CHAPTER VII

SUMMARY, CONCLUSION AND RECOMMENDATIONS
Summary and Conclusion

From the discussion in the preceding chapters it is seen that population growth of Shillong has ushered in rapid urbanisation of this hill station taking within its ambit marginal lands which are not ideal for settlements and other urban function. The population induced urban growth and the associated waste generated by this growing population creating an impact on the fragile geo-environment of this area especially on water. Hence the whole study can be summarised below.

(i) Shillong the capital of Meghalaya is an important urban centre of North East India. It supports about 60 percent of the urban population of the State and 96 percent of the urban population of the East Khasi Hills District.

(ii) Physiographically Shillong is situated on the Meghalaya Plateau. this represents the north eastern extension of the Indian peninsular separated from it by the Garo-Rajmahal gap. The plateau has a chequered history of geological evolution uplifted to its present height of about 600-1900 meters above mean sea level during the post Mesozoic times.

(iii) Shillong is a horst in the central upland zone of Meghalaya plateau. Its average height is 1500 meters above mean sea level The Shillong Peak and Laitkor Peak are the highest part of the Meghalaya plateau marks the southern boundary of the city. Hence it is in the watershed zone between the streams which originate from this central upland zone to drain either into the Brahmaputra system in the north or Surma valley in the south. Numerous streams of primary order which have low
discharge, dominate the landscape, which is the source of water (domestic, agricultural and industrial).

(iv) Geologically the core of the plateau comprises of the oldest rocks in the State, the gneissic complex with dominance of Shillong group of rocks comprising of Khasi greenstones, siltstones, shale, phyllites, sandstone phyllites, quartzites and conglomerates.

(v) Topographically Shillong consist of five units. They can be identified as the northern slopes of the Shillong Ridge located towards the south of Shillong. The Umshirpi valley skirting the south-western part of the study area, the Laitumkhrah-Mawkhar upland where the main localities of Shillong are located. The Umkrah basin lying at a lower altitude, skirts the north eastern section of the Shillong Urban Agglomeration. The Umkrah-Umsning water divide is found towards the north of Shillong. The area slopes gradually toward the north.

(vi) There are 11 drainage basins found in the study area. Of which the Umkhrah and Umshirpi basin encloses the Shillong Municipality having an area of about 10.36 sq km. The township of Nongthymmai is located on the upper course of Umkhrah basin in which the important stream Demthring is located. The townships of Pynthorumkhrah and Nongmynsong have less elevation than the Shillong proper. Madanrtting Township is located in the Umkhen basin. The Mawlai Township lies partly in the Umshing-Umkrah water divide and partly in the Umshing basin which has its source from the Mawpat ridge. The Umkrah, Umshirpi mark the
northern and southern boundary of the Shillong Municipality respectively. The Umkhen has its water source from the Shillong ridges in the south.

(vii) Climatically Shillong can be classed under Cmk designation of Koppen’s climatic scheme with heavy rainfall during summer and mean annual temperature below 18° centigrade. The average temperature of the hottest month is above 18° centigrade. The natural vegetation consists mainly of pines and shrubs.

(viii) The Shillong Urban Agglomeration lies to the south of the Shillong Ranges. Absolute relief increases from north to south. The absolute relief varies between 1080 meters to 1964 meters. About 35.48 percent of the total area is having absolute relief of 1400-1600 meters, which are ideal for urban expansion. An analysis of relative relief indicates that about 42 percent of the total area is under moderate relief of less than 100-200 meters suggesting gentle undulating topography of the area. This is located towards the central and north-eastern part of the study area indicating ideal conditions for urban development. An analysis of average slope also indicates that maximum area of about 62.33 percent of the master plan area is under moderately steep slope of 10-15° to 15-20°. The topography such as steep slope accounting for 11.09 percent of the total master plan area and escarpments deter urban expansion.

With population growth there has been an increasing demand and pressure on land ading to urban sprawl.
(i) This is amply demonstrated by the inclusion of another township (Nongmynsong) within the urban agglomeration (2001 census).

(ii) In the evolution of Shillong it is seen that the city had its birth with the establishment of the Headquarters of the Khasi and Jaintia Hills by the British in 1863-64, which later became the capital of Assam Province in 1874. While selecting Shillong for the capital, the climate, presence of water and topography was kept in mind by the British.

(iii) After Independence it was the capital of Assam till 1972 when it started functioning as the capital of Meghalaya.

(iv) During the time of creation of the state there were four units forming the Shillong Urban Agglomeration. The total geographical area was 21.27sqkm. The Municipality supported a population of about 71.41 percent of the total population of Shillong Urban Agglomeration. In 2001 Shillong Urban Agglomeration consists of seven units, viz., the Municipality, the Cantonment and five townships of Mawlai, Nongthymmai, Pynthorumkhrah, Madanrting and Nongmynsong.

(v) At present the Municipality supports about 49.60 percent of the total population of the Shillong Urban Agglomeration and the townships supports about 45.86 percent of the total population of Shillong Urban Agglomeration. In fact the Municipality records the least decadal growth rate of −0.88 percent while the other extreme is the townships of Madanrting recording the highest decadal growth rate of +85.82 percent (1991-2001). The growth of population in Shillong
Urban Agglomeration is mainly due to the high growth rate of the satellite townships located in the periphery.

With population growth and resultant urban expansion the solid waste generated by this growing population has also increased. The solid waste collection and disposal within the Shillong Urban Agglomeration is divided into two sectors. Organised sector consisting of

(i) The Municipality (looking after the waste disposal of 27 wards within the Municipality) generating around 112 metric tons of solid waste/day. The total waste collected from these ward is approximately 80 metric tons /day. Hence slightly above 30 percent of the waste generated /day is not being disposed

(ii) The Cantonment Board looks after the solid waste collection and disposal of the cantonment. The total waste collection from here is 15-18MT/day

(iii) The Syiem of Myllien looks after the waste collection and disposal of Iewduh. Here the approximate waste generation is 12-24 metric tons /day of which only 5 MT of waste is being disposed off at Mawiong.

(iv) The unorganised sector consisting of five townships where there are no organisations looking after the solid waste disposal system. Here the estimated solid waste generation is approximately 25.75 metric tons/day.

(v) The types of solid waste generated within the Shillong Urban Agglomeration are mainly Municipal solid waste consisting of household waste, constructional demolition waste, institutional waste, commercial waste and natural waste. Biomedical waste, negligible amount of industrial waste.
(vi) The amount of Municipal solid waste generated within the Shillong Urban Agglomeration is approximately 165 metric tons/day. The anaerobic waste disposal plant at Mawiong can handle only 100 metric tons of biodegradable solid waste in a day hence approximately 38 percent of the municipal solid waste generated per day are unaccounted.

(vii) Bio medical waste generated from the hospitals/nursing homes of Shillong is around 15,967 kg per week of which 3955 kg per week are highly infectious. There are certain specific guidelines laid by the Ministry of Environment and Forests for storage, collection and disposal of this waste. Except the Military hospital the rest of the health centres are not following these guidelines. The wastes generated from two slaughter houses are also unscientifically managed.

(vii) The collection of waste followed by the Municipal Board is door to door collection from certain localities and collection from the dustbins once a day within the municipal wards. The Cantonment Board collects waste from the dustbins every alternate day. While the commercial waste generated by the Lewduh market is collected twice daily by one truck having a capacity of 3 tons from the three dustbins located within the market.

(ix) The field study reveals that both waste disposal and water supply requires much more than attention what it is at present. Lachumiere area has a concentration of population with economically well off are having better waste disposal facilities and better water supply system. Jhalupara area has the least facilities of waste disposal and water supply since people living here are economically poor. About
10 percent of the respondents of Jhalupara use pit latrines whose waste is dumped every alternate day into the streams, 33 percent of the respondents here do not have access to proper sanitary latrines, 55 percent of the respondents dispose off their domestic wastes in to the streams directly. In Lachumiere area 5 percent and in Rilbong area 13 percent of the respondents dispose off their wastes directly into the streams. There are three dustbins each in Rilbong, Jhalupara and Lachumiere. But Lachumiere locality is provided with door to door waste collection facility everyday except on Sundays. This suggests that the economically well off sections have better facilities in regards to their waste disposal. They also generate more wastes due to higher standard of living and more resource utilisation.

In Nongthymmai there are 11 localities without a dustbin thus about 65 percent of the total respondents dispose off their domestic wastes directly into the streams. The community manages their own waste disposal. About 45 percent of the respondents here burn their waste during the dry season.

With population growth the demand for water has also increased. At present the water supply of the Shillong Urban Agglomeration is managed by three organisations

(i) The Shillong Municipal Board, the PHE Department of the state and the local boards. At present the Municipality supplies approximately 2650.3 kiloliters of water every day. This water is not treated and comes from its seven springs and stream sources located in the Shillong Ridge to the south of the city. The
PHE has its source from the Umiew River where water is collected at Mawphlang. The total installed capacity is 11.5 million gallons per day but at present only 34095 kiloliters of water is being supplied. Here the water is treated before being supplied to the households. River Umkhen is also tapped by the PHE to supply water approximately 1295.6 kiloliters per day to the townships of Madanrting, Nongthymmai and the other areas within the municipality. River Umsohlang is tapped by the PHE, which pumps around 1363.8 kiloliters of water every day to meet the water requirement of Mawlai Township. The local ‘Dorbars’ have its own sources from within the reserved forests of Shillong.

(ii) At present the quantum of water supplied within the Shillong Urban Agglomeration is around 39504.7 kiloliters/day i.e. approximately 39505000 litres/day, to meet the water needs of a population of at least 267881 persons (census 2001). Thus the per capita water supplied per day is 147.47 litres. Hence there is not supposed to be any water shortage within Shillong. But the quantum of water is not equally distributed as suggested by the zoning of water supply by the PHE Department. There are severe water deficient zones while some zones have surplus water.

(iii) The water is being treated scientifically at Mawphlang for quality supply of water to the people. But the other sources which are tapped by the Municipal Board water is not treated. This untreated water has high coliform gets mixed up with the treated water in the overhead tanks of the 12 zones within the Shillong Urban
Agglomeration that receives water from both sources and ultimately the people of Shillong get contaminated water.

(iv) The leaking pipes passing through the numerous drains which act as waste dumps are also a source of contaminated water gets into the pipes which supplies water to households.

(v) Socio-economic factors may have a role to play in the distribution of water. In Jhalupara about 49 percent water supply is from public taps located in a common place whereas in Lachumiere and Rilbong 100 percent of the respondents have access to water supply within their compound. In Jhalupara 65 percent of the respondents are facing water shortage throughout the year. In Rilbong 40 percent of the respondents face water shortage during the dry season and in Lachumiere about 7 percent of the respondents face water shortage only during the dry season. The PHE and the local Dorbars looks after the water supply for the population of Nongthymmai. Here the local Dorbars are tapping the spring/stream waters from nearby reserved forests of the Shillong Ridge. However the volume of water received are reducing every year, may be due to deforestation.

(vi) The Kharkongor clan controls the local water sources. The overhead tanks where water is collected and distributed are cleaned every year. There are few community taps made available from were water is being sold to the locality through small tankers and human carriers. Hence community plays an important role in the present distribution and management of water in Nongthymmai.
(vii) Due to rugged terrain characteristics where slopes are moderately steep to steep the households requires individual pipelines. These pipelines usually pass through the drains which often act as waste dumps. The leaking pipe passing from these drains contaminates the water. Water sample collected from the four sources shows high coliform level. Therefore water is not potable.

(viii) The population induced urban growth of Shillong without proper facilities are creating geo-environmental problems having its impact on water.

(ix) It is observed that with urban sprawl to the upper ridges towards the south of Shillong which are the main source of water for the population living here are encroached upon. The deforestation is accelerating the landslides, mass wasting and high soil erosion. This in turn is resulting to the problem of sedimentation of the streams affecting aquatic life. Due to deforestation permanent loss of water bodies are taking place as the percolation capacity of the soil is affected.

(x) The Quarrying activities associated with urban growth of Shillong are further accelerating soil erosion and sedimentation problems.

(xi) The rampant waste disposal into the streams of Shillong has made the water not only unfit for human use but also affected the aquatic life. The waste dumps are acting as "fish kills". In fact the streams of Shillong are without any fish.

The Shillong Urban Agglomeration is located between the two small basins of Umkhrarah and Umshyrpi which supports about 85 percent of the present population. The
manifestation of urbanisation in Shillong is leading to the emergence of some well-known geo-environmental problems, which can be summarised as:

(i) Large areas are covered by impervious surfaces that are intercepting precipitation and increasing run off.

(ii) The concrete drainage systems are increasing runoff.

(iii) The stream banks are encroached upon by urbanisation.

(iv) Improper waste disposal system is polluting the streams.

(v) Urban growth is accelerating the erosion process and sedimentation of the streams.

(vi) Changing stream channels are increasing frequency of floods.

From the present study the following conclusion can be drawn

(i) Shillong is located on a hilly terrain where water is generally scarce. It becomes a scarcer commodity in the absence of major rivers and rich ground water aquifers.

(ii) More demand for water is due to the unprecedented population growth in the last few decades. At the same time the quantum of water availability is reducing due to deforestation and growth of concrete structures reducing the percolation capacity of the soil.

(iii) Due to solid waste disposal in the streams, there is rampant pollution, creating more problems to the meager water resources. The streams are loaded with waste which is much beyond their assimilative capacities.
(iv) Umshyrpi and Umkhrah are polluted due to the indiscriminate discharge of municipal solid wastes and raw sewage into their water courses. Regarding the quality of water the State Pollution Control Board designates the streams of Shillong viz. Umshyrpi and Umkhrah as the lowest category 'E' and the water is not fit for even washing of cloths.

(v) River Umkhen receives all the wastes from Madanrting Township while Mawlai Township’s waste is being received by Umshing. These water bodies ultimately reach the Umiam Lake leading to severe eutrophication of the lake.

(vi) The present urban growth of Shillong is leading to problems of waste disposal and affecting the water supply of the area. At present the water catchments of the Umkhrah, Umiew, Umkhen, Umshing, Umsohlang have been greatly disturbed by human interference in the form of urban expansion, quarrying, deforestation and solid waste disposal. Some of these catchments especially on the fringes of the study area can be regenerated and conserved by proactive planning.

Recommendations

To check further geo-environmental degradation in the area the following strategy may be undertake:

(i) The urbanisation processes near the catchment areas of the water sources needs to be checked. Hence the growth of Shillong towards the southern ridges is not advisable. The Meghalaya Protection of Catchment Areas Act 1990 needs to be implemented. This act prohibits the felling of trees, destruction and clearance of
grooves, bushes or any vegetative cover, jhumming or cultivation or use of any insecticides or pesticide, quarrying of sand or stones, excavation of earth, carrying of any activity, which in the opinion is likely to damage the springs, streams, rivulets or water sources in the area.

(ii) Intensive afforestation especially in the catchment area in order to boost the supply of water into the streams of Shillong needs to be encouraged.

(iii) Plantation of indigenous varieties of trees in non-agricultural land in the moderately steep-to-steep slopes should be undertaken urgently. The existing forests needs to be preserved and judicious cutting measures should be undertaken.

(iv) Suitable steps can be undertaken in order to check hazardous exploitation of stone quarries within the catchment areas. A series of small check bunds can to be built downstream of the existing quarries in order to check sedimentation of the streams. To prevent soil loss, land management is important. For this the catchment area must be able to absorb maximum precipitation so as to store water. Hence all the agricultural and non-agricultural land within the catchments needs to be effectively treated for soil and water losses.

(v) A buffer zone needs to be created on the sides of the stream in order to check waste disposal and constructional activities.

(vi) The present municipal supply of water needs to be treated scientifically before being supplied to the overhead tanks of the different localities.
(vii) Dumping of garbage on the banks of the streams should be banned. The population needs to be sensitised on the impact of improper waste disposal on their health.

(viii) In order to check contamination and pollution of the geo-environment from the unscientific disposal of biomedical wastes of the hospitals and nursing homes of Shillong. Segregation of biomedical waste at source needs to be practised; a common incinerator can be built outside the congested areas of the city. The present nature of disposing off the biomedical wastes along with the other municipal wastes needs to be discouraged and the guidelines of the Ministry of Environment and Forest (in regards to bio-medical waste disposal) needs to be implemented.

(ix) The concept of reduction at source, recycle and reuse of the waste generated needs to be encouraged. Here the community can play an effective role in sensitising the population as to convert resource out of the waste.

(x) The community needs to be involved in waste disposal programmes. Waste should be segregated at source into bio degradable and non-biodegradable. The services of the unemployed youth can be harnessed as they can be mobilised to collect waste from the households (door to door collection) against a small amount of payment. The waste thus collected, can be then collected by the concerned authorities to be disposed off in the composting plant at Mawiong (biodegradable) for production of compost. The non-biodegradable waste can be collected from a common source by different organisations that could be reused.
as their raw material for production. Hence waste needs to be viewed as a resource which can enhance both capital and employment opportunities.

(xi) The duplication of organisations in regards to waste disposal and water supply needs to be addressed as no single organisation can be held responsible for the present state of affairs. One household one water connection system should be implemented.

(xii) Water distribution system should be metered with proper pricing policy in regards to water supply to the households. This can check water wastage and misuse.

(xiii) The concept of rain water harvesting can be introduced to augment the present supply.

(xiv) Above all the for the future urban expansion of Shillong, the environment impact assessment should be undertaken before identifying areas for urban growth.