CHAPTER 8

SUMMARY OF RESEARCH

The urban population is increasing all over the world. The materialistic needs and ignorance of natural ecological cycles have deteriorated the environment of most of the urban areas all over the world. The inventions of non-degradable materials have also induced many problems. It is only since the last two decades that a better understanding of the effects of changing environments and ecosystems has been developed. Hence, in urban planning, environmental aspects are of major concern. Condition of water supply services, transportation, drainage/sewerage systems, garbage collection and disposal, livelihood necessities like air, water quality, status of greenery etc. plays a major and important role in making a city environmentally planned. These factors should be given due attention in the studies related to development of an urban area. The same is focused in this study to carry out an analysis of development of Hisar city located in Haryana (India); and to evaluate its future planning dynamics for sustainability of living environment in it. This study would help the planners to visualize the planning process in a different way which is usually overlooked.

The state of Haryana came into existence on 1st Nov. 1966. This was also the onset of Green Revolution. This revolution had played a great role in the development of Haryana, which enhanced the agricultural production and the economic potential of its inhabitants. The urbanization in Haryana increased at a faster rate also because of rapid industrialization from this time. Today about 29% population of the state is living in urban areas and increasing rapidly.

The Hisar is a renowned city of the state which is also acting as a central city for western Haryana as it was the district headquarters of erstwhile Hisar district in which many of surrounding districts were included. It is located at 29° 9' 51" North latitude and 75° 45' 55" East longitudes covering an area of about 45 sq. kms. with in
municipal limits. The national highway no. 10 & 65 are passing through the city and connecting it with the several important cities and towns like Delhi, Rohtak, Sirsa, Fazilka, Ferozpur, Kaithal, Chandigarh, Patiala and Raigarh. The urban population of Hisar city is 2,63,070 which makes 17.1% of total population of the district (Census, 2001). It became Class-I city in 1981 when its population reached to 1,37,369.

Rapid increase in the population has led to expansion of city and has crossed the municipal limits. The main growth of the city is towards southern and eastern sides (south of NH-10) because of the availability of open area. On other sides, Govt. offices and institutions like HAU in the west, Govt. farms & GJU in the north and Cantonment in the east side of the city have occupied the land. In these situations, accompanied with increasing trend of population and nodality of Hisar city, the urban environment can go on deterioration or degradation if not cared in time.

Study regarding the environmental planning and management of urban areas has not been given due attention in Haryana since its establishment. The present study is an effort to examine the status of some crucial parameters like landuse change, morphology of city, population growth alongwith environmental attributes like ground water conditions, air quality/pollution, greenery status, urban heat islands (UHI) effects etc. for Hisar city. These types of study would be helpful for planner to find out the ways that how future planning exercises should be structured without compromising healthy environment of a city.

Encompassing all the fields, the main objectives of this research can be summed up as; to study the morphology and landuse of Hisar City and changes therein during 1985-2005, to analyse and evaluate the urban environment, to examine the role and product of various government agencies of city planning, and finally, to suggest strategic alterations, if so required, by analyzing future plan of city for its sustainable planning and management.

Availability of proper literature is quite essential for all kind of studies. These types of studies were not given much attention in Haryana and scarcity of literature of similar field was also severely faced by the researcher. This problem was resolved
with the help of World Wide Web (internet) that make simple computer a library of versatile literatures. Along with soft libraries or e-libraries in the form of research projects reports; master plan, planning reports & findings and case studies available on various sites; equal time was also devoted in university libraries, research centers or institutions and communicating with resource persons.

The present study is also meant to illustrate the immense use of Remote Sensing & GIS technology in urban environmental studies. This kind of studies requires specific type of information at large scale i.e. at city level which is not a common practice in a country like India. Hence, various departments/offices such as Town & Country Planning department, National Informatics Center, PWD Public Health and B&R, Haryana Urban Development Authorities (HUDA), Office of Municipal Committee, Ground Water cell, Dept. of Environmental Sciences at GJU, Dept. of Agricultural Meteorology at HAU, HARSAC, Hisar and many more were explored. Published information at state and district level such as Statistical abstract of Haryana and Hisar, Census of India publication, Survey of India topo-sheets, Gazetteer of District Hisar along with material available on different sites on web were also pursued. Along with all these sources for secondary data, the Remote Sensing data has also been used to prepare spatial information such as landuse, road network, morphological classifications etc. State of the art techniques of GIS have been used, wherever required, to analyse spatial and tabular data for this research.

Information so generated has been used for different type of analysis, and presented in the forms of thematic maps throughout the study. Chapter schema starts from first chapter that describes synoptic view of study along with literatures that are relevant and reviewed to carry out this study. Second chapter describes geographical characteristics of the city and district as well. Third chapter is meant for landuse and sprawl of city. This chapter contains detailed analysis of landuse change that occurred in the city from 1986 to 2005. The morphological and functional classifications are carried out in fourth chapter. In fifth chapter, qualities of various environmental attributes are analysed using satellite imageries as well as other primary data. Sixth chapter analyses the results in-toto and conclusions are drawn on the basis of research.
The results so derived are again discussed in chapter seven along with the analysis of Future/Master plan of Hisar city, 2021 prepared by Town & Country Planning department. Recommendations on the basis of study are made in chapter six as well as in seven. The main issues related with development and problems of Hisar city and their remedies become apparent going through the research sequentially/chapter wise.

Prior to analyzing geography of the city, a brief note is presented on its history. On historical tracts, the word of 'Hissar' is of Arabic origin, which means 'Fort'. The city was originally called Hissar-e-Firoza (the 'Fort of Firoz), but as the days rolled by, the very word 'Firoza' was dropped from its original name and 'Hissar' remained the name of city which again simplified as Hisar some decades ago. The establishment of Hisar city is supposed to be as a fort in the year 1354 A.D by Firoz Shah Tuglaq. The nobles and Amirs were allowed by the Sultan to get reside inside of fort. The fort-city had four gates which were subsequently named as the Delhi Gate and Mori Gate in the east, the Nagori Gate in the south and Talaqi Gate in the west. The Gujari Mahal still stands in its austere majesty. The last noteworthy person in the history of Hisar before the advent of the British power, was George Thomas (1756-1802). He was an independent ruler of the tract of Haryana, including Hisar, from 1797 to 1802. The Jahaz Pul and the Jahaz Kothi situated to the east of the city of Hisar, still remind the great Irish adventurer. The city gained importance in early sixties when Agriculture University was established.

The climate of Hisar has tropical monsoonal climate and is characterized as arid type. The period from October to June remains almost dry except, few light showers received due to westerly depressions or western disturbances. The summers are generally quite hot and winters are fairly cool. The main characteristics of climate of the district are its dryness, extremes of temperature due to continental location and scanty rainfall. Around 75 to 80 per cent of the annual rainfall is received during SW Monsoon season (June to September). The highest number of rainy days occurs during the months of July and August while lowest during November and December.

The Hisar city is centrally located in district of Hisar. The maximum height reaches upto 225 m in the east whereas a lowest value is 205 m in western parts of the
The population of Hisar city has increased almost by five times from 1951 to 1991. Its population was nearly 35,000 in 1951 which in 2001 reached up to 2.63 lakh persons. As per census of 2001, with an urban population of 2,63,186 and area of 4943 hectares, the population density of Hisar city is 53 persons per hectare. Hisar city is comprised of 31 wards with an additional unit of HAU area. There are only 4 wards having less than 70% literacy while rests are above 70%. Most of the wards are with a sex ratio in range of 800 to 900 females per thousand males while rest of some has shown a shocking figure of 600 to 700 females after thousand males. Hence, demographic factors have shown considerable variations in Hisar city on the basis of ward wise analysis. After general description of geographical facts of the study area, the research proceeds with particular analysis in further chapters.

Population has deep impact on shape and size of urban areas. As population increases in a city, its boundaries expand to accommodate the growth; this expansion is considered as urban sprawl. Usually sprawls take place in the forms of constructions/developments on the urban fringes, at the edge of an urban area or along the highways like in case of Hisar city where growth is concentrated along national highways. The city has shown a vast expansion in last a few decades.

Hisar from the establishment of Haryana became an important city due to a centre of politics in western part of the state. The total area of the city was 17.4 Sq. kms in 1965 i.e. at the time of formation of the state. The original shape of the city was nucleated and encircled by walls with four gates of fort. By the year 1975, the city showed a little expansion. Many new regularly organized localities by this period come up on the map of city. The major development took place around earlier settlements. Total increase of 3.6 sq. kms. was recorded during this decade. Area of the city increased at faster rate during the decade of 1975-85 as compared to earlier decade. During this period the city got the status of class I city in 1981.
remarkable growth was recorded as both, planned and unplanned developments. Till 1986, the city expanded by 1.5 times of area in 1965. A total increase of 5.2 sq.kms was recorded during this decade. Total urban area (irrespective of municipal limits) in 1986 was 26 sq. kms. Urban settlement till 2005 spread over 42 sq.km. area within and outside of municipal limits. In these 20 years, the city showed a remarkable growth with both horizontal and vertical expansion. The changing political scenario and increasing centrality of Hisar city led it to be a growth pole in this region.

Population Projection has also been carried out in the study. Projection of urban population is outcome of various factors. This analysis has been performed in the study on the basis of region’s and urban population of Hisar. These estimates explain that within present municipal limits, the future population would be 4 to 5 lakh till 2021. Including population of whole of Hisar urban area, the estimates can be doubled to 1 million. The same figure has been estimated by Town and country planning department for master plan 2021.

The increasing population essentially has deep impact on landuse change especially in urban areas where landuse rapidly changes at micro level. Land use means the use of particular part of land for particular purpose, such as land is used for agriculture or for residence etc. In the present study, the comparison of landuse has been made in the year 1986 and 2005. It would be helpful to monitor the changes therein with the passage of time and also to predict the trends in future. Landuse of 1986 of Hisar city as published in reports of HARSAC, Hisar shows the city have major landuse classes wiz. Residential, Industrial and Educational. The detailed comparison of change during this span (1986-2005) has been carried out in this study.

Decade of 1980 was the earlier phase of expansion of Hisar city in which major growth took place in the form of unplanned encroachment on the fringe of city. The city had come up with uninterrupted builtup structures by development of earlier vacant land of 1960s & 1970s. The major growth was concentrated along erstwhile main road of city i.e. Hisar-raipur-Hansi road.
Landuse of the city have changed drastically till 2005. Not only the vacant lands have converted to urban use but the earlier categories have also reshuffled their activities. Along all the roads except for planned sectors, the earlier residential classes have turned into mixed landuse classes where minor to major commercial activities have started. Not any exclusive commercial zone was found in the east along NH-10 in 1986, whereas the same area in 2005 has so many thin commercial belts beside the roads. The area falling between NH-10 and balsamand canal have fully developed with dominance of residential classes. Likewise, a big unit of regularly space residential colony (sector 14) is appeared at north end of city. Irregular development have gone in pace with regular development. Big patches of this kind, giving the tone of tissues have emerged out at many places in the city. Many of these are extensions of earlier small colonies whereas some have evolved as new features e.g. amid of kaimri and rajgarh road (south of balsamand canal).

In 1986, total residential area inclusive of all type was found to 1085 ha which increased upto 1770 ha in 2005, hence recorded about 70% growth over 1986’s area. Among residential categories, the area with irregular growth has increased tremendously which is a great threat to urban planning agencies. Commercial activities in residential area have also increased significantly causing increased mixed landuse area in the city. Vacant lands have gone a remarkable change wherein vacant land with infrastructures had increased and without infrastructures decreased. The former was increased to great extent i.e. from 190 ha in 1986 to 582 ha in 2005 while later lost 100 ha and remained to 70 ha only.

To have a broad view about the landuse of municipal wards such as residential, commercial etc.; all the wards are categories into four categories viz. Major residential, Mixed residential, Minor residential and Non-residential. By this analysis, it is found that ward no. 8 to 12, 15, 26 to 28 & 30 are included in first category and wards 1, 4, 13 and 19 falls in second category. The first category denotes that these wards are mainly residential or most of built up area is used for residential purposes. The other categories have decreasing order of residentiality in wards and categorized as mixed, minor residential and non-residential. The decreasing trend of
residentiality also signs towards increasing order of other landuses like commercial, industrial, etc. where quantum of increase is a function of built up area in that ward. Ward no. 7, 16 and 25 fall in third category as they are least used for residential purpose, hence other uses are dominant. This exercise proved to be helpful for particular landuse analysis in GIS on the basis of primary survey i.e. census and technology of RS. This kind of study is very helpful for planning & management of services and resources in an area.

Morphology of Hisar city has also been analysed in the research. On the basis of growth and textural appearance, an urban area can be divided into different morphological units. The classification schema chosen for this purpose was more oriented towards its environmental properties. Cities in the Haryana state have deep historical perspective. But, the Hisar city is new on historical grounds. It is supposed to be established about 800 years ago which is very little period on historical scales. After its establishment, the city grew up very slowly while after independence, it grew fastly because of its educational and industrial importance in the western region in Haryana. The role of planning agencies remained limited within municipal boundaries while with passage of time, urban area has expanded beyond these boundaries.

All the urban area within and beyond municipal limits, is taken for analyzing the morphology of city. The axial limits were HAU farms to cantonment area in west to east direction and Govt. offices of Sirsa road to Gangwa village in north to south direction. The city appears to getting star type shape as urban growth taking place in all radial directions along roads. Total of 44 sq. km has been analyzed for the morphological classification of the city. The foremost establishment of Hisar city i.e. the fort and surrounding area is presented as old fort area. This includes ruins of fort and other structures built therein. The main structures were residential buildings of old rich families which are now outdated and either left unused or restructured for commercial or residential use. This area is main commercial centre of the city. Old town area which spread over 2% of city area developed out sides of various gates of fort. This area is composed of highly dense old localities.
Among rest of the units, a significant area is covered by Institutional or Civic purpose type buildings. These structures cover 22% of total city area. Among this, 21% is covered by the buildings whose ground area in premises is not fully constructed / paved. Most of these units are either meant for academic purposes or for govt. offices, industries, small parks and other civic amenities. These types of structures are very important from environment point of view as they provide open space which plays significant role in thermal profile of a city. On the other hand if such institutions have paved ground area, they may intensify the adverse thermal effects in urban micro climatic conditions. Fortunately, this area found to be very less in Hisar which is approximately 1% of city area. Coverage of these types of buildings has deep control over heat island conditions (UHI effects).

The next category depicts the planned developments in the city. The major portion of the planned structures is residential sectors developed by HUDA. The category of unplanned developments in Hisar city is found as largest category which spreads over 32% of city area. Rest of the units which are neither congested nor have any pattern; rather these are under process of development, are categorized as unorganized development. This category is found over 8.6% area of Hisar city. Most of this type of land is concentrated at fringe area of city where unauthorized development is a common practice.

Morphology of Hisar city presented a complicated pattern of planned and unplanned developments. The former have been taken care by govt. agencies while later have developed automatically with passage of time wherein no attention have been paid to any aspect, except for buildup structures. Such establishments often creates problems for urban utilities and environments when become highly congested.

Urban fabric and forms of structures were dealt in morphology; the functional classification on the other hand is more concerned about spatial adjustments of functions or activities of urban area. On the basis of various theories, an effort has been made to carry out functional classification of Hisar city in this study. Hisar is located in an agrarian culture and lacking in big industrial setups. Distributions of functional units in Hisar city rarely seem to satisfying any of theories coined by
scholars. The two phases as old unplanned and new planned city are the main regions that are separated by a railway line. The city has grown up around a fort which has now turned into the main commercial area or market place of city. This Central Business District has expanded in north south direction along the main road of city. The CBD of Hisar city is located in north western part while growth is more towards eastern sides. Therefore, another business district in eastern region is the need of time. Highly congested settlements reflecting medium to low class residential area, found to be concentrated around CBD and along the roads. Far from CBD, the High class residential area are located in pockets in planned sectors, hence settled irrespective of any proximity with industrial, markets or any other activity. Institutional and govt. units are distributed throughout city and haven’t any theoretical conformity. Industrial centers are more concentrated in eastern side of city along Delhi road. Concluding comment on functional setup of Hisar city is that the road network has more pervasive control over landuse and functional set up rather than CBD or any other factor.

Each and every aspect of a city as landuse, economic development and population diversity, social interactions and others is impacted by Urban Planning. In Hisar, there are various agencies responsible for its planned development. These agencies have their specific type of field and tasks to be carried out. Municipal Council, Town and Country Planning Department, Haryana Urban Development Authority (HUDA), City Improvement Trust, Haryana State Industrial Development Corporation, Housing Board, and Marketing Board are some of these agencies. In the development of Hisar city a significant role had been played by these institutions and their major developments have also been presented in the study.

As cities develop and expand in size, both in terms of space and time, it results in positive as well as negative effects on its physical environment. Study regarding the planning of a city is necessary to ensure the good living standard for its inhabitants. Viewing the close relationships among the city development and its natural environment, some major components of relevant for Hisar city environment have been examined in the research. The broad environmental components such as physiography, geology, drainage, soils etc. are generally considered important for the
cities located on diverse topography like foothills, coasts, slopes, islands or river banks etc. But Hisar city doesn’t have such topographic base and located in deep continental climatic conditions on plane topography. Extreme Climatic Conditions, Pollution (Air) status, Greenery Level and Groundwater Conditions are the main aspects relevant to the city as these dominate the environmental conditions here.

An important environmental issue for urban area is air pollution which has become a global issue. The level of various pollutants in the air of Hisar city has been found out by the information of TEMIS project which aims to supply tropospheric concentrations of the most important pollutants, in the form of concentrations and global maps. NO$_2$ contents show their high concentrations in summers. The level of NO$_2$ over the Hisar region ranges from $4-7 \times 10^{15}$ molec/cm$^2$ in summers. Although at present, this gas was found at marginal stage, its trends are indicating that it can reach to higher level in near future due to increased industrial and transport activities in the city. Sulphur dioxide SO$_2$, has shown least concentrations except for some months.

Aerosols play an important role in the global climate. The aerosols scattering and absorption features depend on their chemical and physical properties. Urban culture and industrial activities produce black carbon which is a content of aerosols. The increasing industrial activities in Hisar urban area is a supporting factor in intensification of this pollutant. Also the presence of mineral dust coming from arid and semi-arid regions (desert dust) and ash by burning of organic material can be considered as important events in the atmospheric conditions of Hisar.

Besides air quality, the ground water quantity and quality is also an important factor for an urban area. The Hisar district area forms a part of Indo-Gangetic plain. The area as a whole is almost flat alluvial plain. The depth of water table varies from 6 to 30 m bgl. The ground water in unconfined condition is abstracted through hand pumps, dug wells and shallow irrigation tubewells. Quantity of underground water in Hisar is sufficient but the main constraint in its use is quality, which is not satisfying BIS standards. The water demand in the city would certainly increase because of population growth and it can be met out only by groundwater. Therefore, an analysis of groundwater quality can help in mapping out the safe quality area.
To carry out this analysis, water samples were collected from different parts of the city in 2009. The analyzed water quality parameters include pH, EC, Ca\textsuperscript{2+}, Mg\textsuperscript{2+}, Cl\textsuperscript{-}, F\textsuperscript{-} and total alkalinity (TA) and total Hardness (TH). These physio-chemical parameters were imported in GIS to carry out spatial and overlay analysis. On the basis of all of the information and BIS standards, the safe groundwater zones are demarcated in the city. The groundwater quality map shows a close relationship with canal path in the city. Safe quality water lies along east west direction around the main canal. This shows the effect of recharge. This area mainly includes the planned sectors and HAU area. The safe zone is surrounded by moderately safe zone. This zone is also elongated from northeast to southwestern direction. Most of residential parts of Hisar city fall in these two zones.

The physio-chemical parameters were selected as per their significance in Hisar region. These results can be very helpful for planning and management of the water supply in Hisar city. As water table in Hisar is shallow (15-22 feet bgl), the safe quality groundwater can be supplied to other parts also. By this the huge demand of water for domestic purpose in summers can be met out.

Urban areas are composed of continuous builtup structures in a congested pattern. This causes increase in the temperature of city form its surroundings. Cores of cities especially situated in continental type climatic conditions as Hisar, suffers from high temperature and urban heat island (UHI) conditions. Therefore, data from two locations i.e. inside and outside of city, have been analyzed to compare its temperature with surrounding area to know the effects UHI. By analysis, it is found that; in the hottest month of May, city temperature is 2 degree higher from surroundings. The city temperature remains higher from surroundings for whole of the year. City annual minimum temperature remains more high i.e. 3.6 degree from surrounding region. Finally, by all analysis it is observed that Hisar city remains 2.8 degree hotter from its surrounding region. Thus it can be concluded that the city has Urban Heat Island (UHI) situation which can grow further in future. In such conditions, the regular open spaces with greenery can lessen the severe hot to some extent. Hence, the continuous/congested structures should be discouraged in the city.
The other attribute of urban environmental profile i.e. green space is a crucial element in modern city planning. The preservation and maintenance of green spaces is important for several reasons. This environmental parameter has been analysed in the study and different greenery classes are identified with the help of FCC. The results i.e. different classes of greenery and settlements are calculated Ward wise. As result it is observed that, the old city comprising of ward no. 5, 6, 8, 9, 11, 12, 17, 18 and 19 have very less green cover i.e. less than 5% of their ward area. Ward no 4, 21, 22 & 23 have 5 to 10% green cover of their ward area. Ward no. 3, 14, 24 and 25 have green cover ranging from 20-30%. The wards at outer part of the city have substantial green cover.

Percentage green cover is controlled by total area of the ward and total green cover therein. Analyzing green cover per unit builtpup area (settlement) seems to be more informative for micro level analysis or urban study. Green cover per 200 sq. meter builtpup area has also been analyzed for each of Ward. The results by this analysis give an estimate of normal green cover per dwelling place. The result shows that, again; the old town of Hisar has very less greenery with respect to its builtpup area. The wards comprising of old town 5, 6, 8, 9, 17, 18, 19, 21 have again appeared with very less green cover i.e. less than 15 sq. meter per unit dwelling place. Ward no. 5, 8, 9 & 19 have very less green cover i.e. less than 3 sq. meters per unit dwelling place. It means that the houses in these wards don’t have a sinque tree in their proximity which reflects that the area is under environmental stress. Greenery of the city has also analysed locality wise; and as result, it is observed that the old main city, Jawahar nagar and Camp area have very less greenery. These colonies were formed after independence and have very less green cover. The sectors 14 and 15 show sufficient green cover. The two universities have enough green space. Hence, this analysis presents a detail account of green space at large scale in the city which is very important for maintaining healthy environment in each locality.

The final result of greenery analysis is that the core area of city is void of green space. This very area of the city is also a business centre of Hisar where people visit daily for various purposes. The wards of old city contain 17% of population who
are living in greenery absent area. Benefits of urban green spaces range from physical and psychological health to social cohesion, ecosystem service provision and biodiversity conservation (Fuller 2009). The importance of greenery in proximity of residence is clear by the study conducted at the Columbia University which found that for every additional 343 trees in every square kilometer, asthma rates decreased by 25% among children aged 4 and 5 in New York. According to a study carried out at the Indiana University School of Medicine, children who live in areas with more greenery actually have a lower likelihood of being obese. An obese child is more likely to become an obese adult, and obesity is an indirect invitation to dangerous health conditions including diabetes, hypertension, sleep apnea and asthma (Gilbert C Liu). So, this gives a new concept of "slim and green" to urbanized societies in commensuration with equation of "clean and green".

A few studies, mostly from medical sciences have been undertaken for analyzing green spaces and health relationship in urban areas. In the literature of geography these particular types of studies which have significant role in urban analysis, were not given due importance. Results of various researches in this line were presented in the study to expound the importance of green space in urban areas. The green cover in the Hisar city is analyzed using high resolution remote sensing data. The urban areas that haven’t any green cover in their proximity were identified by buffering of green space. The map presented in the study depicts the areas which haven’t any green space, reflecting these as the environmental Hot Spots of city which lacking in healthy environments for its inhabitants. This is mainly the unplanned and congested portion of city where the old developments with narrow and irregular streets are located. The major portion of these environmental hot spots fall under ward no. 5, 8, 9, 17, 18 & 19 where most of built up area didn’t have any direct access to green cover.

The study is meant to carry out environmental planning and management of Hisar city. To achieve this goal, various themes are analysed. Result of each of theme has been discussed in detail in different chapters. More emphasis has been given on identifying and demarcating environmental vulnerable area and suggesting preventive
as well as creative measure to maintain city environment livable. The major themes which dealt in the research are Growth trend and direction of city, Population projections, Landuse Change, Morphological and Functional Classifications, Thermal Profiles, Air Pollution, Wind Directions, Groundwater Quality and Greenery Status.

The urban planning exercise is an integrated approach which associates not only economic growth but also many other fields of urban areas as traffic and road planning, healthcare, infrastructure, variations in demographics, landuse and education etc. Good city management endeavors to provide a congenial environment to its citizens. Hence, the themes and results obtained from research in various chapters are again analysed in context of management as well as future planning of Hisar city from environmental point of view. Recommendations are given for both, the present and future setups. The present setups includes all the urban area of Hisar within and beyond of municipal limits. For the future setups, the analysis has been carried out in consonance with master plan of Hisar 2021 prepared by town and country planning department, Hisar. Maintaining greenery and open spaces such as play grounds, parks, broad streets etc., implementation of rain water harvesting systems for the city, peripheral by passes, arterial road network of city for fast connectivity, waste removal and management system, sewerage treatment plants and landuse etc. are widely covered under various recommendations. To improve city road network, 16 kms of arterial roads have been proposed in the research to provided better connectivity among different parts of city. 10 km road length out of 16, is existing already in the form of lower order link roads and suggested to be upgraded and modified; while rest of 6 km is required to be constructed newly. Future landuse of master plan is also examined and suggested to have residential units in southern sides, instead of northern. Likewise, industrial zone is also proposed at northeastern sides along NH-10 by pass.

Hisar city is under the phase of modernization to cope with the trends of well planned modern cities. The educational influence of the city because of so many academic institutions as well as renowned research centers established here, have become an attracting figure which invites people from various parts of country and
abroad to satisfy their needs. If urban centre of international repute like Hisar, are allowed to grow without consideration of environmental aspects, the attracting figures can be countered by adverse conditions of living environment. It would malice the image of city at international platform. Environmental problems are closely associated with geographical conditions and should be dealt with accordingly. The location factor in itself is a big challenge for Hisar. The city is gifted with scanty rainfall, desert topography, seasonal hot and cold waves, burning and freezing temperatures, absence of natural surface water resource and many more. In such conditions, the environmental planning becomes more meaningful in Hisar compared to other city. The study has thrown some light on these crucial parameters for Hisar city.

The study has been carried out with the help of latest techniques of Remote Sensing and GIS. This would also elaborate the use of these techniques in modern day urban planning. In the period of globalization, when newer techniques are replacing the traditional methods, this research would present a new way to manage the resources of urban areas. The environmental aspects in urban planning are not duly cared in India. Hence, these aspects are also not fully undertaken in master plan of Hisar as well as in other planning exercises in the state of Haryana. The study is also a step forward to fill this gap made by lack of such effort in modern day planning.