Editorial

In this issue there are nine papers out of which first two papers are written by seniors. The first paper written by Prof. Kavas Kapadia on 'Reshaping the City: Static Thoughts in Changing Time' brings in to focus the transformation of ideologies taken place during the early period of independence to the present days and its impact on planning and development of Indian cities. As from Gandhian philosophy of self control, honest, pride and poverty an integral part of our life, to self-centric, money making, wealth accumulating and showoff society. The author after explaining the complex phenomena of urban fabric prescribed the development guidelines for reshaping the city in the present context. The paper also discuses about the 'city prosperity index', in order to respond the local and global crisis faced by the cities.

The second paper in the series written by Prof. V. Devadas, and Prof. Najamuddin on the theme 'Postulates for Spatial Planning of Haridwar City' mentions that Haridwar city is one of the key contributors to the development of Uttarakhand State. The city contributes about 25% of the State's GDP, however, in the wake of latest developments, the city is facing a series of issues owing to the ever growing floating population visiting its holy ghats and a continuous influx of migrants from other parts of the State and the country. In this paper, an attempt has been made to analyze Haridwar city in various aspect, which includes its physical setting, demographic pattern, land use, climate change, and infrastructure (physical, social and economic) facilities available in the system; analyze the deficiency in the system; forecast the demand and supply of infrastructure and identify the gap in the system in the year 2031 A.D.; and also recommends postulates for spatial planning for sustainable development of Haridwar city.

The third paper written by Dr. Sanjaykumar G. Sonar, Dr. Dillip Kumar Das, and Isha R. Pawar on the theme 'Some Relevant Issues to Explore Tourism Potentials for Development of Vidarbha Region' highlights that tourism is an instrument for generating employment, earning revenues and foreign exchange, enhancing environment, preserving culture and tradition thereby facilitating overall development. India has great development potentials in tourism sector, and in the recent years it has grown from local economic activity to a major global sector giving employment to a large number of people at various levels. Vidarbha Region, spread across north - eastern part of Maharashtra State, is one of the backward region but having great potentials and scope for tourism development. Utilization of this tourism potentials is helpful in generating revenues through various economic activities in Vidarbha Region.

The next paper on 'Historical Factors Responsible for Underdevelopment of Regions – Comparative Study of Himachal Pradesh and Uttarakhand' written by Dr. Anjan Sen attempts to explore the role of a region's evolving history to its state of underdevelopment. The study is based on a comparative analysis of two mountain states situated in northern India – Himachal Pradesh and Uttarakhand. The two states, situated in the Central Himalayas, share political boundary, and have similar physical and social setting, but display a vast disparity in their levels of development. The analysis of data neither indicates any specific temporal trend nor signifies any precise spatial pattern. Development is a multi-faceted process and among the various factors of development, it is difficult to isolate the role of any one factor, least of all historical, as its impact gets nullified with the passage of time.

The jointly authored paper by A. Madhan, P. Revathy, Dr. S. Lakshmi, and Dr. K. P. Subramaniam on 'A Methodological Framework for Assessing Bus Stop Locations in a Selected Corridor in Chennai with the Application of GIS' states that Bus Stop locations and layout is recognized as a crucial element in the drive to improve the patronage of bus service. Planning of Bus Stop, location is a tool for improving accessibility and consistency in design and provision that make it safe, comfortable, attractive and easy to use. This article explains the methodology

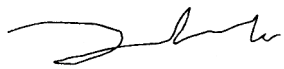
for rationalizing Bus Stops by using Ranking Analysis with the application of GIS for a selected corridor in Chennai.

'Location of Solid Waste Disposal Site using Remote Sensing, GIS and MCDA Techniques in Madanapalle Municipality, Andhra Pradesh', the article jointly authored by Shubhasmita Sahani, Hari Shankar Prasad, and Dr. V. Raghavaswamy highlights that cities and towns are growing rapidly because of increasing population, which is not always contributing to the growth and prosperity of cities and towns, but also contribute to their associated problems, like waste generation and its management. This is directly questioning the sustainability of urbanization. On the other, the quantity of waste is increasing with increasing population, is a serious issue which requires proper planning. A number of processes are involved for management of solid waste, like siting, monitoring, collection, transportation, processing and disposing. However, foremost after collection of solid waste, a site is required for disposing and processing. The study attempts to use Remote Sensing and GIS coupled with MCDA method for analyzing and identifying a dumping Site for solid waste disposal in Madanapalle Municipality in Andhra Pradesh.

Jaideep Kharb, in his paper titled as 'RAY: Ray of Hope for Ajmer' underlines that Rajiv Awas Yojana is a very ambitious scheme of Ministry of Housing and Urban Poverty Alleviation (MoHUPA). In a country like India, where 17.4 percent of urban households are residing in slums, the importance of this kind of scheme becomes more important. Before initiation of this scheme a number of schemes /programs were introduced for providing affordable housing to urban slum dwellers and EWS, at both state as well as center level. This scheme was launched keeping in mind the inclusive approach. Rajiv Awas Yojana is the only scheme of it's kind in which ULBs can adopt a 'whole city all slums approach'. Rajasthan shows considerable progress in last one year following some other states. Ajmer becomes the India's first city who's 'Slum Free City Plan of Action' has been finally approved by MoHUPA.

The paper on the theme 'Estimation of Land Surface Temperature (LST) Using Landsat-7 ETM+ Thermal Infrared: A Case of Shimla (Himachal Pradesh)' written by Shashi Shekhar critically analyzes the LST with land surface aspect in guiding the spatial pattern of the town. It is noted that land surface temperature gradient guided the spatial pattern of the town at the same time it also got modified due to anthropogenic activities of urbanization and got manifested in the form of few urban heat islands (UHI). Historically, Shimla started developing on south slope by virtue of maximum hours of sunshine available during winter. It is the reason that property rent also gets modified accordingly in Shimla. The paper also extracts / estimates temperature from the final LST map for about 90 locations across the city.

In the paper written by Ravinder and Dr. S.P Kaushik on 'Land-Use Change in Urban Environment: Case Study Kaithal, Haryana' by using GIS techniques an attempt has been made to study the changes in urban land-use pattern of Kaithal town over a period of 36 years. Multi source data and maps were used to achieve the objectives. Results of the study indicate that the causal potential factors are governing physical growth and change in the town, through different time periods. The study shows that the town's area was not significantly increased during 1974-1990 period, while urban growth process has gained momentum with the up-gradation of the administrative setup of the town after 1990. The noticeable impact of land-use changes observed the loss of rich agricultural land and natural water bodies. The maximum increase in built-up area both formal as well as informal development are found towards north-eastern parts of the town.



Dr. Sandeep Kumar Raut
Editor

Content

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Reshaping the City: Static Thoughts in Changing Time

Kavas Kapadia

Abstract

This paper brings in to focus the transformation of ideologies taken place during the early period of independence to the present days and its impact on planning and development of Indian cities. As from Gandhian philosophy of self control, honest, pride and poverty an integral part of our life, to self-centric, money making, wealth accumulating and showoff society. The author after explaining the complex phenomena of urban fabric prescribed the development guidelines for reshaping the city in the present context. The paper also discusses about the 'city prosperity index', in order to respond the local and global crisis faced by the cities.

1. INTRODUCTION

A glance at the status of the nation revels that, we are gradually drifting further from the idea of an inclusive society. Hon'ble Pandit Jawaharlal Nehru had reflected his vision for India in the words, "Freedom and power bring responsibility. The service of India means the service of the millions who suffer…..it means the ending of poverty and ignorance and disease and inequality of opportunity….may the star never set and that hope never is betrayed!" Estimates of population below poverty line ranges from as high as 77% to the most recent, best case, so far as 32%. The calorie and protein intake of poor has declined and nearly half of the Indian children, below the age of 5 years, were found to be malnutritioned. Clearly even after 65 years of independence, Pt. Nehru's vision has remained largely unattended so far. While the full impact of the economic laggardness is outside the scope of this paper, the recurring economic and political instability; inability of the government to provide jobs; and the growing lawlessness in the last few decades have combined, amongst many other factors, to produce a derogatory effect on our lives and our cities.

2. IDEALOGY BEFORE 1970'S

A nation born out of a non - violent struggle, overthrowing a regime which had all but milked it dry of resources, India was coming to terms with a sense of insecurity that governed almost all facets of life. During the formative years of independence, the control '*Raj*', where India adopted the Russian model for growth, state control industries and trade, made it difficult for the private enterprises to grow. The main motif of the model was nation building, not to amass wealth for one's own self. Wealth generation was not the idea and money

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making was considered a filthy words and more so, making profit was unethical and almost bordering on an unpatriotic act, perhaps because, there was a general belief that, 'one could only make money by depriving someone else opportunity to do the same'. The notion that, everyone could make money was quite unthinkable. For many years we were made to believe that the virtues of a good life are worth sacrificing all earthly pleasures and possessions. Our religious epics also propagated these values. Poverty was the closest to the simple, basic life. This idea had the sanction of the highest order… "There is a goodness as well as greatness in simplicity, not in wealth". (Gandhi). Poverty was an integral part of our lives and it was best to be accepted unapologetically even with a sense of gratitude and dignity. This idea was often lent itself to the creative endeavors through the medium of cinema by stalwarts like, Khwaja Ahmad Abbas, V. Shantaram and Satyajit Ray. On the one hand moderation was the rule and on the other, opulence the exception. The former is the fate of the masses and latter the privilege of the rulers!

Restricted imports and a limited range of products to choose from, were the main reasons for the manufacturers to ensure a long and useful life of their products. And to ensure the longevity of these products further there was the repair specialist, talented mechanics, craftsmen, cobblers, tailors, all purpose 'fixers', with a sense of pride in their craft of restoration, who could make things workable again. The real practitioners of the mantra 'reduce, reuse and recycle'. Post 1971, an era of economic liberalization, brought transformations and its effects are now beginning felt. The technological transfer of information on the one hand illustrated the adage "information is power" and on the other the ramification/ reluctance of the power brokers to part with the same. In fact, in the early 80's with the introduction of computers, it set the scene for the times to come, a society so dependent on technical gadgets, so that, the modern generation cannot imagine a life without cell phones, TVs and computers.

3. IDEALOGY AFTER 1970

The IT culture arrived with an ironic caveat, that there is 'No Repair'. The keyboard must be thrown away if one key fails and a single chip in the motherboard renders the whole computer system worthless. The 'use and throw' culture of today has proved to be a double disaster. One, it has almost annihilated the breed of talented repairs men, (craftsmen) who paradoxically are most needed in today's desired climate of 'sustainable' living and secondly, it introduced us to solve the new problem of enormous amounts of E-waste.

Post 1971 reforms ushered in not only economic transformations but also turned conventional political and cultural thinking in ideology. The lines, between the personal gain to be rich and powerful and the service to the nation, tended to blur and fuse into each other. Politics began to show definitive signs of being

the … "last resort for scoundrel…". People started looking at ways and means to 'exhibit' their prosperity. A 'car' was an ideal medium for this message and followed by the liberating motorcycle. The utter lack of the provision of mass transportation system makes people to become self dependent in commuting. Cities like Kolkata and Mumbai, with their meager 6% and 14% areas under roads, started to get choked under the onslaught of private vehicles. Today the autos have marginalized the pedestrian in almost all large and medium sized cities. In an interesting finding by the NSSO survey, it is revealed that nearly a fifth of the rural youth, enrolled in vocational training, wish to become a car drivers. This is seen as one of the best job options with no training required and a good salary. One can only speculate on the coincidence of the growing 'road rage' on the roads of the metros.

While the idea of land ownership, as a sign of aristocracy, is very old and socio-culturally accepted. The idea to use property as a symbol of status and later as safe investment was just beginning to catch up. Excessive wealth, mostly a part of the parallel economy (some say largely as a result of excessive 'control raj') began to emerge not only open to public display but with a degree of contempt towards those who were not blessed and smart enough to generate the same. The tremendous hype built into the Indian psyche over years of brainwashing on social value building, climaxing every now and then in the 'Bollywood' classics popular culture, such as, "m*ere paas maa hai*…", has been contemptuously grounded by the modern day value systems. Slogans and messages like 'not for everyone'; 'are you dark skinned?'; 'are you still using your old phone/car?'; and 'sale by invitation only', in the advertisements came to be accepted as the new civic language.

4. CHANGING THOUGHT - TRANSFORMING CITIES

It is found acceptable not only to flash your wealth but also to mock those who have not made it. A country steeped in the culture of caste politics and practicing the same as a tool for manipulation for centuries had discovered another avenue, the class inequity to announce your arrival on the urban scene. The media's ignoble role during the last couple of decades in fueling conspicuous and wasteful consumption and thereby aiding in the declining moral fabric of the nation cannot be fully condoned. Actions and comments of rich and powerful towards the miserably poor folks have exonerated the comment of the French queen Marie Antoinette, on '… why don't they eat cakes', which now suddenly seems a very plausible historic fact.

Newly, rapidly and easily acquired wealth has a lot to do with the deteriorating law and order situation in the country. In the earlier decades, the pace of sluggish economic growth was accompanied by a low growth rate and simple character of the cities and towns. Nostalgia loaded photographs, taken in the late 50's and

60's of Chandni Chawk, Colaba and Chwrangi Lane, show an unrealistic peace and calm. The chaos of bullock carts and '*tongas*' was more than offset by the peace of the absence of the cars. Urban growth went up by 18.3% during 1951-61 and 20.2 % during 1961-71.

The growing demand of affordable housing (it is estimated that the current housing shortage is 24.6 million units and out of these a large part is required for EWS and LIG segments) in the cities has prompted the developers to speculate the price in the growing market and offer a 'dream house' on the fringe or outside the municipal limits. These apartments are mostly unauthorized and unplanned, but for a very 'affordable price', which for a common man would mean an arm and a leg! These peculiar practices by the private developer help in formation of urban agglomerations. Gajanan Khergamker has written in the Times of India that, "An average Indian would need to work for three centuries at a stretch to pay for a luxury home in Mumbai…". While we all know the role of huge money (often black money) in the election process, in many cases the major source of these funds are land and property. Today we are witness to the unpredictable and earlier unimaginable results of the deadly concoction of urbanization, globalization and unpredictable open market. Moral values heading for a rock bottom, hardly a day passes without the news of a scam, each financially bigger than the last. Co-modification of objects, relationships and emotions for sale has disoriented the society and public morals are at a new low.

In 2003 Steven D. Levitt and Stephen J, Dubner written in Freakonomics that, "morality represents the way we would like the world to work and economics determines how it actually works…". During the decade 2001-2011 it was observed that the number of census towns has increased from 1362 to 3894 and majority of these being located on the fringe of metros / cities. The burgeoning urban population within the metros and inadequacy of the planning agencies to sustain the same in a planned way within the city limits, resulted in sprawl on the adjoining lands as 'urbanized land'. The call for living in 'the lap of nature' and similar slogans encourage sprawl, as a result increase travel time and contribute to a larger carbon footprint. Farmers find the advancing physical sprawl of urbanization quite irresistible. A relentless wave that consume productive agriculture land, green belt and robs the town for opportunity to reach an optimal level of density necessary to maintain sustainable habitat. This is reflected through the observation that, the rate of growth of residential density fell during the last decade 2001 to 2011.

5. CONSEQUENCES OF CHANGE

What do you get in return for all these reasons? You get 'Gurgaon'. So potent is the effect of glitz and glamour that virtually every metro today wants in the form of 'Gurgaon', which has become the show piece of the PPP Model for growth in

the country. As per Jessica Siddon, "Gurgaon, as an example of how far private initiative can go when the state is not looking over your shoulder, sweeps aside the critical and often criticized role of particular public officials in enabling private developers to aggregate land and secure development rights". The hard core advocates of the PPP Model never accept the fact that private players, left to play without government supervision, help to widen the gap between the rich and poor.

So, what does all this have to do with city planning? Is the tag of 'smart city', just one more of the sales gimmick? To ensure that it is not, however, it may be necessary to relook at the way we have perceived and deciphered the city, especially in the modern context.

6. MODERN CITY FABRIC

The understanding of the city as a cauldron that holds, churns and enriches the ingredients of 'globalization' and a plethora of overlapping activities synergizing the space (called the modern city). The city is still understood as a two dimensional domain with deterministic areas and predictable activities that respond to the simplistic command expressed in the City Master Plans. The dynamism of the city has left the planner way behind in transforming the image of the city as an entity, which is indifferent to the notion of the area bound activities. This pre-industrial age planning ideas, only suits to the state that is looking to add the number of 'projects' and to complete the picture of the city and also to give profit to the few, land and property speculators.

Hence, there is an inbuilt biasness in the system towards the rich. This is evident from the inability of the government to produce 'inclusive' plans, in spite of a lot of lip service to the term. Exclusive gated communities are encouraged by the police, as it shifts the onus of the security on the Resident Welfare Associations. (Paradoxically, some of the greatest ideas on the global 'co-operation' emerge from the confines of these gated communities). The residents feel secure only if the personal guard is omnipresent outside the gate. Kidnapping as the means of raising quick buck by ransom money, can almost be labeled as the fast growing urban industry. Nothing ensures security unlike money does.

"Why worry that we are moving towards a society in which everything is for sale? The answer is for two reasons. One is about inequity and the other is about corruption. As per Michael Sandle and Allen Lane in 2012, "this explains why the last few decades have been especially hard on poor and middle class families. Not only the gap between rich and poor widened, the co-modification of everything has sharpened the sting of inequity by making money matter more". The declining moral values; rising land prices in urban areas (mainly due to monopolist market created by a sinister alignment of politician, bureaucrat, builder and the law enforcing agencies); the growing informal sector; and the professional need

for creating sustainable habitat, has provided a very challenging task for the planners.

Today, the notions of planning and development are far too concentrated as an economic agenda. Our cities suffer from the fallout of a plethora of 'projects' appended, at the convenience of the bureaucratic initiative and availability of finance, masquerading as town planning. The lopsided after effects of these are there, for us to see, as non user friendly habitat and the 'uglification' of the cities that seems to have taken over. The interface between transportation, land-use and ecological concerns remain on the background. The launch of JnNURM has induced only a very nominal understanding of the significance of infrastructure for improving the quality of life of the residents and consequently inducing self propelled development. This idea of city rejuvenation is as good as the schemes that are interwoven into the multivariate fabric of the city, rather than responding to a list of specific, 'project resultant schemes'.

It may not be out of place to state, that our understanding of the city as a complex web of dynamics of multiple spaces, activities and human interaction, have apparently stretch and deepen in real time; have been conceived in a simple object centric ways with the time scale being a container; and bounding activities that take place there. The traditional and simple liner cause and effect relational attributes of the city activity pattern, have so far been adequately addressed by the static 'master plan or project plan' approach (which freezes the land-use for a long term rigid consideration), drawing upon the accumulated premium as a result of skewed development. The modern day city is an amalgam of many space, time, geographies within the city spaces, has been eloquently dealt within the four steps by Graham, Stephen and Patsy Healey (1999) as follows;

- First, planning must consider relations and processes rather than objects and forms. Western European and American urban dynamics at a particular period in their development need to be replaced by polyvalent, pluralistic and culturally-sensitive appreciation of the relation between social process and urban form.
- Second, planning practice must stress the multiple meanings of space and time. This requires careful attention to the representation of policies and projects in map form, and the expression of time periods. Where two-dimensional representation and fixed time periods are used (for e.g., the 'Five Year Plan' and 'structure plan period'), clarity is needed with respect to whose space and time this is and why it is helpful to use the particular form of expression. Ecosystem base relations, tie places into planetary relations over long time scales and also into the micro relations of species habitat.

- Third, planning practice needs to represent places as multiple layers of relational assets and resources, which generate distinctive power geometry of places. This emphasizes the need to recognize the privileging experience of space and time. The multiple layering is thus neither neutral nor value-free.
- Finally, in this multiplex world, planning practice should recognize how the relations within and between the layers of the power geometries of place are actively negotiated by the power of agency through communication and interpretation. It also emphasizes the importance of recognizing the value systems for mediating the times and spaces of the city. Planners need, not only to facilitate the recognition of values but also to use in plan-making exercises, to help and build a new layer of relational resources at the level of every stage. To provide relational resources there is need to understand the widely-linked diverse relational webs, which transect a place and through which foster relational innovation and richness; discard outdated assumptions; mediate inevitable conflicts without allowing one-dimensional viewpoints; and regain their dominance.

7. RESHAPING STRATEGIES

On the face of a rapidly changing world, where value systems fluctuate as recklessly as the market prices of commodities, the role of the professional planner is extremely important. The capacity of planner to understand, relate and address the multiplex nature of activities in an ever changing scenario is the first step to lead the change on the ground. Appropriate planning policies are necessary for proper planning of urban areas. A lot is happening on this front all over the world. Many countries have common problems and yet the solutions would necessarily differ according to the cultural, social and economic constrains. One most common factor to have emerged in the last decade is the 'political will', to set things right and also inclusion of the stakeholders in some way or the other. The UN document, "The State of the World's Cities 2012/2013: The Prosperity of Cities", encapsulates many broad parameters of development although being universal are applicable to our system. Some basic guidelines worth considering are:

7.1 City Prosperity Index (CPI)

CPI includes 5 dimensions of prosperity: productivity, infrastructure, quality of life, equity and environmental sustainability.

7.2 Responses to Global Crisis

Responses to Global crisis must allow for a vigorous role for cities to play are:

- They are in the best position to boost production in the real sector of the economy at local level, with attendant employment and income generation;

- They can act as the forum where the linkages, trust, respect and inclusiveness are part of any remedy to the crisis can be built;
- Acting locally in different areas and spaces, city responses to the crisis can be structured and included in national agendas for more efficiency, with better chances of flexible responses and more beneficial effects;
- They are in more privileged positions than national governments to negotiate and agree on responses with local stakeholders; and
- They can forge new partnerships and local social pacts, which in turn, can strengthen national governments.

8 CONCLUSIONS

Proper alignment of central and local government expenditures at city level can facilitate transfers and their effective use by city authorities.

Cities can devise a number of safeguards against a variety of socio-economic risks; prioritizing expenditures on social security nets; and local/regional infrastructure, with a view to securing longer-term growth.

Cities can deploy safeguards against the risks of international markets and may bring to bear on local socio-economic conditions for deploying redistributive policies in close collaboration with central governments to reduce income gaps.

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Postulates for Spatial Planning of Haridwar City

V. Devadas and Najamuddin

Abstract

Haridwar city is one of the key contributors to the development of Uttarakhand State. The city contributes about 25% of the State's GDP, however, in the wake of latest developments, the city is facing a series of problems owing to the ever growing floating population visiting its holy ghats and a continuous influx of migrants from other parts of the State and the country. In this paper, an attempt has been made to analyze Haridwar city in various aspect, which include its physical setting, demographic pattern, land use, climate change, and infrastructure (physical, social and economic) facilities available in the system; analyze the deficiency in the system; forecast the demand and supply of infrastructure and identify the gap in the system in the year 2031 A.D.; and also suggested spatial planning postulates for sustainable development of Haridwar city.

1. INTRODUCTION

Urbanization is an important aspect of the process of socio-economic development and is also closely connected with problems pertaining to migration from villages to towns, small towns to metropolises, levels of living in rural and urban areas. The problems pertaining to growth, inequities, unemployment, informal sector, unplanned expansion and conservation of heritage at scales from the mega region down to the neighborhood level are complex and need integrated solutions covering various disciplines. Urban areas are considered as the engines of economic growth of the country. However, present day cities are facing challenges of transformation and management with respect to globalization, competitiveness, sustainability, climate change, livability and inclusiveness. The transformation has a direct bearing on the strategies that need to be adopted to combat the challenges.

Haridwar city is one of the key contributors to the development of Uttarakhand State. The city contributes about 25% of the State's GDP, which is expected to increase much in near future. However, in the wake of latest developments, the city is facing a series of issues owing to the ever growing floating population visiting its holy *ghats* and a continuous influx of migrants from other parts of the State and the country, who are settling here owing to the development of industrial estates in its vicinity. The condition of the city is deteriorating due to rapid population growth and consequent rapid increase in land price. Habitation has extended to low lying areas, where no basic infrastructure is available.

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There are about 31 registered and 10 unregistered slums in Haridwar and are accommodating about 25 % of total population of the city. In these slums, 10 % population do not have legal right over their land and also do not have basic services and infrastructure. At present, around 80 % of the population is covered with sewerage system. A storm water drainage system exists in the city. Drains are mostly *pucca* and open. Proper drainage system is almost absent in slums. Sweeping and Solid Waste Management services are irregular and overall primary collection is poor and 43 % dispose garbage in the open. The river Ganga in this city is polluted due to discharge of untreated waste water into river, waste disposal from cremation ground close to bank of river, bathing and washing and disposal of agricultural, industrial and domestic pollutants from upland.

2. HARIDWAR CITY

Haridwar is situated along Delhi-Niti Pass which starts from Delhi and passes through Meerut, Muzzafarnagar, Roorkee, and Haridwar and goes till the India-Tibet Boundary. Haridwar is well-connected by rail and road. It occupies a position of latitude 29° 58' in the north to longitude 78°10' in the East. Haridwar has the Shivalik mountain range in the north and north-east and river Ganga in the south, which restricts its growth in these directions. Haridwar is a religious city that attracts a lot of tourism, has several small trades, hotel business, transport, and such other activities. Haridwar is also growing as an industrial hub with the establishment of BHEL and a number of medium and large-scale industrial units, which are already operating within the city.

Hardiwar is also one of the four venues in the country for the Kumbh Mela and the Ardh Kumbh Mela, held every twelve and six years respectively. Haridwar is known for its temples, bathing ghats, and tanks. Haridwar stands as the gateway to the four pilgrimages of Uttarakhand. Pilgrims start their journey to four significant pilgrimage centres – Badrinath, Kedarnath, Gangotri and Yamunotri, from Haridwar after taking a holy dip in the Ganga at the most revered location, Brahmkund at Har-Ki-Pauri (Figure 1). Over the next two decades, Haridwar is bound to have spatial expansion in order to accommodate the projected resident population of about 3.15 lakh and provide services to an additional intermittent floating population of 2.56 lakh. Some important city profile details are presented in Box 1.

Fig. 1: Important Locations and Events of Haridwar

Har-ki-Pauri **Kumbh-Mela** **Ganga Aarti**

Box 1: City Profile

Sr. No.	Particular	Details
1	Name of the City	Haridwar
2	Key Economic Drivers	Tourism (Religious Centre), Small and Medium Enterprises
3	Population density	18,507 persons per sq km
4	Floating population	1.65 lakh
5	Decadal Population Growth Rate	28.57% (2001 –2011)
6	Literacy Rate	85% (Male: 88.87% & Female: 80.55%)
7	Sex Ratio	873 per 1,000 males Males-120,201 Female-105,034 (Census 2011)
8	Workforce participation rate	28 % (43,921 main workers and 4,779 marginal workers(Census 2001))
9	Occupational structure	Service – 41.7% Self Employed – 10.3%
10	Vulnerable population (SC / ST)	SC 22,048 (2001 census) ST 87 (2001 census)
11	Area of ULB	12.17 sq km
12	Density	18,507 persons per sq km
13	% Slum Population	55,350 (25% of total population)
14	% Houses in Slums	Not available

3. POPULATION GROWTH

Haridwar's decadal population growth in 2011 was 28.57% which is above the nation's average of 17.64%. The city experienced the highest growth in population of 46.84% in 1971 to 1981 which gradually dropped down to 19.05% in 2001 and is now again showing an upside trend with a decadal growth of 28.57% in 2011. Being a tourist destination, the floating population in Haridwar is huge, and annual average is about 1.65 lakh. A large number of tourists arrive in the month of July during the Kanwar Mela and Somawati Amavasya.

Haridwar hosts about 8 million religious tourists every year. For projection of population (the permanent population) of this city, the tourist arrival per se is not relevant. However, its impact on the sector activities like trade, hospitality services, transportation, etc., cannot be overlooked. The giant public sector unit BHEL (population 43,000 in its colony), a large unit of Hindustan Lever (employment 559), and three engineering units together employ 11,040 workers, have their impact on the tertiary sector of the economy of the city. In private sector also, some large industrial units are functioning in the fringes of Haridwar,

which have impact on the economy of the city; and many more units, which are in the offing, will also indirectly strengthen the economy of this city. As the economy grows, the rate of in-migration of workers will grow concomitantly, which will reflect on the growth of population. The population growth is presented in Table 1.

3.1 Population Projection

The population projection was done using 2nd order polynomial regression. The projection shows that the population figures of Haridwar will touch 3.68 lakh by the year 2041. The rate of population growth is expected to also increase over the years due to in-migration. Besides the tourist population, a large number of daily religious visitors and visitors who come on different business in this head quarter city (Haridwar city is the Head Quarter of District Haridwar) constitute the floating population. The population projection is presented in Table 2 and Figure 2 respectively.

4. LAND USE

The sudden increase in population from 57,338 in 1951 to 1,45,946 in 1981 due to establishment of BHEL led to rapid and unplanned growth of Haridwar city

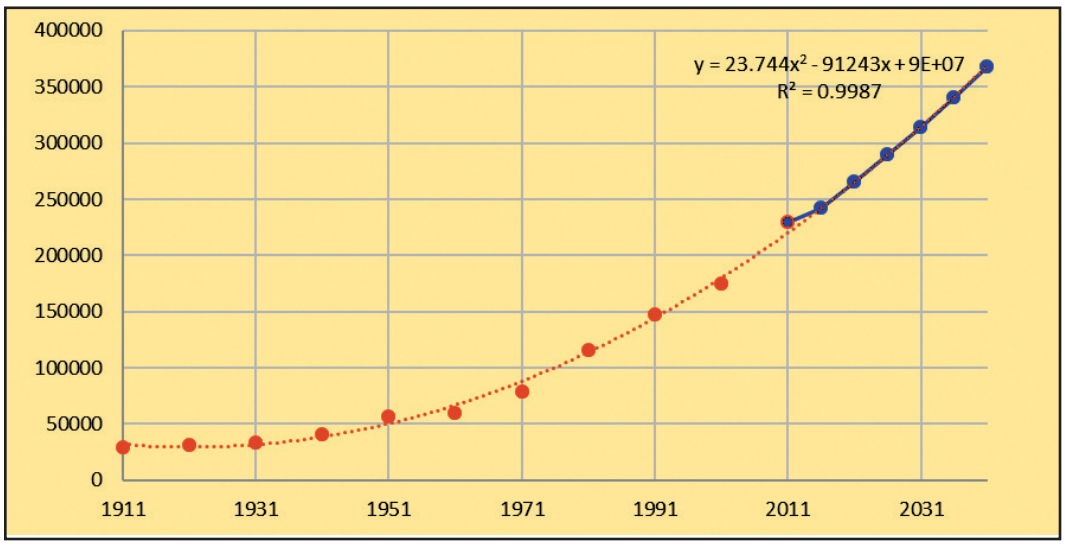
Table 1: Population Growth

Year	Population	Decadal Growth Rate
1901	26000	0
1911	29000	11.54
1921	31000	6.9
1931	33000	6.45
1941	41000	24.24
1951	57000	39.02
1961	60000	5.26
1971	79000	31.67
1981	116000	46.84
1991	147000	26.72
2001	175000	19.05
2011	228832	30.76

Table 2: Population Projection

Year	Population	Decadal Growth Rate
2011	228832	30.76
2016	242185	5.84
2021	265064	9.45
2026	289090	9.06
2031	314263	8.71
2036	340583	8.38
2041	368051	8.06

Fig. 2: Population Projection



resulting in infrastructure deficiencies. In order to ensure planned and controlled growth of Haridwar city and the neighboring rural areas, the first Master Plan of Haridwar was prepared by the Town and Country Planning Division Office (located at Meerut). The first Master Plan prepared for the time horizon of 1985- 2001, still continues to be the legal document. Land use survey conducted in 1985 gives the land use distribution in the Haridwar NPP area covering 1190 ha (11.9 sq km), while the land use proposed for 2001 covers the proposed urbanization area of 4344.25 ha (43.44 sq km). The land use map and distribution of Haridwar city is presented in Figure 3 and Figure 4 respectively.

Overall area of Haridwar city excluding the BHEL and SIDCUL (Industrial zones) is 1747 ha, with a density of 132 ppha. As per the present analysis, the area allocated for the industrial land-use is 1639 ha, which includes BHEL and SIDCUL industrial area. The overall density for this industrial zone (Ward 33-46) is calculated as 29 ppha for a total residing population of 47605 people.

Total area of Haridwar city including BHEL and SIDCUL industrial zones is 3386 ha, which includes 1639 ha of industrial area and the remaining city area of 1747 ha, resulting in net density of 103 ppha, with a total population of 228832. Hence, the overall land use area allocation predictions for subsequent years are taken based on the density of 132 ppha, as it portrays realistic picture of the city growth trend. Haridwar falls under the category of 'medium town(density of 100-150 ppha)' settlement, by virtue of it density of 132 ppha.

4.1 Land Use Projection

According to the projected population for subsequent years, the area to be envisaged for development under the Master Plan has to increase around 9% per a 5 year term. The land use projections are presented in Table 3.

Area under residential land use is 699 ha at present, which has to be increased to 803 ha by 2021, 952 ha by 2031 and 1115 ha by 2041 respectively, as per the UDPFI guidelines for medium density towns.

Area envisaged under commercial land use is 52 ha at present, which has to be increased to 60 ha by 2021, 71 ha by 2031 and 84 ha by 2041 respectively, as per the UDPFI guidelines for medium density towns.

Haridwar being a religious city, area under public and semi-public land use has been revised to 15% instead of 10-12% as prescribed by the UDPFI. Area allocated under public and semi-public land use is 175 ha at present, which has to be increased to 201 ha by 2021, 238 ha by 2031 and 279 ha by 2041 respectively, as per the UDPFI guidelines for medium density towns.

Area allocated under transport and communication land use is 210 ha at present which has to be increased to 241 ha by 2021, 286 ha by 2031 and 335 ha by 2041 respectively, as per the UDPFI guidelines for medium density towns.

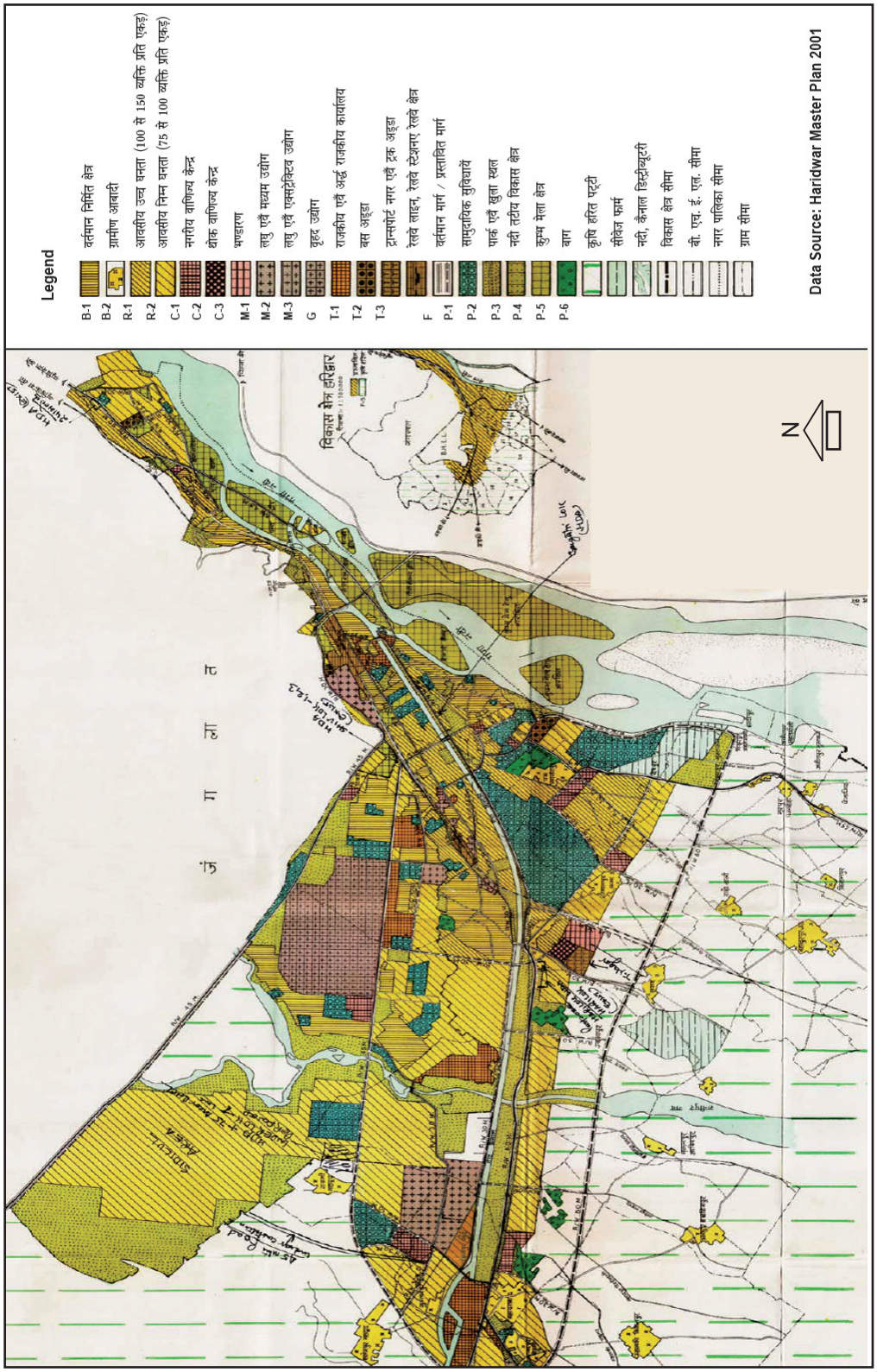
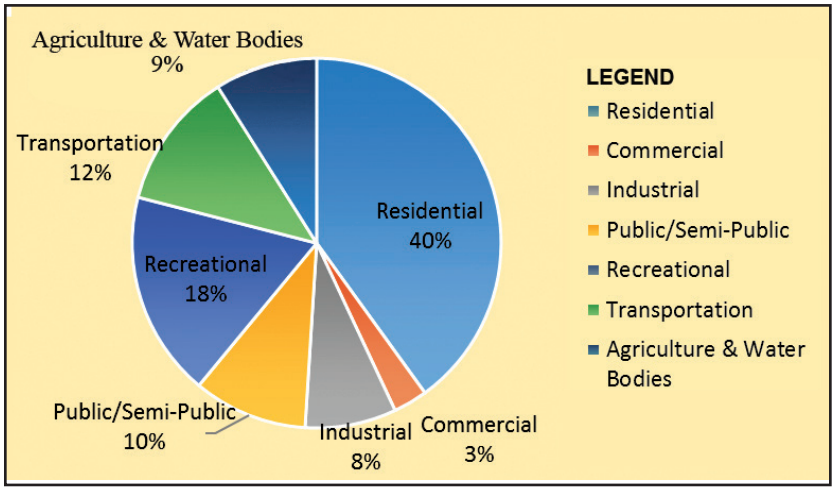


Fig. 3: Land Use of Haridwar City (Haridwar Master Plan 2001)

Fig. 4: Land Use Distribution



Since the last few decades, Haridwar is experiencing physical growth mainly towards the West due to suitable terrain. Future growth is also expected to be in the same direction along Roorkee road, Laksar road and towards Roshnabad. Development of IIE by SIDCUL in Roshnabad is likely to trigger rapid urban growth in this area to support the industrial development. HDA has proposed Harilok Phase II and Indralok housing schemes on Roorkee Road and near BHEL area respectively. Areas along Roorkee road are expected to have higher rate of growth in future. Area along Laksar road is having scattered development on agricultural fields. This is a potential direction of growth but future development must be regulated to preserve the rich agricultural belt.

5. VULNERABILITY TO CLIMATE CHANGE

Haridwar is vulnerable to multiple effects of the climate change. This includes the risks of flooding, air, water pollution, water deficit and increased spread of diseases, landslides, etc. Overall temperature has risen from 1°C to 3°C over the last 100 years, precipitation patterns have changed, and the number of extreme weather events is increasing. Erratic behavior of monsoon with melting of Himalayan glaciers is also the cause of floods for Haridwar city. Extreme events

Table 3: Land Use Area Projections

Landuse	Percentage Area	Yearly Projected Area (Ha)						
		2011	2016	2021	2026	2031	2036	2041
		1747	1835	2008	2190	2381	2580	2785
Residential	40-45%	699	734	803	876	952	1032	1115
Commercial	3-4%	52	55	60	66	71	77	84
Industrial	8-10%	140	147	161	175	190	206	222
Public and Semi-Public	10-12%	175	184	201	219	238	258	279
Recreational	18-20%	314	330	361	394	429	464	500
Transport and Communication	12-14%	210	220	241	263	286	310	335
Agriculture and Water Bodies	Balance	157	165	181	197	214	232	250

going to affect the city are cloud burst and landslides. Landslides of Mansa Devi hill takes place at regular interval.

6. ROAD NETWORK

Road connectivity is one of the most important factors for stimulating growth process in any area. In 2005, all villages except 22 were connected by *pucca* roads in the district. Again, Khanpur and Bahadrabad blocks lag behind in terms of connectivity. Providing regular roads to these villages deserves high priority in development plans of the district. All the sample villages are connected by roads. It is equally important to mention here that despite better road connectivity in all the villages, the condition of roads / streets within many villages is bad, which require immediate repair / maintenance. The road hierarchy can by broadly divided into 5 categories in the study area, based on their widths:

- NH-58 is the widest with 30 m road width. It is under repair since the widening work going on. Major activities on this road are commercial, primarily hotels and restaurants, service shops and a few high rise residential apartments.
- The next category is the 24 m wide road, joining the highway to the Yudhisthir Marg. The road is encroached upon by the parking vehicles and storage by the shop owners. The prime activities are retail shops, financial institutions and residences.
- The third category is of 9 m wide road, and it connects main road to inner pockets, basically catering to planned plotted development. The condition of roads is good and for few stretches, it is concrete too.
- Next category is 2.75 m, which is the peripheral road, running along the distributary canal, and mainly it carries the traffic emanating from the internal roads ending up at this category road.
- The narrowest roads are with width of 1.5-2 m, which are present in the highly dense residential colonies of Ward 25, connecting parallel internal roads.

7. MAJOR FINDINGS

- Keeping in view of the present development scenario and the religious importance of Haridwar, it is advisable to keep its density in the medium town density bracket only. As the useful land is limited due to geographical limitations, (presence of forest area in the north and North-East) low density development is not advisable; even in case of high density development, which in turn means increasing the FAR would have negative implications since it may destroy the image of the city as a religious city and join the horde of modern cities with towers and sky-scrapers.
- The fringe areas to be envisaged for future development need to be acquired along the south-west part of the city, since the north and North-East part of the city is under the forest area. The other reason for choosing this part of the city is its nearness to the industrial area of BHEL and SIDCUL, since

around 7% of the total population is expected to get employment in the industrial sector.

- The area for accommodating the future population, which need to be increased at a rate of around 7%-9% per 5 year bracket need to occupy the vacant areas in the city pocket first. Apart from this, the newer area to be envisaged for residential development shall be connected to the existing NH-58 through arterial roads. Also the satellite township would be with higher FAR to efficiently utilize the fringe area for development.
- Conservation of religious places and properties, under the public and semi-public land use needs to be done, protecting the open areas and gardens in their compounds.
- The land owned by *Ashrams* and religious communities are actually maintaining the open green spaces in the heart of the city, and also helping in accommodating the floating population during various *melas* and fairs, specially the Kumbh and the Ardh- Kumbh.
- It is evident from the traffic nodes and congestion analysis, that there is a need for a bypass for NH-58, since it passes through the main city connecting residential traffic, which is not safe for the inhabitants as well as hinders the speed flow of large transportation vehicles too. By having a bypass, it would be possible to channelize the heavy commercial vehicle traffic inflow out of the city and render the inner pockets safe for commuters.

8. PLANNING PROPOSALS

A major section of the land towards the south and south-west of Haridwar city beneath the Ganga canal is fallow agricultural, with sporadic farming activity (Figure 5). A major expansion of the city is proposed to be done in this direction. This proposal is so that the Roh River and its tributaries and also the Roorkee canal, which are in the North by North West direction of the current Haridwar city does not get polluted by the cities growth. There are small pockets of growth to the South of the Ganga Canal, which can be merged in to the development that proceeds in that direction.

Commercial pockets have been proposed within this new area of development and this shall be done in a stage-wise and sequential manner (Figure 6). Commercial activity has been the backbone of development in Haridwar city. There are few bazaars like the Sarafa Bazaar and the Lakkad Haara Bazaar confined in the city. Apart from these, there is also heavy tourist inflow throughout the year. These activities have developed the city over years. Hence providing the commercial push is best option to strengthen the city's economic development.

Industries have been proposed outside the current Master Plan boundary as the city can do with fewer industries than it already has within its limits (Figure 7). The new industrial areas are kept a bit far from any major water sources so as to limit the direct pollution they cause. Haridwar city and the district is the only

Fig. 5: Expansion of City

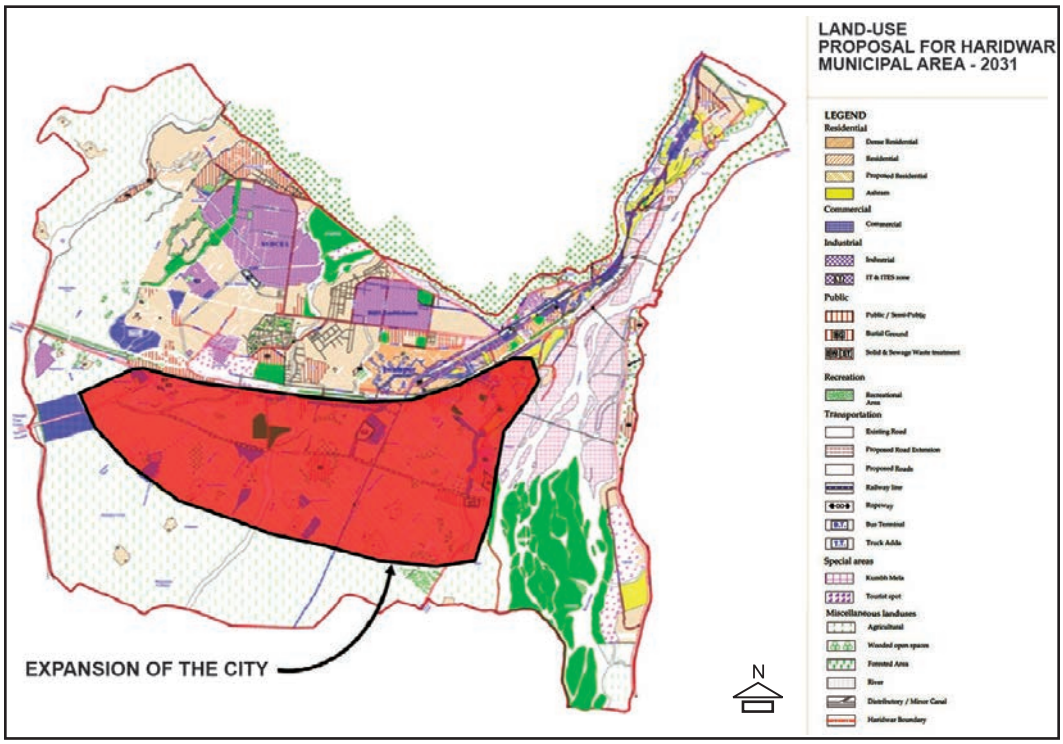


Fig. 6: Commercial Area Development Phases

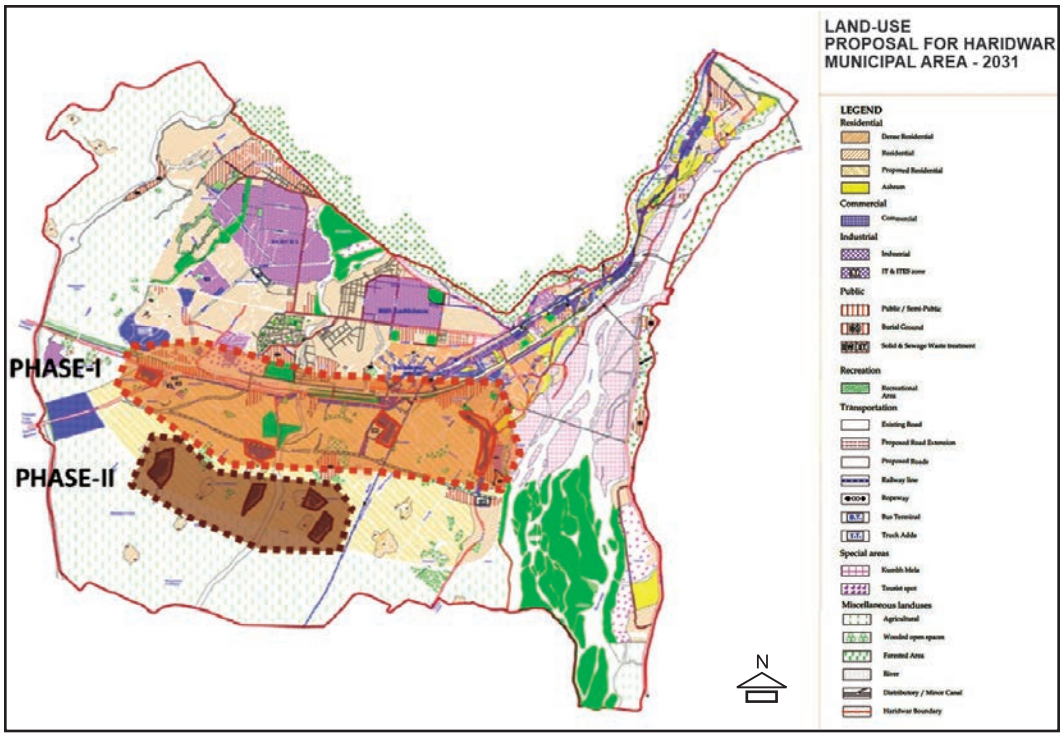
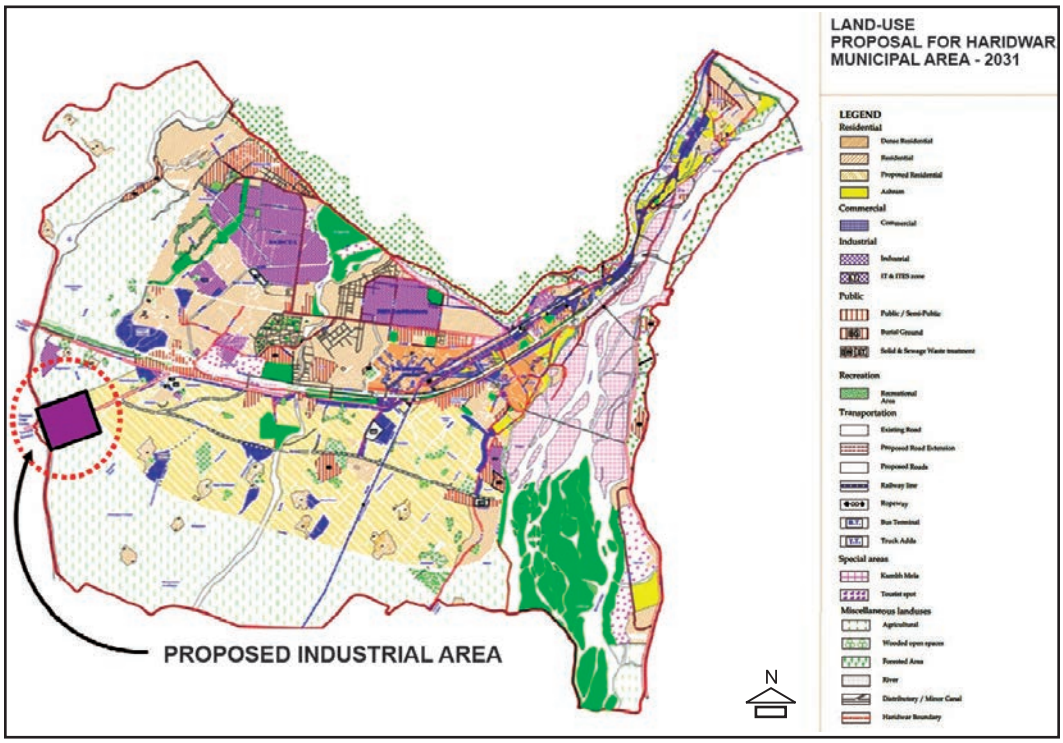


Fig. 7: Proposed Industrial Area



main district, which is located on plains in Uttarakhand State. Hence, industrial development can only take place in this district as it would be exceptionally difficult to build industries on hilly areas. Therefore, industries are being proposed near Haridwar city considering this fact only otherwise, it is not advisable to develop more industries in the city of Haridwar and load the entire system more than it requires. Haridwar is a booming city and has a sizeable worker population that is progressively educating itself and becoming more and more qualified over the years, this makes the area a favorable option for development of industries. The industries have not been proposed too far from the city as the new industries may draw qualified and skilled human resource from the city.

A new Bus Stand has been proposed outside the limits of Kankhal area which is currently a dense residential settlement (Figure 8). The bus-stand is to be located South of the Jwalapur area and this new bus-stand will handle most of the buses coming to Haridwar, and the local transport services only to be allowed to the inner city bus-stand, which is currently functioning as the main bus-stand of the city. This bus-stand might not be an immediate necessity but having the future growth prospects in mind, the Haridwar city will need to segregate inner city and outer city traffic. This new bus-stand is adjacent to the national highway and will reduce the load on the inner city roads as the outer city buses will come only as far as this new bus-stand and then return.

Fig. 8: Proposed New Bus Stand

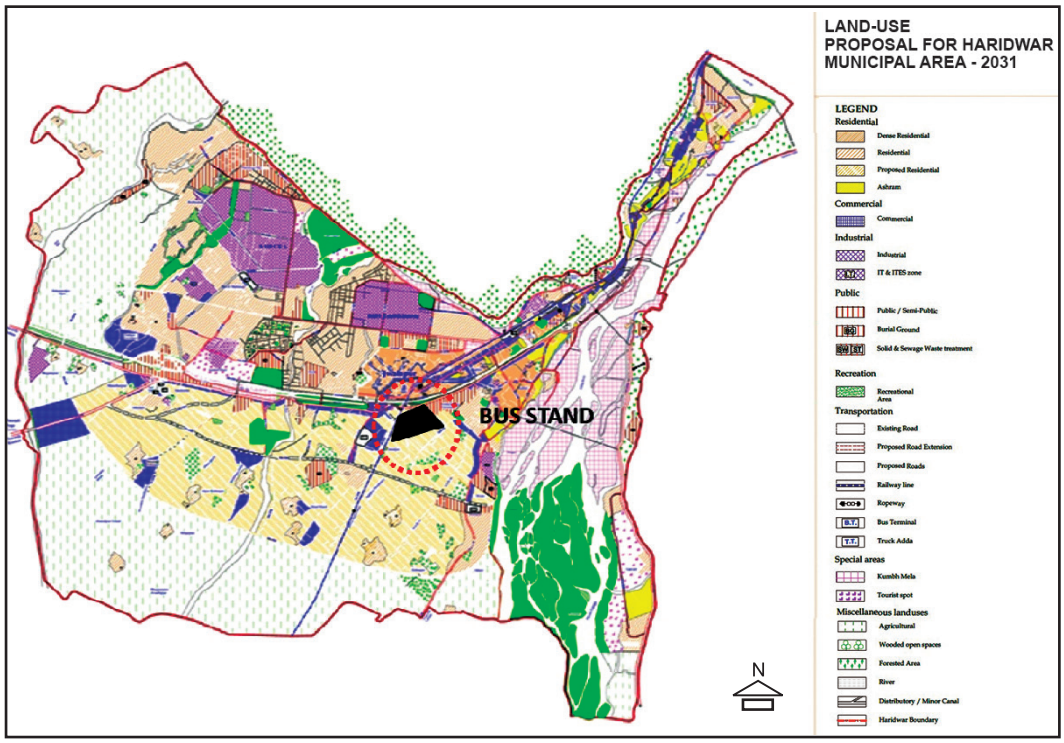
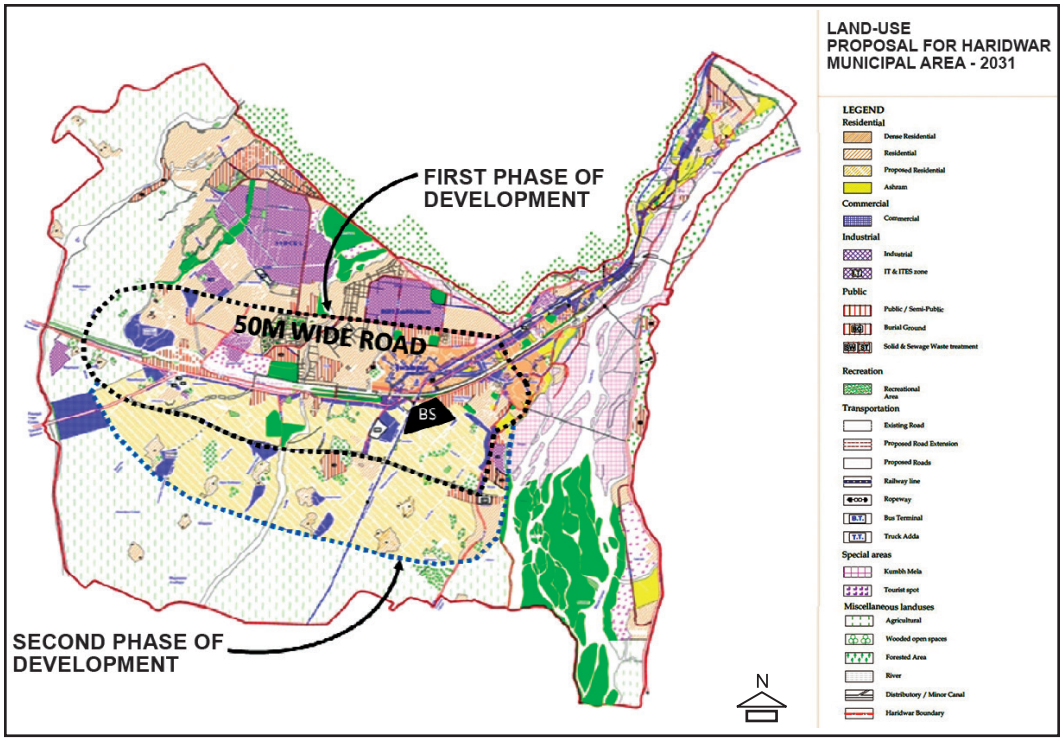


Fig. 9: City Development Phases



An outer ring road of 50 m width and two major inner roads of 30 m width each are proposed to ease the transportation load that will be developed in the future in the newly designated area. These roads also might become part of future bypass roads that may come up (Figure 9).

A sewage treatment and Solid Waste management facility is proposed out of the bounds of current Haridwar municipality, which eventually developed within the purview of residential areas. This facility is very much necessary to the functioning of the entire sewage and solid waste disposal system.

The current railway station at Ekkad shall be strengthened according to the proposal as the railway requirement of the city is already at the breaking point and further growth will easily jeopardize the rail-link related economic growth unless immediate steps are taken to mitigate the situation (Figure 10).

It is also proposed that the railway track be at least doubled and even quadrupled in time as the extensive population growth and further industrial, commercial and pilgrimage/tourist growth will need a lot more cheap and heavy hauling infrastructure. Providing well connected railway links will not only pave the way for the city's economic growth by allowing more transportation in to the city but also will help to develop the entire region

All the well wooded areas in the outskirts of the city are to be cordoned off and placed under the urban local authority of Haridwar city as source of income from

Fig. 10: Development of Ekkad Railway Station

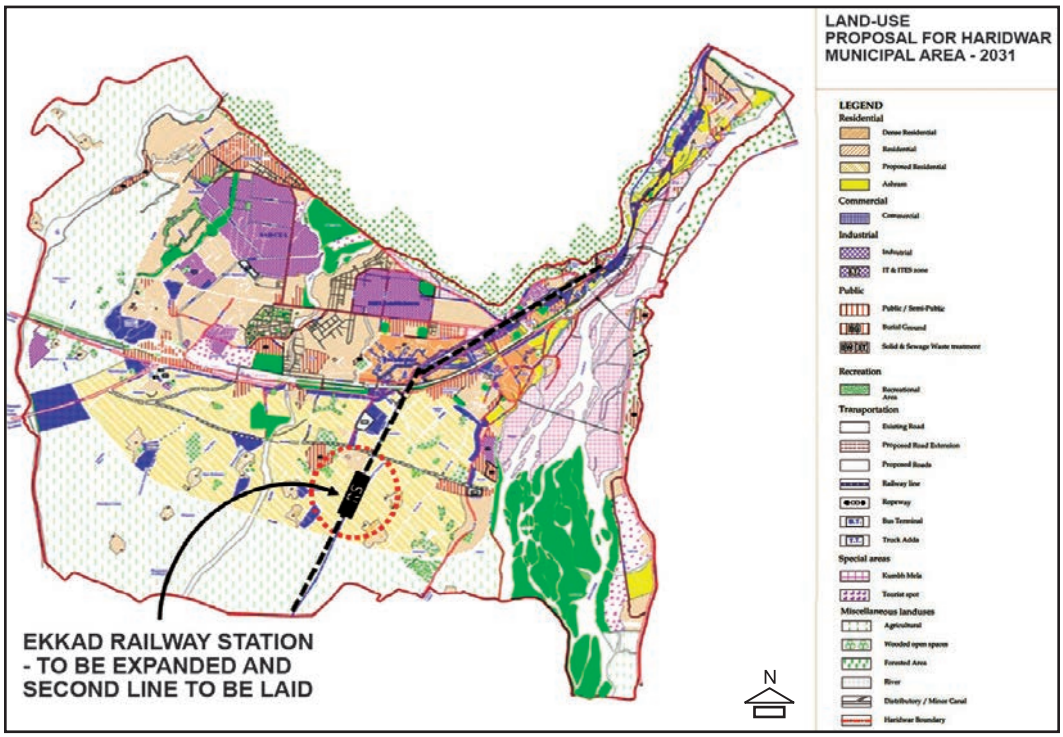
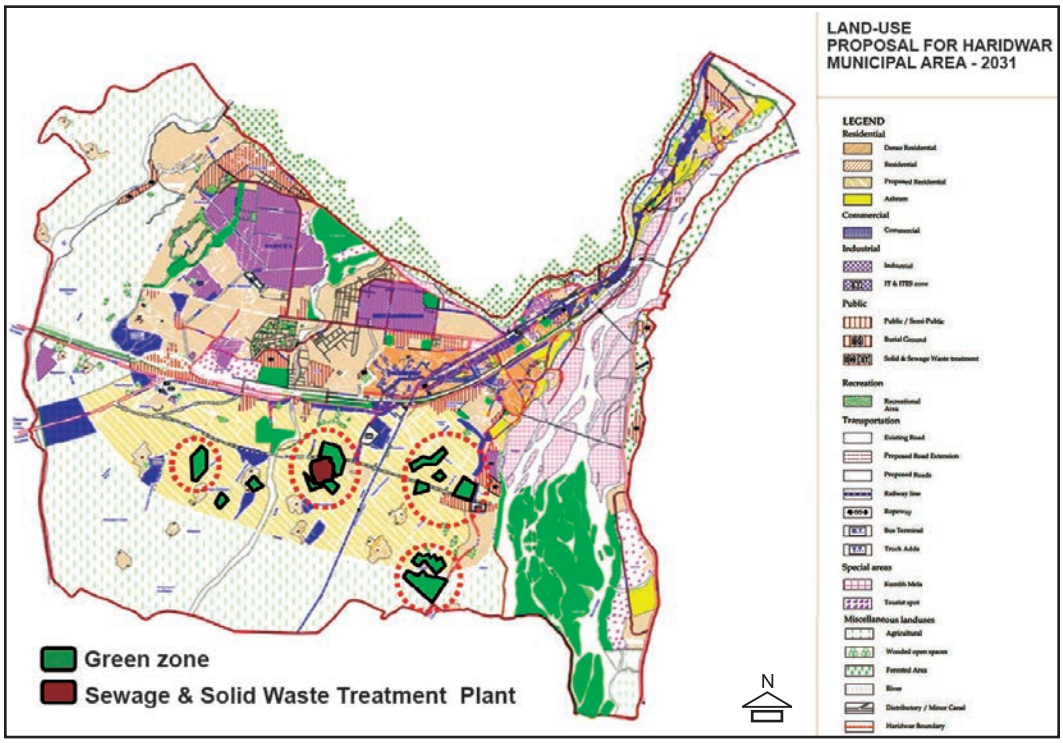


Fig. 11: Green Zones and Sewage and Waste Treatment Plant

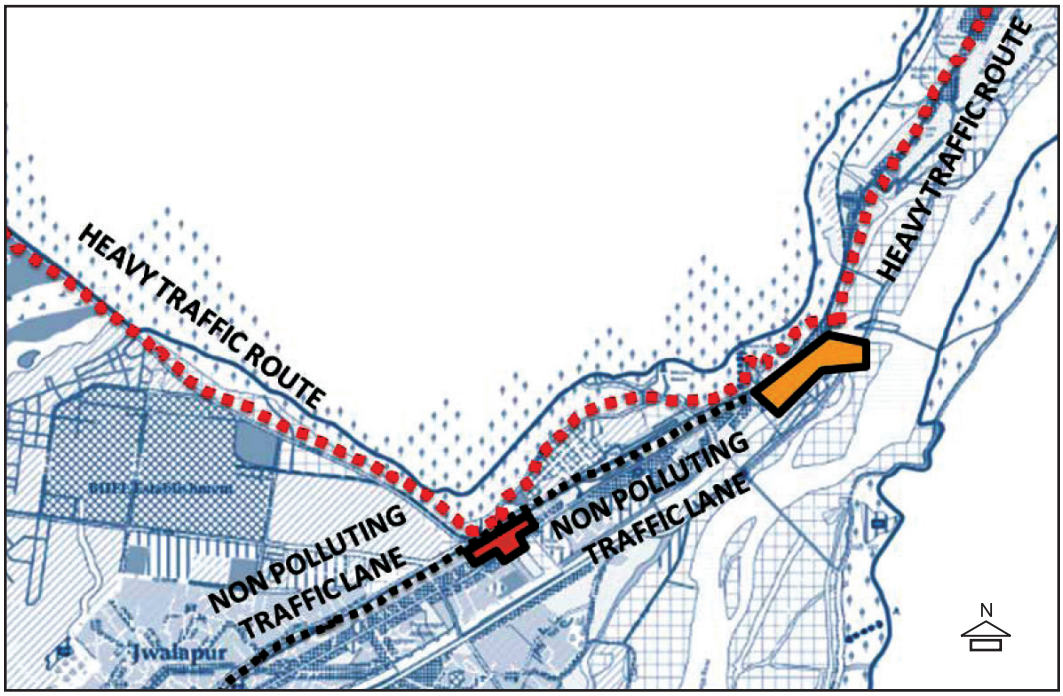


the forest produce. Possible locations have been marked out in the physical land use proposal and it is intended that these regions be used to promote local flora and fauna. These regions may be allowed for public visitation at the discretion of the ULB but it must not harm the green area in itself. These areas can be termed as eco-pockets and are fashioned from existing wooded areas that have been of note in the area that comes under the domain of this master-plan proposal (Figure 11).

A small central park to the new residential development in the south by south west direction of the existing Haridwar city is proposed along the banks of the 'Ranipur Rav' or canal that passes through Ranipur. This area will serve as a central highlight and open space for the future development and also will be close to the highway acting as an advertisement for the city and the proposed settlement. If this piece of land is acquired and developed earlier, then by the period the natural development of the city will extend to the location, this land would have become a well maintained park with interesting and seasoned elements and the real estate around this region could be sold at a higher price by the authorities themselves.

The area around Hari Ki Poudi will be declared as a non-motorized traffic zone with permits/licenses given to the people who have homes in the region. The

Fig. 12: Non-Motorized Traffic Zone



houses in the Hari Ki Poudi area will be phased out over time as a part of making the area a religious focal point of the city. The main road 'Jwalapur Main Road' will be converted in to a non-fossil fuel based traffic road and all traffic can bypass Hari Ki Poudi area through other nearby small road. The said Jwalapur main road can be converted in to a pedestrian mall road thereby not endangering the commercial establishments on the road (Figure 12).

9. CONCLUSIONS

Haridwar city has long way to go for having effective and integrated city development. The city has a characteristic that is very typical of most of Indian cities, i.e. unplanned and haphazard development that is entirely unregulated and is perpetually encroaching on to the streets. Mixed development, which organically grew over the years throughout the entire area has become unmanageable and inadequately serviced. Therefore, an attempt have been made in this paper to identify spatial planning postulates and accordingly proposals have been given, which if implemented in the spirit it has been conceived it will go a long way in sustainable development of Haridwar.

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Some Relevant Issues to Explore Tourism Potentials for Development of Vidarbha Region

Sanjaykumar G. Sonar, Dillip Kumar Das, and Isha R. Pawar

Abstract

Tourism is as an instrument for generating employment, earning revenues and foreign exchange, enhancing environment, preserving culture and tradition thereby facilitating overall development. India has great development potential in tourism sector, and in the recent years it has grown from local economic activity to a major global sector giving employment to a large number of people at various levels. Vidarbha Region, spread across north - eastern part of Maharashtra State, is one of the backward region but having great potential and scope for tourism development. Utilization of this tourism potentials is helpful in generating revenues through various economic activities at regional level, the paper identifies certain issues which are relevant for tourism development in Vidarabha Region.

1. INTRODUCTION

The process of development has been associated with disparity in development since long though supposed to be interlinked. This phonomania has led many planners to think spatial development in a balanced way. Maharashtra State is one of the highly urbanized States of India. However, most of the urbanization has been concentrated in Mumbai-Pune-Nasik Metropolitan belt, whereas, the regions like Vidarbha and Marathwada remained economically, spatially under developed. Vidarbha Region, spread across north-eastern part of Maharashtra State, is economically backward, but it has great potentials and scope for development in various sectors like, agriculture, industries, forests, mining, etc.; including tourism with abundant natural wealth. The Vidarbha Region with its dense forests is home to several wild life sanctuaries and nature parks. Besides this, there is a large hidden potential for tourism activities in religious, natural, historical, social significance, archaeological sites. Exploration of these sites for tourism can attract large amount of foreign and domestic tourist. However, in the absence of information, publicity, non-availability of infrastructure, tourism sector in Vidarbha Region is unexplored. Exploration of this tourism potential can be achieved by formulating strategic implementation approach for tourism development by integrating socio-economic and spatial aspects of tourist destinations. In order to formulate integrated development and implementation approach, literatures pertaining to tourism have been substanirely reviewed in

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this paper, which is also referent for the exploration of Tourism potentials of Vidarbha Region.

2. UNDERSTANDING OF TOURISM

Tourism is a travel for various activities like culture, historical, religious, study, recreational, leisure or business purposes. Tourism arises from the movement of people to various destinations and their stay for few to long period. The journey and stay take place outside the normal place of residence and work, hence, tourism gives rise to activities which are distinct from those of the resident and working populations of the places through which tourist travel and in which they stay. The movement to destinations is temporary and short-term in character, with the intention to return within a few days, weeks, or months. Destinations are visited for purposes, other than taking up permanent residence or employment remunerated from within the places visited. Hence, the purpose of the visit is also an important characteristic of tourism. The World Tourism Organization (WTO), the apex agency in this arena, has defined tourism as, "the set of activities of a people traveling to a place outside his or her usual environment for a specified period of time (at least one night, but less than a year), and whose main purpose of travel is other than the exercise of an activity remunerated from within the places visited". The most important element of tourism is people. Tourism brings different societies, their culture and ideas for interaction. Tourism helps people to achieve practical knowledge and widens the horizon of their outlook, mental and physical satisfaction.

3. CLASSIFICATION OF TOURISM

Based on travelling pattern and purpose of traveling, tourism is classified into various categories. According to time period / duration, tourism is divided into category of short-term and long-term tourism. Further, tourism is classified into international tourism and domestic tourism; incoming tourism and outgoing tourism. In addition to this, tourism is categorized on the basis of mode of organization, as organized by travel agency and by an individual, i.e. organized by families for themselves. According to WTO, tourism is generally divided into the various categories based on origin of tourist. They include, domestic tourism – residents of a country visiting destinations in the own country, inbound tourism – visits to a country by non-residents, outbound tourism – residents of a country visiting destinations in other countries, internal tourism – the combination of domestic tourism and inbound tourism, national tourism – the combination of domestic and outbound tourism and international tourism – the combination of inbound and outbound tourism. The characteristic of tourism destination and tourist behavior provide the basis for the classification of tourism. It is important to classify tourism into various forms. Pierce (1996), viewed tourist destinations from five broad categories namely, attraction (encourage tourists to visit the

Table 1: Various Forms of Tourism

Sl. No.	Forms of tourism	Specification
1	Adventure and extreme	Adventure tourism, Extreme tourism, Space tourism.
2	Culture and the arts	Bookstore tourism, Cultural tourism, Heritage tourism, Literary tourism, Music tourism, Pop-culture tourism, Tolkien tourism.
3	Extralegal	Child sex tourism, Drug tourism, Female sex tourism, Sex tourism, Suicide tourism.
4	Food and drink	Culinary tourism, Wine tourism.
5	Historical	Archeological tourism, Atomic tourism, Genealogy tourism, Militarism heritage tourism.
6	Low-impact	Eco-tourism, Geo-tourism, Responsible tourism, Sustainable tourism.
7	Medical and dental	Dental tourism, Fertility tourism, Medical tourism.
8	Miscellaneous	Accessible tourism, Garden tourism, Sports tourism.
9	Nature and rural	Agri-tourism, Jungle tourism, Rural tourism, Village tourism, Wildlife tourism.
10	Religious	Christian tourism, Halal tourism, Religious tourism.
11	Voyeuristic	Dark tourism, Disaster tourism, Ghetto tourism, Jihadi tourism, Poverty tourism, Township tourism, War tourism.
12	Water-related	Nautical tourism, Shark tourism, Water tourism.

Source: World Tourism Organization (WTO)

location), transport (enable them to do so), accommodation and supporting facilities (for tourists well-being during their stay), infrastructure (assures the essential functioning of all the above sectors). Various literatures have classified tourism forms or types based on purpose of visit or characteristics of tourism site / location. Such classification of forms of tourism has been presented in Table 1.

4. BENEFITS FROM TOURISM

Tourism is one of the largest economic sectors in the world. Economically, it creates jobs from most specialized to the unskilled and contributes to Gross Domestic Product (GDP), as well as, brings in capital investment and exports. Also, tourism offers the opportunity of providing jobs for minority and disadvantaged groups, creating adequate training in management skills, education and technology to local people and increasing incomes for local economies, thereby contributing to the alleviation of poverty in undeveloped regions. Further, there is a great potential for the development of complementary products within the destination. These include everything from vendors offering local handicrafts as souvenirs, service providers, and money changers, to vehicle and equipment rental services, and also a number of informal industries. Several regions have transformed their economies by developing their tourism potential. Therefore, this sector plays very much vital role in expanding economic activities and has the potential to change the economic face of a region. The benefits of planned tourism development are

manifold. Promotion of tourism development would bring many direct and indirect benefits to the people of the country and to the local community of a region. The various listed out direct benefits from tourism are - employment opportunities in tourism and hospitality sector; development of private enterprises; improve standard of living; social upliftment and improved quality of life; better education and training; encouragement of sustainable environmental practices; foreign exchange earnings; cultural fusion ; and urbanization. In addition to this, it includes indirect benefits, such as, infrastructure development; market for the local produce; employment in infrastructure and service sector; preservation of monuments and heritage properties; economic and educational upliftment due to income multiplier effect; contribution to national integration; cultural preservation; environmental protection; enrichment of the social and cultural lives of people, etc.

5. IMPACTS OF TOURISM

Tourism have various types of impacts where tourist visit (e.g., economic, social and environmental), which can be either positive or negative or both. Adequate understanding of the impacts generated by various tourism related activities is essential for formulating policies for the benefit of tourism sector, local communities and environment. Tourism can be well recognized as a major engine of development at national, state and local levels. Tourism generates overall positive economic impact particularly in terms of increasing Gross Domestic Product (GDP), employment opportunities, improve exports, etc. Several regions had transformed their economy by developing their tourism potential. Tourism has great capacity to create large-scale employment varies from the most specialized to unskilled. And also generate income opportunities for local people. Tourism creates local jobs and many opportunities to work, for instance - guides and porters, in lodges, selling local food items and general supplies, renting jeep/car, camp ground and performing cultural shows and so on. These often create many opportunities for women as well. Besides, tourism creates new enterprises, thus, generate new employments and sources of income for the local community. The rise of many micro and small enterprises came alongside the node of tourist centres in the region. Tourism results in additional income earned by local enterprises from goods and services bought by tourists, wage to households in connection with tourism-related employment and income to the government through taxation and fees. The highest beneficiary of tourism is the hospitality sector which provide accommodations, then followed by the restaurant industry and retail sectors. Tourism also involves improvement of international linkages and foreign expertise which leads to technological and knowledge transfers to boost local economy. Tourism can also have a positive impact on overall regional development and also helps to balance inequalities between the various regions of a country. Tourism is a sector uniquely suited to the remote and under developed parts of the region in order to contribute

wide spread spatial development of the region. Regions away from a country's economic development center can be used to promote tourism so as to generate income and reduce out-migration. The benefit of tourism can also improve investment towards better infrastructure development in these remote and under developed regions.

5.1 Negative Impact of Tourism

Uncontrolled and unplanned growth of tourism, in most cases, leads to generation of spatial, social, political, economical and environmental problems. Most of the tourism sites can accommodate optimum number of visitors based on the carrying capacity of designed facilities and available resources and environment, but the situation changes often dramatically when the number of visitors increases beyond certain threshold of facilities. These may cause physical damage to site, drops quality of life and degradation of environment. All these effects are magnified when vehicular pollution and traffic jams are also involved. 'Leakage' is a process whereby part of the foreign exchange earnings generated by the tourism sector is not retained by tourist-receiving regions. It is either retained by tourist-generating countries or repatriated to them in the form of profits, income and royalty remittances, repayment of foreign loans and imports of equipment, materials, capital and consumer goods in order to cater the needs of the international tourist and overseas promotional expenditures.

Literature study suggested that a significant share of the revenue from tourism sector does not stay in the country. Several studies have pointed out that, the tourism sector generally exhibits a high degree of 'leakage' especially when there is a large proportion of foreign ownership in the sector and also due to the high percentage of import content in luxury tourism. Leakages are generally created by the need to import goods (typically luxury food items, alcoholic beverages, etc.), international marketing costs, interest payments on foreign loans and the payment of franchise and management fees to foreign companies. Leakages are often highest at the start of a country's tourism sector due to large amounts of one-time imports needed to start-up tourism enterprises. These leakages, however, tend to decrease over time when economy develops its domestic sources of goods and services. It is, therefore, important to tighten the links between domestic industry and tourism.

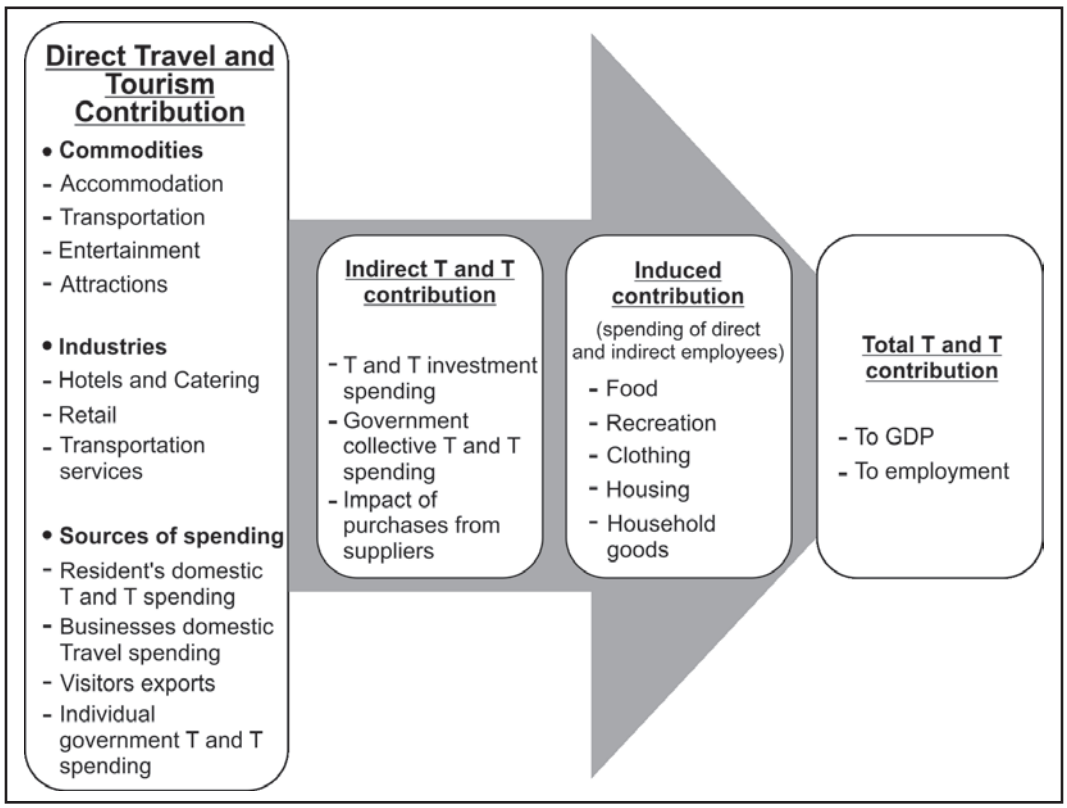
Environmental impacts include, the depletion and pollution of water resources; land degradation; increased level of air and noise pollution; ecological disruption through the alteration of ecosystems; deforestation; and greater amounts of solid waste, littering and sewage in the destination country. It is further, aggravated by increase in traffic during the tourist season, which leads to increased air pollution; increased threat of water resource depletion; generates twice the amount of solid waste; and ecosystems and natural habitat can be damaged

by development of tourist related infrastructure and tourist activities. Socio-cultural impacts include increased crime rate, social stresses and culture clashes arising from differences between income level of visitors and local community; and the commoditization of unique local culture.

6. TOURISM AS A DEVELOPMENT STRATEGY

Tourism is a major phenomenon of the modern society, which has emerged as an economic activity of immense global importance. There is hardly any other field of activity where so many people are involved directly or indirectly. Tourism has found a niche for itself as an instrument for generating employment, earning revenues and foreign exchange, enhancing environment, preserving culture and tradition thereby facilitating overall development of a region. Tourism is a way of life and way of knowledge which promotes the overall development of people. The tourism has very strong linkage to socio-economic progress of the society. The WTO has estimated that tourism is the world's largest service sector and fastest growing sector in terms of revenue generation and also ensures consequential development of infrastructure at the destination. It is smokeless industry in the sense that it earns large sums of foreign exchange without exporting any tangible

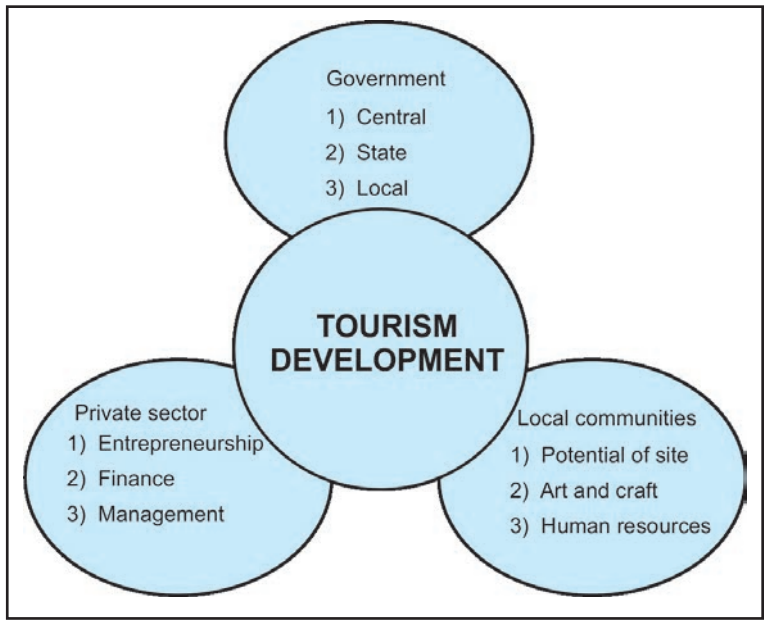
Fig. 1: The Economic Contribution of Travel and Tourism Industry



Source: Travel and Tourism Economic Impact, 2011.

product by providing extensive employment opportunity, not only to skilled but semi and unskilled persons. Tourism can give quick relief to the areas where there is higher rate of unemployment. Tourism sector also became an instrument for sustainable human development including, poverty elimination, environmental regeneration and job creation.

Fig. 2: Factors Affecting Development of Tourism Sector



Source: Tourism as a Development Strategy - Senate Economic Planning Office 2006.

The impact of tourism on the economy varies depending on the tourism strategy undertaken (Figure-1). In reality, tourism sector is still relatively underdeveloped in developing countries, like India and should learn from the experiences of other countries. The potential for foreign exchange and employment generation makes it an attractive tool for economic development. Certainly, several issues need to be addressed to make the tourism sector more competitive. This is to ensure that the sector does not fall into the threat that it has become in other countries. Fortunately, there are mutually-beneficial steps that the government, the private sector and local communities can take to maximize the gains and minimize the losses from tourism (Figure-2).

6.1 Developing Local Industries to Reduce Leakages

The tourism sector in developing countries is particularly susceptible to leakages which, when reaching particular levels, significantly negate the potential financial gains for the host country. Avoiding excessive leakages and thus maximizing the retained profits from tourism is normally accomplished through the strengthening of economic linkages within the local economy. This requires building of a domestic supply chain for goods and services, that would otherwise be purchased externally. When tourism enterprises are able to source their inputs and supplies from local producers, this allows most of the financial benefits of tourism to remain within the host country. For governments and tourism enterprises, strengthening linkages can be accomplished in a number of ways. Immediate measures could include promoting locally owned accommodations, endorsing destinations where they can purchase local crafts and products, promoting resorts that employ local staff and using airlines from the host country. A more long-term solution is to

enhance the capacity of enterprises within and around tourist destinations to intensify the production of goods and services required by the tourism sector as well as provide support to more domestic investors to further expand their participation in tourism sector. Establishing a government loan program, which can be capitalized through earmarked tourism related tax revenues, that assists local start-ups and expansions to meet tourism demands may be considered.

6.2 Establishing Priority Tourism Zones and Providing Incentives

"Tourism Zones" within priority destinations in the region are required to establish with the intention of focusing, spending, attention, encouraging and mobilizing investment in tourism sector. It is envisioned that, tourism-related industries, choosing to locate within the zones, will also be given a number of fiscal and non-fiscal incentives to accelerate the development of tourism. The proposed fiscal incentives for locators include an income tax holiday; gross income taxation in lieu of other national and local taxes; and accelerated depreciation and tax exemption for imported capital investments. Whether the grant of fiscal incentives to tourism zones will accelerate investments is unclear and difficult to quantify. Further, it has been also observed that the provision of lump-sum grants to tourism enterprises, to reduce the fixed capital costs at the start of the business, was proven to be more effective than tax holidays. Hence, the government should not only focus on incentives but provide quality infrastructure and reduce cost of doing business to attract investors for tourism.

6.3 Accelerating Development of Tourism Satellite Accounts (TSAs)

These is no need to emphases that, good policy-making cannot be successful without availability of accurate data. Thus, the absence of Tourism Satellite Accounts (TSAs) continues to hamper policy making for the tourism industry. The TSAs provides a standard framework for organizing statistical data on tourism, as well as, offering an internally coherent view of tourism that is consistent with the principles of the system of national accounts. Furthermore, the development of TSAs will generate a reliable set of data relating to the importance and magnitude of tourism by using the same concepts, definitions and measurement approaches. This will provide indicators of the sector's relative importance to the overall economic picture in the country.

6.4 Ensuring Collaborative Tourism Planning for Sustainability

Negative impact on environmental, social and cultural require proper long-term tourism development planning that takes into account the needs and concerns of various stakeholders like - government, private sector and local communities. Tourism planners need to strike a balance between protecting the integrity of the local culture and environment and ensuring the continuing commercial viability. Thus, planners have to consider factors, such as, the carrying capacity of the region in terms of visitors and essential infrastructure without losing sight

of the need to make a profit. In order to achieve this balance it is essential to ensure involvement and cooperation of all the players at all stages of development of tourism project. Collaborative tourism planning also helps to ensure efficiency and minimizes overlap of functions while providing a system of checks and balances that will take care against conflicts of interest. Furthermore, collaborative tourism planning can help equitably to distribute the benefits and costs of tourism among all stakeholders.

6.5 LEAD A MARKETING STRATEGY

One of the most important components contributing to a successful tourism sector is, the presence of a world-class marketing and promotions campaign, to build awareness of a country's highest potential tourist region. The components of such an effort should ideally include high-profile television and internet campaigns, as well as, greater presence in travel agencies in the form of posters, brochures and other promotional.

7. CONCLUSIONS

In the recent years tourism has grown in India from local economic activity to a major global sector giving employment to a large number of people at various levels. India has succeeded in becoming the most preferred destination amongst domestic and overseas tourists by exposing them to India's diverse culture. India has great tourism potential, which is an excellent condition for development in this sector. Government, till date, has framed various policies and has proposed various schemes along-with incentives for the promotion and development of tourism sector in India. However, government has failed to spelt-out the strategies for implementation and integrations of tourism with their socio-economic and spatial aspects.

There are some areas and regions like Vidarbha Region, whose tourist potentials are yet to be fully explored, therefore, to have a balanced regional development and to avoid the spatial disparity, there is a need to assess resources, development potentials and hidden positive aspects of the tourist destinations within the Vidarbha Region. Based on these assessments of tourist destinations, strategic implementation approach is required to be formulated by integrating socio-economic and spatial aspects of tourist destinations for overall upliftment of the Vidarbha Region.

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Historical Factors Responsible for Underdevelopment of Regions – Comparative Study of Himachal Pradesh and Uttarakhand

Anjan Sen

Abstract

This paper attempts to explore the role of a region's in evolving history to its state of underdevelopment. The study is based on a comparative analysis of two mountain States situated in northern India – Himachal Pradesh and Uttarakhand. The two States, situated in the Central Himalayas, share political boundary, and have similar physical and social setting, but display a vast disparity in their levels of development. The analysis of data neither indicates any specific temporal trend nor signifies any precise spatial pattern. Development is a multi-faceted process and among the various factors of development, it is difficult to isolate the role of any one factor, least of all historical, as its impact gets nullified with the passage of time.

1. INTRODUCTION

To understand the current levels of development as in 2001, between the districts which were princely states and districts which were under British rule i.e. Himachal Pradesh and Uttarakhand is the basic objective of this paper. The level of development is evaluated through demographic factors and it has been hypothesized, that districts under British rule will have lower level of development than princely states, due to drain of resources from the former.

Very few literatures speak about the role of historical factors, especially colonialism, in a region's development and underdevelopment. Friedman (1972) claimed that regional development could not be analyzed purely in economic terms, and power relations in spatial systems needs to be examined. Spatial pattern of resource allocation is limited by spatial distribution of decision-making power.

Slater (1974), defined 'Colonialism' as a formal device, by which large parts of Latin America, Africa and Asia were incorporated into the international capitalist economy. Each colony exclusively traded with its respective metropolitan country. Key positions in colonial economies were controlled by foreign metropolitan capital. The monetary system allowed draining of surplus due to no exchange controls. This is further promoted by unequal exchange of agricultural commodities produced in colonies for industrial goods produced in metro-poles. Local capital accumulation was severely restricted.

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2. METHODOLOGY

Step 1: Delineation of the study area – Two neighboring mountain states, in northern part of India – Himachal Pradesh and Uttarakhand, have been selected for the study. The study conducted at district level covered all 25 districts, 12 in Himachal Pradesh and 13 in Uttarakhand. In 1947, 16 of the 25 districts were under British rule, while nine were under indigenous princes, of whom seven were in Himachal Pradesh.

Step 2: Identification of Indicators – Development is a multi-faceted process, and in the present paper, the level of development in the districts is measured in terms of following six demographic indicators during the census year 2001:

- Population growth;
- Population density;
- Sex ratio;
- Literacy rate;
- Work force participation rate; and
- Urbanization rate.

Step 3: Identification of variables – Calculation of these six indicators listed above requires different types of variables, which are listed below:

- Total area 2001;
- Total population 1991 and 2001;
- Male and female population 2001;
- Age (0-6), Age (7+) and literate population 2001;
- Workers population 2001; and
- Urban and rural population 2001.

Step 4: Collection of data – All the above data was obtained from secondary sources published by the Census of India 1991 and 2001 (Table 1).

Step 5: Analysis of data – The data collected from secondary sources has been analyzed in the following ways (Table 2).

- **Calculation of indicators** – Individual indicator was calculated using various formulas.
- **Calculation of Location Quotient (LQ)** - The LQ is determined by dividing the figure of each indicator of each district ($_d$) by the aggregate figure of the same indicator of the region ($_r$), which is the sum of Himachal Pradesh and Uttarakhand. For example, 'population density' of 'x' district is obtained as

Table 1: Area and Population Data of Himachal Pradesh and Uttarakhand, 1991 and 2001.

S. No.	District	Area	Population									
		Total	Total	Total	Age 0-6	Age 7+	Male	Female	Urban	Rural	Literates	Workers
	Unit	*Sq. Km*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
	Year	*2001*	*1991*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*
	INDIA	**3,287,240**	**846,302,688**	**1,028,737,436**			**532,223,090**	**496,514,346**	**286,119,689**	**742,617,747**	**560,687,797**	**402,234,724**
	HP + UK	**109,156**	**12,221,511**	**14,567,249**	**2,153,169**	**12,414,080**	**7,413,864**	**7,153,385**	**2,774,655**	**11,792,594**	**9,097,654**	**6,126,497**
	Himachal Pradesh (HP)	**39,590**	**3,735,544**	**4,362,862**	**609,958**	**3,752,904**	**2,236,296**	**2,126,566**	**506,337**	**3,856,525**	**2,678,310**	**2,159,422**
S. No. 1-12	55,673	5,170,877	6,077,900	793,137	5,284,763	3,087,940	2,989,960	595,581	5,482,319	3,991,872	2,992,461	1,233,658
	Uttara-khand (UK)	3,088	1,025,679	1,282,143	172,486	1,109,657	679,583	602,560	678,742	603,401	876,441	400,475
S. No. 13-25	53,483	7,050,634	8,489,349	1,360,032	7,129,317	4,325,924	4,163,425	2,179,074	6,310,275	5,105,782	3,134,036	536,633
1	Kangra	5,739	1,174,072	1,339,030	164,566	1,174,464	661,254	677,776	72,285	1,266,745	940,505	588,994
2	Mandi	3,950	776,372	901,344	119,949	781,395	447,872	453,472	60,982	840,362	538,135	454,292
3	Shimla	5,131	617,404	722,502	85,089	637,413	380,996	341,506	167,233	555,269	504,330	370,223
4	Solan	1,936	382,268	500,557	66,434	434,123	270,291	230,266	91,195	409,362	332,410	263,445
5	Chamba	6,522	393,286	460,887	69,579	391,308	235,218	225,669	34,542	426,345	246,169	230,452
6	Sirmaur	2,825	379,695	458,593	68,431	390,162	241,299	217,294	47,670	410,923	274,643	225,872
7	Una	1,540	378,269	448,273	59,712	388,561	224,524	223,749	39,424	408,849	312,278	201,658
8	Hamir-pur	1,118	369,128	412,700	50,699	362,001	196,593	216,107	30,206	382,494	298,498	205,405
9	Kullu	5,503	302,432	381,571	52,820	328,751	198,016	183,555	30,093	351,478	239,649	216,513
10	Bilaspur	1,167	295,387	340,885	42,890	297,995	171,263	169,622	21,951	318,934	231,733	166,708
11	Kinnaur	6,401	71,270	78,334	9,304	69,030	42,173	36,161	0	78,334	51,913	47,811
12	Lahaul & Spiti	13,841	31,294	33,224	3,664	29,560	18,441	14,783	0	33,224	21,609	21,088
13	Hardwar	2,360	1,124,488	1,447,187	262,894	1,184,293	776,021	671,166	446,275	1,000,912	754,948	425,263
14	Dehra-dun	3,088	1,025,679	1,282,143	172,486	1,109,657	679,583	602,560	678,742	603,401	876,441	400,475
15	Udham Singh Nagar	2,542	1,047,191	1,235,614	219,291	1,016,323	649,484	586,130	403,014	832,600	659,165	392,156
16	Nainital	4,251	492,983	762,909	113,645	649,264	400,254	362,655	269,050	493,859	508,731	278,947
17	Garhwal	5,329	682,535	697,078	101,255	595,823	331,061	366,017	89,875	607,203	461,675	269,871
18	Almora	3,139	608,210	630,567	97,368	533,199	293,848	336,719	54,505	576,062	392,640	292,182
19	Tehri Garhwal	3,642	580,153	604,747	98,524	506,223	295,168	309,579	59,846	544,901	337,816	264,715
20	Pithora-garh	7,090	416,647	462,289	72,080	390,209	227,615	234,674	59,833	402,456	296,362	198,709
21	Chamoli	8,030	295,465	370,359	55,710	314,649	183,745	186,614	50,703	319,656	237,354	164,729
22	Uttar-kashi	8,016	239,709	295,013	49,758	245,255	152,016	142,997	22,918	272,095	161,161	135,904
23	Bagesh-war	2,246	228,407	249,462	41,206	208,256	118,510	130,952	7,803	241,659	148,464	118,844
24	Rudra-prayag	1,984	159,406	227,439	35,876	191,563	107,535	119,904	2,732	224,707	141,078	102,033
25	Cham-pawat	1,766	149,761	224,542	39,939	184,603	111,084	113,458	33,778	190,764	129,947	90,208

Source: Census of India, 1991 and 2001.

Table 2: Demographic Indicators of Himachal Pradesh and Uttarakhand, 2001.

S. No.	District	Pop. Growth		Pop. Density		Sex Ratio		Literacy Rate		WFPR		Urbanization Rate		Composite Index (CI)
		Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	
	Unit	%		*p/km²*		*m/1000f*		%		%		%		*Average LQ*
	Year	2001		2001		2001		2001		2001		2001		
	INDIA	22%		313		1072		55%		39%		28%		
	HP + UK	**19%**	**1.00**	**133**	**1.00**	**1036**	**1.00**	**62%**	**1.00**	**42%**	**1.00**	**19%**	**1.00**	**1.00**
	Himachal Pradesh (HP) S. No. 1-12	**18%**	**0.91**	**109**	**0.82**	**1033**	**1.00**	**66%**	**1.05**	**49%**	**1.17**	**10%**	**0.51**	**0.91**
	Uttarakhand (UK) S. No. 13-25	**20%**	**1.06**	**159**	**1.19**	**1039**	**1.00**	**60%**	**0.96**	**37%**	**0.88**	**26%**	**1.35**	**1.07**
1	Kangra	14%	0.73	233	1.75	976	0.94	70%	1.12	44%	1.05	5%	0.28	**0.98**
2	Mandi	16%	0.84	228	1.71	988	0.95	60%	0.96	50%	1.20	7%	0.36	**1.00**
3	Shimla	17%	0.89	141	1.06	1116	1.08	70%	1.12	51%	1.22	23%	1.22	**1.09**
4	Solan	31%	1.61	259	1.94	1174	1.13	66%	1.06	53%	1.25	18%	0.96	**1.33**
5	Chamba	17%	0.90	71	0.53	1042	1.01	53%	0.86	50%	1.19	7%	0.39	**0.81**
6	Sirmaur	21%	1.08	162	1.22	1110	1.07	60%	0.96	49%	1.17	10%	0.55	**1.01**
7	Una	19%	0.96	291	2.18	1003	0.97	70%	1.12	45%	1.07	9%	0.46	**1.13**
8	Hamirpur	12%	0.62	369	2.77	910	0.88	72%	1.16	50%	1.18	7%	0.38	**1.16**
9	Kullu	26%	1.36	69	0.52	1079	1.04	63%	1.01	57%	1.35	8%	0.41	**0.95**
10	Bilaspur	15%	0.80	292	2.19	1010	0.97	68%	1.09	49%	1.16	6%	0.34	**1.09**
11	Kinnaur	10%	0.52	12	0.09	1166	1.13	66%	1.06	61%	1.45	0%	0.00	**0.71**
12	Lahaul & Spiti	6%	0.32	2	0.02	1247	1.20	65%	1.04	63%	1.51	0%	0.00	**0.68**
13	Hardwar	29%	1.50	613	4.59	1156	1.12	52%	0.84	29%	0.70	31%	1.62	**1.73**
14	Dehradun	25%	1.30	415	3.11	1128	1.09	68%	1.09	31%	0.74	53%	2.78	**1.69**
15	Udham Singh Nagar	18%	0.94	486	3.64	1108	1.07	53%	0.85	32%	0.75	33%	1.71	**1.50**
16	Nainital	55%	2.85	179	1.34	1104	1.06	67%	1.07	37%	0.87	35%	1.85	**1.51**
17	Garhwal	2%	0.11	131	0.98	904	0.87	66%	1.06	39%	0.92	13%	0.68	**0.77**
18	Almora	4%	0.19	201	1.51	873	0.84	62%	1.00	46%	1.10	9%	0.45	**0.85**
19	Tehri Garhwal	4%	0.22	166	1.24	953	0.92	56%	0.89	44%	1.04	10%	0.52	**0.81**
20	Pithoragarh	11%	0.57	65	0.49	970	0.94	64%	1.03	43%	1.02	13%	0.68	**0.79**
21	Chamoli	25%	1.32	46	0.35	985	0.95	64%	1.03	44%	1.06	14%	0.72	**0.90**
22	Uttarkashi	23%	1.20	37	0.28	1063	1.03	55%	0.87	46%	1.10	8%	0.41	**0.81**
23	Bageshwar	9%	0.48	111	0.83	905	0.87	60%	0.95	48%	1.13	3%	0.16	**0.74**
24	Rudraprayag	43%	2.22	115	0.86	897	0.87	62%	0.99	45%	1.07	1%	0.06	**1.01**
25	Champawat	50%	2.60	127	0.95	979	0.94	58%	0.93	40%	0.96	15%	0.79	**1.20**

Source: Census of India 2001.

(P_d/A_d), while its equivalent LQ will be obtained as $[(P_d/A_d)/ (P_r/A_r)]$, where, P_d and A_d are respectively the population and area of the 'x' district; while P_r and A_r are respectively the total population and area of the region.

- **Calculation of Composite Index (CI) –** Using the above methodology, six sets of LQ is obtained for each district. All the six LQ figures for each district are aggregated; and averaged by dividing the aggregate LQ figure by 6 (as the number of indices is six). The average LQ figure of each district is its composite index. CI = (∑LQ/ N), where, ∑LQ is sum of all LQ, and N is total number of indicators.

Step 6: Representation of data – The analyzed data of six indicators and one composite index were represented by maps prepared in AutoCAD and Arc View GIS Software. The data in the map has been suitably grouped into three categories – high, medium and low; and represented through choro-chromatic technique.

Step 7: Interpretation of data – The emerging geographical patterns have been explained through various cause and effect relationship.

3. PROFILE OF STUDY AREA

3.1 Geography

Both the states Himachal Pradesh and Uttarakhand are 'kite-shaped', with the south-eastern border of Himachal Pradesh forming the north-western boundary of Uttarakhand. Himachal Pradesh is situated between latitudes 30°30′N and 33°30′N and longitudes 75°30′E and 79°00′E; and is bounded on the north by Jammu-Kashmir, south-west by Punjab, south-east by Uttarakhand and east by China. Uttarakhand is located between latitudes 29°00′N and 31°45′N and longitudes 77°45′E and 81°00′E; and is bounded by Himachal Pradesh towards north-west, Uttar Pradesh towards south-west, Nepal towards south-east, and China towards north-east (Figure 1). In terms of location and physiography, the 25 districts can be placed in following five longitudinal zones:

- Upper Indus-Ganga Plain (*Terai*) – Haridwar and Udham Singh Nagar both in Uttarakhand.
- Lower or Lesser Himalayas (*Siwalik*) – Una, Hamirpur, Bilaspur, Solan and Sirmaur in Himachal Pradesh; and Dehradun in Uttarakhand.
- Middle Himalayas (*Himachal*) – Mandi and Shimla in Himachal Pradesh; and Pauri, Tehri, Nainital, Almora and Champawat in Uttarakhand.
- Upper or Greater Himalayas (*Himadri*) – Chamba, Kangra and Kullu in Himachal Pradesh; and Uttarkashi, Chamoli, Rudraprayag, Bageshwar and Pithoragarh in Uttarakhand.
- Trans Himalayas – Lahaul and Spiti and Kinnaur both in Himachal Pradesh.

3.2 History

The contemporary administrative history of Himachal Pradesh is far more complex than that of Uttarakhand. Himachal Pradesh became a 'constituent unit' of

Fig. 1: Administrative Boundary of Himachal Pradesh and Uttarakhand, 2001.

Indian Union as early as 1948 and achieved 'self-governing' status, i.e. became a 'State', within quarter of a century in 1971; while Uttarakhand attained both the positions only in 2000. The territorial configuration of the study area, prior to 1947 was as follows (Figure 2):

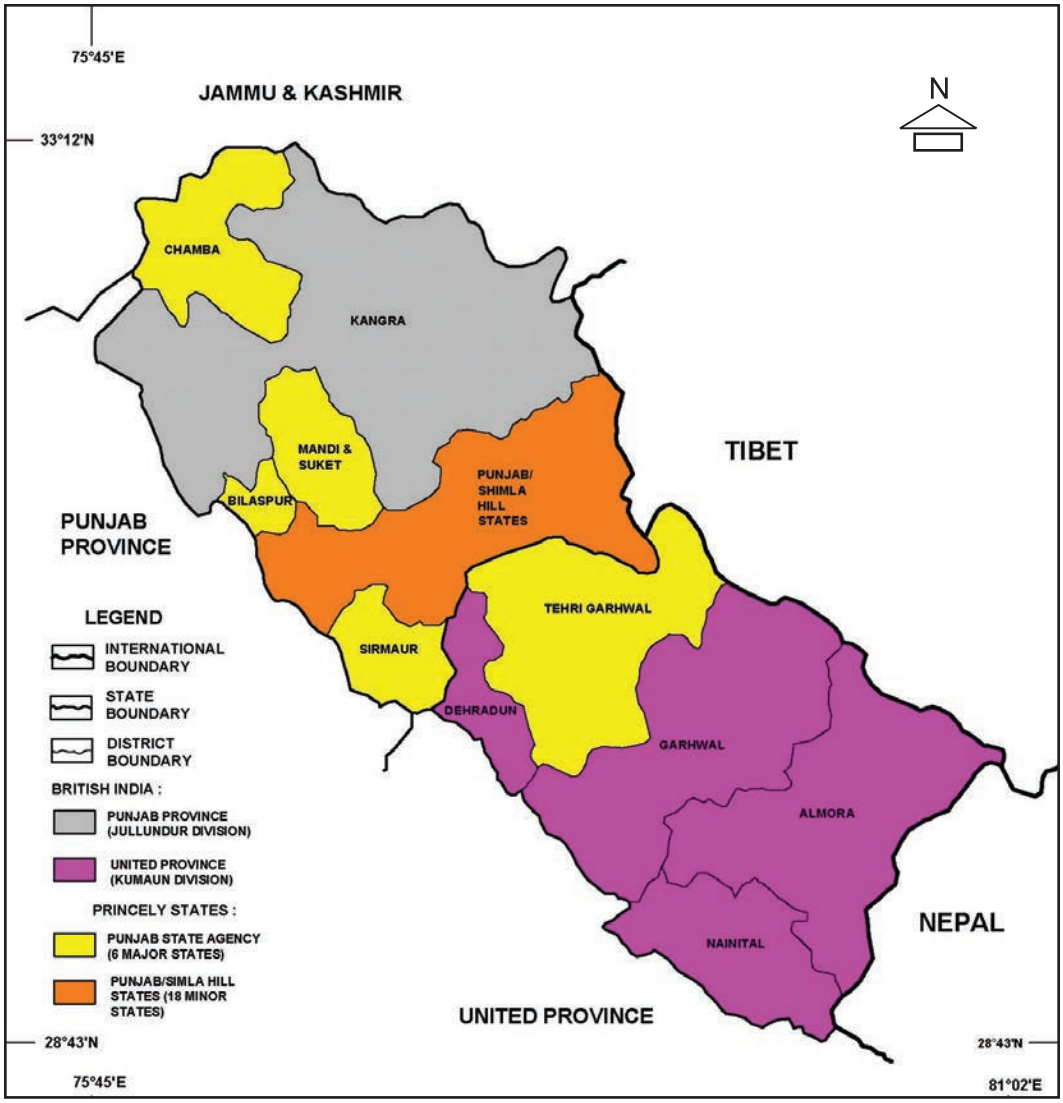
(i) Punjab Province

- Jullundur Division
  - Kangra District – Kangra, Una, Hamirpur, Kullu and Lahaul and Spiti

(ii) United Province

- Kumaun Division

Fig. 2: Administrative Boundary of Himachal Pradesh and Uttarakhand, 1946.



- Dehradun District – Dehradun
- Garhwal District – Garhwal, Chamoli and Rudraprayag
- Almora District – Almora, Pithoragarh, Bageshwar and Champawat
- Nainital District – Nainital and Udham Singh Nagar

• Meerut Division
- Saharanpur District *(a sub-part)* – Haridwar

(iii) Punjab State Agency

• Chamba – Chamba
• Mandi and Suket – Mandi

- Bilaspur – Bilaspur
- Sirmaur – Sirmaur
- Tehri-Garhwal – Tehri-Garhwal and Uttarkashi

(iv) Punjab Hill States –

- Shimla Hill States – Shimla, Solan and Kinnaur

'Himachal Pradesh' was constituted on 15th April 1948 as a 'Chief Commissioner's Province', by integration of four major princely states of 'Punjab States Agency', i.e., Chamba, Mandi, Suket and Sirmaur and all the 18 minor princely states of 'Punjab Hill State'.

Under the new Constitution of India effective from 26th January 1950, Himachal Pradesh became a 'Part C State'. On 01st July 1954, Bilaspur, earlier a major princely state of 'Punjab States Agency' and now a 'Part C State', was merged with Himachal Pradesh.

Under the States Reorganization Act of 1956, Himachal Pradesh became a 'Union Territory' on 01st November 1956. Under the Punjab Reorganization Act of 1966, four hill districts of 'Punjab' State, i.e. Shimla, Kullu, Kangra, and Lahaul & Spiti and hilly tracts of Gurdaspur, Hoshiarpur and Ambala districts were transferred to Himachal Pradesh.

Under the State of Himachal Pradesh Act of 1970, Himachal Pradesh became the 18th 'State' of India on 25th January 1971.

The administrative history of Uttarakhand is far simple. Under the Uttar Pradesh Reorganization Act of 2000, all the eight hill districts of Uttar Pradesh, along with Haridwar and Udham Singh Nagar Districts, were separated and constituted into a new state of Uttaranchal on 09th November 2000, to become the 27th State of India. On 01st January 2007, Uttaranchal was renamed as Uttarakhand.

3.3 Society

The two states are different in terms of religious composition. Himachal Pradesh is nearly-homogeneous with 95% Hindus, compared to 85% Hindus in Uttarakhand, which also has a large Muslim minority at 12%, concentrated in Udham Singh Nagar and compared with a small Muslim minority of 2% in Himachal Pradesh.

Both Uttarakhand and Himachal Pradesh have small Sikh minorities, respectively 2% and 1%, the former in Udham Singh Nagar and the latter in Una. Additionally, Himachal Pradesh also has a small Buddhist minority of 1%, concentrated mainly in Lahaul and Spiti.

The two states, however, are fairly similar in terms of linguistic composition. Himachal Pradesh is 89% Hindi, 6% Punjabi and 1% Nepali speaking; while

Uttarakhand is 88% Hindi, 3% Punjabi, and 1% Nepali speaking. Additionally, Uttarakhand has 6% Urdu and 1% Bengali speakers.

In terms of Scheduled Caste population, both Himachal Pradesh at 25% and Uttarakhand at 18% are higher than India at 16%; while in terms of Scheduled Tribe population, both Himachal Pradesh at 4% and Uttarakhand at 3% are lower than India at 8%.

3.4 Economy

Himachal Pradesh had a GDP of Rs. 15,660 crore in 2000-01, which increased to Rs. 32,220 crore in 2007-08, a growth of 106% over a seven year period. In contrast, Uttarakhand recorded a higher growth in GDP of 142%, from Rs. 14,700 crore to Rs. 35,590 crore.

However, due to lower population, the per-capita income in 2001 in Himachal Pradesh at Rs. 25,770 was not only greater than Uttarakhand at Rs. 17,320, but also higher than India at Rs. 18,710.

4. RESULTS

4.1 Population Density

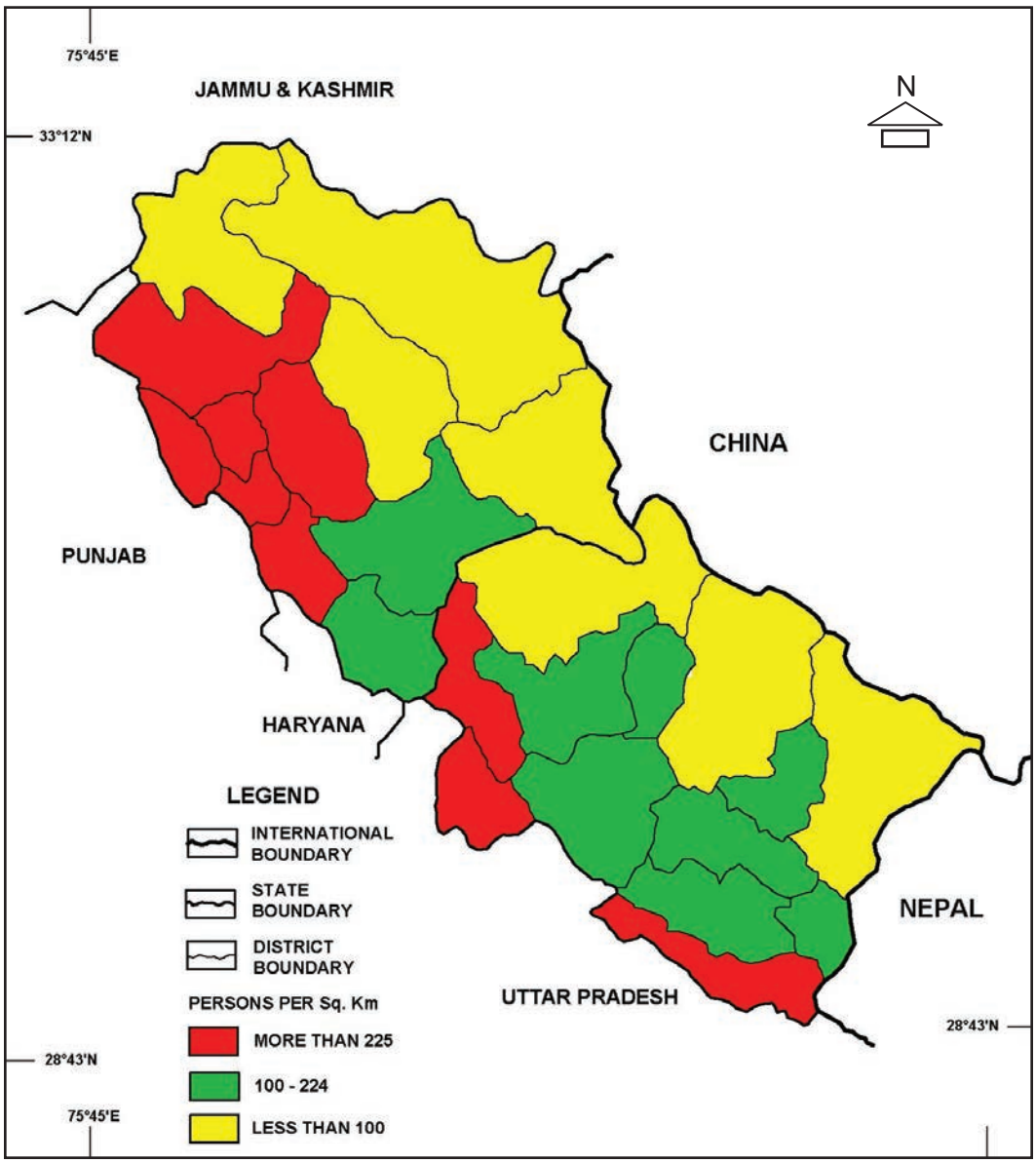
Himachal Pradesh with an area of 55,673 sq km is marginally larger than Uttarakhand, whose area is 53,483 sq km, a difference of merely 2,200 sq km. However, in 2001, Uttarakhand had a substantial larger population at 85 lakh, than Himachal Pradesh at 61 lakh, a difference of sizeable 21 lakh. With a greater population over lesser area, Uttarakhand recorded a population density of 159 persons per sq km, which is 50 points higher than that of Himachal Pradesh at 109 persons per sq km in 2001. However, both the states with mountainous terrain and alpine climate, there population densities are actually very low, compared to 313 persons per sq km for India (Figure 3).

Among the districts, Hardwar in Uttarakhand recorded the highest density at 613 persons per sq km in 2001, while Lahaul and Spiti in Himachal Pradesh had the lowest at 2 persons per sq km in 2001. This contrast is attributed to their physiography, whereby, Hardwar is located in the upper Ganga plains, while Lahaul and Spiti in trans-Himalayas. The latter is marked with rugged topography and extremely climatic conditions marked with severe and long winter.

4.2 Population Growth

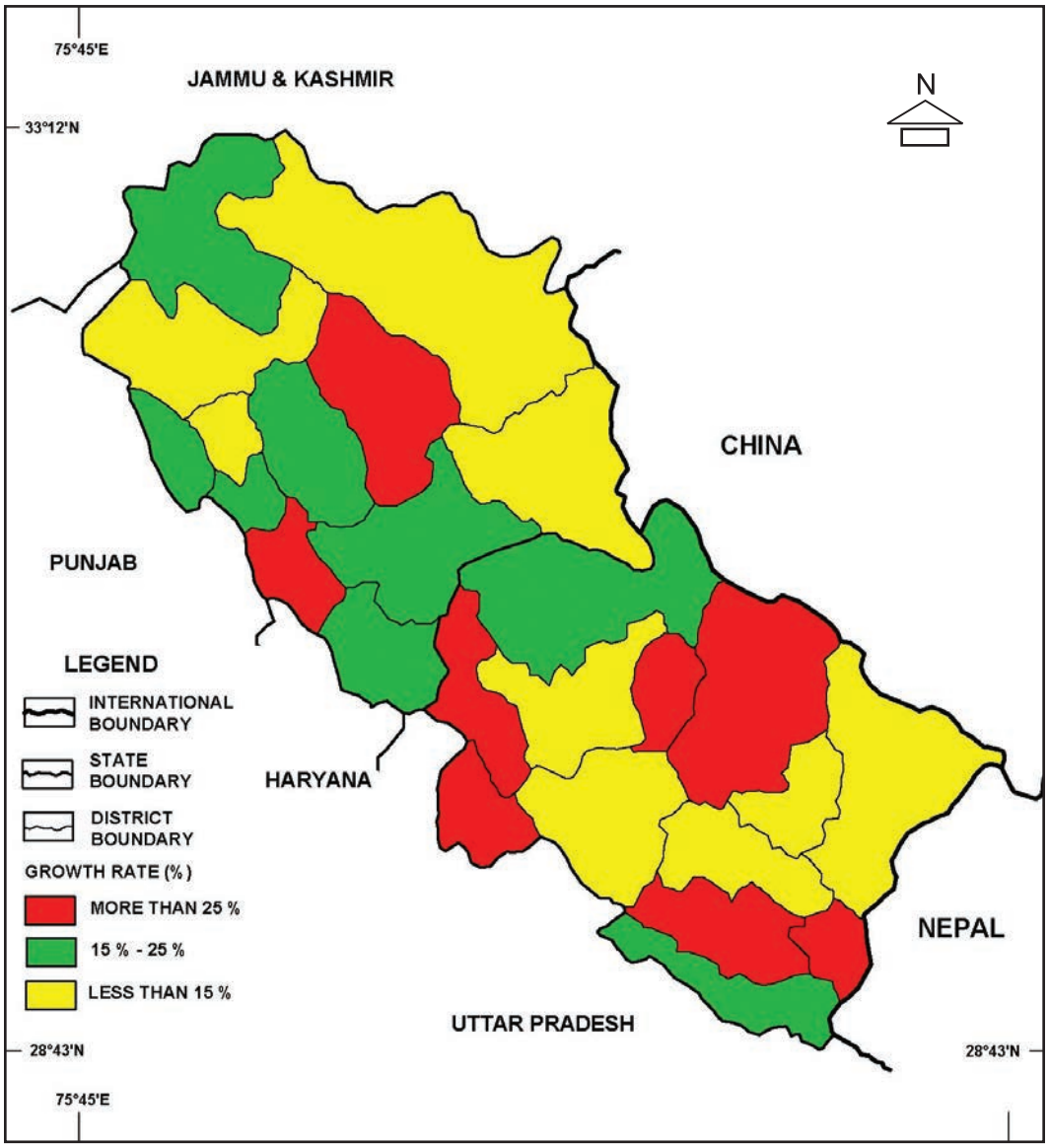
The population of Uttarakhand has been growing more rapidly than in Himachal Pradesh. The population of Uttarakhand increased by 15 lakh, from 70 lakh in 1991 to 85 lakh in 2001, giving a population growth rate of 19% over the decade. Compared to this, the population in Himachal Pradesh grew by 9 lakh, from 52 lakh to 61 lakh during the period, thereby, recording a growth rate of 18%. However, both the states having mountainous terrain and cold climate, the population growth rate is lower than 21% recorded for India (Figure 4).

Fig. 3: Population Density in Himachal Pradesh and Uttarakhand, 2001.



Among the districts, Nainital has recorded a growth rate of 55% owing to flowing of newer economic opportunities, following the rise of Nainital town as the second capital of Uttarakhand. The net growth in number of persons in Nainital was in the order of 2.7 lakh, which is substantial for a hill district and can be reasoned solely due to in-migration. Garhwal, also in Uttarakhand, on the other hand recorded a net population growth of a mere 15,000 over the decade, giving a rate of 2%, which is the lowest in the study area. This again is explained due to out-migration, owing to ebbing of economic opportunities.

Fig. 4: Population Growth in Himachal Pradesh and Uttarakhand, 1991-2001.

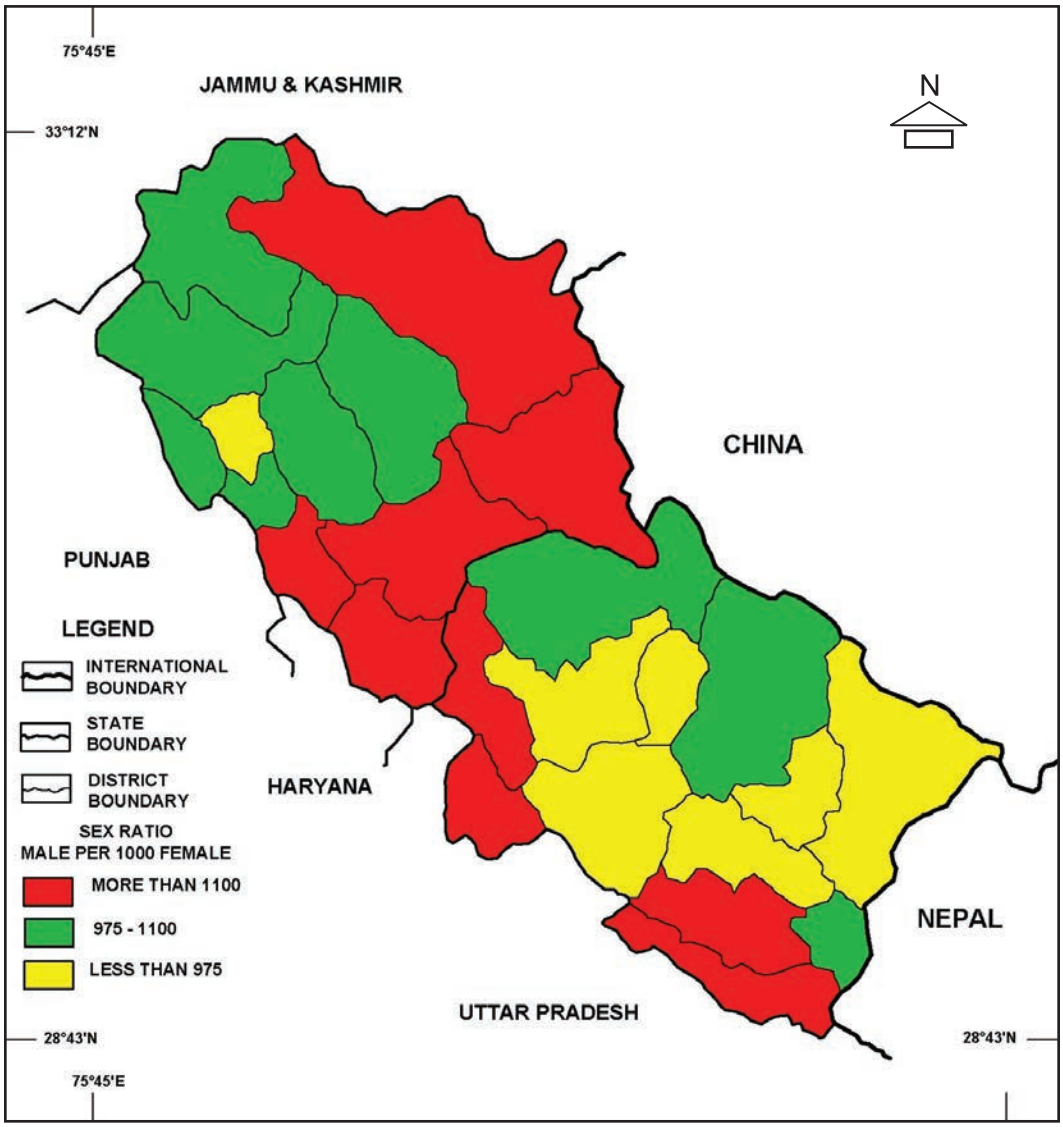


These large scale migrations being male-selective, is reflected in the disparities in sex ratio. Nainital with 1104 males and Garhwal with 904 males per 1000 females are exact mirror copies, indicating as if males of Garhwal have migrated en-masse to Nainital!

4.3 Sex Ratio

In terms of sex ratio, i.e. number of males per 1,000 females, both the states are not only closer (Himachal Pradesh at 1,033 and Uttarakhand at 1,039), but are better than India at 1,072 males per 1,000 females (Figure 5).

Fig. 5: Sex Ratio in Himachal Pradesh and Uttarakhand, 2001.

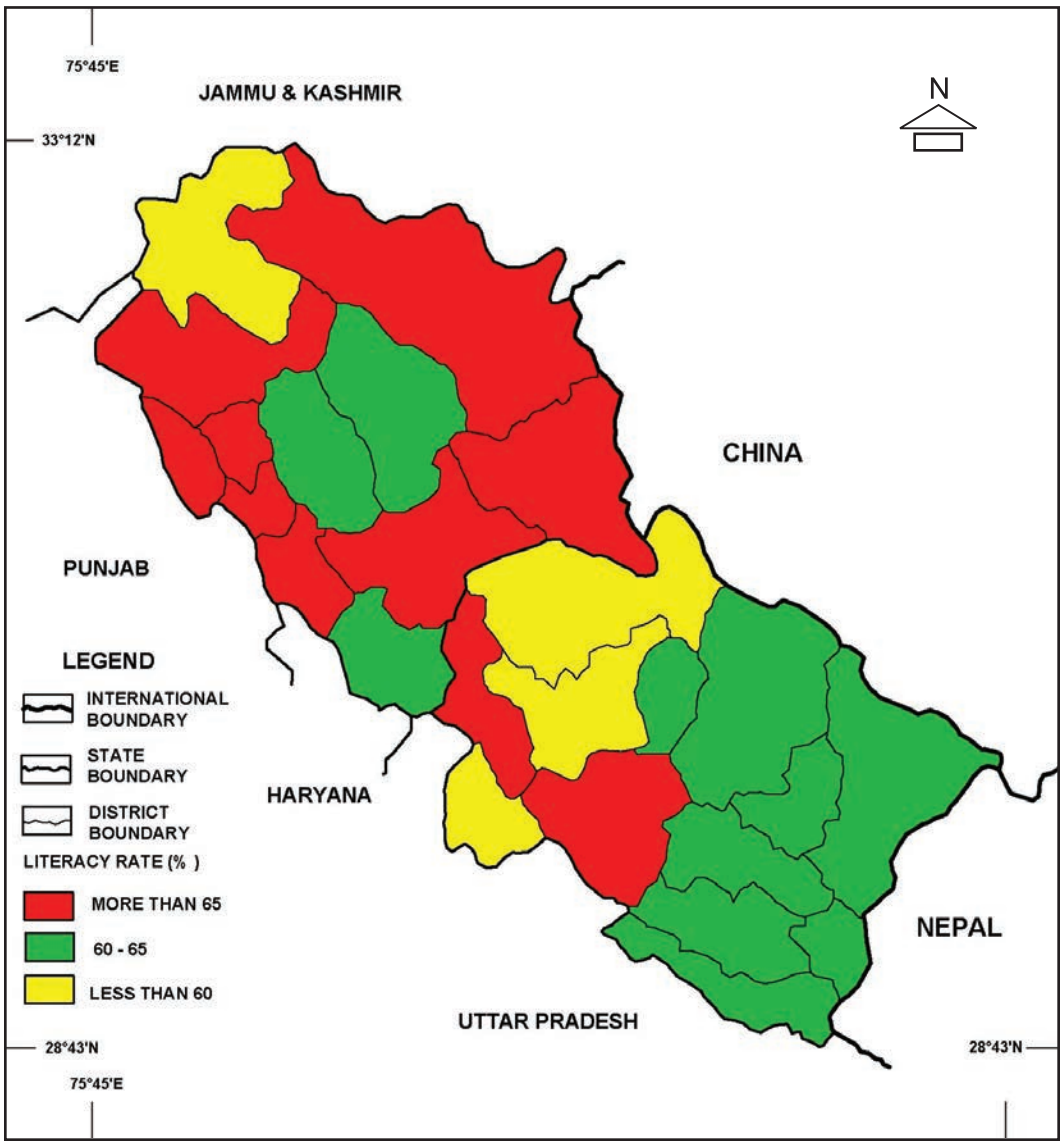


Among the districts, Lahaul and Spiti in Himachal Pradesh and Almora in Uttarakhand are the most opposite extremes. The former recorded 1,247 males and the latter 873 males per 1000 females in 2001. The low sex ratio in Almora is attributed to male selective out-migration for education and employment. However, the high sex ratio in Lahaul and Spiti is inexplicable, as it is situated in an inaccessible Trans-Himalayan zone, which experiences extreme physical conditions and has in-hospitable living conditions.

4.4 Literacy Rate

In terms of literacy rate, Himachal Pradesh has an impressive 66%, with Uttarakhand following closely at 60%; and both much better than 55% recorded

Fig. 6: Literacy Rate in Himachal Pradesh and Uttarakhand, 2001.

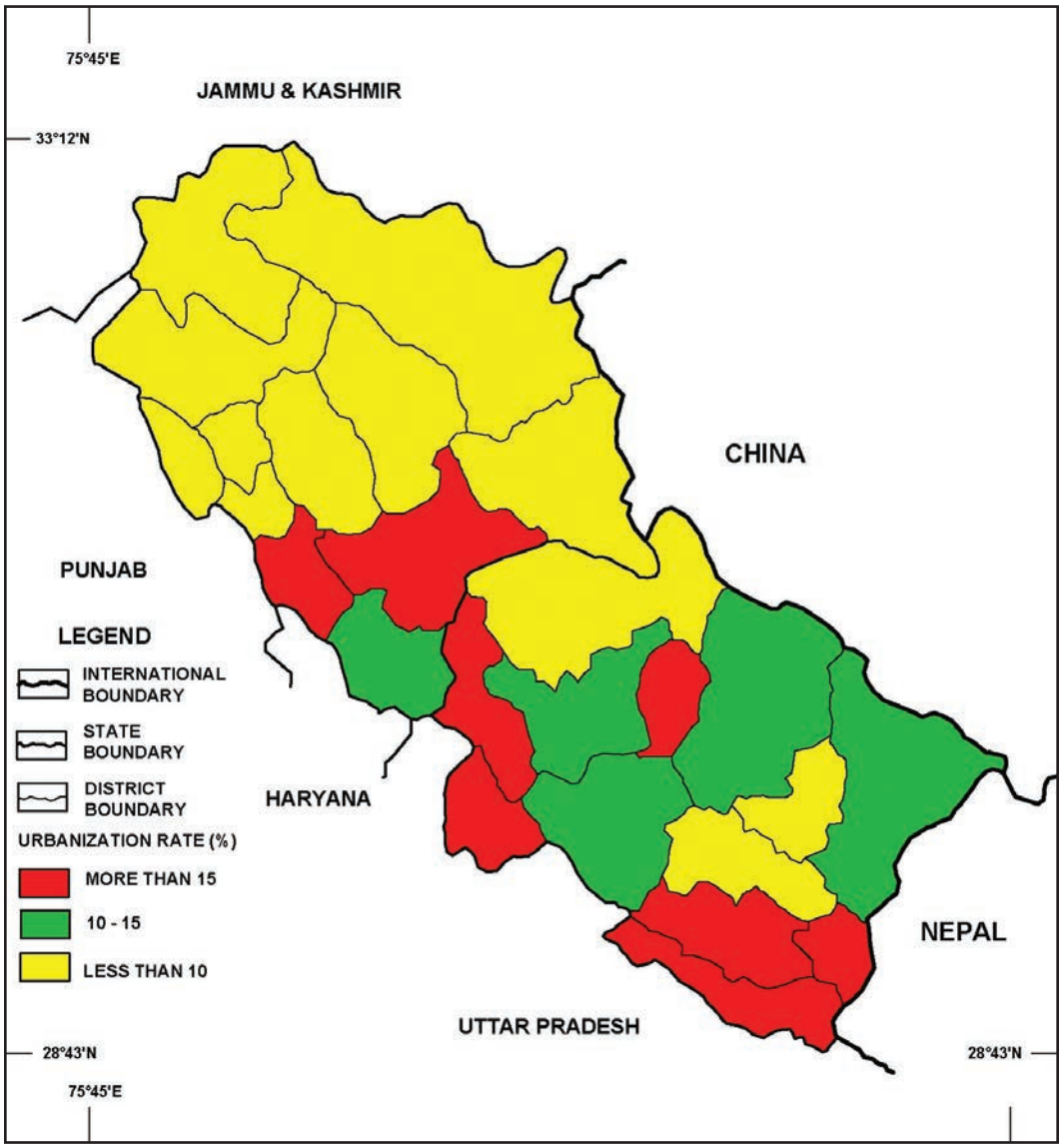


for India (Figure 6). Among the districts, Hamirpur was leading with 72%, closely followed by Kangra, Shimla and Una with 70%, all in Himachal Pradesh. Literacy rate was lowest in Haridwar at 52%, followed by Udham Singh Nagar and Chamba with 53%, Uttarkashi 55% and Tehri-Garhwal with 56%. Literacy rate is low in pilgrimage towns, for example, Haridwar and Uttarkashi; and former princely states, for example, Chamba and Tehri-Garhwal.

4.5 Urbanization Rate

In 2001, Himachal Pradesh had an urban population of less than 6 lakh giving it an urbanization level of 10%, which is tiny when compared to Uttarakhand, with

Fig. 7: Urbanization Rate in Himachal Pradesh and Uttarakhand, 2001.



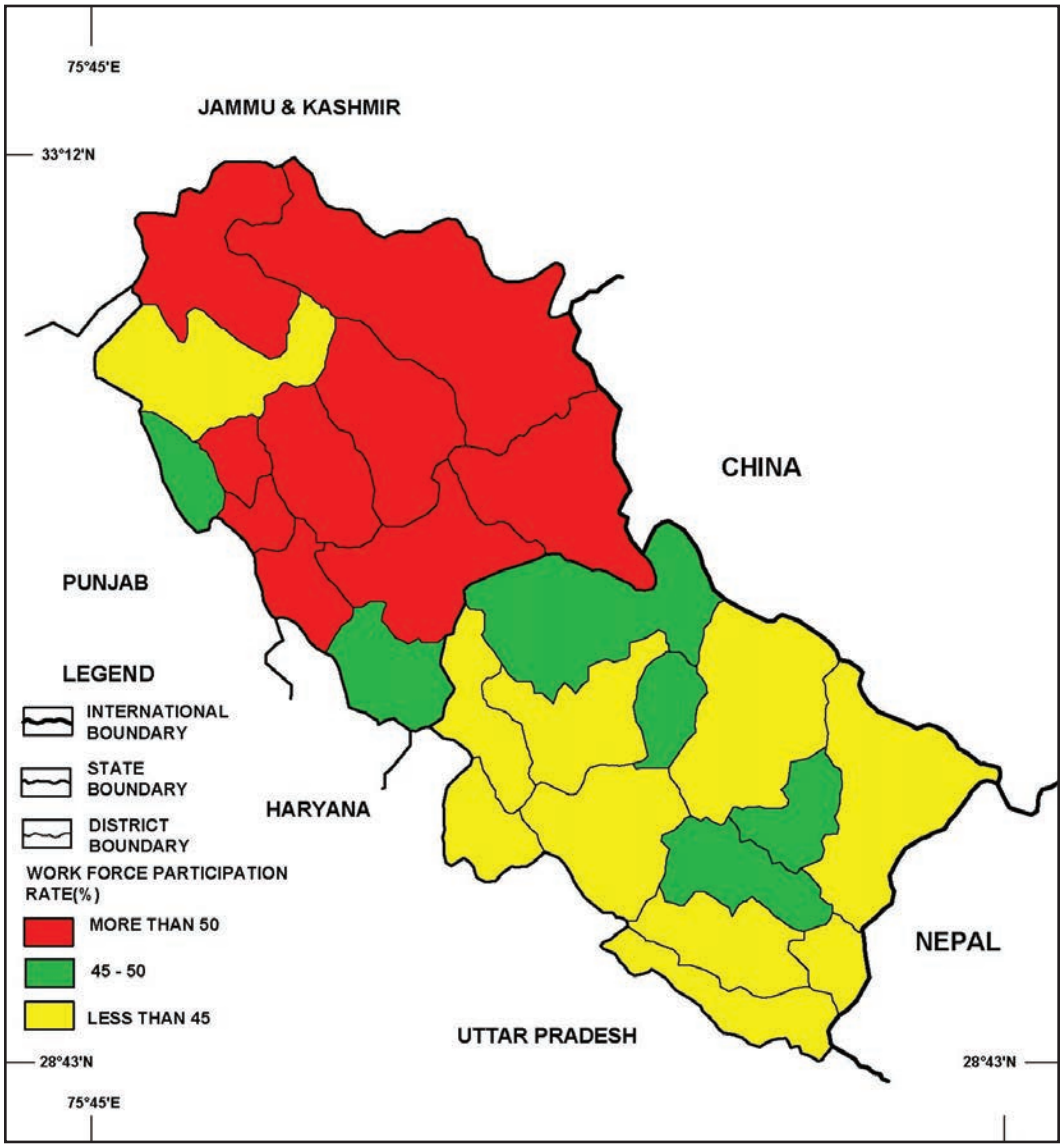
nearly 22 lakh urban population, and an urbanization level of 26%, which is very close to India's 28% (Figure 7). Among the districts, urbanization level is more than half in Dehradun with 53%; about a third in Nainital (35%), Udham Singh Nagar (33%) and Haridwar (31%); and nearly quarter in Shimla (23%). Some of the districts with high urbanization have low literacy rate due to migration of illiterate labour to the larger towns in these districts, for example Haridwar and Udham Singh Nagar. Urbanization rate is nil in the two Trans-Himalayan districts of Lahaul and Spiti and Kinnaur, due to the absence of any towns; and near negligible to low (below 10%) in several other districts across the study area, notable being, Rudraprayag (1%), Bageshwar (3%) and Kangra (5%). This is quiet

natural for a region with rugged terrain resulting in near absence or weak factors of urbanization.

4.6 Work Force Participation Rate

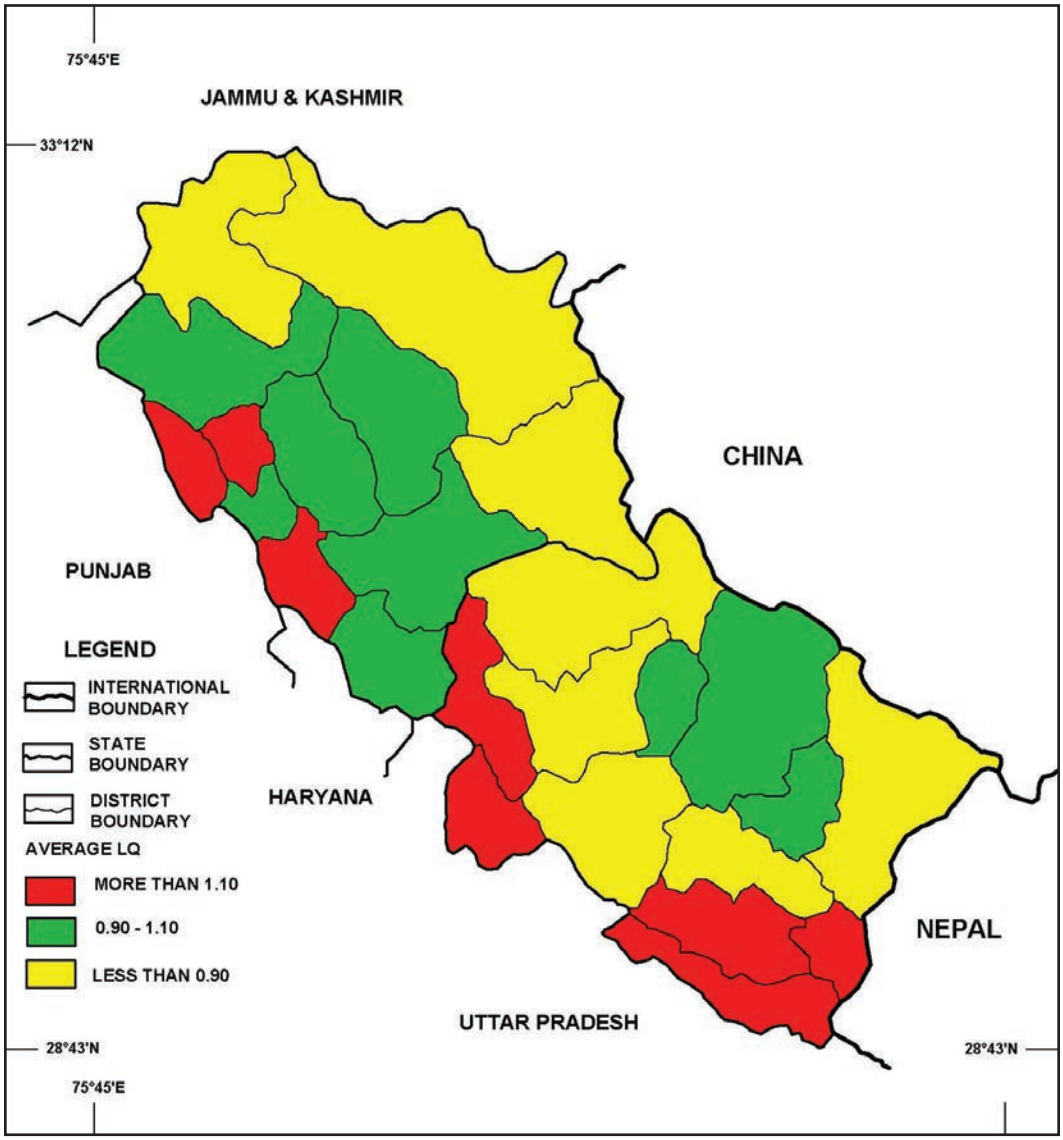
In 2001, Himachal Pradesh recorded a high work-force participation rate of 49%, which is substantially higher than Uttarakhand at 37% and India at 39% (Figure 8). Among the districts, work-force participation rate was the highest in the two Trans-Himalayan districts of Lahaul and Spiti (63%) and Kinnaur (61%). Vast tracts in the two districts being inaccessible and inhospitable, and hence uninhabited, life is very difficult. Hence, all members of the household including children

Fig. 8: Workforce Participation Rate in Himachal Pradesh and Uttarakhand, 2001.



have to work hard to obtain means of livelihood. Since, the growing and working season is also short; all members of the family have to make focused effort during this short period. Leaving aside the three Terai districts – Haridwar (29%), Dehradun (31%) and Udham Singh Nagar (32%), which also have high population density and urbanization rate; the work-force participation rate is more than 40% in almost all the other districts. Unlike developed regions and large metropolitan cities, mountainous tracts usually record high work-force participation rate, as the returns on effort made by one individual is not sufficient to run the entire household. Hence, several members of the household have to work to earn a decent livelihood for the entire household.

Fig. 9: Composite Index of Development Himachal Pradesh and Uttarakhand, 2001



4.7 Composite Index

In 2001, Uttarakhand had a composite index of 1.07, which is marginally higher than Himachal Pradesh at 0.91; a difference of mere 0.18 points, which is not significant. Hence, it may be concluded with confidence that both the states are similar, in terms of levels of development as indicated by the demographic factors. However, variations in composite index are significant among the districts (Figure 9). Among the districts, the composite index is highest in Haridwar with 1.73, closely followed by Dehradun (1.69), Nainital (1.51) and Udham Singh Nagar (1.50), all in Uttarakhand. Solan in Himachal Pradesh with 1.33 is fifth in decreasing order. The composite index is lowest in Lahaul and Spiti (0.68) and Kinnaur (0.71), both in Himachal Pradesh; followed by Bageshwar (0.74), Garhwal (0.77) and Pithoragarh (0.79), all in Uttarakhand. Thus, the results are mixed, which does not gives a clear-cut upper edge to either of the two states comprising the study area.

Table 3: Area and Population Data of Himachal Pradesh and Uttarakhand, 1991 and 2001 (*re-aligned to 1946 boundaries*).

S. No.	District	Area	Population									
		Total	Total	Total	Age 0-6	Age 7+	Male	Female	Urban	Rural	Literates	Workers
	Unit	*Sq. Km*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
	Year	*2001*	*1991*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*	*2001*
	BC + PS	**109,156**	**12,221,511**	**14,567,249**	**2,153,169**	**12,414,080**	**7,413,864**	**7,153,385**	**2,774,655**	**11,792,594**	**9,097,654**	**6,126,497**
	British Colonies (BC) S. No. 1-6	**69,566**	**8,485,967**	**10,204,387**	**1,543,211**	**8,661,176**	**5,177,568**	**5,026,819**	**2,268,318**	**7,936,069**	**6,419,344**	**3,967,075**
	Princely States (PS) S. No. 7-12	**39,590**	**3,735,544**	**4,362,862**	**609,958**	**3,752,904**	**2,236,296**	**2,126,566**	**506,337**	**3,856,525**	**2,678,310**	**2,159,422**
1	Kangra (1+7+8+9+12)	27,741	2,255,195	2,614,798	331,461	2,283,337	1,298,828	1,315,970	172,008	2,442,790	1,812,539	1,233,658
2	Dehradun (14)	3,088	1,025,679	1,282,143	172,486	1,109,657	679,583	602,560	678,742	603,401	876,441	400,475
3	Garhwal (17+21+24)	15,343	1,137,406	1,294,876	192,841	1,102,035	622,341	672,535	143,310	1,151,566	840,107	536,633
4	Almora (18+20+23+25)	14,241	1,403,025	1,566,860	250,593	1,316,267	751,057	815,803	155,919	1,410,941	967,413	699,943
5	Nainital (15+16)	6,793	1,540,174	1,998,523	332,936	1,665,587	1,049,738	948,785	672,064	1,326,459	1,167,896	671,103
6	Haridwar (13)	2,360	1,124,488	1,447,187	262,894	1,184,293	776,021	671,166	446,275	1,000,912	754,948	425,263
7	Chamba (5)	6,522	393,286	460,887	69,579	391,308	235,218	225,669	34,542	426,345	246,169	230,452
8	Mandi & Suket (2)	3,950	776,372	901,344	119,949	781,395	447,872	453,472	60,982	840,362	538,135	454,292
9	Bilaspur (10)	1,167	295,387	340,885	42,890	297,995	171,263	169,622	21,951	318,934	231,733	166,708
10	Sirmaur (6)	2,825	379,695	458,593	68,431	390,162	241,299	217,294	47,670	410,923	274,643	225,872
11	Tehri Garhwal (19+22)	11,658	819,862	899,760	148,282	751,478	447,184	452,576	82,764	816,996	498,977	400,619
12	Punjab Hill States (3+4+11)	13,468	1,070,942	1,301,393	160,827	1,140,566	693,460	607,933	258,428	1,042,965	888,653	681,479

Source: Census of India, 1991 and 2001.

Table 4: Demographic Indicators of Himachal Pradesh and Uttarakhand, 2001 (*re-aligned to 1946 boundaries*).

S. No.	District	Pop. Growth		Pop. Density		Sex Ratio		Literacy Rate		WFPR		Urbanization Rate		Composite Index
		Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	Actual	LQ	
	Unit	%		*p/km2*		*m/1000f*		%		%		%		*Average LQ*
	Year	2001		2001		2001		2001		2001		2001		
	BC + PS	**19%**	**1.00**	**133**	**1.00**	**1036**	**1.00**	**62%**	**1.00**	**42%**	**1.00**	**19%**	**1.00**	**1.00**
	British Colonies (BC) S. No. 1-6	**125%**	**6.51**	**147**	**1.10**	**1030**	**0.99**	**63%**	**1.01**	**39%**	**0.92**	**22%**	**1.17**	**1.95**
	Princely States (PS) S. No. 7-12	**17%**	**0.87**	**110**	**0.83**	**1052**	**1.01**	**61%**	**0.98**	**49%**	**1.18**	**12%**	**0.61**	**0.91**
1	Kangra (1+7+8+9+12)	16%	0.83	94	0.71	987	0.95	69%	1.11	47%	1.12	7%	0.35	0.84
2	Dehradun (14)	25%	1.30	415	3.11	1128	1.09	68%	1.09	31%	0.74	53%	2.78	1.69
3	Garhwal (17+21+24)	14%	0.72	84	0.63	925	0.89	65%	1.04	41%	0.99	11%	0.58	0.81
4	Almora (18+20+23+25)	12%	0.61	110	0.82	921	0.89	62%	0.99	45%	1.06	10%	0.52	0.82
5	Nainital (15+16)	30%	1.55	294	2.20	1106	1.07	58%	0.94	34%	0.80	34%	1.77	1.39
6	Haridwar (13)	29%	1.50	613	4.59	1156	1.12	52%	0.84	29%	0.70	31%	1.62	1.73
7	Chamba (5)	17%	0.90	71	0.53	1042	1.01	53%	0.86	50%	1.19	7%	0.39	0.81
8	Mandi & Suket (2)	16%	0.84	228	1.71	988	0.95	60%	0.96	50%	1.20	7%	0.36	1.00
9	Bilaspur (10)	15%	0.80	292	2.19	1010	0.97	68%	1.09	49%	1.16	6%	0.34	1.09
10	Sirmaur (6)	21%	1.08	162	1.22	1110	1.07	60%	0.96	49%	1.17	10%	0.55	1.01
11	Tehri Garhwal (19+22)	10%	0.51	77	0.58	988	0.95	55%	0.89	45%	1.06	9%	0.48	0.74
12	Punjab Hill States (3+4+11)	22%	1.12	97	0.72	1141	1.10	68%	1.09	52%	1.25	20%	1.04	1.05

Source: Census of India, 2001.

If the data, indicators, location quotients and composite index of 2001, are re-aligned as per territorial configurations and boundaries existing in 1946 (Tables 3 and 4), they too do not indicate much disparity between the British colonial provinces and Indian princely states. The former records a composite index of 1.04 compared to 0.91 for latter, a divergence of sheer 0.13 points, which is not significant. Here, too it may be concluded with confidence that both the territorial groupings – colonial provinces and princely states, are similar, in terms of levels of development as indicated by the demographic factors. However, significant variations in composite index exist among the districts as per 1946 borders. Haridwar (1.73), Dehradun (1.69) and Nainital including Udham Singh Nagar (1.39) all part of British provinces have high composite index, while Tehri-Garhwal (0.74) and Chamba (0.81) among Indian states, while Garhwal (0.81), Almora (0.82) and Kangra (0.84) among British provinces record low composite index. Rest of the region – Bilaspur, Simla hill states, Sirmaur, and Mandi and Suket – all Indian states have moderate composite index.

5. CONCLUSIONS

There are two contradictory paradigms. Slater (1974) argued that a region under colonial control will not develop much due to drain of wealth, while if it is under local control, the resources will be utilized for the benefit of local people. However, Rostow (1960) had earlier decreed that presence of a foreign colonial power is must for the growth of a local economy, while Friedmann (1972) favored localization of power and decision making power in few hands for the development of a region. Presence of a foreign power brings support in terms of finance and technology, which is not available to indigenous states. Hence, in the modern world, despite positive intentions of the native states, they still have to depend upon external sources for ushering in development. Thus, former colonies, and last vestiges of colonies today, for example Goa in India, Hong Kong in China, French Guinea, British Falkland or Gibraltar, etc; are actually more developed than their neighboring areas. Though, colonialism in Middle Ages brought slavery, poverty and exploitation, they also brought virtually each and every means of modern science and development to the aboriginal people.

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Chandigarh

India has many famous ancient cities and buildings. Among these reminders of the past, there now stands a new and utterly different, growing cities – Chandigarh, which is, in the main, the creation of the famous architect. Le Corbusier . . . . I think, however, that Chandigarh is a great creation, which has already powerfully affected Indian architecture and brought new and fascinating ideas to our architects and town planners.

Let this be a new town symbolic of the freedom of India, unfettered by the traditions of the past . . . an expression of the nation's faith in the future.

Pt. Jawaharlal Nehru

A Methodological Framework for Assessing Bus Stop Locations in a Selected Corridor in Chennai with the Application of GIS

A. Madhan, P. Revathy, S. Lakshmi, and K. P. Subramaniam

Abstract

Bus Stop locations and layout is recognized as a crucial element in the drive to improve the patronage of bus service. Planning of Bus Stop location is a tool for improving accessibility and consistency in design and provision that make it safe, comfortable, attractive and easy to use. This article explains the methodology for rationalizing Bus Stops by using Ranking Analysis with the application of GIS for a selected corridor in Chennai.

1. GENERAL

Bus Stops attain their importance to the transit services from being the main point of contact between the passengers and buses. Being the first point of contact between passengers and transit services, access to public transport Bus Stops is an important factor affecting overall transit trip travel time. Spatial attributes, location and spacing of Bus Stops, significantly affect transit services performance and passenger satisfaction, as they influence travel time in addition to their role in ensuring reasonable accessibility. Every transit trip begins and ends with pedestrian travel. Therefore, access to a Bus Stop is considered a critical factor for assessing the accessibility of Bus Stop location.

Rationalization of location of Bus Stops means re-organizing the existing Bus Stops in a given route based on certain criteria, such as, passenger density (number of passengers who will board and alight the buses in a particular Bus Stop), land-use pattern in and around the Bus Stop, the inter-Bus Stop distance, etc. Since, the Bus Stops would have been decided many years before, the then density of the passengers and land-use pattern would have undergone a drastic change and the location of existing Bus Stops would have not been rationalized to keep pace with these changes. Hence, there is an increasing need for the review of existing Bus Stop locations.

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2. NEED FOR STUDY

Chennai is the fourth largest metropolitan city in India. Development has taken place at a faster pace compared to other towns. The location of existing Bus Stops were identified about five to ten years ago, taking into consideration the various criteria like, land-use, accessibility to passengers and passenger density. Since then a lot of land-use changes and intensification have taken place. With the present day conditions, it is observed that, some Bus Stops are under utilized and some others are over utilized. Since, there is a need to provide an equal and optimal accessibility to the users, the Bus Stops should be reviewed and relocated if found necessary. Hence, a study on the same is necessitated.

3. OBJECTIVES

The objectives of the study are:

- To study the existing Bus Stop locations along a corridor with respect to IRC Guidelines.
- To apply Geographical Information System (GIS) Software for analyzing the location of Bus Stops on the basis of passenger density, existing road network and accessibility to draw inference and findings.

4. BUS STOP GUIDELINES

Indian Road Congress (IRC) had proposed Guidelines for location of Bus Stops for rural and urban areas.

IRC: 70-1977, "Guidelines on Regulation and Control of Mixed Traffic in Urban Areas", had given following recommendations for identification of location of Bus Stops in urban areas:

- The Bus Stops should not be located too close to the intersection as they can cause obstruction to vehicular flow. It should be at least 75 m away from intersection on either side of Stop;
- Bus Stops should as far as possible be located to disembark passengers at safe places, such as, curbs or islands;
- For buses intending to turn right at an intersection, the stop should be sufficiently away from the intersection, so that the Bus can be maneuvered easily from curb to extreme right lane before intersection;
- Spacing of Bus Stops in busy streets should be kept as low as possible consistent with passenger convenience in order to avoid congestion due to interference by stopping buses;
- The Curb-loading Bus Stops should preferably be planned by recessing the curb sufficiently, so that the Bus Stops are completely out of the moving lanes. The length of the recess should generally be 15 m for single Bus Stop. For multiple Bus Stops, length can be increased by 15 m for each Bus Stop;

and As buses, while parking and un-parking at Bus Stops, conflict with the slow moving vehicles, the alignment of bus bay and slow moving lane should be so arranged as to avoid conflicts.

IRC: 80-1981, "Type Designs for Pick-Up Bus Stops on Rural (i.e. non-Urban) Highways", had given following recommendations for location of Bus Stops in rural areas:

- The governing consideration when locating pick up Bus Stops are - increased overall traffic and minimum interference to through traffic;
- Bus Stops should be sited away from bridges and other important structures, also from embankment sections more than 4 m height;
- Bus Stops should not be located on horizontal curves or at the top of vertical curves;
- Bus Stops should not be located too close to the road intersections. A gap of 300m from tangent point of intersection to the start or end of the bus bay will be desirable, particularly intersection with main roads. At minor intersections (eg.: junctions with village roads), distance of 60 m may be accepted as a special case;
- At major four-way intersections involving transfer of a substantial number of passengers from one pick-up stop to the other, it might be desirable to construct a single composite Bus Stop of suitable design to cater to all the bus routes effectively;
- Bus Stops on opposite side should be staggered to a certain extent to avoid undue congestion on the highway;
- No structures other than sheds for passengers are allowed at Bus Stop. The sheds should be setback from kerb line by at least 0.25 m; and
- Bus Stops should have proper slopes to drain off rain water.

5. STUDY AREA

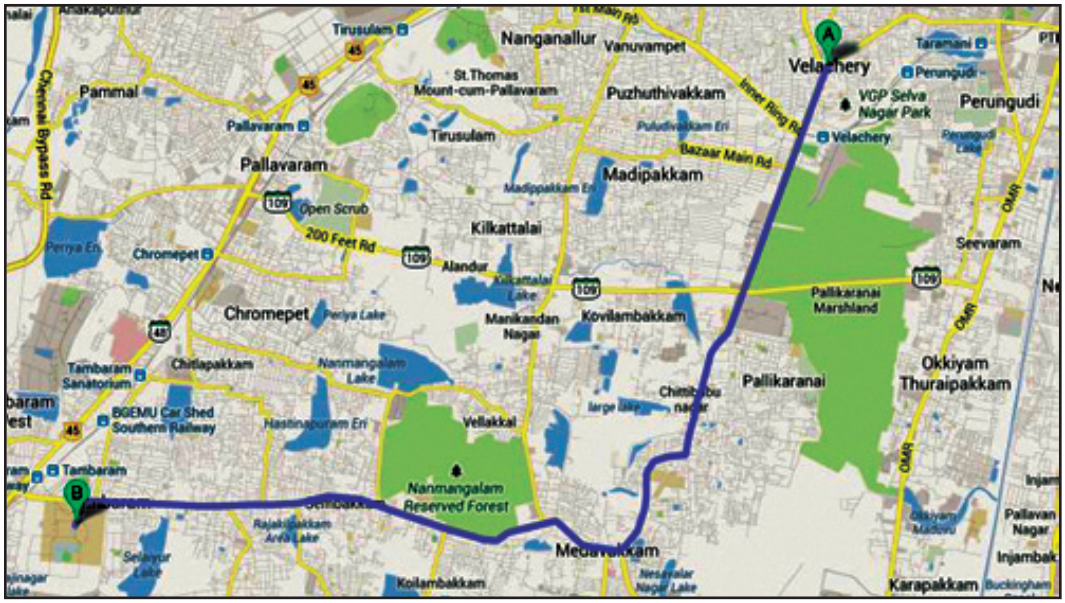
The study area selected for the analysis is Velachery Bus Terminus to East Tambaram corridor. Most of the study areas are sub-urban areas and they have high scope for future development. So it is important to properly locate the Bus Stops along the corridor with adequate facilities to minimize the pedestrian conflicts, obstruction to traffic flow and to reduce the risk of accidents at the Bus Stop. Figure 1, shows the map of the corridor undertaken for the study.

6. DATA COLLECTION

The data to be collected for the study are:

- Bus Stop inventory;
- Digitizing study corridor;

Fig. 1 Study Area



- Land-use around the Bus Stop
- Passenger density;
- Dwell time and clearance time; and
- Passenger Survey through questionnaire.

Bus Stop Inventory Study

Bus Stop inventory consists of studying the existing Bus Stop location, its geometrical features and other characteristics. The inventory consists of studying the following characteristics at each Bus Stop.

- Spacing between Bus Stops;
- Location from intersection;
- Number of loading areas;
- Loading area;
- Set back from road;
- Shelter and seating; and
- Signage.

The above parameters are recorded at each Bus Stop and compared with IRC specifications. Based on the inventory study of Bus Stops along the corridor, only those Bus Stops, out of 21 Bus Stops are selected, which require rationalization. Some of the pictures taken at the Bus Stops in the Study Corridor are shown at Figures 2, 3 and 4.

Fig. 2: Narayanapuram Bus Stop

Fig. 3: K.P Oil Mill Bus Stop

Fig. 4: Kamarajapuram Bus Stop

Figure 2 of Narayanapuram Bus Stop shows that the Bus Stops is located right on the carriageway and causes obstruction to the smooth flow of traffic. The Bus Stop also does not have any shelter and seating facilities.

Figure 3 of K. P Oil Mill Bus Stop shows, absence of shelter, seating facilities, sign boards etc., make the passengers to wait under scorching heat and dust.

Figure 4 of Kamarajapuram Bus Stop shows, adequate loading area, shelter over roof, waiting area with benches and display boards.

Digitizing Study Corridor

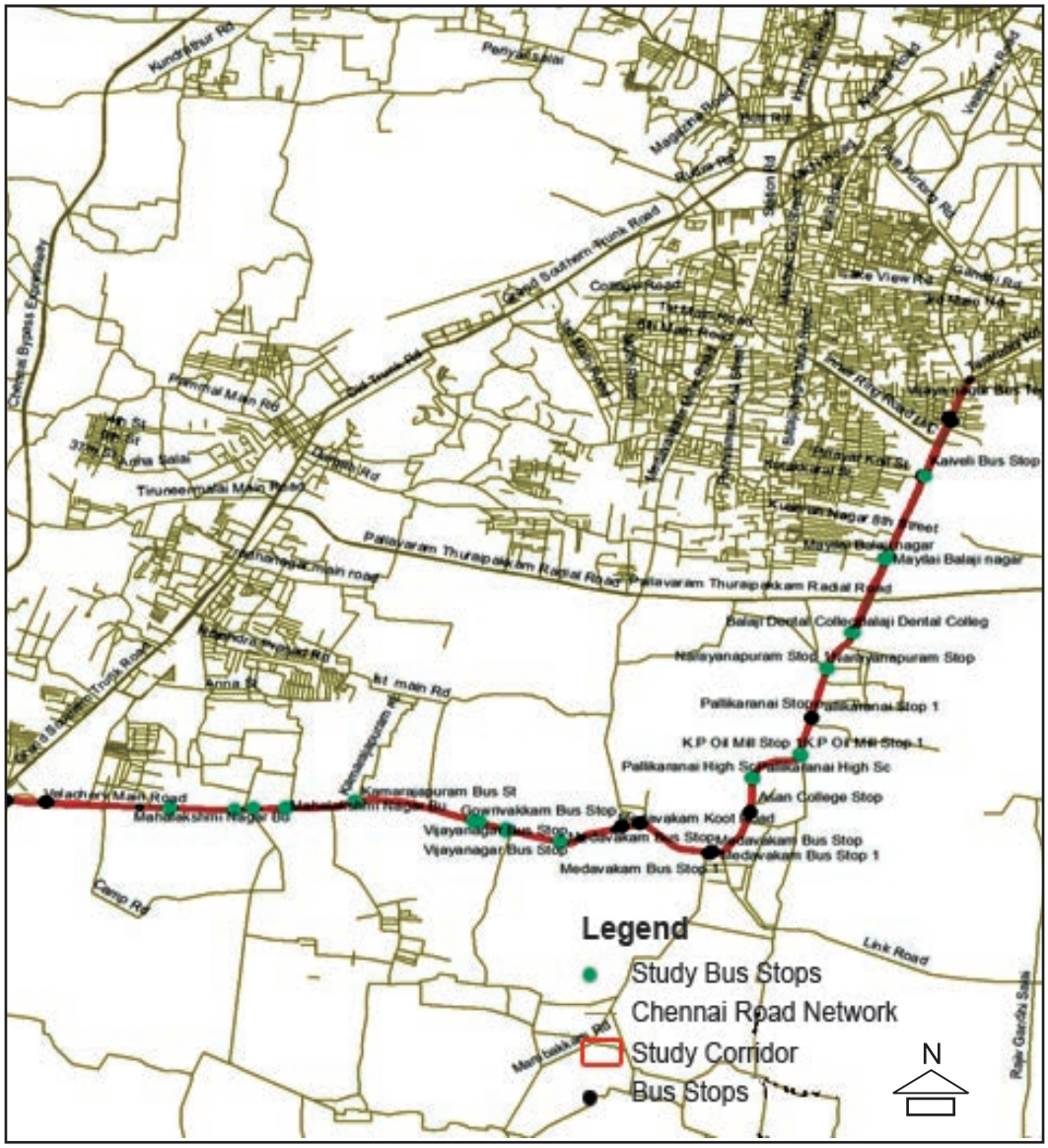
A GPS survey is conducted at all Bus Stop locations and coordinates are recorded. By using ArcGIS Software and recorded coordinates the road network of the study corridor is digitized (Figure 5).

Land-Use around Bus Stop

The land-use distribution and the concentration of activity centres at a distance of 750 meters from the road, along the selected route, have been taken into consideration.

From the preliminary study, Bus Stop inventory and land-use analysis, some of the Bus Stops along the study corridor are taken for the study. The Bus Stops located at important residential and commercial areas, which are potential trip generators and have scope for improvement. The Bus Stops selected are Ram Nagar, Balaji Nagar, Balaji Dental College, Narayanapuram, K.P Oil Mill, Pallikaranai School, Vijayanagar, Santhoshpuram, Gowrivakkam, Kamarajapuram, Mahalakshmi Nagar, Camp Road and Aathi Nagar.

Fig. 5: Digitized Study Corridor



Passenger Density

Passenger density is recorded at all Bus Stops selected for the study between 8.00 AM to 10.00 AM, as it has been observed that, during this period more people are expected to use the Bus Stop. Passengers boarding and alighting from each bus are counted and recorded at each Bus Stop.

Dwell Time Survey

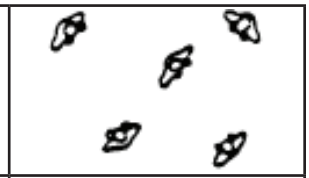
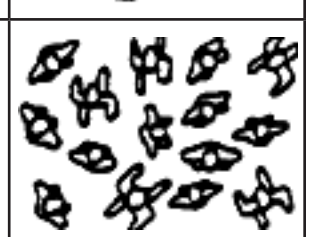
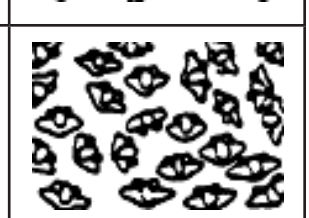
The dwell time and clearance time are counted and recorded at each Bus Stop selected for the study. The survey was conducted between 8.00 AM to 10.00 AM.

The data on dwell time and clearance time are required to calculate the Bus Stop capacity.

Loading Area

Bus loading areas are curb-side spaces where a single bus can stop to load and unload passengers. Bus Stops are formed from one or more loading areas, depending on how many buses can use the stop simultaneously. The recommended procedures for computing the size of passenger waiting areas at Bus Stops is based on maintaining a desirable level of service. The concept of passenger

Fig. 6: Level of Service for Passenger Waiting Area

LEVEL OF SERVICE A Average Passenger Space: ≥ 1.2 sq mt per person Average Inter-Person Spacing: ≥ 1.2 m Description: Standing and free circulation through the queuing area without disturbing others.	
LEVEL OF SERVICE B Average Passenger Space: 0.9-1.2 sq mt per person Average Inter-Person Spacing: 1.1-1.2 m Description: Standing and partially restricted circulation to avoid disturbing others within the queue is possible	
LEVEL OF SERVICE C Average Passenger Space: 0.7-0.9 sq mt per person Average Inter-Person Spacing: 0.9-1.1 m Description: Standing and restricted circulation through the queuing area by disturbing others is possible: this density is within the range of personal comfort.	
LEVEL OF SERVICE D Average Passenger Space: 0.3-0.7 sq mt per person Average Inter-Person Spacing: 0.6-0.9 m Description: Standing without touching is impossible. Circulation is severely restricted within the queue and forward movement is only possible as a group. Long term waiting is discomfort	
LEVEL OF SERVICE E Average Passenger Space: 0.2-0.3 sq mt per person Average Inter-Person Spacing: ≤ 0.6 m Description: Standing without physical contact is unavoidable. Circulation within the queue is not possible. Queuing can be sustained only for short period without discomfort.	
LEVEL OF SERVICE F Average Passenger Space: ≤ 0.2 sq mt per person Average Inter-Person Spacing: Close contact Description: Density is extremely discomforting; no movement is possible within the queue; potential for panic exists.	

level of service is presented in the Highway Capacity Manual. Level-of-services descriptions for passenger waiting area are shown in Figure 6.

The procedures to determine passenger waiting area at Bus Stops is based on maintaining a desirable pedestrian level of services. For most of the Bus Stops, the design level of services should be of category C to D or better.

Based on the desired level of services, the average pedestrian space, as given in Figure 6, is chosen. The maximum demand of passengers waiting for a bus, at a given time, is estimated. The effective waiting area for each Bus Stop required is calculated by multiplying the average pedestrian space and maximum pedestrian demand.

Bus Stop Capacity

The capacity of individual loading areas is fundamental to determine the capacity of Bus Stops and facilities. The average dwell times at loading areas are fundamental to determine the capacity of those areas. The simplest possible theoretical model for estimating Bus Stop capacity given by National Cooperative Highway Research Program (NCHRP) is given below.

$$Qc = \frac{3600}{td + tc}(\text{buses/hr})$$

Qc - Theoretical Bus Stop Capacity (buses/hr)

td - Average dwell time (sec)

tc - Average clearance time (sec)

The degree of saturation, which is a key performance measure of a Bus Stop is defined as the ratio of flow to the theoretical capacity can be found as shown below:

Degree of Saturation = (Q/Qc) x 100 (%)

Qc - Theoretical Bus Stop Capacity (buses/hr)

Q - Observed Bus Flow (buses/hr)

For each of the Bus Stop, theoretical Bus Stop capacity (Qc), observed flow of buses (Q) and their degree of saturation are computed. The observed flow of buses is less compared to theoretical capacity at most of the Bus Stops along the corridor. The main reason for this condition is that, only few buses stop here i.e. white board buses. Even though the land-use has changed drastically over the years they are still operated as ‘skip stop’ or ‘white board stop’. The Bus Stops which have potential ridership should be identified and proper measures should be taken to improve the Bus Stop capacity.

Passenger Survey through Questionnaire

The survey is conducted at all the identified Bus Stops for the study. The passengers are asked questions at the Bus Stop and also with people around adjacent to Bus Stop in same location. The sample size adopted for the survey is randomly depend on the passenger density at the Bus Stop. The objective the survey is to find the opinion of passengers regarding the facilities at the Bus Stop and waiting time at the Bus Stop.

7. ANALYSIS USING GIS SOFTWARE

The steps involved in Arc View (GIS) Software for conducting analysis, are explained below:

Creating Attribute Table

Attribute table for each field is created. Besides the inbuilt fields in the attribute table, for the 'Bus Stops' theme the other fields in the attribute table included are the following:

- Name of the Bus Stop;
- Bus Stop accessibility;
- Spacing between Bus Stops;
- Presence of bus bay;
- Offset from road;
- Bus Stop facilities;
- Available loading area;
- Required loading area for LOS D;
- Degree of saturation; and
- Bus Stop signage.

Querying Analysis

After creating attribute table and the necessary fields, the data are entered into the respective fields for analysis. After entering data for each field in their respective column, they are retrieved by querying analysis in order to assign score for each field based on the nature of data with respect to that field.

Populating Fields, based on query

After entering data in the respective column for each field, the required field values are queried by using querying analysis. Those fields are calculated by giving scores for each value of the field by using field calculator.

Applying Weightage

The important step in ranking and weightage analysis is assuming appropriate weight for each parameter taken for the analysis. The weightage factor should be assumed only after thorough studies. The weightage can also be assumed by 'Delphi Technique' by consulting with various experts in the respective field. Here the weightage factor is assumed on the basis of literature review depending on the importance of the parameter (Table 1).

Table 1: Weightage

Parameter	Weightage
Bus Stop Accessibility	25
Shelter and Seating facility	18
Bus Stop Capacity	17
Loading Area Size	15
Bus Stop Spacing	11
Offset from road	9
Signage and Markings	5

Ranking Bus Stops

After assuming the weightage for the parameters, the ranking of Bus Stops are done. The scores are already assigned for all the fields depending upon their respective field values. Then the fields are multiplied with their respective weightage and final score for each field is obtained. After calculating the score for each field, all the fields in a row are added to get the total score for that particular Bus Stop. Similarly, the total score is obtained for all the Bus Stops undertaken for the study. The score for Bus Stops located along the study corridor towards Tambaram is shown in Table 2.

Table 2: Bus Stop Score

Bus Stop	Total Score
Aathi nagar	23.5
Narayanapuram	26.5
K.P Oil mill	41
Vijayanagar	41.5
Gowrivakkam	45
Mahalakshmi nagar	45
Balaji nagar	50
Balaji dental college	53.5
Pallikaranai school	54
Santhoshpuram	71
Camp road	76
Kamarajapuram	80

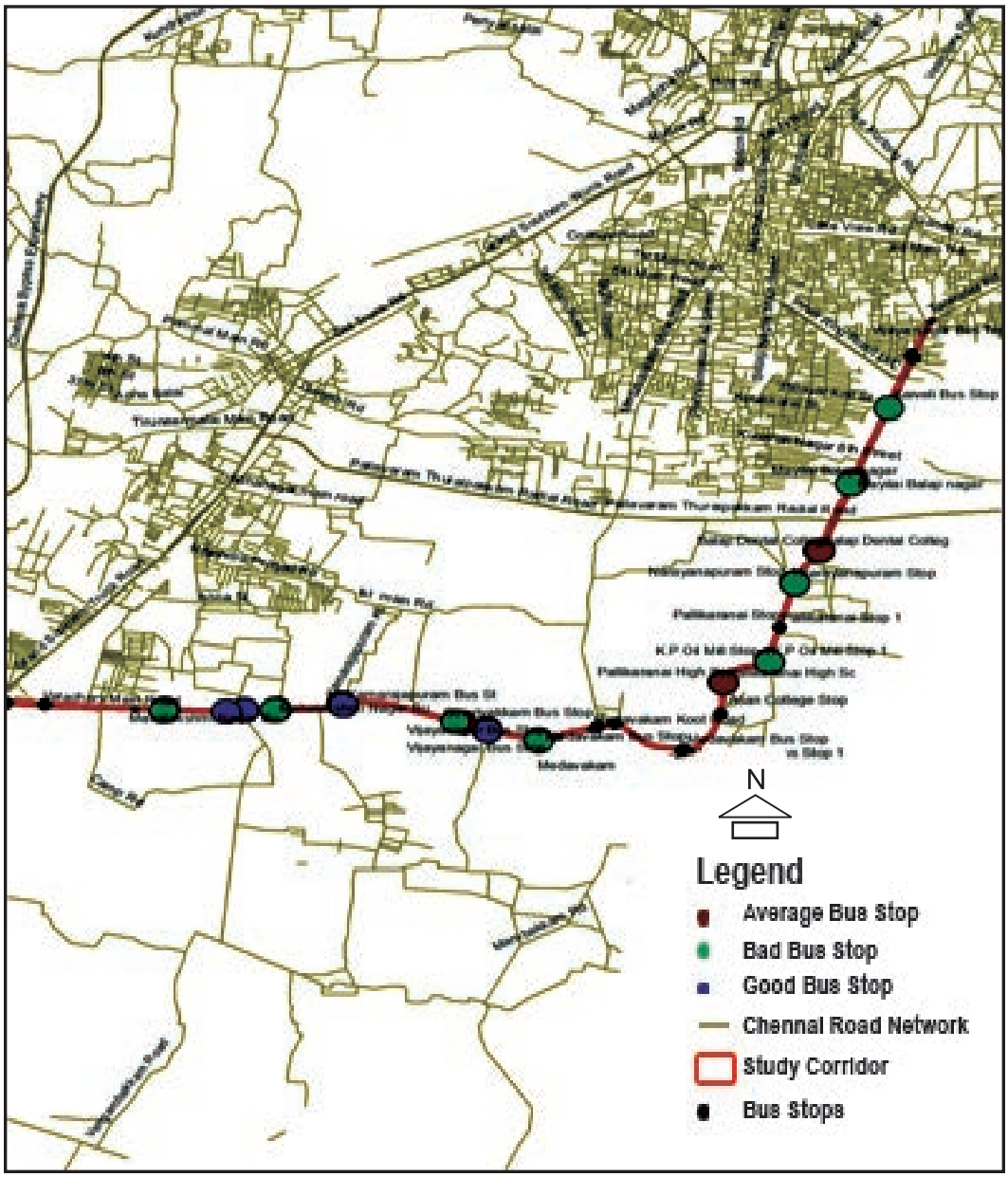
By using Arc View (GIS) Software, Bus Stops with different scores can be viewed and located easily in a map which is very useful when doing analysis for big cities.

8. FINDINGS

By using ranking and weighting method Bus Stops are analyzed, ranked and located using Arc View Software (GIS). Bus Stops are categorized as bad, average and good based on their scores.

From the Table 2, it is observed that, Narayanapuram and K. P. Oil Mill Bus Stops with the value of 26.5 and 41 respectively have been ranked as "bad". Figures 2 and 3 have also confirmed the similar existing condition. However, Kamarajapuram Bus Stop with the facilities like, shelter, adequate space for boarding and alighting as shown in Figure 4 have scored a value of 80, and ranked as "good". Hence, from the above study on the Velachery to Tambaram East Corridor, those Bus Stops which are categorized as bad or average, should be taken up for rationalization and appropriate measures with respect to its location and facilities should be taken, to make them convenient for passengers. The Bus Stops based on their category are located on a map shown in Figure 7.

Fig. 7: Map indicating different category of Bus Stops



- Score < 50 : Category - **Bad**
- Score 50-70 : Category - **Average**
- Score >70 : Category - **Good**

9. CONCLUSIONS

Bus Stops are crucial element for bus transportation. But they are not given the necessary importance by planners as they are placed without any proper

studies. In this study an attempt has been made to rationalize the Bus Stops on a Velachery to Tambaram East Corridor which are already located many years ago. Similar studies are required to be undertaken at all the Bus Stops located along the important routes in the city and Bus Stops should be made more accessible, convenient, reliable and safe. This could play a significant role for enhancing the patronage of bus transportation.

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Location of Solid Waste Disposal Site using Remote Sensing, GIS and MCDA Techniques in Madanapalle Municipality, Andhra Pradesh

Shubhasmita Sahani, Hari Shankar Prasad, and V. Raghavaswamy

Abstract

Cities and towns are growing rapidly because of increasing population, which is not always contributing to the growth and prosperity of cities and towns, but also contribute to their associated problems, like waste generation and its management. This is directly questioning the sustainability of urbanization. On the other, the quantity of waste is increasing with increasing population, is a serious issue which requires proper planning. A number of processes are involved for management of solid waste, like siting, monitoring, collection, transportation, processing and disposing. However, foremost after collection of solid waste, a site is required for disposing and processing. The present study attempts to use Remote Sensing and GIS coupled with MCDA method for analyzing and identifying a dumping Site for solid waste disposal in Madanapalle Municipality in Andhra Pradesh.

1. INTRODUCTION

Starting from early civilization, urbanization in some or the other way has contributed to garbage as an unavoidable by product of our various activities (Zareena Begum, 2006)1. The only difference is the type of garbage or waste produced and its management. Present day human interference with the environment is leading to unbalanced interactions creating waste which is complex in composition and quantity. Over the years, humans understood its impact on the environment and are now trying to correct or compensate for their actions. But, for the past few decades an unfettered increase in untreated waste has accelerated various environmental hazardous impacts. This has raised questions about the sustainability of the production of waste, as by products of progress and growth. (Geoffrey B. West, 2010)2. Increasing population is largely responsible for deteriorating the environmental conditions and the answer to the question of sustainability in regulating is one of the important issues, which is, solid waste generation and its management. Proper treatment of the waste is possible, when there is an optimum Site for dumping the waste. This is necessary for protecting the environment and ecosystem. Solid waste management is a means to prevent, recycle and manage solid waste effectively, to protect human health and environment (U.S. Environmental Protection Agency, 2002).

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The advancement of technology in Remote Sensing and GIS enables unique capacity to provide the information about the resources of the earth through its spectral reflectance properties, synoptic view and also have capacity to monitor resources at different time periods to understand the type and dynamics of the object under investigation. Its correlation with others factors help to understand natural and anthropogenic changes on the earth surface to analyze various site suitability parameters. The conventional way to carry out the process is time consuming. The same analysis can be done rapidly using scientifically derived data from remote sensing and integrating the same with collateral data through Geographical Information System (GIS) and spatial (analysis) tools for a better decision making process.

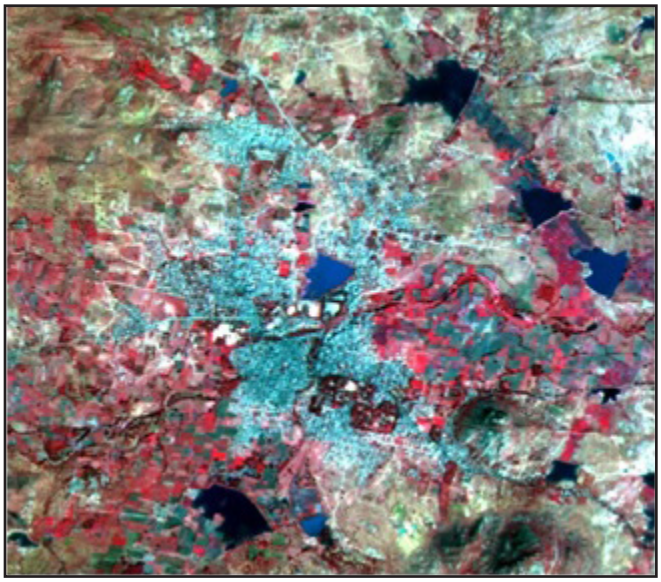
Similar kind of studies have been carried out by various individuals and groups by using Remote Sensing and GIS technology, for sustainable management of municipal solid waste in a growing urban environment, Pandey Prem et al. (2012). Solid waste management and disposal in Mafraq City, Al-Ansari N. A., AlHanbali A. and Dhayaflah R., (2012); the land-use and land cover and solid waste disposal site – using Remote Sensing and GIS in Sakkottai Block, Sivagangai District, Tamil Nadu, Tamilenthi S Chandra Mohan et al., (2011); selection of landfill sites for solid waste treatment in Damaturu town using GIS Techniques, Ayo Babalola and Ibrahim Busu, (2011); landfill site selection for municipal solid waste management using Geographic Information System and Multi Criteria Evaluation, Yahaya Sani and Ilori Christopher, (2010); suitable site determination for urban solid waste disposal using GIS and Remote Sensing techniques in Kottayam Municipality, Nishanth. T, Prakash M.N Vijith. H. and Mangattuparamba, (2010); site suitability analysis for urban development using GIS, Jain Kamal and Subbaiah Venkata Y, (2007); using GIS in solid waste management planning: A case study for Aurangabad India, Ahmed Shaikh Moiz (2006); and so on.

The present study analyses the site suability for the solid waste disposal in Madanapalle Municipality of Andhra Pradesh. The Multi Criteria Decision Analysis (MCDA) based approach in GIS environment has been used by adopting guidelines given by Andhra Pradesh Pollution Control Board (APPCB), Government of Andhra Pradesh and Urban Development Plans Formulation and Implementation (UDPFI) Guidelines of Ministry of Urban Affairs and Employment, Government of India, New Delhi (1996).

2. STUDY AREA

Madanapalle town is geographically located at 13° 33' North Latitude and 78° 30' East Longitude. It is the '*mandal'* headquarters in Chittoor District of Andhra Pradesh (Figure-1). The town is located 71 km from the district headquarters of Chittoor town. It has a population of 1.50 lakh (Census 2011). It has an extent of

Fig. 1: Madanapalli - Satellite Image



14 sq km of municipal area and is covered by 10 villages. Madanapalle has mild to warm summers with temperatures ranging between 30° to 35° C. The maximum temperature is around 40° C. Winters are cold with temperatures ranging between 7° to 15° C. Summer season extends from March to June, followed by rainy season from June to July and thereafter, winter till February. It has an elevation of 695 meters (2,280 feet) above Mean Sea Level (MSL). The region is characterized with hills and ridges, forest, wastelands and agricultural land on lower slopes. Horsley hills are situated near Madanpalle at an altitude of 1314 m. (4400 ft) above MSL.

3. METHODOLOGY

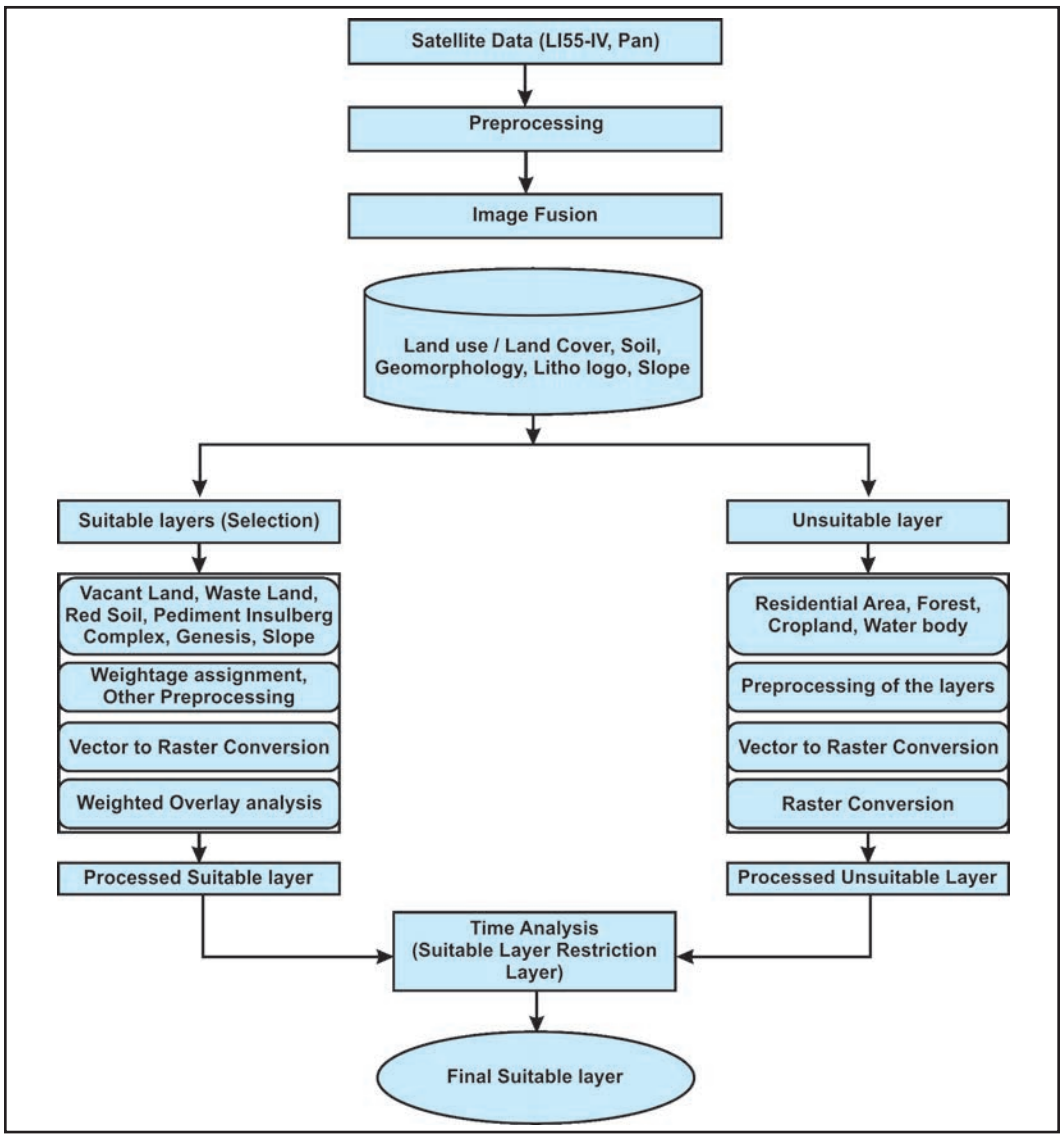
The flowchart at Figure 2 shows, the methodology adopted for the analysis of the study. Site suitability analysis is carried out based on analyzing the characteristics of the site in the study area. The database is derived from the satellite image of IRS LISS- IV and Cartosat -1 PAN Image of 2006. Further, the fused image (LISS IV and PAN) and thematic database generated under the National Urban Information System (NUIS)14 Scheme have been used. The Table-1 gives the source and database used for the analysis from the satellite image.

Due to urbanization changes take place in land-use and such a change when coupled with unplanned growth often leads to misuse of land. When a land is suitable for one type of land-use but put to use for some other purpose, then, the optimum utilization of the land is restricted. So, a proper assessment of all parameters of land is very important to analyze. In the study, parameters analyzed for identification of the suitable site for disposing solid waste are- land-use, geomorphology, soil, slope and distance from road, which contribute significantly to the suitability analysis. The fused image was used to produce the land-use map of the study area. Fused images offer the advantage of the spectral characteristics of LISS IV images and spatial resolution of PAN images in extraction of land-use data very clearly. Table-2 shows, land-use and other categories with scores / weightage assigned.

Table 1: Data from Satellite Image.

Sl. No.	Source	Database (layers)
1	NUIS	Land-use
2	NUIS	Geomorphology
3	NUIS	Lithology
4	NUIS	Soil
5	BHUVAN	DEM (slope)
6	NUIS	Road, Admin Boundaries etc

Fig. 2: Methodology



Slope: Topographic parameter such as slope is very important for site suitability. Thus, DEM was downloaded, from the NRSC Geo-Portal "Bhuvan" and the slope data is derived by using the surface analysis tool available in Arc GIS software. The slope map was prepared with inclination upto 30° (where upto 10° is given highest weightage for site suitability), Table-2.

Lithology: The lithological data was interpreted from the satellite data by analyzing the image interpretation elements, such as, image tone, texture, etc. Geological details and structural features enabled to generate the basic geological layers of dyke and rock types. The layer was used for field validation and the final lithological layer was generated.

Table 2: Weightage for Different Land-use Categories.

Sl. No.	Category	Layers	Class Scores	Category Scores	Weightage
1	Landuse / Cover	Residential Area	1		R
		Industrial Area	1		
		Mixed Build UP	1		R
		Commercial Area	1		R
		Recreational Area	1		R
		Public /Semipublic	2		R
		Communication	1	32	R
		Public Utility & Facility	2		R
		Vacant Land	3		
		Agriculture Land	1		R
		Water Body	1		R
		Forest Land	1		R
		Waste Land	3		
2	Soil	Alluvial Soil	1	22	22
		Black Soil	1		22
		Mixed Soil	2		44
		Red Soil	3		66
3	Slope	0° -10°	3	5	15
		10°-20°	2		10
		20°-30°	1		5
4	Geomorphology	Flood Plain	1	7	7
		Pediment	3		21
		Pedi plain	2		14
		Residual Hill	1		7
		Pediment Inselburg Complex	3		21
5	Lithology	Basic Dyke	3	6	18
		Gneissic	2		12
		Granite	1		6

Source: NUIS Scheme.

Geomorphology: In the study area the geomorphological features like fluvial (flood) plain, pediment, pediplain, inselburg landform were interpreted from image and the layers were generated and verified during field work.

Soil: It is an indicator of fertility which is based on the type of soil, hence, a set of decisions were arrived for site suitability. Image enhancement technique like contrast stretching is applied to enhance the contrast among the various soil mapping units. After preparing the land-use layer, the soil map was prepared by pre-field interpretation. Ground truth collection / verification helped in post-field analysis. The soil depth and texture were collected in the field (Table 3).

Table 3: Soil Depth and Texture

Soil					
Sl. No.	**Factor**	**Layer**	**Class Score**	**Category Score**	**Weightage**
1.	Soil	**Type**		22	
		Alluvial Soil	1		22
		Black Soil	1		22
		Mixed Soil	2		44
		Red Soil	3		66
2.		**Texture**			
		Rocky	2		44
		- Clay	3		66
		Fine	1		22
		Sandy Skeletal	1		22
		Loamy Skeletad	1		22
		Clayey Skeletal	3		66
		Loamy	1		22
3.		**Depth**			
		Very Shallow (<25cm)	3		66
		- Shallow (25-50)	3		66
		Moderately Deep (50- 100cm)	1		22
		Deep (100 - 150cm)	1		22
		- Very Deep (>150)	1		22

(Source: NUIS Scheme)

Geomorphological and lithological layers data were also used for soil interpretation. It has been noticed that in the study area, basically, there are four types of soils, namely, Black Soil, Alluvial Soil, Red Soil and Mixed Black and Red Soil.

Land-use: It is an important indicator for identification of location and spatial distribution of urban and non-urban categories. Important Land-use layers include residential, public utility, recreational and so on. The non-urban features include agriculture, water bodies, wasteland and vacant areas. Madanapalle town is largely surrounded by non-urbanized features.

4. DATA ANALYSIS AND RESULTS

The data was analyzed based on suitability criteria for identification of solid waste disposal site and thereafter given the scores / weightages of land suitability in order to apply the MCDA technique. Table-4 shows the suitability score / weightage.

Table 4: Weightage of Different Data Layers.

S.No.	LAYER	WEIGHTAGE
1.	Waste Land	32
2.	Vacant Land	28
3.	Soil	22
4.	Geomorphology	7
5.	Lithology	6
6.	Slope	5
		Total Weightage= 100

Multi Criteria Decision Analysis (MCDA) is a technique which helps in structuring the multi-faceted decisions and evaluating the alternatives (Yahaya Sani and Ilori Christopher, 2010). As decision increases in complexity and importance, so does the need to formalize the decision by using available information, and to document the rationale (Randal Greene, 2011)16. In general, decision analysis uses a set of systematic procedures for analyzing complex decision problems. The basic approach is to divide the decision problem into smaller, understandable parts, analyze each of them, and integrate these parts in a logical manner to produce a meaningful solution (Malczewski Jacek, 2006). The site suitability analysis for solid waste disposal considers several parameters and as interaction between all the parameters is very complex, the MCDA approach is applied to derive at appropriate decisions. The formula (given by: Luis Carlos Berrocal, 2012) considered for the analysis is:

$S = \Sigma wixi \; x \; \Pi cj$

Where:

S — is the composite suitability score

Xi — factor scores (cells)

wi — weights assigned to each factor

cj — constraints (or Boolean factors)

Σ — Sum of weighted factors

Π — Product of constraints (1-suitable, 0-unsuitable)

Based on the land-use type and the scores, it is understood that, wasteland, vacant land or open land are the land-uses type which can be considered for arriving at the location of solid waste disposal site. Further, these land-uses are analyzed by overlaying other data layers, like soil, geomorphology, lithology, slope and transportation (Table-4).

Based on the type, texture and depth of the soil, it has been determined that, the red soil with depth upto 50 cm is to be considered as suitable for the solid waste disposal site, whereas, the alluvial and black soil are considered unsuitable, as these are highly fertile for agriculture use. Choosing such soils may not be at optimum utilization of the land. A steep to very steep slope, during the time of rain induces the movement of water from higher slopes to the lower slopes and in that situation, the waste will move with flow of water and would spread to the low lying areas, such as, agricultural and residential areas. Therefore, it is always preferable to select the solid waste disposal site in an area with a comparatively very low slope or a flat area.

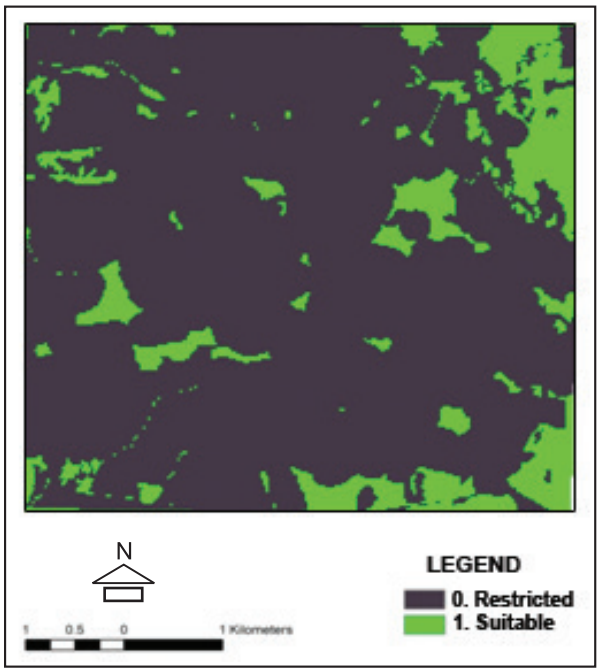
Here, the slope upto 10% is considered as suitable for identification of solid waste disposal Site. Similarly, with respect to lithology and geomorphology, pediment and inselburg landforms are considered as highly suitable for the disposal site.

As, in all similar type of studies, for understanding the environmental impact, the APPCB Guidelines and available data were used and for analysis the availability of the appropriate databases is very crucial. The data layers which were considered unsuitable for the solid waste site as per the APPCB guidelines are:

1. Forest Area
2. Water Bodies
3. Residential Area
4. Agriculture Area
5. Recreational Area

Before the data was considered for processing with MCDA technique, the layers, which are strictly considered as unsuitable, like recreational, residential, forest, vegetation and water bodies have been prepared as the restricted layer. These layers were also considered based on APPCB Guidelines. Similarly, in case of soil, lithology, slope and geomorphology, the restricted layers having Red Soil with 50

Fig. 3: The Restricted Sites for Solid Waste Disposal



Note: Unsuitable layer consist of recreational, forest, residential and water body data layers with proximal region, according to the APPCB Guidelines.

Fig. 4: Suitable Sites for Solid Waste Disposal

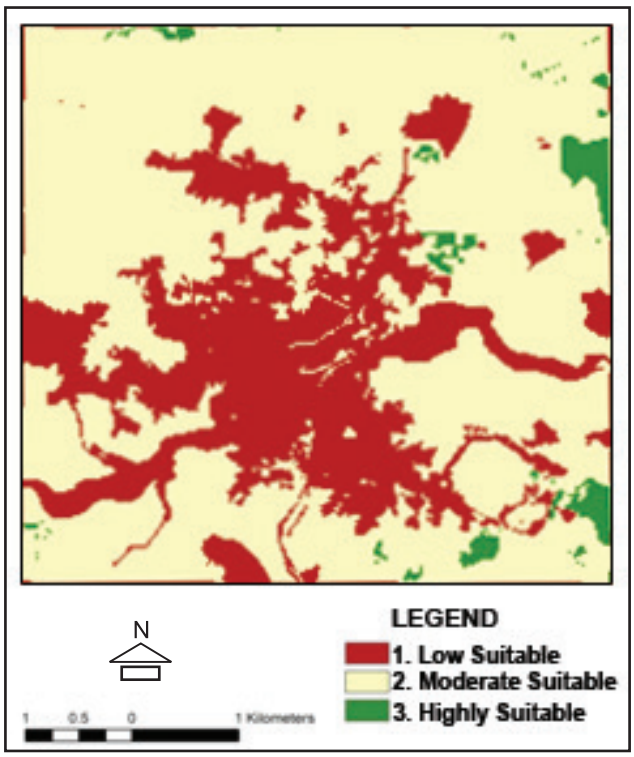
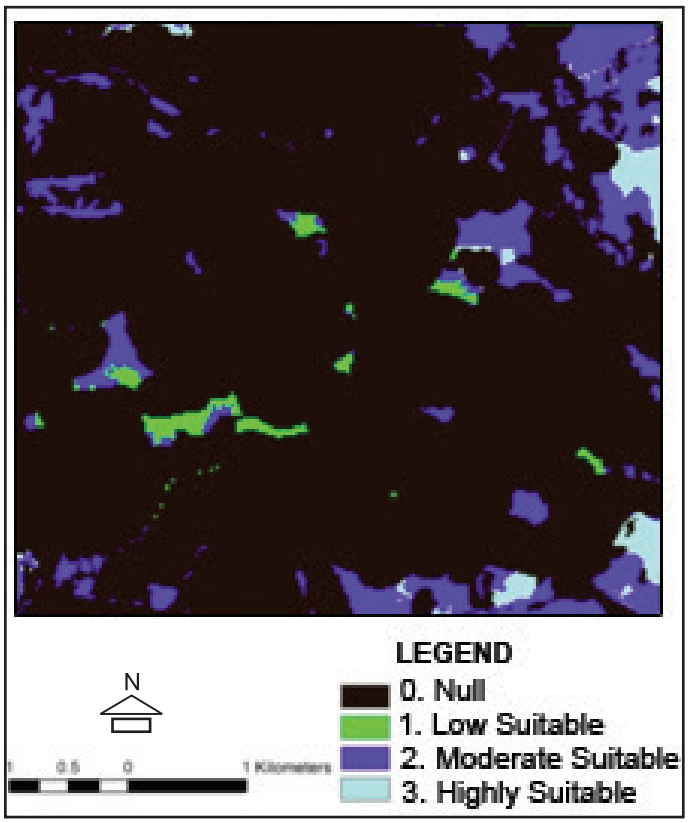


Fig. 7: Suitable Sites for Solid Waste Disposal.



cm depth, 10% slope area, lithology and geomorphology (Table-4) were prepared. The Figure-3 shows, the layers where Code-1 means the area is less suitable, whereas, the area in green or with Code-3 is highly suitable for solid waste disposal sites. The unrestricted or suitable layers include vacant land and wasteland. The Figures 4, show, the 'Model Builder Environment' for the analysis. The 'Model Builder' was used to do the analysis by using various geo-spatial tools like, 'clip', 'select', 'conversion', 'raster calculator', 'raster overlay', reclassification and so on from Arc GIS 10.1.

The suitable layer and unsuitable layer were then derived by assigning the weightages land criteria and finally both were analyzed by using the Multiplication Time Tool, available in Arc GIS 10.1.

After, the suitability analysis (classified as highly suitable, moderately suitable and less or low suitable) the road buffer is overlaid with the suitability layer and finally the suitability based on the proximity to the proposed site was considered as the highly suitable site. For disposing the solid waste material, road transport is considered as one of the major criteria for the site selection. Figure 5 shows, the raster output of the suitable sites.

5. CONCLUSIONS

The study enabled to arrive at selection of sites for the solid waste disposal in Madanapalle town of Chittoor district, of Andhra Pradesh. The selection of the sites is based on the, 'Multi Criteria Decision Analysis (MCDA)' method, wherein thematic details on geo-morphology, lithology, soil, slope, land-use and roads were considered. Andhra Pradesh Pollution Control Board (APPCB) Guidelines were referred for overlying and the criteria score and weightages were assigned to the database. The site suitability has been carried in Raster format by adopting the 'Weighted Overlay' method by using the Arc GIS software. The analysis of the study indicated that the major extent of the study area is urbanized and from the remaining available area three sites (which fulfilled the criteria adopted for site suitability analysis) were found suitable. They cover a total area of 0.40 sq km or 40 ha. Each of the three sites are located in the north-east and south-east of Madanapalle town in Basnikonda village, outside the Municipal limits.

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RAY: Ray of Hope for Ajmer

Jaideep Kharb

Abstract

Rajiv Awas Yojana is a very ambitious scheme of Ministry of Housing and Urban Poverty Alleviation (MoHUPA) Government of India. In a country like India, where 17.4 percent of urban households are residing in slums, the importance of this kind of scheme becomes more important. Before initiation of this scheme a number of schemes /programs were introduced for providing affordable housing to urban slum dwellers and EWS at both State as well as Center level. This scheme was launched keeping in mind the inclusive approach. Rajiv Awas Yojana is the only scheme of it's kind in which ULBs can adopt a 'whole city all slums approach'. Rajasthan has shown considerable progress in last one year following some other states. Ajmer becomes the India's first city who's 'Slum Free City Plan of Action' has been finally approved by MoHUPA.

1. INTRODUCTION

Adequate shelter means more than a roof over one's head. It also means adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and durability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as, water-supply, sanitation and waste-management facilities; suitable environmental quality and health-related factors; and adequate and accessible location with regard to work and basic facilities. Hence, all of these should be available at an affordable cost. Adequacy should be determined together with the people concerned, bearing in mind the prospect for gradual development. Adequacy often varies from country to country, as it depends on specific cultural, social, environmental and economic factors. Gender-specific and age-specific factors, such as, the exposure of children and women to toxic substances, should be considered.

The provision of adequate housing for everyone requires action not only by governments, but by all sectors of society, including the private sector, non-governmental organizations, communities and local authorities, as well as by partner organizations and entities of the international community. Within the overall context of an enabling approach, governments should take appropriate action in order to promote, protect and ensure the full and progressive realization of the right to adequate housing.

After decades of the independence, it is still grappling with the unmet adequate housing needs of thousands of its citizens. To tackle the acute housing shortage,

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the Centre launched the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) in December 2005, for providing housing and basic services to urban poor / slum dwellers in 65 selected cities under the sub - mission, 'Basic Services to the Urban Poor' (BSUP), and in other cities and towns, under the 'Integrated Housing and Slum Development' programme.

In addition to above the government launched the 'Rajiv Awas Yojana' (RAY) Scheme in June, 2011 aimed to create a 'slum-free India' by providing financial assistance to states that are willing to assign property rights to slum dwellers and provide them decent shelter along with basic civic and social services for development of slum.

RAY envisaged by President of India, to Joint Session of Parliament, on 4th June, 2009 (Box-1), taking a view for *"Slum Free India".*

Rajiv Awas Yojana Scheme, a federal programme dedicated to make India "Slum Free", was declared by Government of India (Box-2). The focus of the scheme is to provide benefits to slum dwellers to augment their life standard.

2. WHY RAY IS UNIQUE?

In order to achieve the goal of Rajiv Awas Yojana, the special feature make it unique is the involvement of private sector, community and stakeholder participation. RAY adopts an approach that favours in-situ redevelopment of slums rather than relocation (Box-3 and 4). Relocation considered rare to rarest case, for example, if any slum is located in hazardous or objectionable location / condition then only it is considered for relocation. It is reflecting the programs sensitivity to the potential for loss of income or livelihood in the event of resettlement. RAY with motive to, not disturbing their livelihood, shifts them only the nearest possible location in case of relocation (Box-5).

Box - 1

Address by President of India to Joint Session of Parliament, 04 June, 2009

"My Government proposes to introduce a Rajiv Awas Yojana for the slum dwellers and the urban poor on the lines of the Indira Awas Yojana for the rural poor. The schemes for affordable housing through partnership and the scheme for interest subsidy for urban housing would be dovetailed into the Rajiv Awas Yojana which would extend support under JNNURM to States that are willing to assign property rights to people living in slum areas. My Government's effort would be to create a slum free India in five years through the Rajiv Awas Yojana".

Box - 2

Prime Minister's Address to the Nation on 15th August 2009

"We had started the Jawaharlal Nehru National Urban Renewal Mission for the urban areas. We will accelerate this programme also. Today, lakh of our citizen live in slums which lack basic amenities. We wish to make our country slum free as early as possible. In the next five years, we will provide better housing facilities to slum dwellers through a new scheme, Rajiv Awas Yojana".

Box - 3

In-situ Re-Development:

Development of entire slum by providing adequate housing and infrastructure (civic and social) to the slum dwellers after demolition of the existing built structures.

Box - 4

In situ Up-gradation:

Development of the entire slum by filling gaps in housing and infrastructure (civic and social) to the slum dwellers without complete demolition of the existing built structures.

Box - 5

Slum Relocation :

Intervention in this case would include adequate housing and infrastructure (civic and social) to the slum dwellers on alternate site. Relocation should be done only for untenable slums with emphasis on providing mobility and recreating livelihood linkages.

Box - 6

New Housing:

Slum dwellers without pucca houses should be provided with new dwelling unit (Single storey or Multi-storied building) of carpet area between 21-27 sqm. With two rooms, kitchen, bathroom, water sealed toilet and individual potable water connection facility.

Box - 7

Incremental housing:

Incremental housing may be considered in case the existing dwelling units built by the slum dwellers need improvement i.e. if the dwelling unit is a pucca construction but having less than the desired minimum floor space or rooms, additional provision of rooms, toilets etc. should be considered to meet the minimum criteria (In case land is not available for expansion, vertical development may be considered).

Secondly, programmes of housing and Infrastructure running before RAY will not considered entire town/city as a whole. At the same time the beneficiary were not identified on the basis of their casts, minority status or BPL households but each and every person residing within the slum boundary is liable to take advantage of the RAY Scheme. RAY not only provides good housing to slum dwellers but also provide the good quality of infrastructure and to link up the slum with entire town/city.

A Slum Free City Plan of Action (SFCPoA) is an important instrument under RAY and the foundation for cities to attain the objective of RAY. It is a citywide plan of action, which consists of a plan, to bring about the improvement of existing slums and strategies for prevention of future slums. In doing so, the "Slum Free City Plan of Action", takes into consideration not only the present status and priorities of slum dwellers but also the resources and capabilities of the city in improving the quality of life of the urban poor and the capacity of the urban poor to be partners in the development process in such a manner that slum development shall be at par with the formal system.

RAY considers not only the construction of new houses for slum dwellers but also have scope of 'incremental housing' and 'rental housing' (Box-6, 7 and 8).

Capacity building, Administrative and Other Expenses (A and OE) and IEC activities are also part of this scheme. GIS mapping of all town/city and delineation of slums boundaries have also been done under this progrem, so that, local body can easily monitor the growth of slums and shall take necessary actions. The financial share of states, ULBs and beneficiary are very less; so the scheme is easy to grasp. Under RAY there is a provision of nigh shelters also.

3. FUNDING PATTERN OF RAY

In RAY there will be an upper ceiling of 5 lakh per DU for cities with population more than 5 lakh. This ceiling would be at 4 lakh per DU for smaller cities with population less than 5 lakh. In North - East (N-E) and special category States, upper ceiling would be at 5 lakh per DU irrespective of population of the city. Upper ceilings, as above, would also include cost of civic infrastructure and social amenities. Cost of civic infrastructure and social amenities per DU should not exceed 25% of the project cost. Land cost will not be admissible for Central Government funding under the scheme. Beneficiary contribution is necessary to bring sense of ownership among the beneficiaries and is provided at the minimum of 10% in the case of SC/ST/OBC/PH/single woman/other weaker and vulnerable sections and 12% in case of general category (Table 1).

Box - 8

Rental Housing:

Rental housing may be the preferred choice to accommodate tenants of slums, labourers, floating population and urban homeless. Recognizing that managing such rental premises is challenging, States/UTs will be required to clearly enunciate mechanisms for managing such premises including fixation of rent, operation and maintenance, vacancy norms etc. The carpet area of rental DUs is expected to be between 16-20 sq mt with shared civic infrastructures. However, rental DUs with carpet area between 21-27 sq mt can also be proposed in exceptional cases.

Table 1: Beneficiary Contribution in RAY

Category	Type of City / Urban Agglomerations (UA) as per 2011 census	Components	Contribution of			Beneficiaries (%)
			Centre (%)	State (%)	ULB (%)	
A	Cities/UAs with Population 5 Lakh and Above	Housing	50	25	-	25
		Infrastructure	50	25	25	0
B	Cities/UAs having Population Less than 5 Lakh	Housing	75	15	-	10
		Infrastructure	75	15	10	0
C	Cities/UAs North Eastern Region and Special Category states (Jammu & Kashmir, Himanchal Pardesh and Uttarakhand)	Housing	80	10	-	10
		Infrastructure	80	10	10	0

Source: RAY Guidelines

4. RAJASTHAN INITIATIVES

Rajasthan lead in RAY in the entire country. According to the 2011 Census, 5.6% of Rajasthan's total population and 22.4% of urban population lives in slums. At the same time Rajasthan continues to try so fill up the gap between houses and households. Rajasthan launched their 'Affordable Housing Policy' in 2009 and 'Township Policy' in 2010.

Till 31st December, 2013 there were 55 towns/cities in preparatory stage and 23 are at implementation stage. In preparatory stage, both Rajasthan and

Utter Pradesh have been included 8 towns/cities each, but Rajasthan shows good progress up to 31st December, 2013. Rajasthan succeeds in approving Rs. 431.33 crore pilot projects for housing and infrastructure, which is highest in the country. At the same time there is only one approved SFCPoA in India that is Ajmer-Pushkar. Ajmer-Pushkar SFCPoA declared as a model template by Ministry of Housing and Urban Poverty Alleviation for preparation of SFCPoA for other cities.

5. WHY AJMER SFCPOA IS UNIQUE?

Ajmer Slum Free City Plan of Action (SFCPoA) has been considered by Ministry of Housing and Urban Poverty Alleviation (MoHUPA) for President Award on 21st January, 2014, at Vigyan Bhawan, New Delhi. Ajmer has achieved a national level reorganization by completing country's first SFCPoA and Detailed Project Report for 5 cities, worth of more than Rs. 400 crore approximately.

Ajmer has 83 slums with 22207 households in these slums. In Ajmer 33.75 percent of households in slums are having insecure tenure as, 32.66 percent slum dwellers income is less than Rs. 3000 per month; 8.28 percent are working as daily laborer and 36.78 percent as casual laborer; 14.81 percent BPL families; and 48.40 percent belongs to SC / ST category.

Fig. 1: Situation of Slums in Ajmer

Moreover, 5.38 percent houses are on rent in slums at the same time 12.73 percent households are residing only one room accommodation. These figures are very wide on city level.

At city level according to 2011 census housing scenario reflects the shortage of housing supply in Ajmer. The city has 81396 units, against the 82249 total numbers of household required. Thus there was a shortage of 853 houses out of the existing stock. However, out of 81396 households, 1323 houses were in dilapidated state and not livable. The data reflects the housing shortage of 2176 household in 2001. Ajmer urban agglomeration has a population of around 551,360 person and 542,580 of the city (2011 census). 103208 households in Ajmer urban agglomeration according to census 2011 and housing shortage is 29811 houses. There are 15.71 percent *katcha* houses; 18.16 on rent; and 21.79 percent living on one room accommodation (Figure 1).

Box - 9

Obsolescence Factor:

Percentages of households living in the dwelling units having age 40-80 years and are in bad condition and percentage of households living in all structures aged 80+ years, irrespective of condition of structure, taken together as obsolescence factor for the purpose of the report.

The Ninth Plan Working Group on Urban Housing had adopted the obsolescence factor as "percentage of households living in 80+ years old dwelling units"

Box - 10

Congestion Factor:

Percentage of households in which at least one couple is not having a separate room to live in. This includes the households in which couples are sharing the room with 10+ age member of the household.

The Ninth Plan Working Group on Urban Housing had adopted the factor as "percentage of married couples require separate room/house".

The uniqueness of this SFCPoA is not only because of providing good methodology for making Ajmer slum free but because of its slum prevention strategies considering the congestion and obsolesce factor, migration factor, service sector, future housing projections and earmarking vacant land for affordable housing and also night shelters as per the direction given by the Supreme Court on dated 5th May, 2010 (Box-9 and 10).

6. CONCLUSIONS

RAY is quite beneficial for urban poor people of India, and it has shown considerable progress in housing sector in urban India. The positivity comes in this scheme due to it's large scale public participation, and consideration of livelihood for slum dwellers, as well as assessment of city's future housing requirement by considering congestion, obsolesce and migration factors along with natural growth, and earmarking of land for up-coming affordable housing projects, to meet the cities future housing requirement. The sources of funding and administrative setup to fasten the progress, with tentative financial requirement has already been mad as part of SFCPoA. It is hoped that the RAY will actually prove to be the 'ray of hope' for slum dwellers of Ajmer.

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Editor

Estimation of Land Surface Temperature (LST) Using Landsat-7 ETM+ Thermal Infrared: A Case of Shimla (Himachal Pradesh)

Shashi Shekhar

Abstract

The paper critically analyzes the LST with land surface aspect in guiding the spatial pattern of the town. It is noted that land surface temperature gradient guided the spatial pattern of the town at the same time it also got modified due to anthropogenic activities of urbanization and got manifested in the form of few urban heat islands (UHI). Historically Shimla started developing on south slope by virtue of maximum hours of sunshine available during winter. It is the reason that property rent also gets modified accordingly in Shimla. The paper also extracts / estimates temperature from the final LST map for about 90 locations across the city.

1. INTRODUCTION

Land surface temperature (LST) is emerging as one of the most important tool for spatial data measured by satellite remote sensing by using band 6 (thermal) of Landsat 5 and 7 and latest Landsat-8 Thermal Infrared Sensor (TIRS). It is related to surface energy and water balance, which is used for wide applications such as climate change, urban climate, the hydrological cycle, and vegetation monitoring. LST variations in space and time, measured by satellite remote sensing, are used for the estimation of a multitude of geophysical variables, such as evapotranspiration, vegetation water stress, soil moisture in addition to environmental planning of cities.

In recent past, sensors, such as the Moderate-resolution Imaging Spectroradiometer (MODIS) and the Advanced Very High Resolution Radiometer (AVHRR), have been providing global thermal data twice daily, using two long-wave infrared (LWIR) bands though on moderate resolution. Landsat-5 Thematic Mapper (TM), Landsat-7 Enhanced Thematic Mapper Plus (ETM+) and Landsat-8 Thermal Infrared Sensor (TIRS) have started providing thermal data with a higher spatial resolution but with a 16-day temporal resolution. Since satellite remote sensing provides a repetitive synoptic view in short intervals of the Earth's surface, it is a vital tool for monitoring LST over urban heat islands.

Normally, the climate in and around cities and other built up areas is altered due to changes in LU/LC and anthropogenic activities of urbanization. But in contrary to above, surface temperature also plays an important role in determining the spatial growth of a mountainous city like Shimla. Urban settlement has historically

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developed on southern slope, which receives maximum hour of sunshine in winter. Since winter is very harsh, human habitation continued to flourish on southern slope, which is evident in the spatial pattern of surface temperature estimated through Landsat satellite data. Consequently the southern part tended to lose moisture content and remained devoid of dense vegetation cover. This in turn also led to increase in surface temperature, which was also influenced by alteration and conversion of vegetated surfaces to impervious surfaces. Consequently, the temperature difference between built-up urban and vegetated settings has led to the emergence of many urban heat islands (UHI).

2. STUDY AREA

Shimla Planning Area (SPA), the only Class I city in the Himachal Pradesh, has recorded a population of 1,71,817 with a floating population of 75,000 during 2011. About 82% of whole population of SPA lives in Municipal Corporation, Shimla including Dhalli, Tutu, and New Shimla. As per the Census 2001, Dhalli, Tutu and New Shimla urban agglomerations were part of Municipal Corporation and later notified under Special Areas having a total population of 13.83 % of the total population of Municipal Corporation. In August 2006, these Special Areas were again merged back into Municipal Corporation. Besides, 12% population of total SPA Area lives in Kufri and Shoghi Special Areas and 6 % population lives in newly constituted Ghanahatti Special Area.

2.1 Temperature Pattern

Shimla features a sub- tropical highland climate (Cwb) under the Köppen climate classification. The climate in Shimla is predominantly cool during winter and moderately warm during summer. Temperatures typically range from −4 °C (25 °F) to 31 °C (88 °F) over the course of a year. The average temperature during summer is between 19 °C (66 °F) and 28 °C (82 °F), and between −1 °C (30 °F) and 10 °C (50 °F) in winter (Wikipedia).

3. METHODOLOGY

The following methods were used to normalize the raw DNs to TOA radiance and later TOA radiance were converted to surface radiance for the current study based on the metafile of the ortho-corrected datasets.

TOA (Top of the Atmospheric) Spectral Radiance Scaling Method

$$L_\lambda = ((LMAX - LMIN_\lambda)/(Q_{CALMAX}-Q_{CALMIN})) * (Q_{CAL}-Q_{CALMIN}) + LMIN_\lambda$$

Where:

L_λ = spectral radiance at the sensor's aperture [W/(m^2 sr μm)];

Q_{CAL} = the quantized calibrated pixel value in DN;

$LMIN_{\lambda}$ = the spectral radiance scaled to Q_{CALMIN} [W/(m² sr μm)];

$LMAX_{\lambda}$ = the spectral radiance scaled to Q_{CALMAX} [W/(m² sr μm)];

Q_{CALMIN} = the minimum quantized calibrated pixel value (corresponding to $LMIN_{\lambda}$) in DN;

1 for LPGS products, 0 for NLAPS products

Q_{CALMAX} = the maximum quantized calibrated pixel value;

(Corresponding to $LMAX_{\lambda}$) in DN = 255.

(All above parameters obtained from the scene's .MTL file)

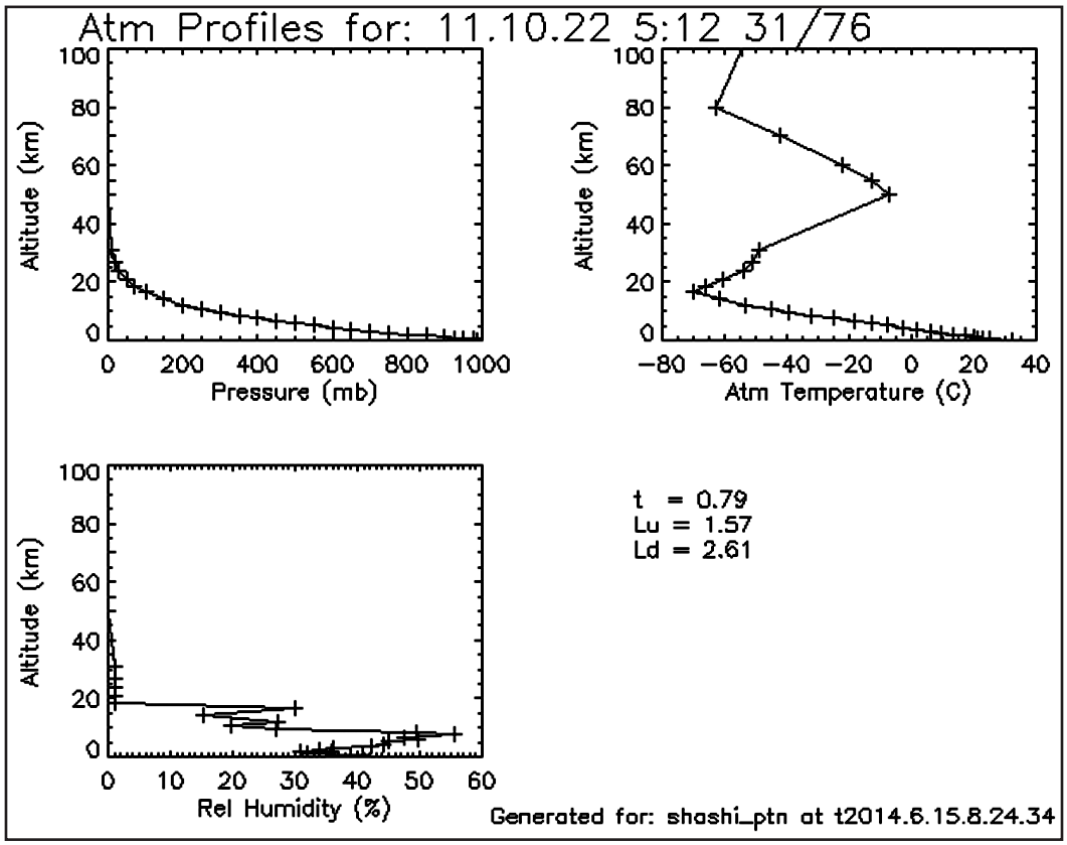
3.2 TOA Radiance to Surface Radiance

The surface radiance is then calculated using the Reference Channel Emissivity (RCE) method. This procedure assumes that all pixels in a channel of the thermal infra-red band have the same emissivity constant, from which a surface radiance image is extracted. Removing the effect of the atmosphere in the thermal region is an essential step when using thermal band data for temperature studies (K. Babu Govindha RAJ and Kevin Fleming). Knowing the properties of the atmosphere, a radiative transfer model was then used to estimate the transmission, the upwelling and downwelling radiances. Once these parameters are known, it is possible to calculate surface radiance. In this study the same is calculated through web-based Atmospheric Correction Parameter Calculator (ACPC, http://atmcorr.gsfc.nasa.gov/cgi-bin/atm_corr/atm_corr.pl) to estimate the surface radiance (Figure 1).

Box - 1: Atmospheric Correction Parameter Calculator

Date (yyyy-mm-dd)	:	2011-10-16
Input Lat/Long	:	31.000/ 76.000
GMT Time	:	5:12
L7 Spectral Response Curve from handbook		
Mid-latitude winter standard atmosphere		
User input surface conditions		
Surface altitude (km)	:	-999.000
Surface pressure (mb)	:	-999.000
Surface temperature (C)	:	-999.000
Surface relative humidity (%)	:	-999.000
Band average atmospheric transmission	:	0.83
Effective bandpass upwelling radiance	:	1.37 W/m^2/sr/um
Effective bandpass downwelling radiance	:	2.25 W/m^2/sr/um

Fig. 1: Atmospheric profiles calculated using the Atmospheric Correction Parameter Calculator for the scene dated 16th October 2011)



The above stated tool calculates the profile based on inputs such as date, time, latitude and longitude. The conversion of TOA (Top of the Atmospheric) radiance to surface radiance is done using the following equation (Barsi et al., 2003b):

Where L_T is the radiance of a blackbody target of temperature T Kelvin (surface radiance), L_{TOA} is the TOA spectral radiance calculated using the equation at (3.1), is the atmospheric transmission at the sensor's aperture, is the surface emissivity, L_U is the upwelling spectral radiance between the surface and the sensor (in Wm^{-2}, sr^{-1} μm^{-1}) and L_D is the downwelling spectral radiance from the sky (Wm^{-2}, sr^{-1} μm^{-1}), which were obtained from Figure-1.

3.3 Surface Radiance to Surface Temperature

Surface radiance is finally converted to surface temperature (Barsi et al., 2003b)

$$T = \frac{K_2}{\ln\left(\frac{K_1}{L_T} + 1\right)}$$

Where:

T = Surface temperature in Kelvin

K_1 = Calibration constant = 666.09

K_2 = Calibration constant = 1282.71

L_T = Surface radiance from equation at (3.2)

The temperatures are estimated in degrees Kelvin, and are then converted to degree Celsius by T (Kelvin)-273.15.

4. RESULT AND DISCUSSION

The resultant surface temperature map is presented at Figure – 4 indicating that surface temperature varies as per the land uses such as built-up areas and forest areas. Though there is a strong relationship between topographic parameters such as aspect and temperature gradient in the spatially distributed dataset of Shimla. Also areas having less vegetation cover and bare soil tend to have high temperature. Areas located south of Sanjauli and Panthaghati characterize high temperature zone. However, dense forest of Kufri depicts the opposite pattern. Urban growth (Figure-3) has historically followed the south aspect, which is reflected in temperature pattern as over 75 percent of urban habitation was in the high temperature zone as per the pie chart at Figure-2.

4.1 Land Surface Temperature estimation

As per the Worldwide Bioclimatic Classification System, Shimla has an average high temperature of 17.2°C during the month of October (Table-1). The location of Indian Meteorology Department (IMD) observatory is located near Central Potato Research Institute (CPRI), Bemloi Shimla, the location of which displays the estimated LST of 15.6°C, which is quite close to high average of 17.2°C for the month of October 2011.

The thermal energy responses of different land use types such as urban built-up, soils and vegetation cover in the study area indicate the variation in surface temperature of different surface types. The analysis of imagery indicates that built-up areas and barren lands are the places with highest surface temperature. Forest areas are the places with the lowest temperature.

Fig. 2: High Built-up Area in High Temperature Zone.

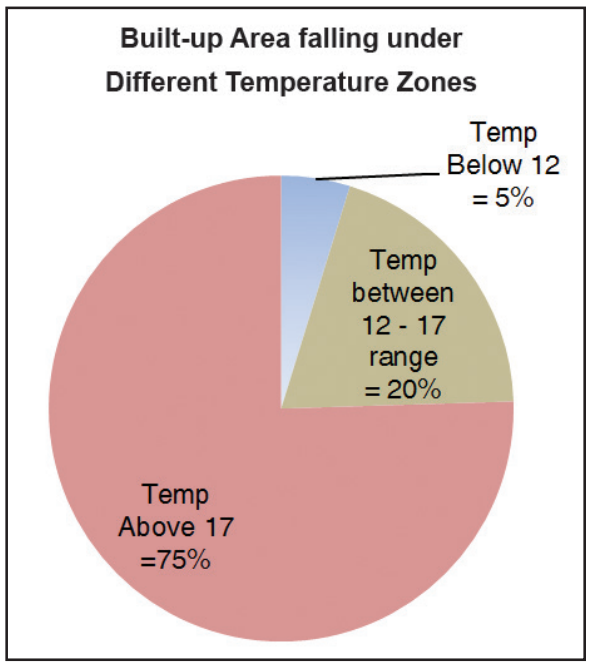


Fig. 3: Landsat FCC (Builtup shown in light cyan) Built-up area seen in Landsat 8 Image during 2011

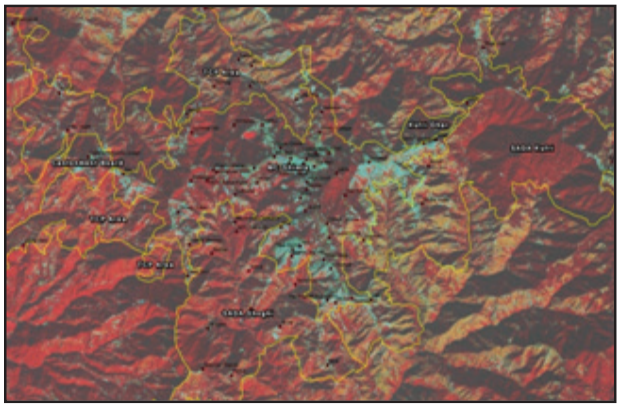


Fig. 4: Suitable Aspect, Aspect of Shimla

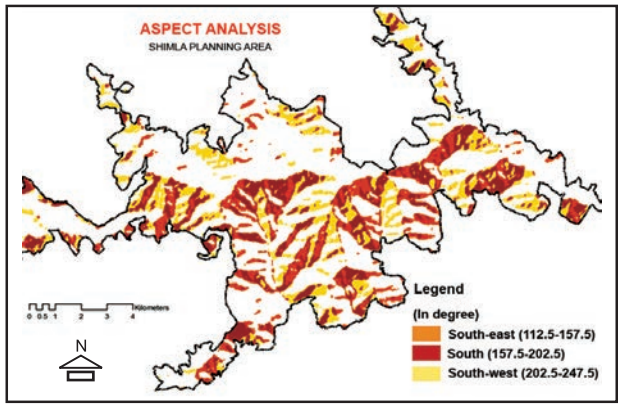


Table 1: Climate data for Shimla

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	17.2 (63)	19.4 (66.9)	23.9 (75)	28.3 (82.9)	30 (86)	30.6 (87.1)	27.8 (82)	25.6 (78.1)	24.4 (75.9)	23.9 (75)	19.4 (66.9)	20 (68)	30.6 (87.1)
Average high °C (°F)	8.3 (46.9)	8.9 (48)	13.9 (57)	18.3 (64.9)	22.2 (72)	22.8 (73)	20.6 (69.1)	19.4 (66.9)	19.4 (66.9)	17.2 (63)	13.9 (57)	10.6 (51.1)	16.3 (61.3)

(Source: Worldwide Bioclimatic Classification System, wikipedia)

Fig. 5: Land Surface Temperature (LST) through Landsat 7 ETM+ sensor, Land surface temperature – 2011

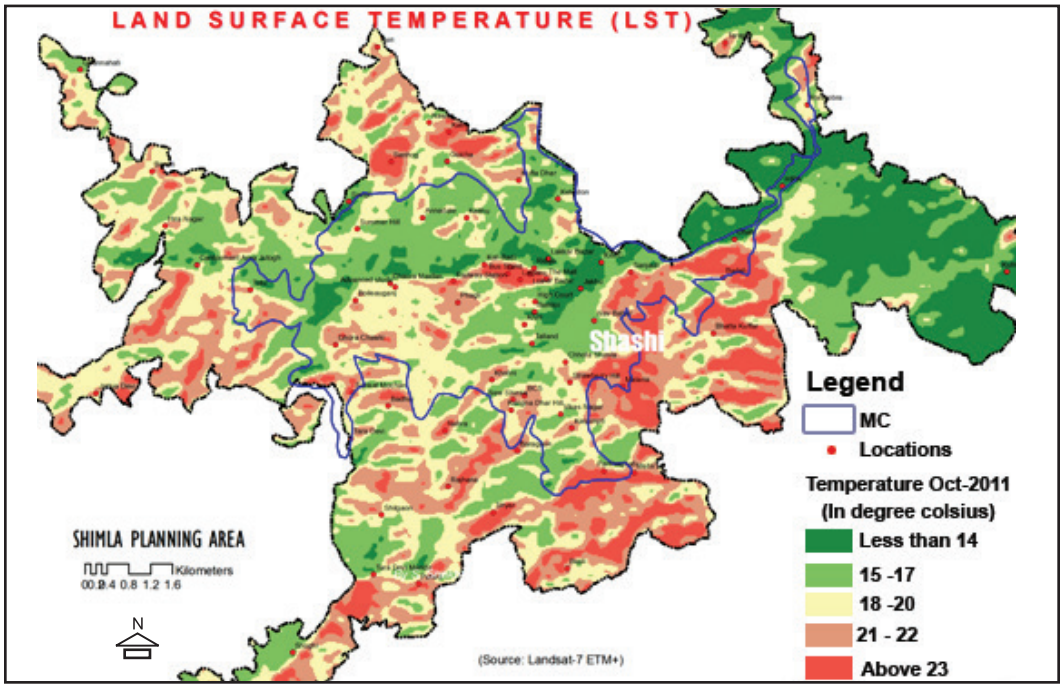
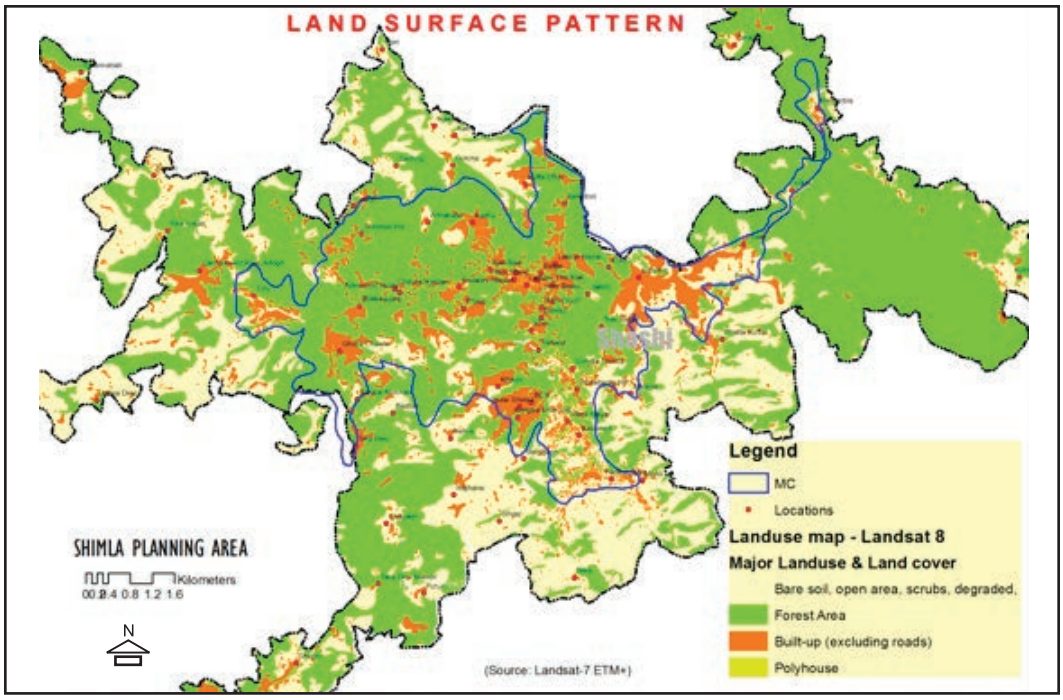


Fig. 6: Landuse and land cover map derived from Landsat-8 with Supervised Classification, Land Use and Land Cover



In the above two maps (Figures-5 and 6), it can be observed that land use pattern particularly settlement development followed the south, southeast and southwest aspects and winter temperature helped to beat the winter. Furthermore, spatial pattern of settlement development, southern aspect and temperature seem to mimic each other and share strong correlation.

Fig. 7: Major areas and their estimated LST

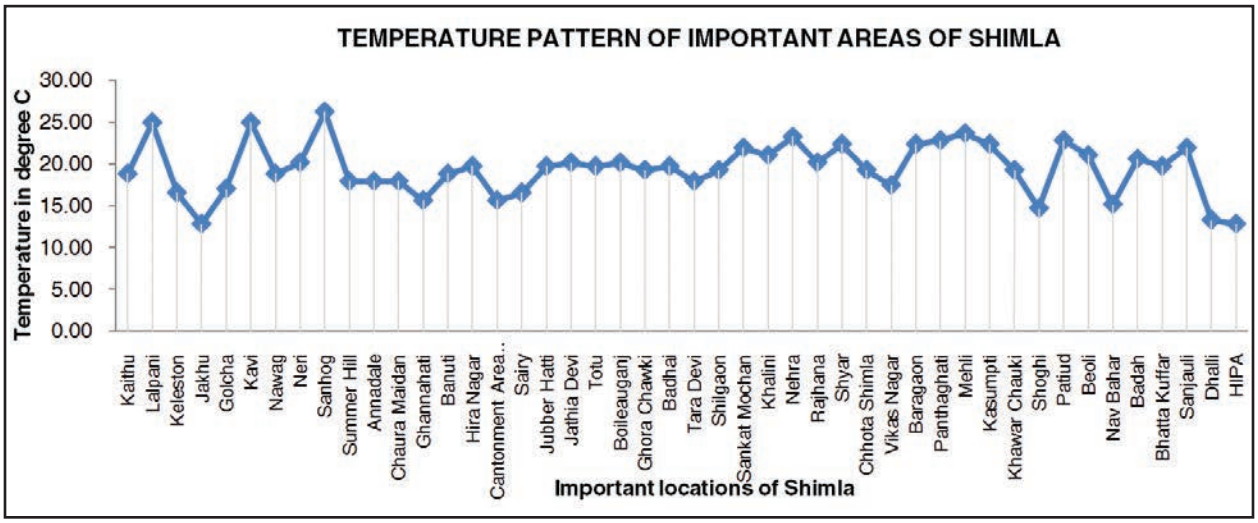
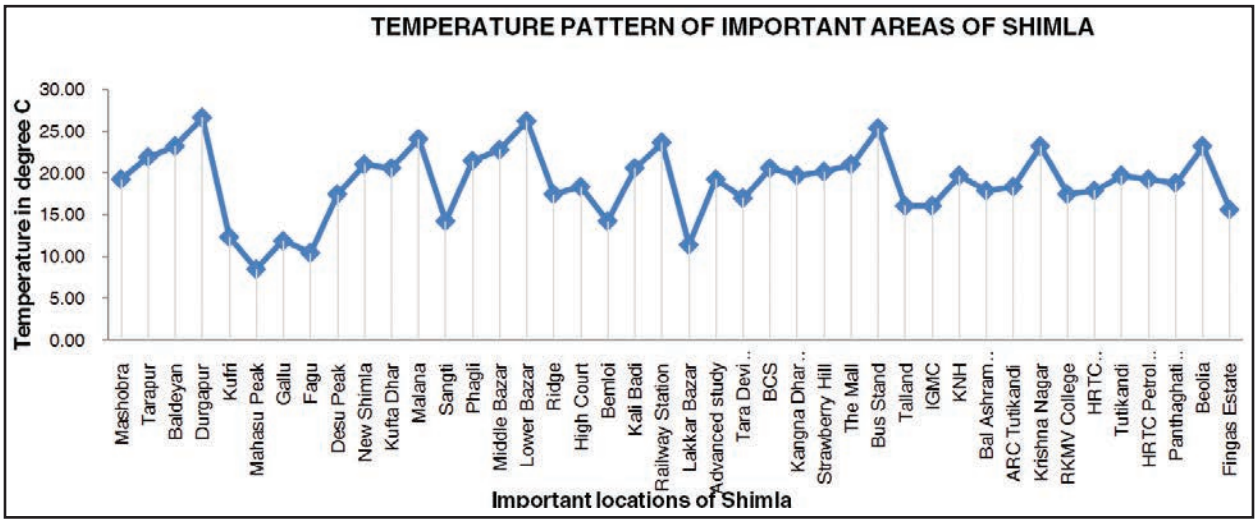


Fig. 7 (Continued): Major areas and their estimated LST



4.2 Estimated Temperature of Various Mohallas / Locations in Shimla

About 90 locations of major *mohallas*, landmark public places and other major locations have been geo-located on the map. All these locations have been overlaid on LST to extract surface temperature from the LST map for the month of October 2011 to have a comparative view of temperature pattern across areas, which is presented in a line chart at Figure - 7. It is important to note that property rent is highly influenced by sunshine duration during winter.

5. CONCLUSIONS

In this paper, an attempt has been made to estimate surface temperatures for Shimla Planning Area, Himachal Pradesh, though the use of Landsat-7 ETM+ thermal band data, which are the freely available dataset for estimating LST for any topographic and climatic conditions across the globe. The thermal energy responses of different land use types and soil in study area indicate the variation in surface temperature of different surface patterns.

Surface temperature controls the surface heat and water exchange with the atmosphere effecting climatic change in the area. Land surface temperature and LU and LC helps to find out the best solutions for locating sites for township development to decentralize and ease the growing pressure on solar energy power plants, management and improvement of urban environment quality and the planning strategies for heat island reduction, etc.

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Land-Use Change in Urban Environment: Case Study Kaithal, Haryana

Ravinder, and S.P Kaushik

Abstract

In this paper, by using GIS techniques an attempt has been made to study the changes in urban land-use pattern of Kaithal town over a period of 36 years. Multi source data and maps were used to achieve the objectives. Results of the study indicate that the causal potential factors are governing physical growth and change in the town, through different time periods. The study shows that the town's area was not significantly increased during 1974-1990 period, while urban growth process has gained momentum with the up-gradation of the administrative setup of the town after 1990. The noticeable impact of land-use changes observed the loss of rich agricultural land and natural water bodies. The maximum increase in built-up area both formal as well as informal development are found towards north-eastern parts of the town.

1. INTRODUCTION

Urbanization can be defined, "as a process which reveals itself through temporal, spatial and sectoral changes in the demographic, socio-economic, technological and environmental aspects of the given society. Urbanization is a progressive concentration of population in urban areas (Kingsley Davis-1965). To detect the dynamic land-use changes, analyze the social and cultural impacts and evaluate the influence of those changes to natural environment will increase knowledge of understanding of human-environment interactions. There are many positive factors in the cities, as large cities are usually dynamic growing centers for modern production and industry; availability of large financial services; facility for international trade and commerce; higher education; and better health facilities. That is why, cities are more efficient than smaller towns in terms of production, economic growth and also income generation. On the one hand, people's economy and life expectancy in the city will increase and on the other, economy will become more stable and stronger (Brookfield and Byron, 1993; Bilsborrow, 1998).

The impact of growth process of the city is reflected in two ways, firstly, the urban inhabited areas experience continuous change, leading to structural, compositional and infrastructural readjustments and secondly, the adjacent non-urbanized areas are put to urban use, thus, changing the overall shape and size of the city. Geographic Information Systems (GIS) and Remote Sensing technologies have been well recognized than the traditional methods for surveying the change of urban environment (Da Costa, 1999). Remote Sensing

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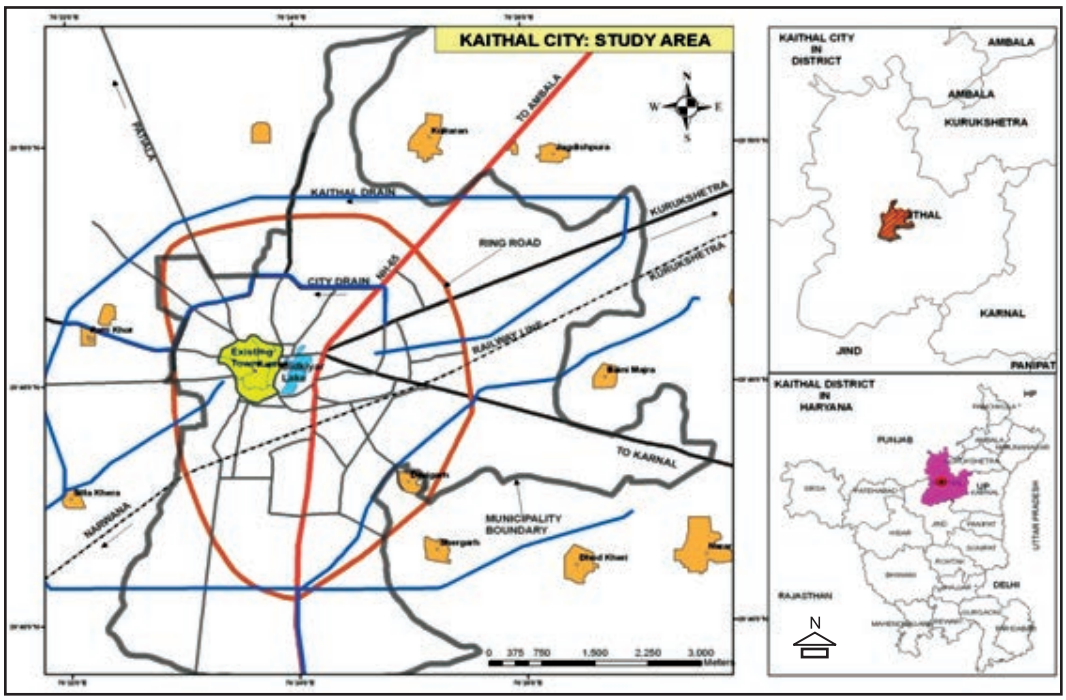
data is very useful because of its synoptic view, repetitive coverage and real time data acquisition. The digital data in the form of satellite imageries enable us to accurately compute various land-uses categories and helps us to maintain spatial data, which is very essential for monitoring urban expansion and change detections studies (Lo, 1981; Mukherjee, 1987; and Quarmby and Cushine, 1989). Sharma in 2001, observed that quantification of land-use changes in urban environment is efficiently analyzed through GIS techniques, even if the resultant spatial datasets are of different scales and spatio-temporal resolutions. In this paper, an attempt has been made to study the changes in urban land-use pattern of Kaithal town over a period of 36 years through GIS. Multi source data and maps, such as, Survey of India Toposheet were used for the year 1974, Landsat TM satellite imageries (30m) for the year 1990 and QuickBird satellite images, available on Google earth used for the year 2010.

2. PROFILE OF STUDY AREA

Kaithal district is bounded by Punjab State in the north and north-west, Jind district in the south-west, Panipat and Karnal districts toward south- east and the Kurukshetra district in the north-east. Kaithal town is situated on $29^{0}42'9''$ North latitudes and 76^{0} $23'49''$ east longitudes (Figure-1). The general topography of the town is flat. General slope of the town is from north-east to south- west, as most

Fig. 1: Kaithal Town Study Area.



Source: Prepared in GIS, Municipal Committee, Kaithal

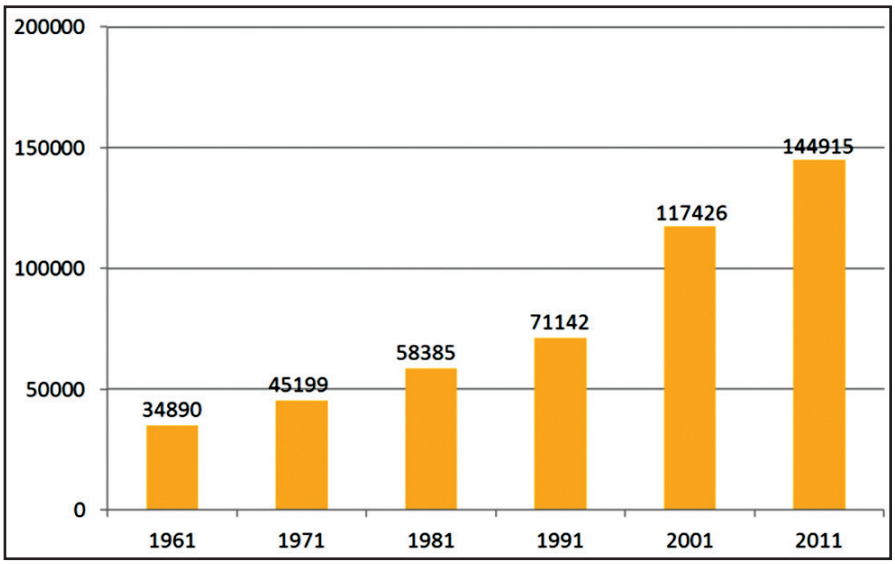
Table.1: Population Growth

Year	Population	Decadal Growth (%)
1961	34890	------
1971	45199	29.55
1981	58385	29.17
1991	71142	21.85
2001	117426	65.06
2011	144915	23.41

Source: Draft Development Plan -2021 Kaithal and Census-2011

of the canals/ drains flow in same direction. The main town is situated on an elevated land but it is surrounded by several ponds and mounds in the west and north-west including an extensive 'Bidkiyar Lake', covering the major potential area in the vicinity of the town. NH-65 passing through the main town connecting the State capital Chandigarh to Hissar. Town has Municipal Council and it is a class-I town with a total population of 1,44,915 persons, as per Census, 2011. Kaithal emerged as a center of commercial business and educational activities after becoming a district headquarter in Nov, 1989. Kaithal is also known for one of the largest food grain market in the state of Haryana. The population has increased more than five times from 1961 to 2011 (Table-1 and Figure-2). According to the study undertaken by Town and Country Planning Department, the main factors responsible for increase in population are, immigration from surrounding villages for better facilities and job opportunities; immigration from Punjab State during the days of terrorism; and various small and medium scale agro-based industries. On the one hand, Kaithal town during the last decade expended its administrative establishment being a district headquarter and HUDA developed residential sectors on the other. Kaithal town also experienced development of new grain market and sugar mills. All these development leads to expansion of Kaithal town on rich agricultural land in its surrounding. In the process of development and demand of land, even natural rivulets and water bodies in the vicinity of the town transformed into concrete jungle. As a result the problem of water logging during Monsoon seasons has increased. In addition, in the absence of proper disposal arrangement for solid wastes, drains are often choked.

Fig. 2: Decadal Growth of Population.



3. OBJECTIVES AND METHODOLOGY

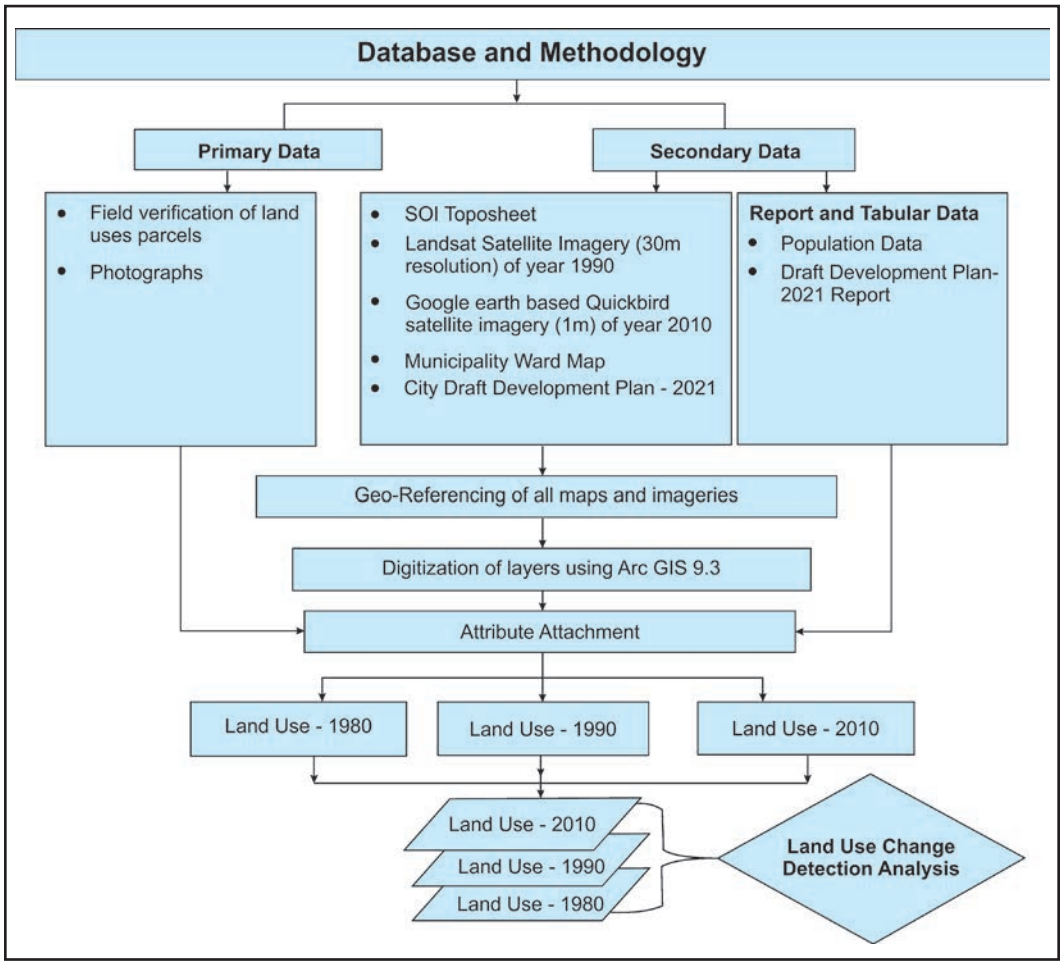
3.1 Objectives

The main objective of the present study is to analyze the physical expansion of city and the impact on land-use change during 1974 -2010.

3.2 Methodology and Databases

The present study is based on multi-source database. The Survey of India (SOI) Toposheet (53c/5) at 1:50,000 scales, is used for the extraction of land-use information for the period of 1974. Since Toposheet depicted only physical expansion and not the detailed land-use, therefore, few senior citizens were also interviewed in order to collect the land-use information. Year 1974 is considered as a base year for the study as during this year, planning of urban centers in Haryana was started. For the preparation of land-use map of 1990 and 2010, open source data available on internet was used. The Landsat TM and MSS (30m resolution) satellite imageries scenes have been downloaded from Global Land Cover Facilities website of Earth Science (http://glcfapp.glcf.umd.edu), in order to prepare land-use map of 2010, QuickBird satellite images (0.61m resolution) available on Google earth have been used. In addition, a municipal ward map and proposed land-use map for 2021, prepared by State Town and Country Planning

Fig. 3: Flowchart of Database and Methodology



Department have also been used. In order to bring on common scale all the three years collected datasets were geo-referenced. The available satellite data have been visually interpreted and integrated with intensive field checks and land-uses layers were digitized and attributed on Arc GIS 9.3 Software. Finally, the land-use maps of respective year were superimposed upon each other in order to analyze the variation in land-uses. Based on the attribute tables for each year, statistical analysis of land-use changes was analyzed in MS Excel package. The approach and methodology followed in this study is shown in Figure 3.

4. RESULT AND DISCUSSION

The present study revealed that, during 1971 area of the city was only 1614.49 acres with total population of 45,199 persons, which increased in 2011 to 9895.64 acres area and population of 1,44,915 persons. The Kaithal town has grown beyond the municipal limits of 40 sq km in 2010. The Proposed Draft Development Plan-2021 reflect that by 2011 total population of the town would be 1,44,915 persons with a significant decline in decadal growth rate of 23.41 %, whereas,

Table 2: Kaithal City: Percentage of Land-use and built-up change from 1974-2010 within the Municipal Boundary.

Land-use/cover Categories		Total Area (acre)			Area (in Percent) of Total			Area (in Percent) of Continuously Built-up Total		
		1974	1990	2010	1974	1990	2010	1974	1990	2010
Residential	Built-up	312.76	675.31	2561.56	19.37	32.83	25.89	45.23	38.13	51.93
Commercial		69.23	161.74	237.06	4.28	7.87	2.40	10.01	9.13	4.81
Industrial		21.26	104.43	630.23	1.31	5.07	6.37	3.08	5.90	12.78
Public and semi-pubic use		53.66	264.49	375.23	3.32	12.86	3.79	7.76	14.93	7.61
Transport and communication		58.54	159.67	377.22	3.63	7.76	3.81	8.47	9.01	7.65
Recreational		NA	38.99	162.86	NA	1.89	1.65	NA	2.20	3.30
Sub-total (Built-up)		515.45	1404.63	4344.16	31.91	68.28	43.91	74.55	79.3	88.08
Water bodies	Non Built-up	111.49	120.59	208.19	6.93	5.86	2.10	16.12	6.81	4.22
Vacant		64.58	245.83	380.09	4.00	11.96	3.84	9.33	13.89	7.70
Sub-total (continuously built-up)		691.52	1771.05	4932.44	42.84	86.1	49.85	100	100	100
Agriculture		922.97	285.83	4963.20	57.16	13.90	50.15	categories total / continuously builtup total × 100		
Total		1614.49	2056.88	9895.64	100	100	100			

Source: Area is calculated from different satellite imageries (SOI Toposheet 53c/5 for 1974, Landsat satellite imagery for 1990 and Google earth based QuickBird satellite imagery for 2010).

built-up area of the town experiences 8 time increase from 515.45 acres in 1974 to 4344.16 acres in 2010 (Table -1). During the study period, town has not only expanded from its original size but there was a significant conversion of area among different land-use categories. Figure-4 shows, the changes in various land-use categories as well physical expansion and direction. Table-2 shows that, town has a significant change in land-use during the period 1974-1990 and 1990-2010.

Table-2 shows, categories wise percentage of land-uses change within municipal boundary for 1974, 1990 and 2010. Similarly Figure-5 shows, land-use change from 1974 to 2010 within municipal limits of Kaithal town. Figure-6 reflects that in all land-use categories there is continuous increasing trend, whereas a sharp decline of agriculture land during 1990 and during 2010 again massive increase of agriculture area, due to extension of old municipal boundary limits.

Table-2 also represents the continuously growth of Kaithal town beyond the municipal limits. The dominant land-use is residential which is continuously increasing due to migration and population growth, whereas, industrial and recreational land-use have shown a marginal increase during the study period. During 1990-2010, significant impacts have also been observed on natural water bodies and vacant land as area under water bodies reduce from 7 % to 2 %. This was mainly because of the unauthorized encroachment over the natural water bodies towards north-west side of the town.

Table-3 and Figure-6 show, categories wise change of built-up under different land-uses from 1974 to 2010. The dominant land-use is residential which is increasing continuously as a result other land-use have also change considerably.

Fig. 4: Kaithal Town: Land-use changes from 1974-2010 within Municipal Boundary.

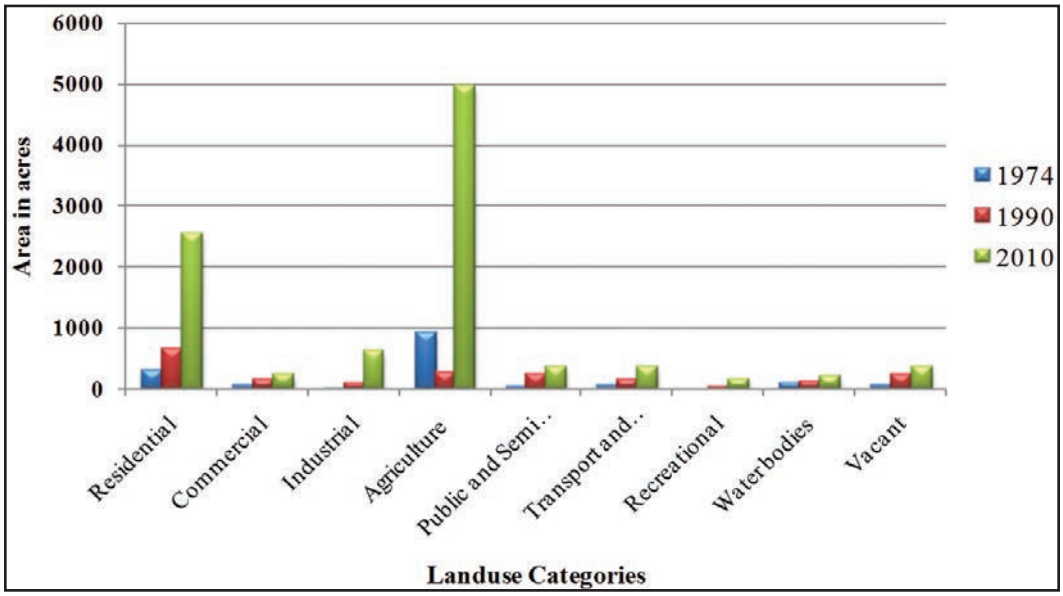


Table 3: Category wise change of Built-up area under different land-uses from 1974 to 2010 within Municipal Boundary.

Laud use/cover Categories		Total Area (acre)			1974-1990			1990-2010		
		1974	1990	2010	Area (acre)	Percent Change	Percent Change Continuously Built-up Total	Area (acre)	Percent Change	Percent Change Continuously Built-up Total
Residential	Built-up	312.76	675.31	2561.56	362.55	89.87	34.84	1886.2	24.06	59.67
Commercial		69.23	161.74	237.06	92.51	22.93	8.89	75.32	0.96	2.38
Industrial		21.26	104.43	630.23	83.17	20.62	7.99	525.80	6.71	16.63
Public and semi pubic use		53.66	264.49	375.23	210.83	52.26	20.27	110.74	1.41	3.50
Transport and communication		58.54	159.67	377.22	101.13	25.07	9.72	217.55	2.78	6.89
Recreational		NA	38.99	162.86	NA	NA	NA	123.87	1.58	3.91
Sub-total (Built-up)		515.45	1404.63	4344.16	850.19	210.75	81.71	2939.5	37.5	92.98
Water bodies	Non Built-up	111.49	120.59	208.19	9.1	2.25	0.87	87.60	1.12	2.77
Vacant		64.58	245.83	380.09	181.25	44.93	17.42	134.26	1.71	4.25
Sub-total (continuously built-up)		691.52	1771.05	4932.44	1040.5	257.93	100	3161.3	40.33	100
Agriculture		922.97	285.83	4963.20	-637.1	-157.93	$\frac{\text{categories total}}{\text{continuously builtup total}} \times 100$	4677.3	59.67	$\frac{\text{categories total}}{\text{continuously builtup total}} \times 100$
	Total	1614.4	2056.8	9895.6	403.3	100		7838.6	100	

Source: Area is calculated from different satellite imageries (SOI Toposheet 53c/5, 1974; Landsat satellite imagery, 1990; and Google earth based Quick bird satellite imagery, 2010).

Fig. 5: Categories wise change of built-up area under different land-uses from 1974 to 2010.

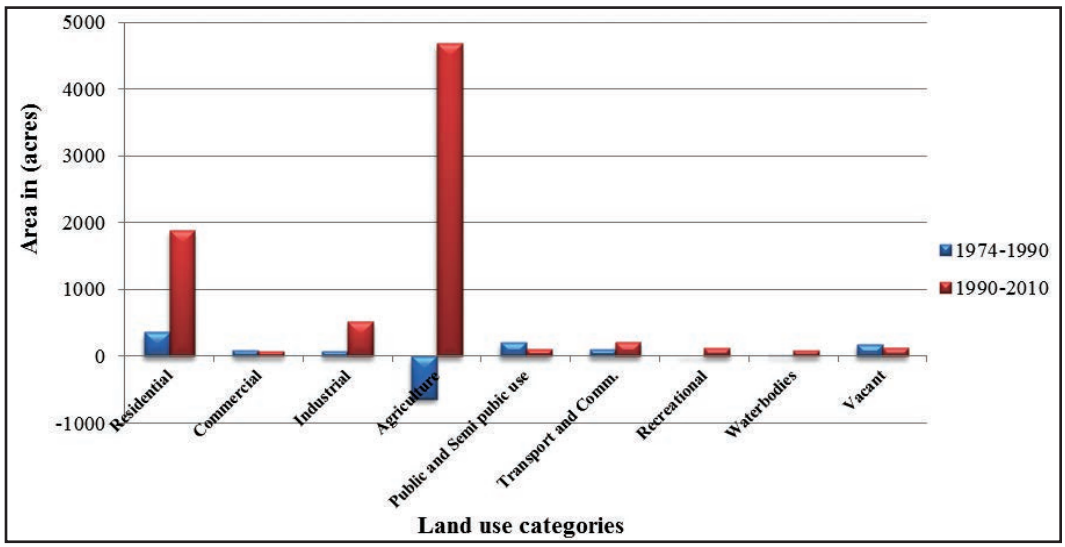
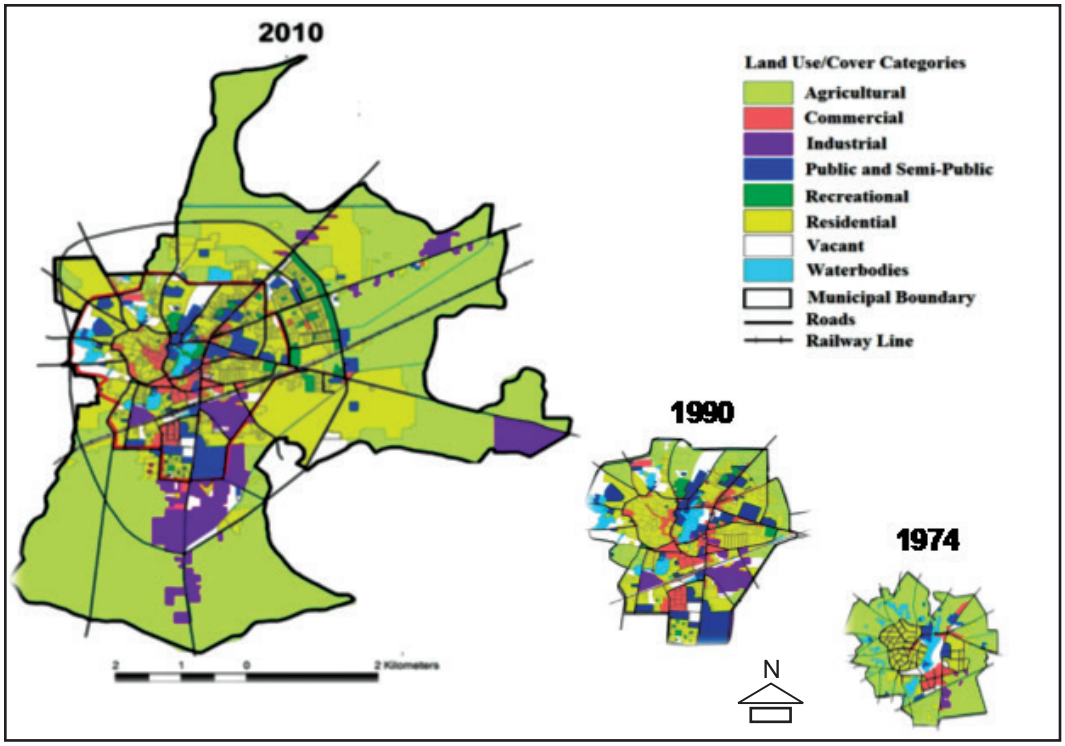


Fig. 6: Kaithal Town: Land-use/Land Cover Map of 1974, 1990 and 2010.



Source: SOI Toposheet 53c/5, 1974; Landsat satellite imagery, 1990; and Google earth based QuickBird satellite imagery, 2010.

Industrial land-use change during the period of 1990-2010, which is almost double as compared to 1974-1990, whereas, vacant land experienced sharp decline.

4.1 Land-use Change (1974-1990)

There was not significant land-use conversion during this period because of slow growth of urbanization. Residential land-use experienced highest growth, whereas agricultural land-use displayed negative growth, because agricultural land was put to other use due to rapid urbanization. New colonies such as Model Town, Ashoka Garden, Amar Garh Colony and Ram Nagar were added during this period.

4.2 Land-use Change (1990-2010)

The highest area increase during this period is of agricultural land-use (59.67 percent). This is because municipal boundary has extended during this period and incorporated large area of surrounding agricultural land of *Arjunnagar, Patti Afghan, Friends Colony, Bye pass and most of the areas covered towards* Ambala, Kurukshetra and Karnal Roads. Agricultural land-use is mainly extended in outer periphery areas, which cover ward no. 4, 15, 17, 18, 23 and 26. The residential land-use has the second largest area. During this period, Kaithal became

headquarter of the district and many residential colonies were established. Sugar mill which is one of the biggest industry was established in 1991. Apart from that many rice sellers and other industries, such as, spare parts, shop factories, etc.; were established during this period which gave boost to the development of small and medium scale industrial units. Commercial area had a remarkable increase along the major roads and axial routes and some of the area within old walled city. After becoming District Headquarter, many government and public sector units such as Haryana Urban Development Authority (HUDA), new bus stand, mini secretariat; etc.; were established which has increased the area under public and semi-public land-use. Recreational zone is related to entertainment and many parks (*Children Park, Town Park,* etc.), tourist place (*Koyel complex*), religious center and other facility were established during this period.

4.3 Urban Built-up Growth Pattern and Direction

Figure 6 reveals that town has grown organically more or less in radial shape up to 1990. This process has gained momentum after 1990 when Kaithal town was up-graded administratively as a District Headquarter. The agricultural land has experienced rapid transformation and mainly towards Karnal and Ambala Road. The linear growth is also noticed along the major road mainly towards north-east, east and south-east directions. Maximum development and expansion has been observed under residential uses both in the form of planned as well as un-planned development. By considering Proposed Development Plan-2021 and existing physical growth pattern, it is expected that the future growth and direction of the town will be mainly governed by the existing transport corridors. The following potential factors are analyzed to understand the future direction of growth and pattern of development. The associated problems and prospects are also analyzed.

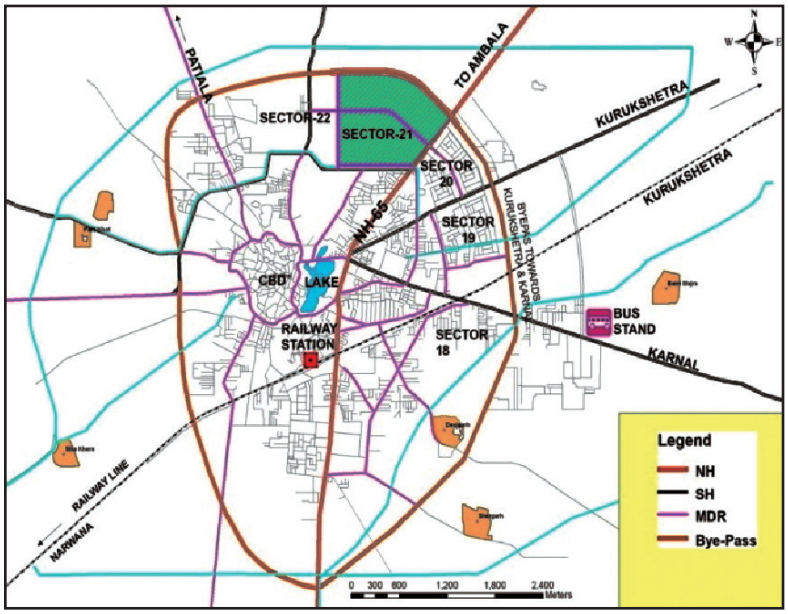
Residential Sector: Although, the decadal population growth is reduce to 24 % during 2001-2011 from 65 % during 1991-2001, residential areas recorded significant increase due to continuous increase in population. The total area under residential land-use approximately increased from 312.76 acre in 1974 to 2561.56 acres in 2010. Built-up area has expanded in all directions but more towards the north-east direction on the Karnal- Ambala Road. The urban expansion towards south-west is very limited. The town is experiencing increasing rate of built-up in both planned and unplanned development.

Unplanned Residential Colonies: The private developers are providing houses for high or middle income group, while the low income does not have option of buying houses according to their affordability. As a result, lots of informal settlements pockets, (such as, *Janak Puri Colony, Maya Puri Colony, Bhagat Singh Colony* and *Roop Nagar*) have developed on the periphery of the town along the

major Karnal-Ambala Roads in leapfrogging manner. This will create difficulties for providing infrastructure facilities to the town dwellers.

Planned Housing Sectors: In the recent time, Kaithal town has experienced high rate of growth and transformed most of agricultural land into planned residential estates. In the north-east part of the town some of the examples are sector-18, sector-19, sector-20, sector-21 and sector-22 developed by Haryana Urban Development Authority (HUDA). Modern township is also developed by private builders like Sun City and Best City with all infrastructure, facilities and services. These will continue to attract city citizens residing in dilapidated condition within old walled town (Figure 7 and 8).

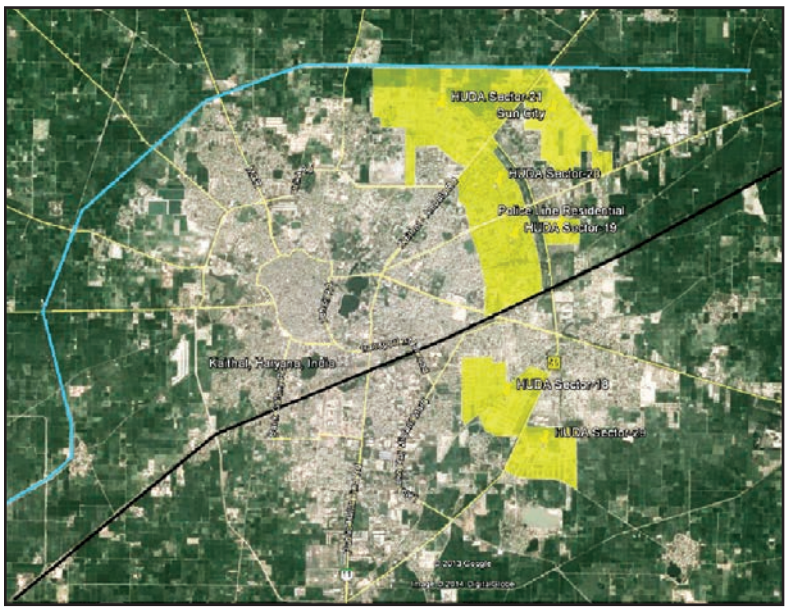
Fig. 7: Kaithal City: Location Map of Planned Housing Sectors



Source: Google Earth imagery, 2010.

Commercial Sector: Commercial areas have increased from 69.23 acres in 1974 to 237.06 acres in 2010 in the central part of the city, along the main roads, C.B.D and within the old walled town areas. Commercial sector are developed capturing land from unplanned residential area, old buildings and vacant land. Some special market, such as, *Shastri Market* (Cloth), *Talai Bazar* (Wholesale), *Sabjimandi* (Fruit and vegetable), *Grain Market* (Anajmandi), *Sadar Bazaar, Sharafa Bazaar* (Gold and jewelers) etc. *Sadar Bazaar, Old Sabjimandi, Chatravas Road, Tractor and Truck Market, Nota Chowk* are some of the example of wholesale markets, which developed near Railway Station and this is the main areas

Fig. 8: Planned Development (Yellow Highlighted)



which make the Central Business District (C.B.D) of Kaithal town. These areas also experience high land value which force to transform residential area into commercial areas.

Industrial Sector: As far as industrial area is concerned, Kaithal also experience increase in area from 21.26 acres in 1974 to 630.23 acres in 2010. Industries have come up in a haphazard manner around the city and mainly on Kaithal-Jind Road connecting NH-65 (Hissar to Chandigarh). Availability of transport, communication and raw materials provide an economical location to develop the industries on Kaithal-Jind Road. A cooperative sugar mill was established in April, 1991 on Kaithal-Karnal Road. There are many agro-based and allied industries like rice sellers, oil mills, flour mills, bakeries, sugar mill, and leather factories. Engineering and Chemicals Industries are also located in Kaithal city.

Public and Semi Public Facilities and Accessibility: The public and semi-public area of Kaithal city had recorded a massive increase from 53.66 acres in 1974 to 375.23 acres in 2010. North, north-east, east and south-east part of the town are comparatively free from problems like water logging and flooding, and highly accessible to all major facilities and locations, such as, main bus stand, colleges, secretariat, and government hospital, etc., by wide roads, which encourage location and expansion of Public and Semi-public areas. Municipal committee is located nearby the central business district (C.B.D) and it is one of the main administrative units of the town.

5. CONCLUSIONS

Urban built-up areas in the Kaithal town had a eight time noticeable increase from 515.45 acres in 1974 to 4344.16 acres in 2010 (Table-1), inspite of experiencing low population growth rate, comparatively from the past decade. This is because of the following reasons:

HUDA sector (sector 18, 21 and 22) or private housing sector (Sun City and Best City) are authorized in recent years and it's not developed properly. Most of area / plots are vacant but total area is also included in category of residential (Fig. 6 and 7 shows the location of HUDA and private sector).

Core area (C.B.D) is continuously getting converted to commercial use, so people who lives in this area are economically strong, their desire and dilapidated condition of old walled town also attract new construction on large scale.

Although, built up area has expanded in all directions it is more pronounced in the north-eastern part of the town, towards Karnal- Ambala Road. This is mainly because of low risk of water logging and flooding problems. The urban expansion towards north-west has been limited as have less accessibility and prone to high

flood risk. The old city area significantly being converted from residential to commercial or mix land-uses. In the present study, remote sensing satellite data and GIS overlay techniques have been recognized as a tool to analyzed spatio-temporal land-use changes during 1974-2010. Which demonstrate that the land-use maps can potentially assist decision-makers to guide strategic implementation of sustainable land-use planning and regularization.

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