighali pukhuri, Jorpukhuri and Nagkota pukhuri also cover the city. Guwahati is the largest urban center in Assam comprising of 24% of the total urban population of the state. The population within Guwahati Municipal Corporation area is 809,895 as per 2001 census. Guwahati has 60 wards according to Guwahati Municipal Corporation which covering an area of 216 square kilometer (Gogoi,2012):.



Map no.1 Location Map of the City

Objectives of the Study: The present study aims to-

- Identify the factors that effect on degradation of natural resources.
- Know the degradation pattern of natural resources.
- Find out the impact of degradation on environment.

II. MATERIALS AND METHOD

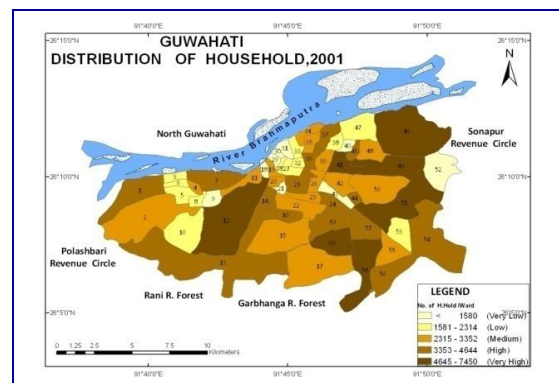
The methodology adopted to study the degradation of natural resources and its impact on environment, necessitated the use of primary and secondary data. The unit of observation has been confined within the limits of Guwahati city. The study being geographical, both primary and secondary data have been collected in order to arrive at a clear conclusion. The study has been carried out in three phases - pre field work, field work, and post field work. In the pre field stage secondary data has been collected from diverse sources like Guwahati Municipal Corporation, Guwahati Metropolitan Development Authority, Town and Country Planning office, Census of India and visiting various web sites. General information on Guwahati regarding land use, physical characteristics, industry etc. has been collected from different official records and libraries. Over and above, discussion and focused interviews were held with various stakeholders to gain insight into the problems related to resource degradation and its impact on environment. The conclusions of the study have been drawn on the basis of the findings derived from the analysis of both primary and secondary data and also from personal observations in the field.

III. RESULT AND DISCUSSION

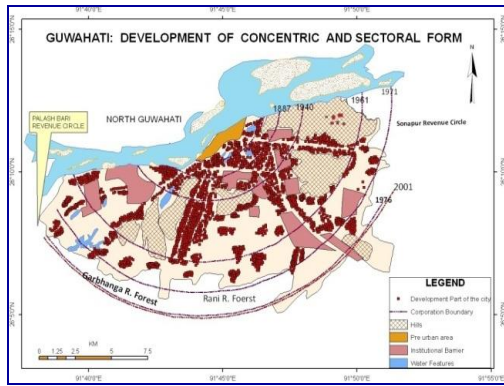
Factors That Effect on Degradation of Natural Resources:

As had been evident with urbanization across the developing world, the city attracted or and continues to attract all classes of migrants who became its residents. On one end of that migration were the elite who arrived and rapaciously cornered the best residential and commercial spaces with scant regard to civic or environmental concerns, and even breaking or bending laws at will; and on the other end the impoverished whom the city enabled to eke out a living who had to find spaces to take shelter wherever they could, even encroaching on forest land. Guwahati the capital city of Assam and gateway of north east India is facing heavy population flow from inner and outer side of the city. As a result the percentage of area under residential use is increasing continuously although the total area considered has been increased to some extent. This is definitely due to the growth of population. But there is no substantial increase in area under other uses like transportation, market places, green belt and recreation. This indicates that development in basic services is at a far slower pace than the growth of population.

Transfer of capital and establishment of new industry and rampant growth of commercial activities added salt into the problem. Encroachment over vulnerable lands, growth of several new colonies, filling up of low lying areas for residential establishments led to abrupt and abnormal horizontal expansion of the city. All legislative checks and control on land-use pattern for planned development of the city was foiled completely. The physiographic set up of the region has important bearing on land use pattern and planning of the city. The city is growing rapidly in last few decades with growth rates of 131.60 in 1971-1991 and 38.59 in 1991-2001. The total area of the city was only 43.82 square kilometer in 1971. In 1974 it came under the administration of Municipal Corporation with 34 wards and the area increased to 216.79 square kilometers (Govt. of Assam, 1999). In this way the development of Guwahati is being started in sectoral form (Map-3). The municipal area remains the same in 2001 also, although the area under Guwahati Municipal Development Authority or that of Greater Guwahati has increased to 262sq.kms. The total population has increased from 252305 in 1971 to 809895 in 2001(COI, 2001). The density of population is 3735 persons per square kilometer in 2001. Due to undulating surface the distribution of household in the city is not equal. The distribution of household is shown in map number 2.



Map no. 2



Map no. 3

Guwahati since 1972 has been the capital of the reorganized state of Assam. Before 1972 it was never a state head quarter in modern times except for a brief period, though in ancient times the area was location of various pre-historic urban settlements. As a head quarter of the state administration, the city became the central place of the state with respect to various Government services, more intensive linkage with its hinterland and better linked in terms of transport and communication. These factors contributed to enormous density growth of Guwahati during 1971 – 2001 as can be seen from table number 1.

Table - 1: Growth profile of Guwahati in relation to urban growth in Assam.

Year	Population (000)	Decadal Growth	Share (%) In urban population of Assam
1901	11.6	-	15.13
1911	12.5	7.03	13.43
1921	16.5	32.04	12.97
1931	21.8	32.26	13.44
1941	29.6	35.79	14.22
1951	43.6	47.36	12.65
1961	100.7	130.9	12.89
1971	123.7	22.9	9.6
1981	200.3	61.87	11.24
1991	557.6	188.25	23.22
2001	809.8	38.6	24

In 1901 the population was 11661. In 1921, the rate of population increase was 32.40 percent (12481 to 16480). The rate of increase for next decade (1931) was also the same that means 32.22 percent (217970). The significant development

during the British period was the establishment of the cantonment at Paltan bazaar, opening new lines of transport and communication and improvement of old ones within the town which were added to the city. During the decade 1931-1951, the city recorded an increase of population of 35.78 percent i.e. from 21797 (1931) to 295698 (1941) from 1951 to 1961 the population increase was significantly, from 43615(1951) to 10072(1961). With the increasing and expansion of population and their activities the land use pattern has been changing day by day and as a result of this the natural resources are decreasing day by day. The table 1 shows the landuse pattern of the city and it also shows how natural resources are degrading day by day by the human activities from 1977 to 2007.

Table - 2 : Areas under Different Land Use Categories in Guwahati, in Km2 (%), 1977-2007.

Land Use Category / Year	1977	1999	2007
Agricultural Land	15.79 (7.00)	12.46 (6.00)	9.85 (5.00)
Barren Land	30.68 (14.00)	17.5 (8.00)	0.36 (5.00)
Dense Forest	40.76 (19.00)	35.9 (17.00)	23.0 (11.00)
Swamp	24.07 (11.00)	21.1 (10.00)	94.5 (44.00)
Built up Land	49.02 (23.00)	70.3 (32.00)	94.5 (44.00)
Open Forest	7.96 (4.00)	11.9 (5.00)	15.8 (7.00)
River	21.56 (10.00)	25 (12.00)	22 (10.00)
Sand Bar	15.9 (7.00)	12.1 (6.00)	1.14 (6.00)
Scrub Land	10.45 (5.00)	9.7 (4.00)	9 (4.00)
Wetland	0.6 (.003)	0.6 (.003)	0.58 (.003)
Total Area	216.79 (100)	216.79 (100)	216.9 (100)

Source : Borah .J, and Gogoi B, 2012

On the basis of remote sensing data, there has been considerable decrease in agricultural land (from 7% to 5%), barren land (from 14% to 5%), dense forest (from 19% to 11%)

and swamps (11% to 8%) during the period 1977 – 2007. As expected, the area under built up land has increased tremendously, i.e. from 22.61 per cent of the total area to 43.59 per cent with a rate of increase of 3.09 per cent per year. By analyzing the land use data it has been found that the rise in built up area is at the expense of forest land, barren land, agricultural land and swamps. In the earlier decades i.e. in 1970s and 1980s the expansion of built up area was mainly at the cost agricultural land (ARSAC, 1991). The hills in the city have dense and open forests cover. Clearance of these forests has resulted in degradation of natural resources and leads to pollution of environment.

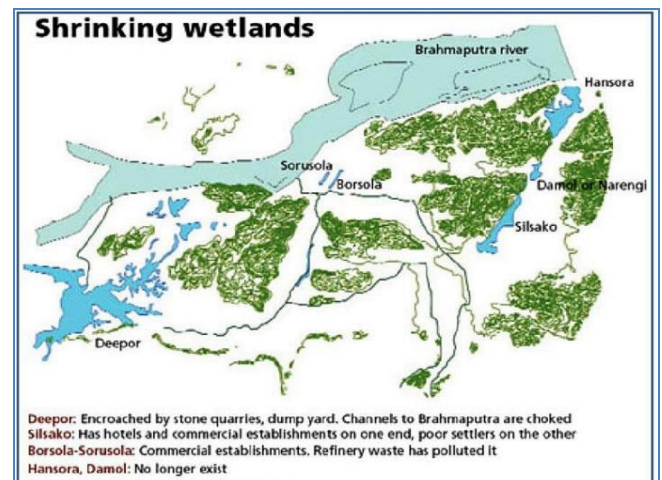
Degradation Pattern of Natural Resources:

The increasing population has created a lot of civic and environmental problems in Guwahati. Influx of the immigrant both from inside and outside the state into the city is the prime factor of population explosion. Unplanned growth of city functions resulted into the present chaotic civic situation in the city. The natural environment is progressively destroyed for unplanned construction of buildings and roads, release of industrial wastes to the drainage channels, stagnation of filthy water in the intermittently unfilled depressions, which become the breeding place of mosquitoes, etc. have created serious problem of natural resource degradation and environmental pollution, endangering the health of civic life of Guwahati.

Natural resources are precious gift of the nature to the human beings. A country or an area may be rich by its own natural resources. Guwahati the capital city of Assam is rich by its natural resources and it attracts people from the pre historic period. Diverse landscape pattern along with rich flora and fauna, historical and religious monuments makes the city more attractive. The surface of the city is not plain. It has many hillocks and numerous surface water bodies comprising wetlands and ponds which hold water for a considerable period of time after the rains. Different rare species of wild animals, snakes and butterflies, plants including orchids are found on the hills. Wetlands are considered as a natural resource because it is the habitat of various aquatic plants and animals. The wetlands are locally known as beel and name of the beel found in the city are Deepar beel, Hahsora beel, Narangi beel, Silasako beel, Borsola beel and Sarusola beel. Among these the Hahsora, Narengi and Silasaku are located in the eastern part of the city while the Sarusola and Borsola in the middle part and Deepar beel in the western part (Map-5).

Wetlands are the kidneys of nature. They recharge groundwater and serve as storm water deposits. People depend on them for fishing and agriculture. They also influence a region's micro-climate. Borsola-Sorusola and other wetlands which are critical storm water basins are either polluted or encroached upon. Pollutants from the Noonmati oil refinery, owned by the Indian Oil Corporation, have turned the water at Sorusola black. Borosola looks like a garbage dump. Flanked by the landfill on one side, Deepar beel, as the wetland is called, was notified Ramsar site for 40 sq km area. Now, only 10 sq km is available for water spread. On the southern end of Deepar are stone quarries, adjacent to the Rani-Garbhanga reserve forests, a

crucial elephant corridor and habitat of the hoolock gibbon. Intermittent blasts, thick dust from the quarries and constant groaning of trucks make Deepar look more like an industrial hub. Quarrying within Deepar has pushed this once-pristine ecosystem to the brink of disappearance, says a Planning Commission field report of 2008. It also fixes the blame on construction of a railway line, large-scale encroachment, heavy siltation from the denuded hills, accumulation of filth and waste from the Bharalu and Bahini rivers, unregulated fishing practices and invasion of aquatic weeds.



Map no.5

But Guwahati has grown in the last two decades because of construction work on its wetlands. The national highway to Dispur, which once had wetlands on either side, now has shopping malls, apartments and showrooms. Residential areas like Tarun nagar and Lachit nagar are also built on wetlands.

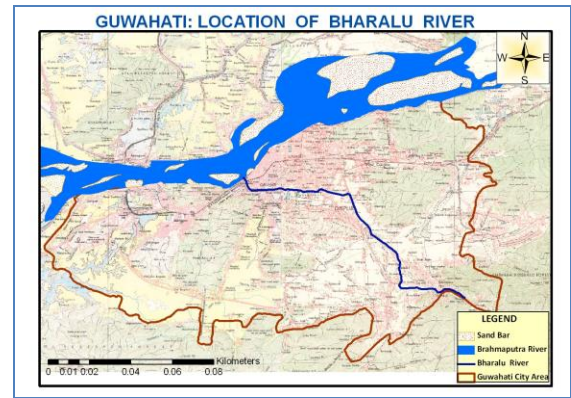
The large number of wetlands that Guwahati once had is now being reduced to fragmented forms. With the growing population and increase in the buildup area, the aforesaid beels have a significant role and it will be appropriate if each of these is dealt with separately. Though there are also a number of small streams emerging from the surrounding hills that flow through the city, yet most of them have been converted into constricted drains by the encroaches and because of the disposal of waste by the inhabitants. Deepar beel which has been designated as a Ramsar site in 2002 is facing encroachment in a big way. The 24 hectare municipal dump yard lies on the eastern corner of Deepor, a biodiversity-rich wetland near Guwahati. It is also the lone Ramsar site in Assam. Wetlands of global importance are conserved and protected through the international treaty, Ramsar Convention. The dump yard came up in 2005, three years after Deepor was declared a Ramsar site.

Sola beel, one of the notable wetlands of Guwahati city, is situated near Paltan Bazaar. The beel once provided a habitat for a large number of flora and fauna and receives rainwater from nearest hills and plains is now transformed into a

Dumping site. The misfortune of this beel (wetland) started when the Revenue Department initiated the process of issuing land documents to the people who started residing on its banks. While issuing such land documents, the importance of this wetland as a storm water reservoir was not taken into consideration. Encroachment started on the lake and as a result, the size of the beel started shrinking rapidly. Silsako, once a 120 hectare wetland, has turned into a grand multiplex. It has a tennis court, a hotel owned by the Tata Group, a hotel management institute, an institute for social studies . On the other side of Silsako are over 1,000 hutments. Most families settled here about 15 years ago. The collapse of the rural and agricultural economy post-1990s and the boom in construction and service sector around Guwahati fuelled this migration.

Among the several tanks located in the city the major ones are Joor pukhuri, Dighali pukhuri, Nagkata pukhuri and Silpukhuri . Besides the tanks there are several natural springs in Guwahati city which are located in the hills. The river Bharalu is the main natural drainage line flowing through the city and is the outlet through which the city's whole sewage is disposed to the river Brahmaputra . The upper part of the Bharalu is known as river Bahini, which has already been diverted by a canal to the river Basistha near the military Hospital. The river has been conveniently diverted near Dispur to straighten the meander and is ultimately connected with Basistha at Dakhingaon. From here the river flows towards Deepar beel Via Mora Bharalu. The closure of the sluice gate near the Pragjyotish college results in the accumulation of the rainwater from the catchments area in the drain. As this water cannot flow out through the Mora Bharalu(dead river) to Deepar beel, the shallow and narrow channel of Mora Bharalu fails to clear off the accumulated water with any great speed. This keeps the water level of the Bharalu river high for weeks together and causes water logging in the entire low-lying areas of the basin. The middle part of Mora Bharalu river bed is at a higher elevation due to which it fails to carry off the normal discharge.

Bharalu is the only river that is within its entry and exit of Guwahati City and it is the most polluted river in Guwahati (Map-6). It flows through the city with many pollutants. The water of this river is not suitable for uses. It is observed that human activities along the river with visible encroachment to the banks, contribute to the heavy level of pollution of the river. This is the section that industrial discharges and municipal sewerage are discharged into the river. Human settlements along the Bharalu river have increased dramatically due to the growth of the city and population increase.



Map no.6



Waste dumping in Bharalu

This has raised serious concern for the environmentalists on the area of Bharalu river for the last two decades. The river has seen a massive deterioration in quality with the increase in population of the city. This increase in the city's population coupled with a sluggish economy has led to the mushrooming of slums, which tend to reside next to the riverbanks of which sanitation facilities are non-existent. Since the communities are not served by amenities and public utilities, they have tended to discharge their raw sewage into the streams next to them. This has led to the well being of communities living downstream of the Bharalu river being adversely affected. Also lack of environmental awareness and law enforcement capacity has left Guwahati residents with a deplorable situation impacting adversely on all who live in, or indeed visit the city.

Impact of Degradation on Environment :

As all these natural reservoirs of water are being encroached and filled up as a result flood has become a regular phenomenon in the city leading to an unhealthy situation .Like other old cities of India, Guwahati has also the bitter legacy of urban sprawl and unplanned growth. Topographic constraints, non-existent urban planning and particularly, encroachment on public land and non-enforcement of municipal regulations are the main reasons those have turned Guwahati into one of the unplanned city of the country. Degradation of natural resources and create environment problems like soil erosion and siltation. Loss of forest cover is an important contributing factor to the occurrence of land slide in the city in recent years. Landslide now becomes a common environmental hazard all over the world. The nature of slope and the geomorphic processes induce

landslides, but it became more hazardous as soon as the settlement process started on the hills (Sarma, S. 1988).

The hills of the Guwahati city are coated with a thick layer of immature soil with low permeability, which naturally became more landslides prone during rainy season. There are 18 hills in Guwahati out of which many are landslide-prone. The State Soil Conservation Department has identified 8 of the 18 hills in Guwahati city as unfit for human habitation by virtue of being landslide-prone. The Kharguli, Narkashur, Fatasil, Panjabari, Noonmati, Upper Hengrabari, Gotanagar and Jyotinagar hills are prone to soil erosion or landslide.

Unauthorized rapid growth of settlement on the hills is said to be the root cause of most of the landslides. In addition, major deforestation has contributed to the existing malice. The frequency of landslides increases with the increase of settlement. Majority of the landslides since 1990 have occurred in the low and moderate risk zones because of ever-increasing human habitation. The hills, which are currently in the low landslide-prone category, will soon become high-risk zones because of rampant encroachment. Degradation of natural resources in Guwahati has also affected the city's biodiversity and has led to the rise in incidents of man-animal conflict.

Earth-cutting and deforestation on the foothills has emerged as a grave environmental hazard, adversely affecting the fragile hill eco-system and triggering a host of civic woes for the residents of Panjabari, Khanapara, Basistha, Beltola, areas.



Degradation Soil cover in Guwahati

Flash floods, waterlogging and dust pollution have aggravated in the area due to the deforestation and earth-cutting in the foothills. Once a picturesque area with verdant hills on both sides of the meandering highway, Jorabat's beautiful landscape now stands disfigured with ugly scars due to the vandalism taking place on the foothills. With much of the green cover of the foothills now eroded, particularly those on the Meghalaya side, the red topsoil has become loose and a short spell of rain is enough to bring it down.

Dust pollution is a constant problem with a veil of dust covering the area all the time. Water logging is another menace, as the hills are now bereft of much of their water-retention capacity due to deforestation. A single burst of shower is enough to inundate parts of the highway and low-lying areas. With the rainy season on, the threat of landslides also looms large over the area. With the monsoons on, landslides are a distinct possibility

in the area. A landslide here will not only cause destruction of life and property but will also block the arterial highway linking Guwahati with areas in the east and the south. The deforestation on the foothills is further worsening the problem of flash floods and water logging in the plain areas of Panjabari, Beltola and Basistha.

Increasing population leads to corresponding increase in traffic population. The problem of traffic congestion has become horrible. Robust growth of real estate sector, the scarcity of drinking water has been looming large. Man made problem flash flood is significant in Guwahati over the years. The encroachers in order construct houses and cut the hill slopes. The encroachers are not spare low lying wetland areas of the city also. It changes the physiography of the city. Moreover improper disposal of Municipal Solid Waste clog the drains of the city and in rainy season artificial floods are occur. The twin man-made factor creates flash flood in Guwahati city. Flash flood is making life measurable in the city.

Floods are one of the most common disaster phenomena, causing considerable personal injury and property damage. Problems related to flooding and vulnerability of the population have greatly increased in recent decades due to several factors including changes in land-use in the hinterlands, urbanization of flood-prone sites, squatter settlements and sub-standard constructions, and increased household density (Munich Re., 2002; Pelling, 2003). The swamps and 'beels' in city act as storage of rain water during the monsoon. Filling up of these swampy areas is the major cause of city's flash flood.

IV. CONCLUSION

Degradation of natural resources has emerged as one of the major concerns of the world community as significant environmental impacts are attributed to it. Present study revealed that the population in the city has been rapidly increased after the shifting of capital from Shillong to Guwahati. Due to rapid population growth and urbanization, Illegal settlements, industries and excessive growth of invasive species the natural resources has been degrading gradually. As a result hills and wetlands are encroached. Hence, with a depleting green cover on the hill tops and hill slopes, shrinking wetlands and low lying areas due to human interference and encroachment, the environment in the city is witnessing and experiencing unprecedented pollution (Deka et al, 2011). It is not only the disposal of waste on the land, clogging drains and constricting roads, but also the defective collection and disposal mechanism on the part of the administration that has led to the deterioration of the living environment on the one hand and the degradation of the surface and ground water quality on the other. The disappearing wetlands and hill slope destabilisation have worsened the situation. Guwahati has several forested hills, but many have been denuded. The red, slushy mud gushes with rainwater flooding the city. The soil of the hill is also used to fill the wetlands and as raw material in the construction industry. Two-thirds of the city was built by filling lowlands and wetlands with the hill soil. Keeping change pattern in the city it is being recommended to the planners and managers to take urgent and necessary measures for conservation of beels and hills, which will otherwise, became extinct in the near future. Lastly, to

protect the natural resources from habitat loss, fragmentation and alteration the following recommendations are given

- Regular monitoring of the wetland and hill using various modern techniques,
- Continuous environmental awareness program among local people.
- Alternative livelihood options to those depends upon the beel.
- Proper enforcement of the policies.
- Afforestation around the barren area.
- Minimize the encroachment around the beel and hill area. Unauthorized encroaches are to be evicted from vulnerable points for which strict legislative control will be necessary.

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