Aerial expansion of cities in India has occurred on the surrounding agricultural lands for the urban development process. Unlike the cities in the west, urban sprawl in India occurs in a more or less contiguous form from the city limits towards the fringe areas. In the west, there is generally a gap between the city limit and the patches where built-up areas come up in the form of sprawl. Unlike this in Indian context, urban sprawl and the city share common boundaries. Hence the distance factor is missing in India is case. In the wake of urban expansion agricultural fields are acquired by the government agencies for urban development. These areas are turned into planned residential or commercial areas. But the problem is with the unplanned and haphazard urban growth that takes place on the agricultural land.

The present structure of most of the Indian cities indicates successive growth around their cores in the form of encroachment into the rural fringe areas. With one third of the country’s population already living in urban areas, it becomes imperative to have current information on urban growth patterns and its impact on the living environment. It is evident that the current trend of urban growth is haphazard along the urban-rural fringe areas in most of the Indian cities. In order to be able to provide basic amenities and infrastructure for the complex and dynamic urban environment there is an obvious need for planners and administrators to monitor the chaotic growth pattern and changing land use along the urban-rural fringe, as well as within the densely populated urban core. The outward spread of cities is accompanied by many environmental problems: changes in the land use patterns, fragmentation and destruction of wildlife habitat, discharge of polluted runoff water into main river channels etc.

The present study has analysed urban sprawl and urban land transformation in India taking Rohtak city as a case study with the help of remote sensing and GIS techniques. According to Census of India 2011, Rohtak is the third largest city of Haryana. Urban growth has taken place at a fast pace in the National Capital Region during the recent past. Towns and cities have expanded their boundary towards agricultural land or open land. Many towns and cities are growing very fast due to its proximity to national capital, Delhi. Rohtak city, located at a distance of 75 kilometres
from National Capital of Delhi on National Highway No. 10, is one such example. Delhi is a Metropolis city in the Northern Region of India. Rohtak city lies in the National Capital Region. According to NCR Regional Plan 2021, Rohtak city is one of the Regional Centres with population ranging from 3 lakh to 10 lakh. A Regional Centre is a well established urban centre and one among the highest order settlement of six-tier hierarchy of urban settlements in India.

The study is mainly based on secondary data. However, field observations were also undertaken for ground truth verification. The survey of India Toposheet No. 43-D/9 at the scale of 1:50,000 was used. In addition, LANDSAT TM 1989, IRS P6 LISS-III (Resourcesat–1) 2002, IRS-P6 LISS-IVPAN (mono) 2005 & 2011 acquired from Google earth have also been used. Various maps and data taken from different government agencies like Town and Country Planning, Office, Rohtak, MC Office, Rohtak, Census of India, Ground Water Cell, Haryana, Department of Agriculture, Haryana used to complete the study.

Evidences indicate that the initial site of the city was a mound. Rohtak belongs to the genre of ancient settlements in Haryana, which have continued to flourish at their initial sites and have continued to their present status of important urban centres. The history of Rohtak goes back to Mahabharata time, where it is referred as Rohitika, which is mentioned in Mahabharata in connection with campaign of Nakula, the Pandva warrior. The growth of Rohtak during various periods of history was initiated and sustained by the locational advantages in terms of its proximity to Delhi. The location of the city on an important ancient routes connecting Delhi to other parts of the country helped its growth as an economically important trading centre and a strategic frontier post during ancient and medieval periods. Currently, Rohtak is functioning as a dormitory city of Delhi facilitating the movement of people and goods.

The main concentration of population in Rohtak city was in the Walled City. Just like other Indian cities the Walled City attracted people throughout the centuries of its existence and Rohtak city is not an exception. But the Walled City could hold the population up to a certain level. Population of the city continued to increase throughout its history and this increase in population occurred in the form of spread around the Walled City along rail and road network. A high density of population promoted concentration of commercial activities in the central part of the city. Also, in the south
direction of the Walled City, the expansion was due to the establishment of the Railway Station. In the space between the Railway Station and the Walled City was located the wholesale grain market, which initiated the external growth in this area. Commercial activities in the subsequent stages got concentrated along Railway Road and Quila Road. Currently, the area contains the characteristics of Walled City and is the Central Business Area of the city.

With the establishment of the Mughal Empire at Delhi in 1526 A.D., the political centre shifted from Multan to Lahore which formed the apex of the Delhi-Multan-Lahore triangle. Lahore was directly connected with Delhi. This resulted in the loss of the advantage of being on an important route, which the city had enjoyed earlier. However, the influence of the Muslims as the ruling class continued.

The city is an important centre for educational facilities in the region. The educational institutions in the city were established by governmental as well as non-governmental agencies. In 1860, an Anglo-Vernacular school was established inside the Walled City. In 1905, the Jain community in the city also established a Primary School inside the Walled City. The Industrial Training School was established in 1907, and an Inter College for boys came into existence in 1927. This was upgraded as a degree college in 1941.

At the time of the partition of the country in 1947 there was a mass in-migration of population from West Pakistan. At the time an estimated 25,000 Muslims, who had formed about 50 percent of the city’s population, left the city and were replaced by even a larger number of displaced persons originating in West Pakistan. As far as Rohtak is concerned, two camps of refugees with a capacity of 50,000 were established here in November 1947. This in-migration let to a rapid growth of population in the city and the religious composition of the population also underwent change. The mixing of in-migrants with existing population of the city has given rise to new socio-economic classes. Also, the occupation of the population of the city has changed.

Many educational institutions came into existence in different parts of the city. A Women’s College came into existence at the site of Boys’ College established in 1957. Also a coeducational college to provide professional training in education was started in the same year. The college is named after Sir Chhotu Ram, a Jat freedom fighter and a minister in the undivided Punjab. It attracts students from different parts of India. A
Regional Centre, affiliated to Panjab University, for Post Graduate Studies was established in the city in 1962. This was later converted into a full-fledged university presently known as Maharishi Dayananad University.

Growth rate of the population in the city has varied from decade to decade. Just as elsewhere in the northern India, population of the city grew at a very slow pace till the early decades of the last century. This was due to prevalent high death rate in the wake of malaria and plague. For instance, the population of the city grew at the rate of only 0.19 per cent during 1901-11. The highest growth rate was experienced during 1941-51 when population grew at a rate of 50 per cent because of heavy in-migration at the time of partition.

Most of the urban settlements in India are patterned by a simple law i.e. the oldest parts are the most densely populated while the newly developed areas are marked with relatively sparse population. Rohtak city also follows the same pattern. The interior or the oldest part which is situated on a mound is densely populated. The highest concentration of population is seen in the Walled City. Low concentration of population lies in the outer area of the city. It includes planned residential areas like Model Town and residential sectors developed by Haryana Urban Development Authority. Along with them, the unplanned areas located in the outskirts of the city are also marked with low concentration of population. As a result, population density is higher in the central parts and as one moves away from the centre, the density of population tends to gradually decline. The peripheral areas have the lowest density of population. Thus, distances from the city centre and population density are inversely related. This is by and large the common feature of all Indian cities. Among other social and demographic characteristics, sex composition, literacy levels and distribution of Scheduled Castes are worth mentioning. Just as elsewhere in urban India, there is a preponderance of male in the population which can be attributed to the incidence of male selective migration of population from the countryside in search of better job or employment opportunities. In terms of literacy rate the Rohtak ranks seventh among the Class-I cities in Haryana. The city is a premier education centre of the state. Apart from a university and a good number of colleges, the city also houses the only medical university in Haryana. Scheduled Castes form nearly 13 per cent of the population of the city. The highest density of Scheduled Caste population occurs in the north and west of the city.
The process of urban sprawl refers to the spread of urban settlements towards the rural fringe. In other words, it is the growth of built up area outside the city limits. Many large urban centres are facing problems of the congestion of the city core and, in some cases, cities are facing decay also due to saturation within the proper city or the urban limits. This results in pressure on the cities. Fringe areas and nearby villages start merging, and over time become part of the city due to the process of suburbanization. Rapid growth of population and congestion of the core areas encourage middle class people to seek residence along the fringe areas and, thus the process of urban sprawl starts. Slowly the surrounding villages are absorbed and the sprawl further extends outward into a new fringe area. Sprawl, thus, is a continuous process of expansion of cities. The suburbanization in many Indian cities started with newly added industrial and commercial functions. The cities have developed haphazardly without proper planning, because planning was introduced only after the conditions started failing.

The present study has examined the process of sprawl of Rohtak city over a period of 38 years i.e. 1973 to 2011. The built up area of the city has grown by almost five times while the population of the city has barely trebled. The growth rate in built up area is thus more than twice as that in population growth during the period. It means the growth of city is mainly horizontal at the cost of surrounding agriculture lands. The growth of the built up area also shows that the expansion of the city is not demand driven.

The process of sprawl in the present study has been analysed using Shannon's Entropy. Shannon's entropy provides a useful measure and enables us to distinguish between different types of urban sprawl. Shannon's Entropy value ranges from 0 to \( \log (n) \) where ‘n’ refers to the total number of observations involved in calculation of the value. Values closer to zero represents a compact distribution or homogeneity of urban growth and values closer to ‘\( \log (n) \)’ indicates dispersed distribution of sprawl. Higher values of entropy thus indicate the occurrence of sprawl.

The municipal boundary of Rohtak city has changed from time to time. The latest renewal of its limit occurred in 2010, when Rohtak Municipal Committee was upgraded to Rohtak Municipal Corporation. In the present study the MC limit of 2010 has been considered as base for examine the trends in sprawl study of the city. For working out Shannon's Entropy value, researcher has made use of ward level data on land use/land cover. The present study presents an account of sprawl over a period of nearly 4 decades.
The number and areas of wards have undergone change from time to time. In order to overcome the problem, the municipal limit of 2010 was divided in the form of grids of 1.5km X 1.5 km dimension. The total geographic area of Rohtak city Municipal Corporation was represented in forty seven grids. Thus with ‘n’ being equal to 47, the upper limit for the value of Shannon’s entropy could be 1.672 (i.e. log 47). The values of entropy are close to its upper limit which reveals the occurrence of urban growth and dispersed distribution of the variable (i.e. the built-up area). A perusal of the Shannon's Entropy values for different periods indicate that sprawl of the city has a tendency of moving away from compact to dispersed.

The growth of a city generally occurs along the main transport network. Therefore, transport network of the city mainly National and State Highways were taken for measurement of urban sprawl. In this, buffer zones along the roads were created with the help of GIS to show the impact of transport accessibility on urban sprawl. These buffers have also been used to calculate Shannon's Entropy index. It is also generally suggested that the urban sprawl is affected by distance from city centre although access to road network plays its own role. Therefore, Entropy was calculated based on the distance from the city centre to address the distance decay properties of urban sprawl. The city core which basically corresponds to the oldest pocket of inhabitation was demarcated after consultation with the local planning authorities. Old Sabzi Mandi at the northern end of the Quilla Road forms the centre of the city. Most of the commercial facilities in Rohtak city are located in the city core.

The study has revealed that urban development over time has not been uniform in all directions. The growth of built up area of the city was more towards the eastern side/parts up to 1973. Thereafter, up to the end of 1980s, the expansion of the city was more inclined to the southern and western direction. Beyond this and up to the early years of the present century, areas surrounding the core of the city witnessed rise in density of built up area. However, this accentuation of density of built up area was not uniform but mainly concentrated in eastern and southern direction. Growth in density of built-up area was more marked towards the south between 2002 and 2005. The higher density area has a continuous spread in all direction except in the northern side. The northern parts of the city were marked with growth of lower density. It is mainly because several educational institutions have come up in this part of the city. The growth of medium and lower
density built-up area is witnessed all around the city. But this growth is very slow in the northern side. It is because of the fact that the planned residential areas have come up in mainly in the eastern side of the city along the National Highway No. 10 towards National Capital of Delhi. The northern parts have witnessed growth in residential area at a much smaller scale. In general, the ‘built-up area density’ declines with increases in distance from the centre of the city. In the present case also the same pattern exists. However, what differentiates the eastern zone from the southern zone is a more abrupt decline in built up area density in the later than in the former. A more gradual decline in ‘built-up area density’ in the eastern side is reflectance of the magnet effect of Delhi.

An examination of the entropy values corresponding to the buffers created along National Highways and State Highways indicate more consistent built up area near major roads. As distance increases from road the consistency of built up area decreases. The overall entropy value decreases with increase in distance except in the last buffer (1250 meter). The decreasing value of entropy with increase in distance from major roads shows that urban development that is compact near major roads gradually culminates into dispersed type.

In order to examine the process of sprawl, the city was divided into grids. The Shannon’s entropy values were calculated for each of the grids. The values were then assigned to the centre point of respective grids i.e. centroids. To show the smooth pattern of Shannon’s Entropy interpolation methods has been used. It is used with the help of centroids of the each grid using ArcGIS (ESRI product) software extension Spatial Analyst Tools. Based on the interpolation of Entropy value the shape of city appears like an ellipse shape in year 1973. Its major axis and minor axis are in east-west and north-south directions respectively. These axes mainly follow the major road transport routes of the city. Major axis follows the National Highway No. 10 which connects Delhi with Hissar and passes through the heart of the city. Similarly minor axis follows and the National Highway No. 71 and 71A respectively. The central part of the city which contains the largest Entropy value is represented by circle which is surrounded by circles of lower values towards the outer parts of the city. During the periods under study it is found that the major direction of expansion of the city is towards east i.e. towards Delhi, the national capital. After 2005, the growth of the city towards east and also towards north becomes more prominent. The politico-economic factors and growth of ‘real estate’
business both under public and private sectors have led to unprecedented expansion of Municipal limit. Expansion towards east as a magnet effect of Delhi continued and the city limit went beyond the Jawahar Lal Nehru Feeder Canal after 2007.

Land has become an increasingly scarce resource due to growing population pressure and increasing demand of food. Therefore, information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. Land use/land cover pattern of a region is an outcome of interplay between various natural as well as socio-economic factors. Land use/land cover refers to the utilization of land by man in time and space. Land use and land cover (LULC) change now forms the centre-stage of concern for environmental change at the global level.

On the basis of toposheet and satellite images, land use and land cover of Rohtak was analysed in terms of eight classes. These classes are urban built up, rural built up, water bodies, forest area, agricultural area, open area, industrial area and parks/gardens. It may be recalled that Municipal committee of Rohtak became Municipal Corporation in 2010. With this up-gradation of civic status, the boundary of the city was expanded and eight villages namely- Bohar, Asthal Bohar, Garhi Bohar, Majra, Kheri Sadh, Kanehli, Sunari Kalan and Sunari Khurd were brought under municipal limit. Land use/land cover (LULC) in Rohtak has been analysed in two different ways. In the first, LULC is calculated on the basis of geographic area of the city exiting at respective time points. In the second, a common geographic area that corresponds to MC limit for 2010 has been taken as base for working out the share of lands under different uses.

Agricultural land was the main dominant class till early 1970s. However, share of area under ‘agricultural uses’ is reported to have declined considerably in the subsequent years. The share of built up area shows a corresponding increase during the period. It is interesting to note that agricultural land once again acquired a dominant position in 2011. This is because of expansion of the boundary of the city in 2010 that engulfed a large amount of agricultural lands in the surrounding areas. Much of the lands continue to be under ‘agricultural uses’ till the present moment. Built-up area in the city constituted about one fifth of the total area till the end of 1980s. But between 1989 and 2002, built up area underwent a two fold increase in absolute term. Thus, in terms of its share, built up area became the most dominant category accounting for over 45 percent in 2002. The
same continued up to 2005 also. Much of the expansion of built up area seems to have occurred on agriculture lands. However, data pertaining to 2011 reveals a near reversal of the land use pattern with agricultural lands once again gaining its prominence and a corresponding decline in the share of built up areas. It may be recalled that the total geographical area under the municipal limit of the city grew by more than three times on the surrounding agricultural lands between 2005 and 2010.

The analysis based on a common boundary taking Municipal Limit in 2010 as a base year also shows agricultural land as the dominant ‘land use’ class in the city. Nearly nine-tenths of the total area as per 2010 municipal limit was under agricultural uses at the time of 1973. It shows the dominance of agricultural land in the periphery of the city. With expansion of built up area, the ‘agricultural lands’ has decreased at each successive time point. The built up area has increased constantly over the study period. During the period under study the built up area in the city has increased nearly five times.

The study shows that open area of the city has also continuously expanded. The growth rate of open area that was slow up to 2005 accelerated thereafter. ‘Open area’ increased around five times during the study times. The significantly large share of open area at the present time shows that it is ready for future urban development. In other words, these open lands would soon be converted into built up area for both residential and industrial purposes. This part of the state has undergone unprecedented progress during the tenure of the current chief minister. The government has acquired agricultural lands for urban development. This land is acquired to develop residential, institutional and industrial area.

Absolute area under ‘water body’ has also increased. Although, area under natural water body has declined overtime, the same under manmade water body has reportedly increased. The increasing demand of water for development of new industrial and residential sectors has promoted construction of new water reservoirs in the city at several locations. Parks and garden are mainly located in planned residential areas particularly those developed by Haryana Urban Development Authority.

Distance and direction are two major aspects in any geographical study. An attempt has therefore been made to examine the impact of distance from the city core on land use/land cover in Rohtak city. Concentric circle method is effective for analyzing the
quantity and distribution of different categories of land use with respect to distance from a pre-determined urban centre. An inverse relationship can easily be seen between distance and areas of urban built up land use. The curves of urban/built up areas rose dramatically over the years, with peak values moving outwards indicating a rapid urban expansion over the past nearly four decades. Importantly the magnitude of this shift has amplified between 2002 and 2011, especially in zones located between 4 and 6 kms from the city centre. As is expected, the open area curve of 2011 was much higher than for other years in terms of overall trends from city centre to distance of 11250 m.

The growth of the city based on direction also been analysed. Between 1973 and 2011, spread in built up area in Rohtak city showed clear orientation towards eastern, southeastern and northeast directions. Although, built up land has expanded in all directions between 2005 and 2011 inclination towards eastern and south eastern sides continued to persist. This spatial pattern of expansion of residential land reflected influence of the transport network mainly National Highway No. 10. Main growth in the eastern direction was towards the national capital of Delhi. Expansion of built up area in the northeastern direction mainly represent development that has taken place near new Bus Stand after 2005 when a Sport Complex and new residential sectors came up. In addition, lands were also developed by a private builder viz. Sun City in this part. The spatial orientation of open area expansion from 1973 to 2011 can clearly be seen towards eastern and south eastern direction of the city. The lands in this direction were mainly acquired by the government for planned residential areas. This is particularly after 2005 when large amount of land was acquired for IMT (for industrial purpose) and private builders (for residential purpose). These are yet to be developed till the research was accomplished.

In the present study images pertaining to four time-points were used for change detection. This provides input for change detection over three different periods. During the period 1973 to 1989, a drastic transformation occurred on ‘agricultural land’. Agricultural land was mainly transformed into ‘open land’ although a part of ‘agricultural land’ also went into urban built up land. Next to this, transformation of ‘open land’ has also been significant. During this period planned residential areas were confined in eastern direction of the city along National Highways no. 10. A significant feature of the city’s landscape was the residential area along the main roads. Rohtak city is famous for
educational institutions and large number of institutions came up with corresponding infrastructure development leading to the increase in built up area. Maharshi Dayanad University come into existence in 1976. Such a large scale land transformation in the form of the urban expansion has occurred mostly on fertile land and open/waste land. During the period between 1973 and 1989 Tilyar Lake was developed for tourism purpose in the eastern side of the city on the highway connecting Rohtak with Delhi. The lake is spread over an area of 132-acre (0.53 km²) area. It also increased the area of water body (lake) and green area of the city.

During 1989 to 2005 also land transformation continued in the same pace. On the whole the pattern was same as that witnessed during the previous period i.e. 1973 to 1989. Actually, the patches of lands which were vacant or ‘open land’ till 1989 got transformed into built up area by 2005. Residential areas grew in all directions although major growth was taking place along National Highways and State Highways. Many educational institutions mainly schools came up in the outer parts of the city. This feature of transformation was seen during 2005 to 2011 also. Expansion of many educational institutions during 2005 -2011 also resulted in conversion of open area into built up area. For example Maharshi Dayanad University and Jat Education Society expanded their buildings and constructed new buildings in their campus on the open spaces. The magnitude of agricultural land being transformed into open is striking greater during 2005 to 2011 as compared to the past. The size of agricultural land converted into open land during 2005- 2011 alone is more than three times than that during 1989 to 2005.

Identification and demarcation of suitable lands for future urban development is an important aspect in the urban planning. Rohtak city is located on fertile agricultural land. Optimum and judicious uses of land for different purposes assume paramount significance in the wake of growing competition. It may be noted that only those lands which are not suitable for agricultural purposes should be used for urban development. In the present case for this purpose, a land suitability analysis was undertaken based on select parameters. These parameters are proximity to major roads and built up areas, quality of soil and status of ground water in terms of water table depth and quality. The analysis based on these parameters was carried out with the help of Analytic hierarchy process (AHP). AHP is a classical procedure for land suitability analysis. It provides a
systematic approach in decisions-making process concerning site selection and appropriate allocation of lands for different uses.

In the AHP analysis the above mentioned determinants were differentiated in terms of its relative significance in governing urban land use. It is needful to mention that the already built up areas in a city cannot be considered for future development because once a building is constructed, it remains in existence for a minimum of 50-75 years, if otherwise not damaged, or does not demand renovation. Likewise, ‘water body’, forest area and parks are not suitable for future development for residential and other urban uses keeping in mind ecological concerns. Rural area and their surrounded pasture lands are called ‘Lal Dora’ within which no construction is allowed. Therefore, these areas are not considered suitable for accommodating future growth of the city. Thus, ‘open land’ and ‘agricultural land’ both within and in the immediate peripheral areas are the most suitable lands for urban development. In AHP higher values were given to the areas which are closer to major roads. In order to find out better accessibility to the existing road, buffer zones were created for different distance bands from the roads, mainly National Highway and State Highways to generate road proximity map. Proximity to National and State Highways are given higher value in AHP vice-versa

Proximity to already built up land is also an important considerations for planners. Neareness to already built up land means nearness to certain central services including transport network. Thus, proximity to the built up land acts as an important determinants of cost of future urban development. That is why proximity to urban built up land has been assigned higher importance than the areas which are located away from the built up land. On the basis of accessibility to built-up land, buffers were created.

Increasing population leads to growing demand to land. Therefore, areas with fertile soils should not be encroached upon for urban development. In other words, areas with less fertile soil should be preferred for urban development, while areas with fertile soil should be left for agricultural purposes. For future urban development, therefore, lands with low fertile soil were assigned higher values than those with fertile soils. As already mentioned earlier, open area and agricultural land offer the best choice for urban development.
Ground water depth and its quality also form an important concern for urban planners. Ground water is an important resource for urban existence and growth. In Rohtak city, growing population coupled with desire for better quality of life is placing an ever increasing demand on good water resource. At the same time, however, depth of water table also plays an important role. It goes without saying that higher ground water depth is more suitable for built up area than low water table depth. It is because low water table areas which are water logged pose problem for urban expansion. Weightages have been assigned accordingly to different categories of water table depth. Rohtak city is located in an area whose economy is predominately based on agricultural activity. For sustainable agricultural development, it is essential to utilize the irrigation potential. The quality of ground water is the result of all the processes and reactions that have acted on the water from the moment it condensed in the atmosphere to the time it is discharged by a well. Keeping this in mind, low values were assigned to fresh under-ground water and vice-versa.

On the basis of suitability analysis, a map was prepared showing four different suitable categories viz. high suitable, moderate suitable, low suitable and not suitable. High suitable areas accounting for 17.23 percent of that total suitable area is surrounded by existing built up area of the city except some portion in the southern part s of the city. The extension of the zone is demarcated by transport network i.e. along NH-10 towards Delhi and SH-18 towards Sonipat in the eastern part, along NH-71 towards Jind in the north eastern part and along SH-16 towards Bhiwani. ‘High suitable’ areas in the form of patches scattered all around the city can be seen on the map. Most of them are however, connected by road network. The largest among them can be seen in the northern part of the city along NH-71A near Bahanwas village. The ‘high suitable’ zone is surrounded by moderate high suitable zone. This is elongated in the east-west direction of the city and covers around one fourth of the total area. Thus, approximately 60 percent of the total area falls under ‘high and moderate suitable zones’. Only 40 % of land falls under ‘low’, ‘not suitable’ and unclassified categories.

The Town and Country Planning Department, Rohtak, has prepared the Development Plan of Rohtak city in consultation with the National Capital Region Planning Board (NCRPB). This is the main reason that Rohtak city is getting funds both from the state government and NCRPB. According to NCR Regional Plan 2021, Rohtak
city is one of the Regional Centres with population ranging from 3 lakh to 10 lakh. A Regional Centre is a well established urban centre and one among the highest order settlement of six-tier hierarchy of urban settlement in India. The Draft Development Plan of Rohtak city for 2025 was prepared in 2006. The next year i.e. in 2007 the Revised Draft Development Plan of Rohtak city for 2025 was prepared. Therefore, a critical evaluation of the Revised Development Plan of Rohtak city for 2025 was undertaken. Critical evaluation is based on seven criteria viz. difference between DDP 2006 and Revised DDP 2007, growth of population, suitable land for future urban growth, green belt, urban village, loss of agriculture land and unauthorised colonies.

The present system of urban planning in India is based purely on population projections. In the present case the Development Plan is also prepared on the projected size of population for the year 2025. The population of the city corresponding to the base year i.e. 2001 as stated in the two documents do not match. In the revised document the population of the city is projected to grow at a rate of as much as 65 per cent over a period of four years only i.e. 2021 to 2025. The corresponding figure proposed in the original document was 55 per cent. In this very short duration of time the growth rate seems to be inflated. It means that proposals of the Development Plan of the city for 2025 are based on exaggerated rate of growth in population. The geographical area of Rohtak city under proposed plan for 2025 is thus much larger than what the actual demand of land will be. The projected population for 2025 in the two documents also differ from one another by a significant manner. Interestingly, the revised document proposes a population size that is smaller than that of the original document. On the other hand the area under residential uses has been increased in the revised document. There is a mismatch between population projection and proposal of residential uses of land for Development Plan 2025.

The revised DDP had anticipated a growth rate of 40 per cent during 2001-2011 in the population of Rohtak city. However, when 2011 Census results were declared it was found that the population of the city grew at the rate of only 26.67 per cent. The magnitude of difference between anticipated and actual growth rate is too large to be explained in terms of mere wrong assumptions. In other words, it is evident that the projected rates of growth were deliberately exaggerated in order to justify an increased allocation of lands for residential purposes. The actual growth rate in the population of
the city in the past has formed base for future development plans. In addition to this, the residential sectors namely Sector 2, Sector 2 Part, Sector 3, Sector 3 Part and Sector 4 of HUDA are yet to be fully developed. As revealed in the primary survey/ personal visits of the researcher around 45 percent of the total plots in these residential sectors are still vacant.

When the proposed land use plan as per revised DDP of the city was overlaid on the land suitability analysis output some interesting facts were revealed. Several patches of high fertile lands in the southern part of the city along Jhajjar Road have been earmarked for future urban development in the proposed plan. It is important to note that such lands cover nearly 3000 acres. On the contrary, as was revealed by land suitability analysis, the north-western parts of the city along Jind road would have been a ‘highly suitable choice’ for future urban development. Perhaps the planning authorities did not take into account the quality of land objectively.

The green belt along both sides of the road is missing in Rohtak city. Here it is noted that the DDP is prepared for 2025 but the roads/ bypass i.e. bypass in the northern part of the city behind Bus Terminal which were completed around 5 years ago are still without green belt. In the DDP all the National Highways are proposed to have green belt of 60 metres on both the sides. Despite this, recently the constructed bypass of NH-10 near Kheri Shad village does not have green belt. A few patches of green belt are found in the city in residential sectors developed by HUDA on the NH-10 and near IMT on NH-10.

In 2010, the Municipal committee of Rohtak city was upgraded to Municipal Corporation. The boundary of the city was expanded and eight villages namely- Bohar, Asthal Bohar, Garhi Bohar, Majra, Kheri Sadh, Kanehli, Sunari Kalanand and Sunari Khurd were brought under municipal limit. In the DDP for 2025 of Rohtak city no mention has been made concerning planning of these urban villages. The proposed plan is restricted to the urban areas only. This leaves out the edges or the urban fringe (where villages are located), often the most dynamic areas of urban growth. As could be seen the plan does not include Lal Dora and therefore rural-urban linkages do not get integrated in the future growth plan of Rohtak city.
Growth of unauthorized colonies is an integral part of the emerging economies as cities attract more in-migrants that require spatial expansion. The field experiences of the researcher indicate that in most of the cases rural people, who migrate to Rohtak city mainly for better service including education for children, purchase agriculture land from the land owner through registry and construct their houses. By the time the fringe area is merged into Municipal Area, demand for the provision of basic services becomes a major issue. In Rohtak with the passage of time such unauthorized colonies are regularised. The regularization process of these unauthorised colonies is an integral part of vote bank politics. These unauthorized colonies do not get mention in the DDP 2025. The lands on which these colonies exit form part of DDP. So, the implementation of future plan as per DDP will largely depends on these unauthorized colonies.

It has been observed that a metropolitan city exerts its magnet effect on the spatial spread of lower order towns/ cities in it surrounding. National capital of Delhi is the only metropolitan in the northern India. Rohtak city is located in close vicinity in the National Capital Region. In the spatial spread of Rohtak city during the recent past, the magnet effects of Delhi can easily be observed. Although, the city has expanded in all directions, there is a marked inclination towards the eastern side indicating the magnet affects of the national capital.

The rate of growth in its geographical area has not been in commensurate with growth in population. The proposals in Draft Development Plan of Rohtak city are also based on exaggerated rate of growth in population. The magnitude of difference between anticipated and actual growth rate is too large to be explained in terms of simple wrong assumptions. It is evident that the rate of growth has been deliberately inflated so as to justify the scale on which land has been acquired for further development. Good quantity of land has been acquired for this development. Due to this fertile agricultural land has been converted into non agricultural uses. This has serious consequences for ecosystem. In fact there appears to be a nexus between executives and ‘real estate’ business. In other words, the aerial expansion of the city is not demand driven but an artificial one.

In India, population pressure on agricultural land is higher as compared to the past. Fertile agricultural land is more appropriate for agricultural uses rather than non-agricultural uses. Horizontal expansion, therefore, offers a limited solution to growing demand of land for urban uses. The horizontal growth of cities also affects the prospects
of agricultural activities, as more and more farmland is being used for non-agricultural purposes. Also, it would be difficult to provide basic amenities if cities continue to grow horizontally beyond a certain limit. Researchers have therefore emphasised on vertical expansion rather than a horizontal one as strategy of urban planning. Unlike the situation in the cities of developed west, vertical expansion in the context of a city of the size of Rohtak, offers a sustainable solution for growing demand of land. It will save the agricultural land. Also, the vertical expansion helps to provide basic facilities to the population because it reduces the cost of such services. Therefore, the government will have to promote vertical expansion rather than horizontal expansion for the time being.