



## Urban Sprawl and other Spatial Planning Issues in Shimla, Himachal Pradesh

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### Abstract

*The paper seeks to identify spatial planning issues and analyze the urban sprawl through the use of spatial data from secondary and free sources information. It has emerged that natural resources of the city have shown gradual decline in forest cover and limited agricultural areas. It also discusses the planning constraints and dearth of spatial data, which are inhibiting research and planning activities of this city. It also takes a look at the green area to assess how much green is green area of Shimla besides analyzing other spatial issues of the town? But first of all, it critically examines the prevalent planning process of the city.*

### 1. INTRODUCTION

Better spatial planning is accomplished through the use of latest, accurate and high resolution timely data, which helps planning fraternity to plan for the better future. Himachal Pradesh is one of the few states, which has its own Town and Country Planning Act enabling the Town and Country Planning Department to plan the city for sustainable development. Himachal Pradesh, being a mountainous state, is fragile in nature therefore planning needs to be done with utmost care. Today all its towns are experiencing haphazard and ribbon development. This calls for rational and GIS based spatial planning and solutions to regulate haphazard growth. One of the main excuses today we come across is the lack of spatial data for better planning. Researchers studying urban development and environmental issues of Shimla have constantly been complaining the unavailability of requisite, standard and recent land use map and other spatial data of the city. Old land use map in circulation, which is redundant in view of the rapidly growing urban environment of Shimla, is of no use today.

The other common reason is lack of GIS software, technical expertise, GIS compatible data and costly GIS software so on and so forth. It is an established fact that more than 80 percent of our secondary source data of our daily life have geographic connotations and references. Today is the day of geo information whereby there is no dearth of spatial data or software. Satellite data is moving towards sub-meter resolution and accuracy and it has become the most important input to GIS based planning. Google Earth<sup>1</sup> and Microsoft Bing Map<sup>2</sup> have created enormous awareness and are revolutionizing the whole world. The GIS software such as ArcGIS 10 users has seamless access to Bing

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Maps. ArcGIS Desktop, ArcGIS Server, and ArcGIS Web Mapping users can directly connect to Bing Maps to enhance their GIS projects. Therefore, high resolution data have reached one's desktop. Willingness and desire to implement the GIS in a project is more important today. Hundreds of free GIS based data as well as open source GIS software are afloat on the internet. Low interval Survey of India contours and village references are no longer the most important requirement or possession today. The mapping policy of Survey of India has long been an irritant for free flow of spatial information, data, maps among researchers or planners particularly for states touching international boundaries. The 90 meters SRTM<sup>3</sup> elevation data and 30 meter ASTER<sup>4</sup> DEM are widely used by GIS professionals even in India to meet their elevation data requirements. It is needless to say why these three dimension data are so important for hill and mountainous state like Himachal Pradesh. With the availability of stereo capability of CARTOSAT-2 with resolution better than 1m in panchromatic band (0.5  $\mu\text{m}$  - 0.85  $\mu\text{m}$ ) with 9.6 Km swath from IRS sensors, researchers are in a position to generate their own DEM at a resolution of 2-5 meters, which are excellent in urban planning studies. In addition, DIGITAL GLOBE have also launched stereo capable World View<sup>5</sup> - 2 Satellite recently, which is capable of collecting along-track stereo-pairs with 8 multi-spectral bands capabilities and 1 panchromatic band with spatial resolution of 0.46 meter with high with radiometric resolution as well. In addition to conventional bands, few bands such as coastal, yellow, red-edge are very interesting additions, which shall be so useful for urban vegetation analysis particularly in the context of Shimla apart from generating DEM and high resolution land use and land cover maps. These bands have started giving some promising results so far as urban studies are concerned.

Today, development plans prepared for cities and towns of Himachal Pradesh seem to be inherently weak on modern technological inputs such as GIS and remote sensing. It presents a subjective picture of issues and problems such as increasing lots of dilapidated houses, rapid growth of the city or aggravating forest degradation or expansion on unsustainable slopes, etc. Exact and accurate delineation or estimation of the amount, magnitude, extent of damages and problems of the city and town would have been an ideal analysis. Town planning discipline is an art and science both. Development plan must present the accurate problems and estimates of the problems for better and accurate remedial measures. Development plan thus appears to be subjective, voluminous and its analysis is based on revenue records prepared long back thus fail to detect and assess present scenario. However, this is imperative in view of the acute shortage of professional town planners with the local town planning agency.

## 2. RECENT INITIATIVES

Initiatives made by the Ministry of Urban Development funded National Urban Information System (NUIS) Scheme in March 2006 is to develop GIS databases



for 152 towns and cities in the country in two scales i.e. 1:10,000 and 1:2,000. In addition, utility mapping at 1:1,000 scale are also being undertaken for 24 towns. Apart from spatial data, the scheme has another component i.e. National Urban Data Bank and Indicators (NUDBI). The spatial and attribute databases thus generated are said to be useful for preparation of master plans, town planning schemes and serve as decision support for e-governance. Work of spatial data is being undertaken by the Survey of India, Dehradun, and the National Mapping Agency. Fortunately Shimla is covered under this project and one hopes that base maps are available to the TCPD for planning purposes.

However, in spite of the initiative taken long back, one is yet to see any availability and utilization of such data for any application in urban planning. Moreover, by the time data shall appear lots of changes would have taken place defeating the very purpose of effective planning. This is long standing issue of master planning. By the time data are ready, things have changed dramatically. Difference between any foreign agency and Indian agency is that Indian planning agencies are not able to produce or generate data timely.

### **3. SHIMLA PLANNING AREA: ESTIMATING URBAN SPRAWL**

In order to ensure planned and regulated growth, Government of Himachal Pradesh or GoHP constituted Shimla Planning Area (SPA) through notification in November 1977. About 82 percent 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 Agglomeration (UA) were part of Municipal Corporation and later, notified under Special Area (SADA) having 13.83 percent population of the total population of Municipal Corporation. In August 2006, these Special Areas were again merged back into Municipal Corporation. Besides, 12 percent population of total SPA lives in Kufri and Shoghi Special Areas and 6 percent population lives in newly constituted Ghanahatti Special Area. Shimla Planning Area (SPA) comprise of Shimla Municipal Corporation (SMC), recently merged Special Areas of Dhalli, New Shimla, and Tutu, and Special Areas of Kufri, Shoghi and Ghanahatti.

There is also a Cantonment Board though managed by its own authority. In 1924 the Government in Council declared Jutogh as a Cantonment Board under Section 2, clause XV of the Cantonment Act, 1924. The Cantonment Board is spread over an area of 1.41 sq km. The Cantonment was originally built for and occupied by Gurkha Troops but after 1857 revolt a mountain battery was quartered and thereafter a detachment of the British Infantry was stationed. The Cantonment Board served a population of 1,396 in 1981 in civil area. Number of houses in the Board area is 109. Present population according to 1991 Census is 1,636. The Cantonment Board obtains its water supply in bulk from military station

and redistributes it in the Board area. The Cantonment Board provides basic amenities in the cantonment area.

Needless to say that Shimla has been playing multiple roles including administrative, educational, touristic centre, heritage city etc. for a long time. This has led to the formation of a primate city in the state and consequently it is growing exponentially.

Urban sprawl of the city has been estimated from the documents and maps procured from Municipal Corporation, Town and Country Planning Department and other free satellite data as discussed above (Fig. 1). Shimla has experienced massive growth during the last few years in the form of unplanned ribbon

Fig. 1: All round Urban Sprawl - in Formation

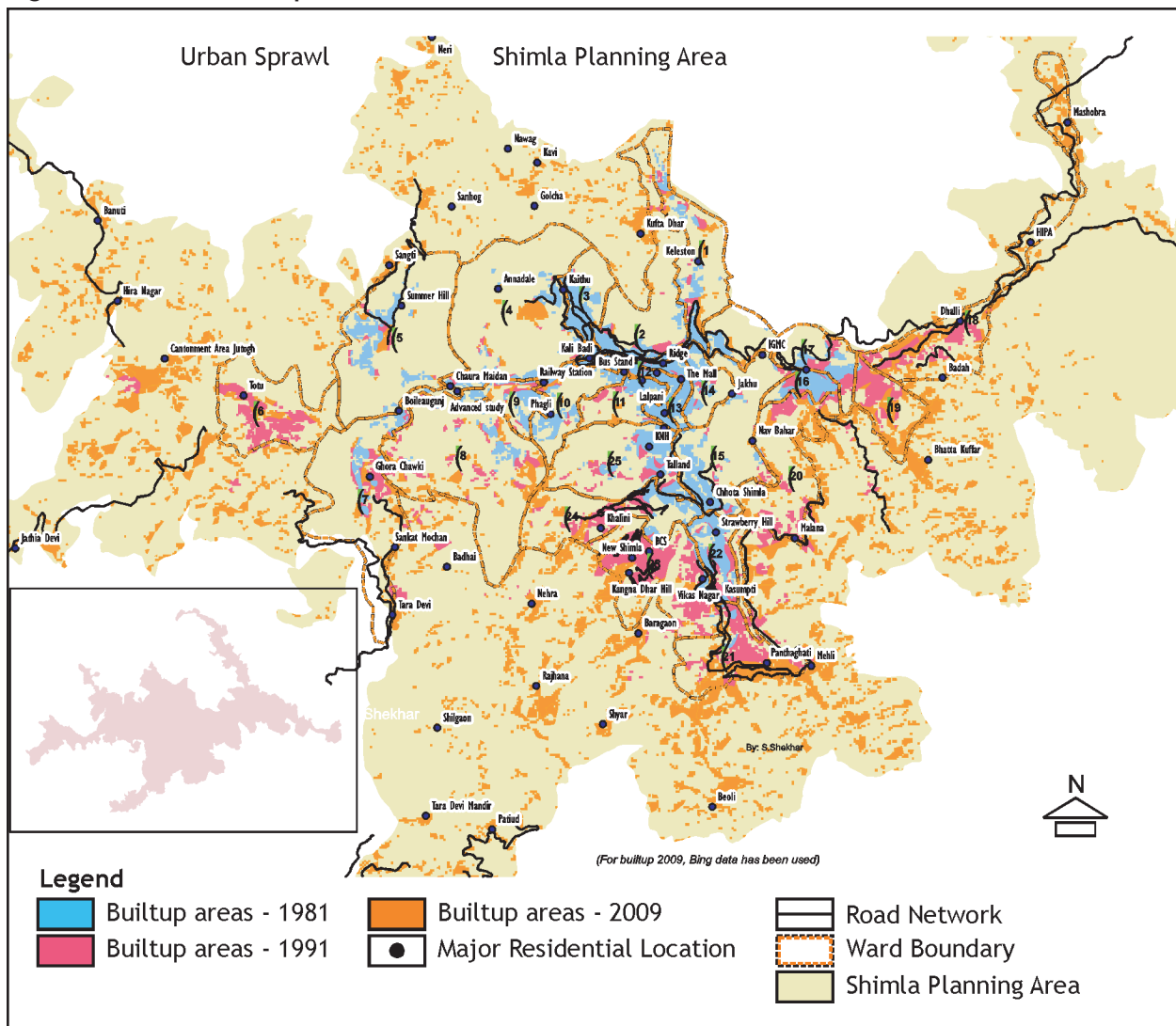
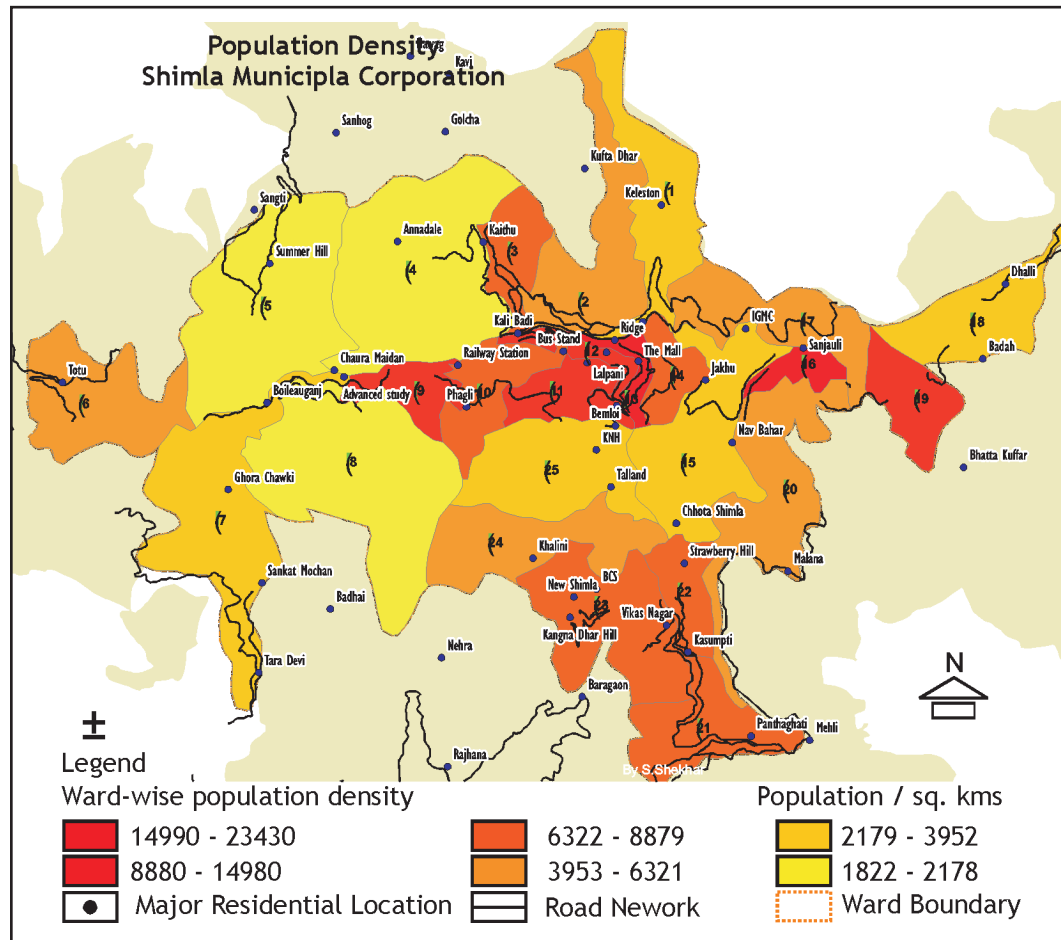




Fig. 2: Ward-wise Population Density



development along the highways and even minor roads emanating from the city. A vast city scape and sprawl is in the formation. Whereas, the already existing areas have got congested, the fringes are acquiring serious problems. Urban sprawl is observed almost in all directions. In addition to ribbon development along road networks, southern, eastern and western facing slopes have also been experiencing huge urban sprawl. Besides ribbon development, the city is growing on even unsustainable slopes and away from road networks. Many areas are inaccessible and even emergency services cannot reach them. Population densities of few areas have reached serious proportions (Fig. 2).

As per this study, built-up areas excluding transportation network has increased from about 11.08 percent to above 17 percent in Shimla Planning Area (SPA). In addition, the forest cover has declined from 61.12 percent to about 54 percent and so is the case with agricultural land, which has also shown decrease from 21.8 percent to about 18 percent. If satellite data from Cartosat and WV-2 data were available, it would have been accurately assessed.

#### 4. HOW MUCH GREEN IS GREEN BELT OF SHIMLA

Government of Himachal Pradesh has notified 17 green belts vide notification No. HIM/TP-RW-AZR/2000-III dated 11 February 2000, which included Tutikandi Forest bounded by Bye-pass and Cart road, Nabha Forest, Phagli-Lalpani Forest, Bemloe Forest, Himland Forest, Khalini, Chhota Shimla Forest, Chhota Shimla Forest above Cart road, Kasumpti Forest, Charlie Villa Forest, Forest between Himfed Petrol Pump and Secretariat, Jakhu Forest (3 portions), Bharari-Shankli-Ruldu Bhatta Forest, Summer Hill Forest and Area in between Boileauganj-Chaura Maidan known as Ellesium Hill. The green pockets are located either in the Core or in Restricted Areas, where there is already heavy stress and strain with respect to services, infrastructure and transportation. The stress is reflected in large proportion of its land under non-forest use.

As per Shimla Development Plan, the green belts in Shimla Planning Area is spread over 414 hectares out of which 78 percent area is either under forests or open area. Out of the remaining, 2 percent area, 13 percent is built up and 9 percent is under roads and paths. About 42 percent of the total green area is under forest cover and 36 percent is open area occupied by shrubs, bushes and grasslands. Out of this 150 hectare open area, 124 hectare is under state government ownership and just 26 hectare is in private ownership. However as

Fig. 3: Green Area of the city

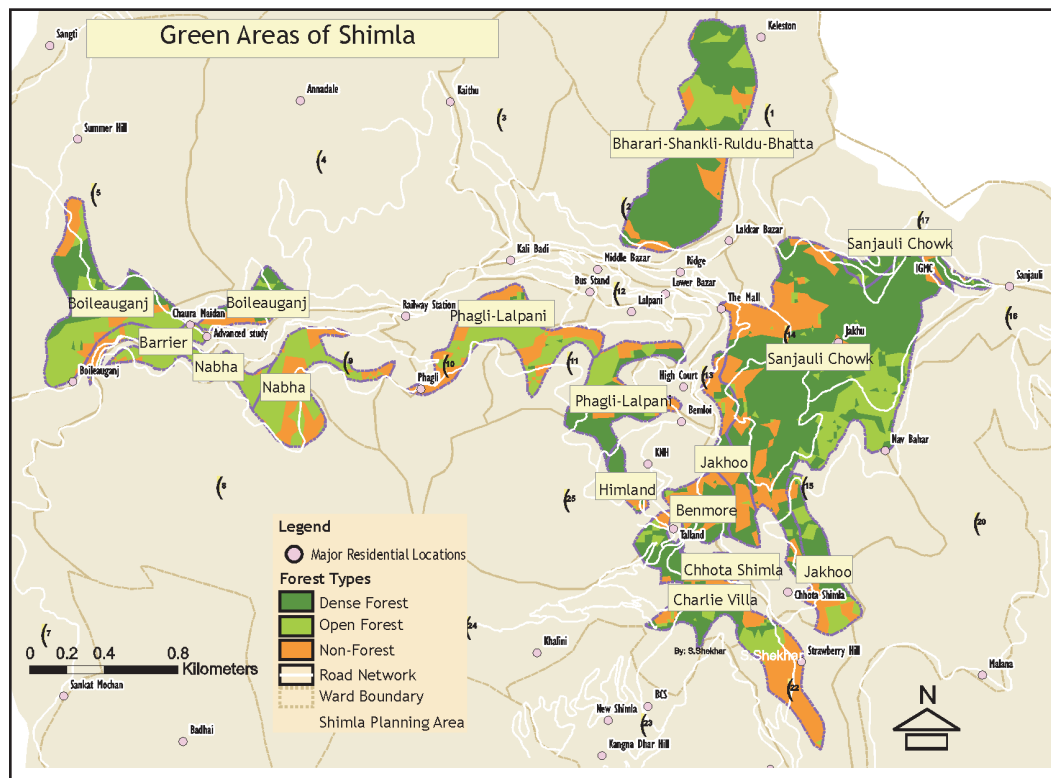
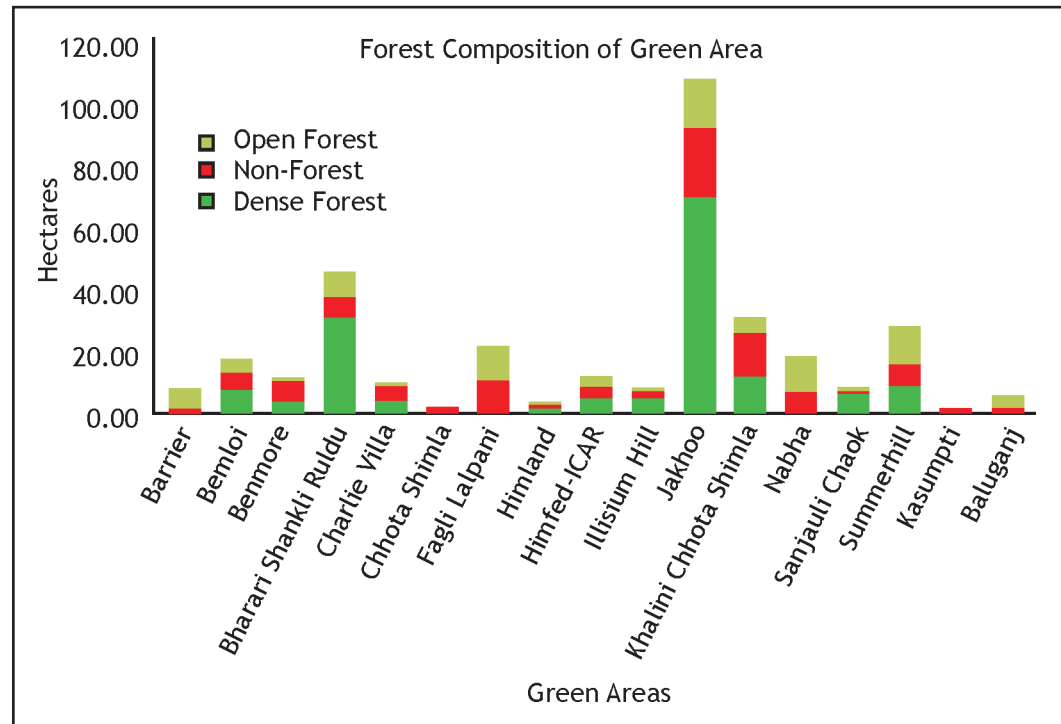




Fig. 4: All Types of Forests and Scrubs in Green Area



per this study, green cover along with open forest including all sorts of scrubs constitutes 71 percent of its area, which shows a decline from 78 percent. The non-forest land constitutes 29 percent of total geographical area (TGA) of SPA. Green area-wise dense forest and open forest status are as follows:

- Having analyzed through coarse satellite resolution of lower than 24 meters, results are coarse, broad and indicative only. It will be desirable to undertake the study at higher resolution of less than 2 meters in order to have accurate assessment. In addition, in view of the availability of satellite data in Red, NIR, Yellow bands, Red Edge bands (portion of EM spectrum), stresses on vegetation could also be easily assessed.
- Shimla is not only expanding horizontally, but it has recorded high density of population in various pockets, which is not causing undue stress on nearby vegetation but is detrimental in view of the high risk earthquake ZONE-IV and sinking zone. As against the recommended density of 450 persons per hectare in hill settlements, the town's localities have densities ranging from 2,500 to 3,500 persons per hectare for the same area.

Slope<sup>6</sup> violation is a regular occurrence in Shimla Planning Area. Construction on slopes higher than 45 degree has been observed in many areas. Therefore, risk analysis based on slope is important and a prerequisite for planning process in any

hilly and mountainous state. In addition of contour being the primary source of slope analysis, satellite data has emerged to be very important source of digital topographic database as also discussed above. In view of the fact that Shimla falls in seismic Zone-IV of earthquake, experts say that it will have cascading effect in terms of damage in case of any such occurrence. In such a scenario, no building is safe. Therefore, risk analysis of such a zone is of utmost importance, and slope analysis is crucial.

According to the Geological Survey of India, slope more than 250 is not conducive to urban use. However, as per the slope analysis of Shimla Planning Area based on 30 meter ASTER data, most of the land falls above 250. Constraint with this low resolution topographic data is that, it is not able to detect high slope area, consequently it was not possible to accurately detect and assess slopes above 450 with better accuracy. Nevertheless, buildings on high slopes are presented in Fig. 5.

**Table 1: Slope and Stability**

Slope	Stability
00-150	Most stable for urban use
150-300	May be utilized for urban development
300-450	Small sized construction where there are in sites rock exposure
450-600	Should not be normally used without exceptionally sound protective measures.
More than 600	Should not be used

Source: Geological Survey of India (1950).

**Fig. 5: Built-up Areas on High Slopes**

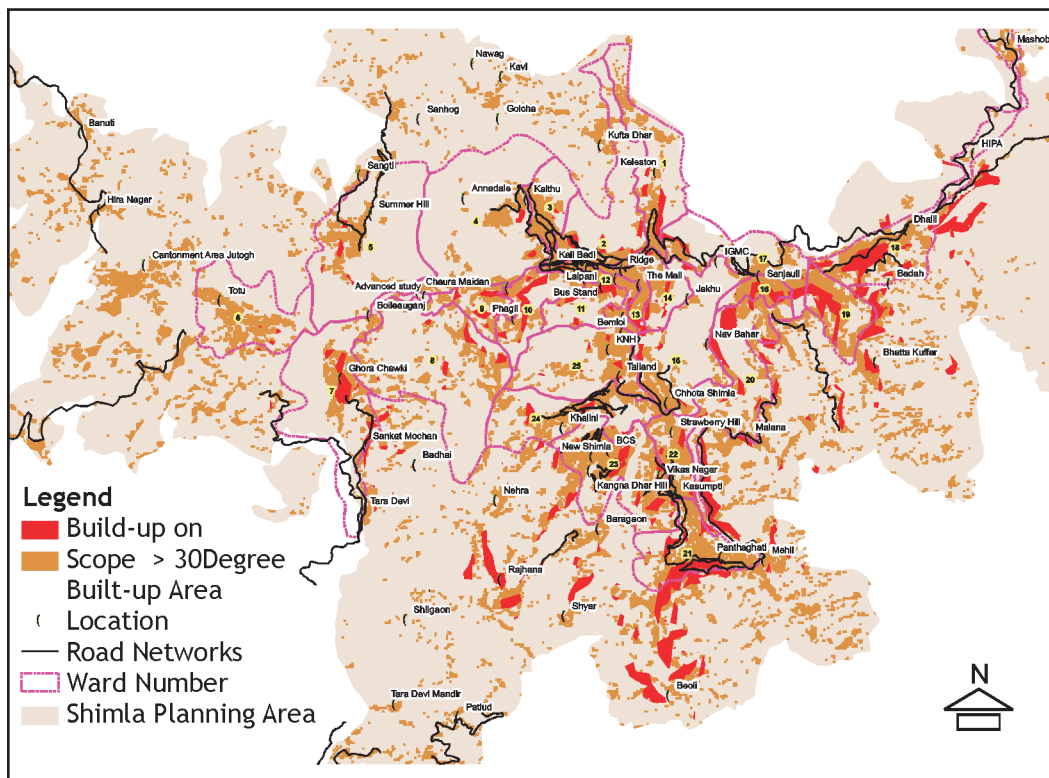
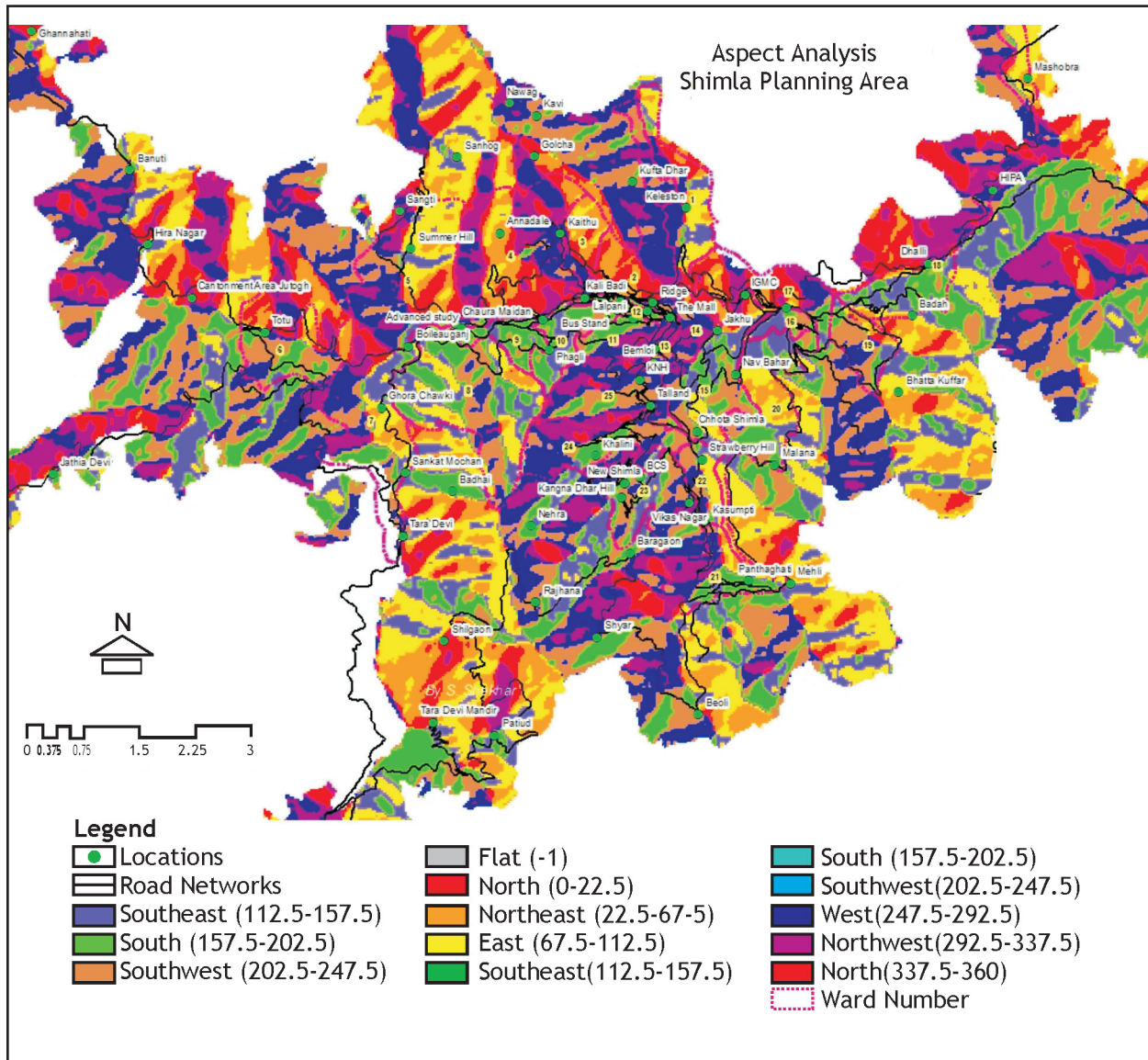




Fig. 6: Aspect Analysis<sup>7</sup> of Shimla Planning Area



Although Shimla Municipal Corporation has quite belatedly prohibited any construction on slopes steeper than 45 degrees, the damage has already been done. As per one estimate, some 90 percent of central Shimla is built on a 60 degrees slope, and is covered with buildings which are four to five storeys high. In the event of an earth tremor, devastation could be enormous with buildings on slopes steeper than 45 degrees collapsing like a house of cards. As per the sloping aspect analysis, most of the areas have southeast facing aspect with 17.4 percent of total area, followed by south 14 percent, northeast 14.3 percent. Southeast and north facing aspects have lower percentage of aspects in Shimla Planning Area. Aspect map is presented in Fig. 7.

Natural setting of Shimla has already been disturbed a lot due to felling of trees even by foul means to give way for construction. Accurate estimates of damages are needed to be properly investigated through vegetation index based analysis.

Sinking problem of Shimla has again come to the fore, when some portion of the Ridge Maidan recently witnessed sinking. Geologically weak areas, identified as highly sinking areas, which include the northern slope of the Ridge extending upto Grand Hotel in the west, covering Lakkar Bazaar, Central School upto Auckland Nursery School, Dhobi Ghat

below Idgah electric sub-station and sliding areas including Ladakhi Mohalla, the spur below the office of the Director of Education and surrounding areas of Clark's Hotel are also integral parts of green areas. Any further addition of load is likely to be hazardous in these areas. Moreover, Shimla also falls in Seismic Zone-IV, which is also susceptible to earthquakes.

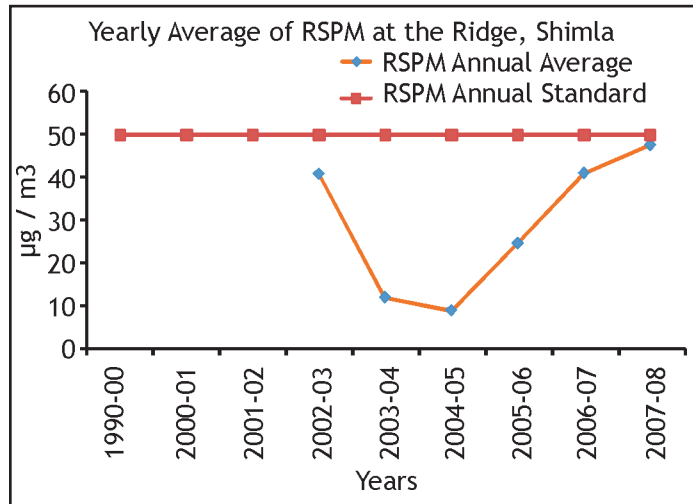
Shimla city and its surrounding areas have a complicated physiography due to tectonic events, folding, faulting and thrusting processes, and resulting inversion of topography and formation of irregular landforms. On account of predominance of dolomite and limestone rocks, landslides are common. As rocks are unstable, dislocation of buildings is quite likely and can occur after any heavy spell of rainfall. Being located in seismic zone, it is susceptible to earthquakes.

## 5. ENVIRONMENTAL POLLUTION

Although environmental pollution such as air, water, noise and land pollution have not assumed serious proportions in the city of Shimla unlike some other towns in plain areas of north India. Nevertheless, Shimla has shown increasing trends with respect to some important pollution parameters.

**Air Pollution:** Air pollutants have shown increasing trend in Shimla. H.P. State Pollution Control Board monitors some of the important air quality parameters regularly at two places<sup>8</sup> one at the Ridge and another at Bus Stand Shimla. There is a certain increase in the level of RSPM at both the locations. Even the Ridge Maidan falling in sensitive zone category has registered increase and close to the permissible limit. Vehicular pollution is the prime cause of increasing air

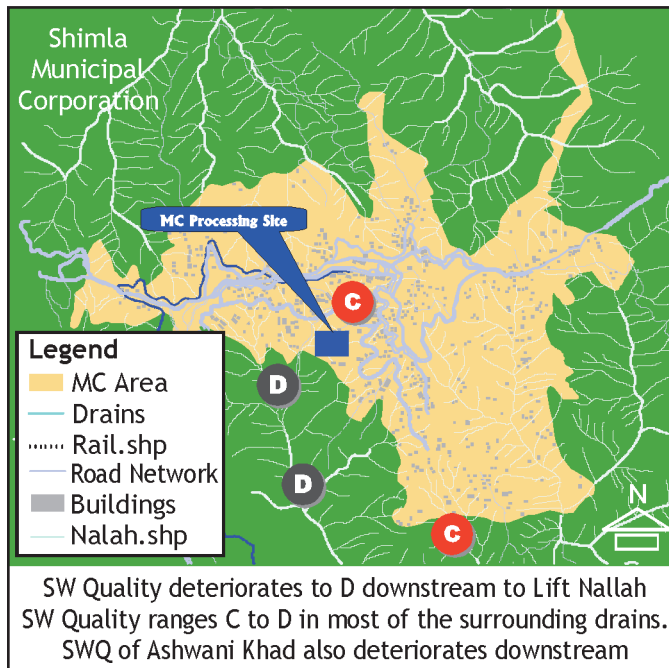
**Fig. 7: Air quality (Respirable Suspended Particulate Matter) at Ridge Maidan, Shimla**



Courtesy: HPSPCB Shimla



**Fig. 8: Downstream Water Quality**



Courtesy: HPSPCB Shimla

pollution particularly along road networks and bus-stands.

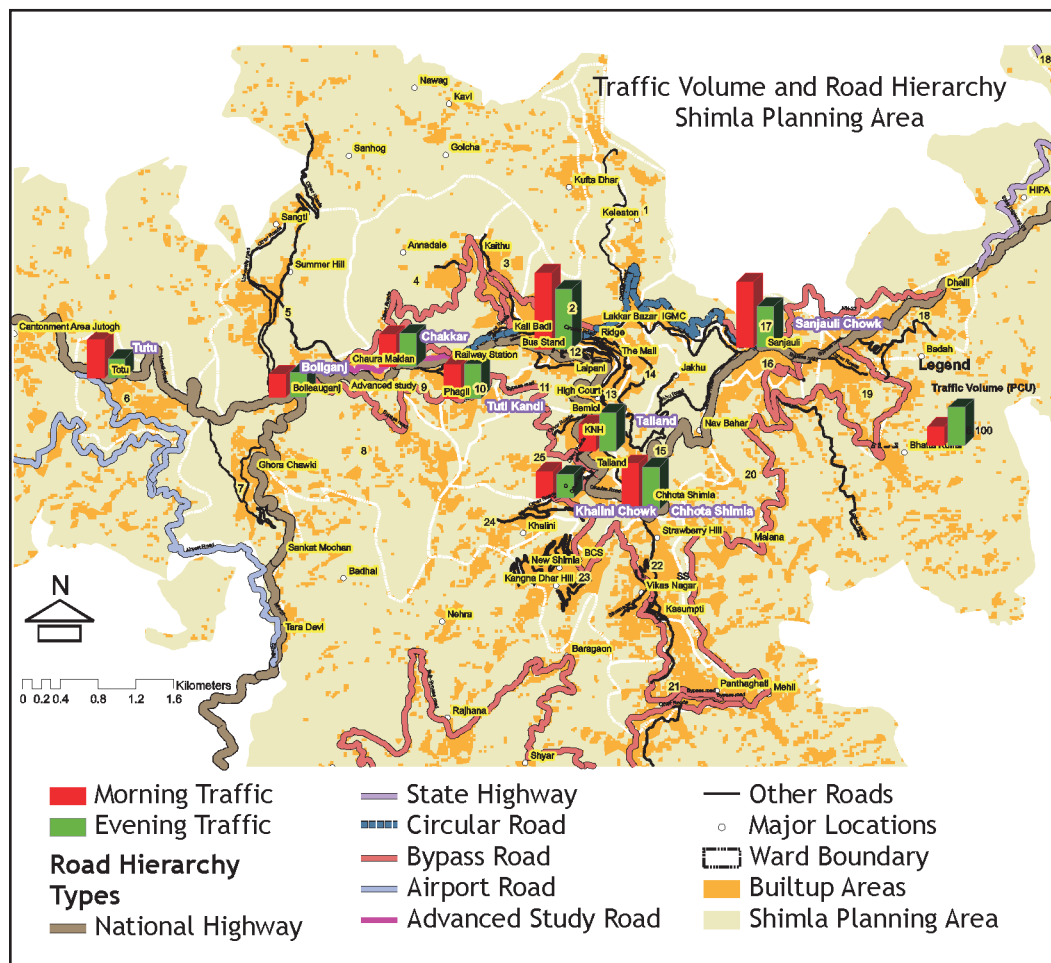
**Water Pollution:** Water pollution is also one of the key concerns of Shimla Planning Area. This assumes critical importance in view of the limited water resources available for drinking water and other consumption of the city. As drinking water problem of the city is well acknowledged by all sections of the city dwellers, improper use of water and further pollution of this scarce resource are evident from the data analyzed by the Board. As on date a large number of hoteliers are discharging waste water openly into various khads and nallahs along with domestic discharges. As sewage concentration in waste water is very high in surrounding khads of Shimla and there is not enough water for effective dilution and purification (self-corrective measures

of the running water) in the khads. One of the important parameters of surface water quality viz. Total Coliforms (TCs) are observed to be on the rise for quite some time reflecting higher concentration of sewage and untreated disposal of wastewater. The State Board monitors surface water quality about 4-5 khads and nallahs in and around Shimla. The quality of these khads has deteriorated because of untreated disposal of waste water, which is shown on Fig. 8.

Traffic volume on the Shimla roads are observed to be very high and the city is getting congested day by day on account of burgeoning private vehicles, rampant encroachments and lack of any other alternative mode of transportation. Traffic speed at many points of the city gets seriously compromised. Traffic jams have become a regular feature on most of the networks such as Cart Road or other corporation roads in Shimla.

Cart Road or Circular Road is the main arterial road of Shimla and the only road open for city traffic movement without much restriction. Cart Road also known as Circular Road or Motor Round Road is part of NH 22 starting from Railway Tunnel No. 103 to Dhalli Tunnel and traversing around the Shimla Hill. Even today, the width of Cart Road at few locations is restricted to only 5m owing to non-availability of land. On average road width is about 8 m. The length of Cart Road is 18 km, delimiting Core Area. Cart Road is the only option for traffic movement, and is functioning beyond its capacity as per IRC specifications (Refer

Fig. 9: Traffic Volumes More than Design Capacity



Data courtesy: TCPD Shimla

Fig. 9). Other important roads of Shimla share more or less similar features. All roads connecting to Cart Road are municipal roads that are maintained by Shimla Municipal Corporation. Total length of roads for vehicle movement under the Municipal Corporation as per data available with the SMC is 74.6 km.

The Mall is the central market place in the core area and houses a number of heritage sites and buildings. The major tourist attraction of Shimla is the Mall. Roads from Boileauganj to Scandal Point and from Scandal Point to Secretariat and from Scandal Point to Sanjauli Chowk form the Mall road. The road along the Mall is basically for pedestrian movement and entry is restricted for vehicles except for vehicles with permits and emergency vehicles.

The capacity of two lane road is 750 PCU per hour as per IRC:86 code of 1983 for urban roads between intersections on road with free frontage access, parked vehicle and heavy cross traffic. From the above figure, it is evident that Cart



Road is servicing more than of four times its capacity. Actual traffic volume is 3,018 PCU at ISBT, 1,422 PCUs at Lakkar Bazar, 1,619 PCU at Secretariat, 1,318 PCU at Talland, which are much higher the design capacity of roads in Shimla.

## 6. CONCLUSIONS

Congested built up areas, traffic hazards, over concentration of the central part of the city, unauthorized constructions, land degradation, mixed land use, growing vehicular pollution are the common problems of Shimla and these are getting aggravated with each passing day. However, the most important issue appears to be lack of proper planning, negligible use of modern tools and techniques and most of all the lack of planning professionals. Planning Department is at the crossroad and stagnant. The Department has everything such as adequate legislative support, head office with field networks, increasing responsibilities and mandate, growing manpower except town planners (barring few, who are at retiring age). Planners in Shimla appear to have taken the back seat. Data analyzed through free data sources are estimates only, which may change with accurate assessments.

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## FOOTNOTES

1 Google Earth is a virtual globe, map and geographic information program that shows the earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS over a 3D globe.

2 Bing Maps™ is an online mapping service that enables users to search, discover, explore, plan, and share information about specific locations. It has road maps, labeled aerial photo views, low-angle high-resolution aerial photos, and proximity searching capabilities.

3 Shuttle Radar Topography Mission (SRTM) digital elevation data on a near-global scale is the extensively used complete high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during an 11-day mission in February of 2000.

4 ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) is a Japanese sensor which is one of five remote sensing devices on board the Terra satellite launched into Earth orbit by NASA in 1999. The instrument has been collecting surficial data since February 2000. Its resolution is 30 meter.

5 The World View-2 sensor provides a high resolution Panchromatic band and eight (8) Multi-spectral bands; four (4) standard colors (red, green, blue, and near-infrared 1) and four (4)



new bands (coastal, yellow, red edge, and near-infrared 2), full-color images for enhanced spectral analysis, mapping and monitoring applications, land-use planning, disaster relief, exploration, defense and intelligence, and visualization and simulation environments.

6 Slope identifies the steepest downhill slope for a location on a surface. Slope is calculated for each triangle in TINs and for each cell in rasters. For a TIN this is the maximum rate of change in elevation across each triangle. For rasters it is the maximum rate of change in elevation over each cell and its eight neighbors.

7 Aspect is the direction that a slope faces. It identifies the steepest down slope direction at a location on a surface. It can be thought of as slope direction or the compass direction a hill faces. Aspect is calculated for each triangle in TINs and for each cell in rasters. Aspect is measured counterclockwise in degrees from 0—due north—to 360—again due north, coming full circle. The value of each cell in an aspect grid indicates the direction in which the cell's slope faces.

8 The State Pollution Control Board monitors the air quality of Shimla at two locations. Station No. 1 is located at Takka Bench which falls under Sensitive Area Zone 'S' for which air quality standards fixed are 100  $\mu\text{g}/\text{m}^3$  [1  $\mu\text{g}$  (micro-gram) = .001 mg (milli gram)] for Suspended Particulate Matter (SPM) and 30  $\mu\text{g}/\text{m}^3$  for Sulphur and Nitrogen Oxides (SO<sub>2</sub> and NO<sub>x</sub>). The monitoring is being done on every Monday, Wednesday and Friday in a week. Station No. 2 is located on the top of the main building of Bus Stand. It falls under Residential (Commercial) Area Zone 'R' for which standards are 200  $\mu\text{g}/\text{m}^3$  for SPM and RSPM, 80  $\mu\text{g}/\text{m}^3$  for NO<sub>x</sub> and SO<sub>2</sub> respectively. The monitoring is being done on every Tuesday, Thursday and Saturday in a week.

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