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### Application of GIS and Remote Sensing for Developing Block GIS : A Case Study of Hawalbagh the Developing Block, District Almora, Uttarakhand

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#### Abstract

Decentralized planning is carried out from the bottom in which village panchayat is asked to prepare a plan for the economic development of the village. The planning strategy will be made on the basis of the problems the area is suffering from and the available local resources. The present work attempts to create a GIS database for Hawalbagh Development Block of the districts of Almora in Uttarakhand. It extends between 29° 32' 30"N to 29° 44' 23"N latitude and 79° 31' 11"E to 79° 43' 50" E longitudes and cover an area of 267.89 sq.km. Located in the lesser Himalayan terrain. Hawalbagh Blocks enjoys cool temperature climatic conditions. According to 2001 census, the block has a population of 59,227 persons in which male population 48.61% and female has a population of 51.39%. The present study is based on various data sets i.e. toposheet (1966), Landsat data (1990 & 1999) and IRS LISS III data (2004) obtained from Centre of Excellence For NRDMS in Uttarakhand Kumaun University SSJ Campus Almora. The entire digital database of the Hawalbagh development block was prepared with the help of ARC GIS Software which is user friendly and famous software developed by Environmental system research in corporate Redland California. Image classification through ERDAS (earth Resource data Analysis) software developed by Leica Geosystems geospatial Imaging, LLC 5051 Peachtree corners suite 100, Norcross, GA, 30092, U.S.A. In the year 2004 forest cover of total area was 45.47 percent, barren land 39.72 per cent, agriculture land 12.32 per cent and urban area 2.49 per cent. The Hawalbagh development block is divisible in four absolute relief zones varying between 1000-2200m, and in four categories of relief i.e., Low, Medium, High and Very high. Table 2 contains the distribution of area under different relief zones. Maximum area lies in the medium relief zone which includes 44.51 per cent of the total study area.

**Key Words:** 1. GIS, 2. Remote Sensing and 3. Decentralize Planning.

#### Introduction

Geo-spatial data plays a crucial role in the development of the economy and promotion of industrialization at national and local level. Geospatial data is created through the Geographic Information Technology. Geographic Information Technology has been developed at a remarkable pace over the past two decades and will play a key role in development of nations in the 21st Century. Many

countries have already prepared their strategic development plans for application of GIS technology with gigantic financing endeavours. Now time has come for all decision makers to discuss the appropriateness of GIS technology and its applications to rural development, forest management, urban development planning, land information systems and agricultural development. This will also provide a suitable solution for the use of GIS for educational infrastructure development with special emphasis on rural sector in India.

The 73<sup>rd</sup> Amendment Act, 1992 envisages the Gram Sabha as the foundation of the Panchayat Raj System to perform functions and powers entrusted to it by the State Legislatures. Gram Sabha means a body consisting of persons registered in the electoral rolls comprised within the area of Panchayat at the village level. Drafting and implementation of development plans for the uplift of the villages would be vetted and monitored by the Gram Sabhas. Village is thus an atomized part of the national level micro-space, and hence village planning is required to be carried out scientifically so as to generate development from grassroots.

### Objective

The fundamental objective of the present work is to develop Block GIS which includes the study of the following:

1. To prepare Land use Land cover map.
2. To prepare Terrain mapping and analysis.
3. To prepare socio-Economic Infrastructure map (i.e. Education Centre, Health Centre, Roads).

### Study Area

The study area of the present work is the Hawalbagh development block is one of the eleven blocks of District Almora of the Uttarakhand state. Almora town is situated in this block. It lies between  $29^{\circ} 32' 30''$  to  $29^{\circ} 44' 23''$  N Latitudes and  $79^{\circ} 31' 11''$  to  $79^{\circ} 43' 50''$  E Longitudes (Fig.1). Encompassing an area of 267.98 km<sup>2</sup>, it lies in the Lesser Himalayan terrain. Hawalbagh block enjoys the cool temperate climatic conditions. The Hawalbagh block consists of 10 nayaypanchyats, 124 grampanchyats and 234 villages. Many sub-urban areas and services centers (, Majkhali, Hawalbagh, Kosi, chanoda, Kathpuria, Sitalakhet, etc) and the Almora Town itself lie in the Blocks. According to 2001 Census, the block has a population of 59,227 persons in which male population is 28,793 and female has a population of 30,434. Out of the total male population 18,687 are literate and the female literates are 10,649. Children those who are less than 6 year are 11,063.

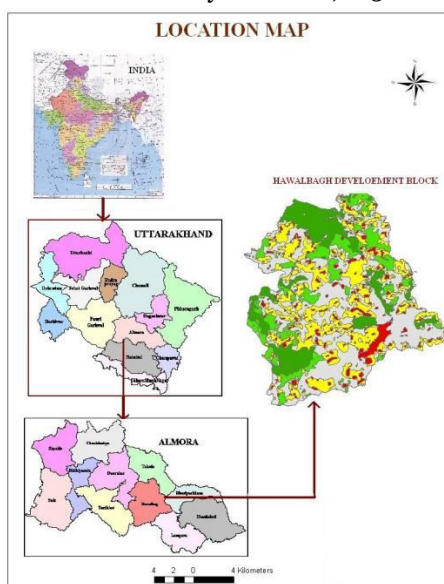


Fig.1: The location map of the Hawalbagh development block, district Almora.

**Methodology**

For the present study toposheet of year 1966 the Hawalbagh development block of district Almora was used, Landsat satellite images for the study area were acquired the years 1990 and 1999. Both the data are obtained from Global Land Cover Facility (GLCF). LISS III satellite image of the study was used for the year 2004, obtained from Centre of Excellence for NRDMS in Uttarakhand Kumaun University, SSJ Campus Almora. Figure.2 shows the analytical procedures of the present study.

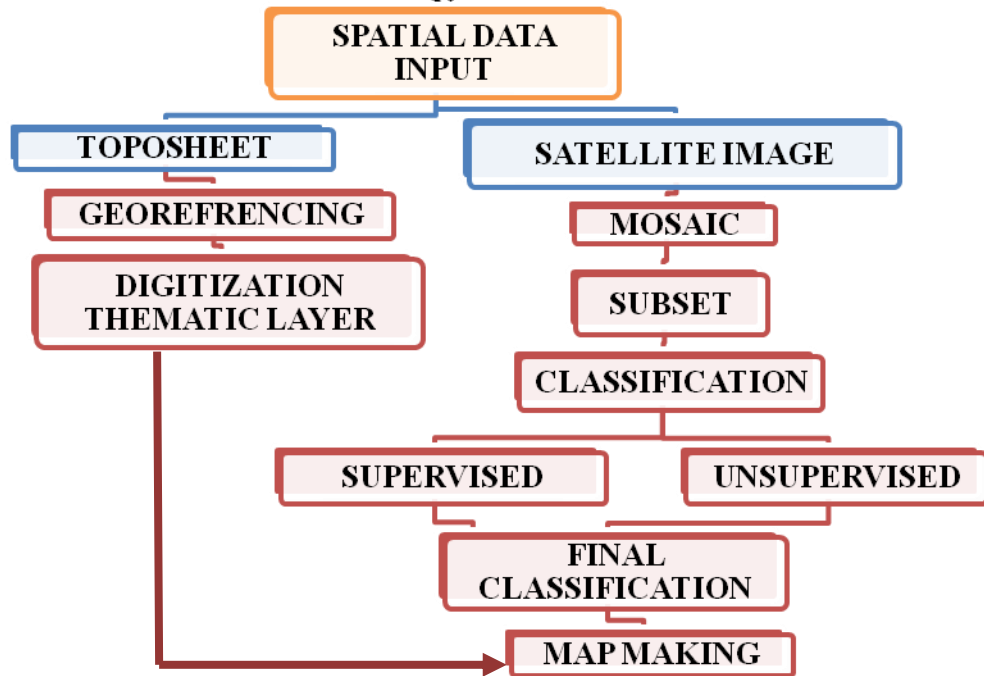


Fig.2: Flow charts showing analytical procedures of the present study.

The entire digital database of the Hawalbagh development block was prepared with the help of ARC GIS Software which is user friendly and famous software developed by Environmental system research in corporate Redland California. In the Arc GIS software, an Arc Map module was used. In Arc Map 3D Analyst was used to create the digital elevation model. Spatial Analyst tool was used to create slope, and aspect. Image classification through ERDAS (earth Resource data Analysis) software developed by Leica Geosystems geospatial Imaging, LLC 5051 Peachtree corners suite 100, Norcross, GA, 30092, U.S.A. In this software was used the classification modules for the image classification for different years.

**Results and Discussion**

**Land Use and Land Cover**

The static land use/land cover distribution of each study years as derived from the maps are presented in Table1. The land use/land cover distribution map of the year 1966 was derived from Toposheet (Fig.3). In the year 1966 out of total area, Almora urban areas covered by 1.32 per cent. Almora urban areas are developed in linear pattern along the National Highway No.87. Maximum Percentage of the study area is barren land and the barren land is mostly dominated in the central part of the study area. It covers an area of 43.88 per cent. 29.12 per cent area covered by forest land. Forest land is mainly dominated in extreme North, NW and SW portion of the boundary. One patch of Sitoli reserve forest is found in the southeastern part. 29.95 per cent area is covered by agricultural land. Which mainly dominates in NW and middle part of the study areas 5.46 per cent is covered by built up land, where the

reserve forest is available, there is no built up land, the distributional pattern of the built up land is uniform throughout the study area.

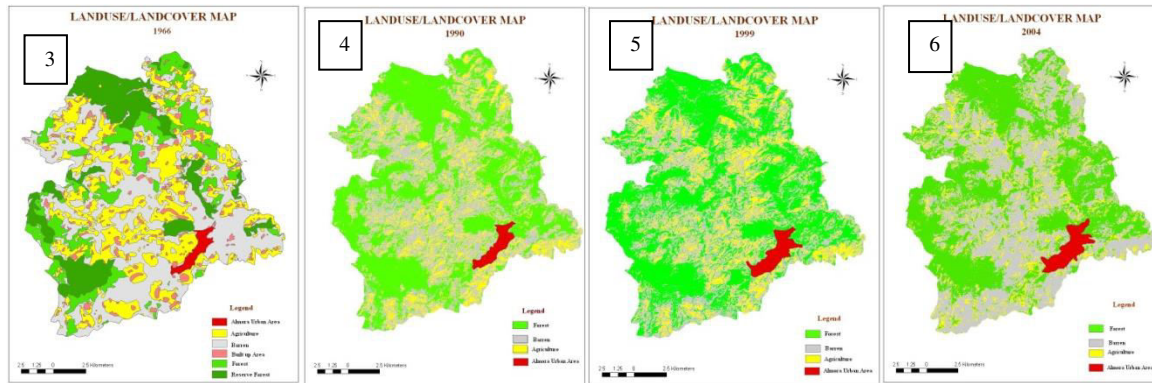
Figure 4 is derived from Landsat image 1990 of Hawalbagh development block, district Almora. In the year 1990, 37.23 per cent of the area was covered by barren land, which includes the villages of Gwalokat, Mat, Barsimi, and Khoni Dal. These villages are situated in the middle part of the study area. In this year, agriculture land is 16.11 per cent of the total study area. Agriculture land is dominated in the Manan, Jyala, Syura, Chan, Devil, Lat. Mal and sarsyson. Present forest land covered the 45.15 per cent of the total account of the study areas. Main Forest areas are Syahi Devi, Sitoli Airadeo, Chitai, and Kalimath reserve forest. These reserve forest are dense reserve forest. In this year Almora has about 1.53 per cent urban area.

Figure 5 is derived from Landsat image of Hawalbagh development block, district Almora in 1999. In the year 1999, the total land use is 46.18 per cent covered by forest land. In this year barren land has 36.61 per cent covered in the study area. Agriculture land covered 15.08 per cent of the total study area. In this year, Almora urban area has 2.14 per cent in the total account of the study area.

Figure 6 derived is from LISS III image of Hawalbagh development block of district Almora in 2004. In the year 2004 forest covers total area of 45.47 percent. Forest is dominated in the SW, N, NW, NE and E portion of the study area. Except in the SE part of the study area two patches are situated. One patch of the Sitoli Reserve forest and second patch are Khunt and Bimola villages. 39.72 per cent of the study area is barren land. Barren land is mostly dominated in the central part of the study area and one patches developed in the surrounding of NE and NW of the boundary. Out of the total areas, agriculture areas cover 12.32 per cent. In the Manan, Chuansali, Mal, Bansgar, Joyli, Naula, Sainar, and Barsimi villages mostly agriculture land is dominated. Almora urban areas covers about 2.49 per cent of the total area.

**Table 1: Area under different Land use/Land covers categories of the Hawalbagh development block, district Almora.**

Land use land Cover categories	Years							
	1966		1990		1999		2004	
	Area (km <sup>2</sup> )	Area (%)	Area (km <sup>2</sup> )	Area (%)	Area (km <sup>2</sup> )	Area (%)	Area (km <sup>2</sup> )	Area (%)
Forest	78.1442	29.12	120.7675	45.13	123.5836	46.18	121.6775	45.47
Barren Land	143.1205	43.88	99.6457	37.23	96.8975	36.61	106.3021	39.72
Agriculture Land	69.4554	26.15	43.1171	16.11	41.4554	15.08	32.9742	12.32
Urban Areas	3.5473	0.85	4.0586	1.53	5.6524	2.14	6.6351	2.49



Land use/Land covers maps of the Hawalbagh development block, district Almora for the years: 1966 Fig.3 (based on SOI Toposheet), 1990 Fig.4 (based on Landsat Thematic Mapper), 1999 Fig.5 (based on Landsat Enhance Thematic Mapper) and 2004 Fig.6 (based on LISS III).

### Terrain Mapping and Analysis

#### Digital Elevation Model

Digital Elevation Model is the maximum height of surface unit from the sea level. To prepare Digital Elevation Map, the Hawalbagh development block was divided into grids of one square kilometer. Maximum height from the mean sea level of all the grids of one square kilometer of the block was obtained by using contours map drawn from the Survey of India Topographic sheet (53 0/10). Figure 7 depicts the Digital Elevation map of the Hawalbagh development block.

The Hawalbagh development block is divisible in four absolute relief zones varying between 1000-2200m, and in four categories of relief i.e., Low, Medium, High and Very high. Table 2 contains the distribution of area under different relief zones. Maximum area lies in the medium relief zone which include 44.51 per cent of the total study area. It is observed in the form of narrow belt, extending north east to south east of the boundary, circular belt round the south west and north portion of the boundary. 8% villages of the study area under this category. Only 1.04 percent of the total study area falls under the region of very high relief where the relief always ranges above 2000m. One patches of very high relief zone are situated in the Syahi Devi reserve forest.

**Table 2: Distribution of area under different relief zones of the Hawalbagh development block, district Almora.**

Altitudinal Zones in meter	Area		Category of Relief Zones
	In km <sup>2</sup> .	In %	
1000-1100	1.83	0.68	LOW
1100-1200	11.50	4.29	
1200-1300	46.38	17.33	
1300-1400	55.53	20.75	
1400-1500	53.91	20.14	MEDIUM
1500-1600	37.58	14.04	

1600-1700	27.62	10.32	HIGH
1700-1800	18.37	6.86	
1800-1900	9.03	3.37	
1900-2000	3.00	1.12	
2000-2100	1.91	0.71	V. HIGH
2100-2200	0.89	0.33	
Total	267.58	100	

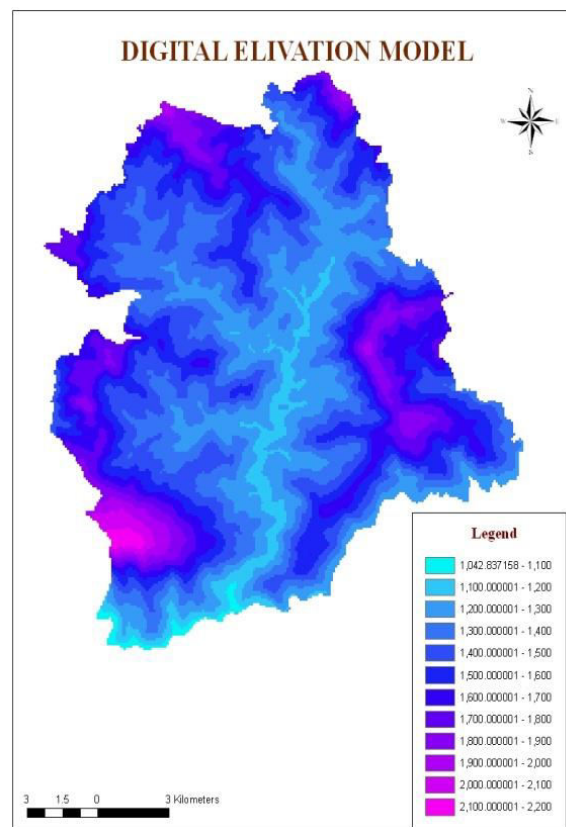


Fig.7: Digital Elevation map of the Hawalbagh development block, district Almora.

### Slope

Slope map for the Hawalbagh development prepared by using Digital Elevation Model. Figure 8 depicts the distribution of surface Slope within the study area. The Slope of the development block ranges between 0° to 37°. Table 3 shows the distribution area under different Slope groups in the Hawalbagh development block.

The slope angle measures between 5°to15° in these areas of moderate slope which include 48.27 per cent of the total study area. It extending north to south of the study area. This is the commonest class of the slope which exhibits the regional picture of slope of study area. As, rule, Steep slope corresponds

high relief and relatively hard bed rocks. It includes 0.7884 per cent of the total study area which is small area Surrounds by SE boundary.

**Table 3: Distribution of area under different slope groups of theHawalbagh development block, district Almora.**

Slope Groups (in°c)	Area		Remark
	In km <sup>2</sup>	In %	
0-5	41.60	8.99	GENTLE
5-10	79.29	17.13	MODERATE
10-15	114.94	24.83	
15-20	116.04	25.07	M.HIGH
20-25	77.70	16.79	HIGH
25-30	28.39	6.13	
30-35	4.57	0.98	STEEP
35-40	0.24	0.06	V.STEEP
Total	462.81	100	

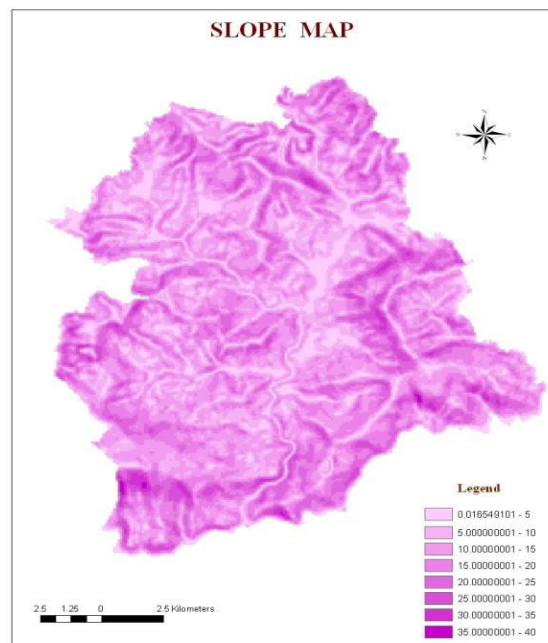


Fig.8: Slope map of the Hawalbagh development block, district Almora.

**Aspect**

Aspect map for the Hawalbagh development block, was prepared by using digital Elevation Model. Figure 9 depicts the distribution of aspect within the study area. Table 4 shows the distribution area under different aspect groups in the Hawalbagh development block.

East direction which includes the largest part (28.98 %) of the study area, such conditions is mainly confined to the Syahi Devi, Chana, and Airadeo reserve forest, and extreme east portion of the boundary. Only 0.08 per cent of the total study area falls under North-West direction. Such patches of this direction are mainly distributed in central part of the boundary.

**Table 4: Distribution of area under different aspect groups of the Hawalbagh development block, district Almora.**

Aspects Name	Area		
	(in°c)	In km <sup>2</sup>	In %
N	337.500-22.500	27.23	10.17
NE	22.500-67.500	51.61	19.28
E	67.500-112.500	77.55	28.98
SE	112.500-157.500	64.27	24.01
S	157.500-202.500	33.74	12.61
SW	202.500-247.500	10.84	4.052
W	247.500-292.500	2.10	0.78
NW	292.500-337.500	0.21	0.08
Total		267.58	100

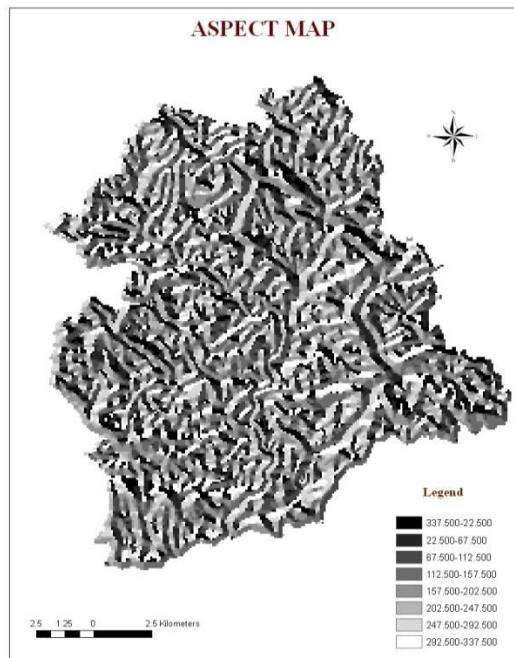


Fig.9: Aspect map of the Hawalbagh development block, district Almora.

**Drainage**

In the study area total Stream length is 1193.01 km (Fig. 10), in which perennial river length is 151.57 km (based on Toposheet map, 1966). Drainage density map for the Hawalbagh development block, prepared by using stream. Figure 11 depicts the distribution of drainage density within the study area. In the study area medium drainage density is dominated. High drainage density is occupies three small patches in the NE portion of the study area, four small patches situated in the North portion of the area and five small patches is situated in the central part of the study area. Low drainage density is dominated in the Almora urban area and some small patches situated in the central part of the study area. High drainage density is good for agriculture.



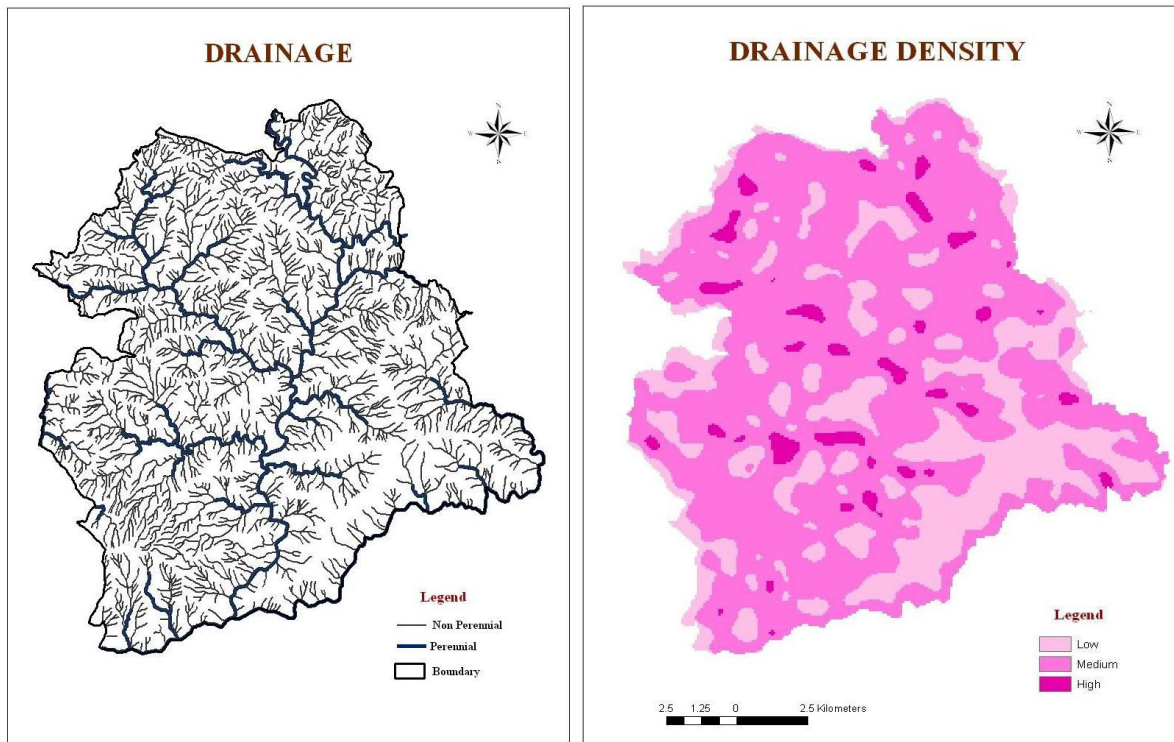


Fig.10 Drainage map and Fig.11 Drainage Density map of Hawalbagh development block, district Almora.

### GIS of Development Infrastructure

#### GIS of Education Centers

Figure 12 depicts the distribution of education centers within the study area. Table 5 shows the numbers of different types of education centers of the Hawalbagh development block, district Almora. In this block 112 of primary school (Fig.13) are available out of the 234 villages (Fig.14). Some areas are primary schools are not available due to reserve forest (e.g., Airadeo, Okhlar, Syahi Devi and Chitai Reserve Forest). But Primary school are almost equally Distributed. Maximum education centers occupy around the Almora urban areas. One Government Hotel Management Institute situated in the Khatyari village, Hawalbagh development block, district Almora.

**Table 5: Number of different types of education centers of the Hawalbagh development block, district Almora.**

Name of the Education Centre	Number of the Education Centre
Government Girls High School	1
Government Girls Inter College	1
Girls High School	3
Government Inter College	9
Girls Inter college	2
Junior High School	19
Primary school	112
Government Industrial Training (ITI)	2
Hotel management Institute	1
University Campus	1
Private Degree College	1

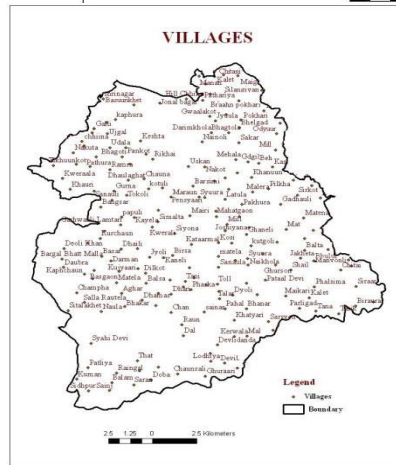
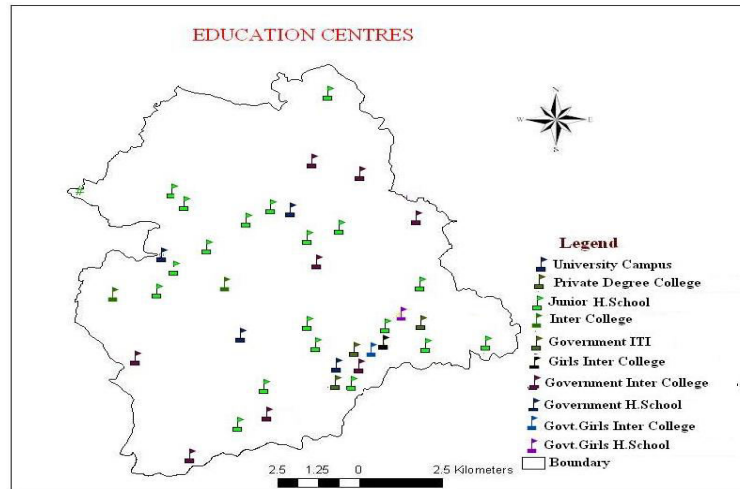


Fig.12

Fig.13 Primary Schools and Fig.14 Villages map of the Hawalbagh development block, district Almora.

Education Centers,

### GIS of Health Centers

Figure 15 depicts the distribution of health centers within the study area. Table 6 shows the numbers of different types of health centers of the Hawalbagh development block, district Almora. In this Block Medical facility is good comparison than the other block District Almora. Because one district Hospital, one Base Hospital, and one women Hospital are situated in this block.

Table 6: Number of different health centers in the Hawalbagh development Block District Almora.

Name Of Health Centre	Number of Health Centre
Base hospital Almora	1
District Hospital	1
Women Hospital	1
Primary health Centre	1
Additional primary Health Centre	2
Homeopathic hospital	1
Aryvedic hospital	5

Child maternity Centre	18
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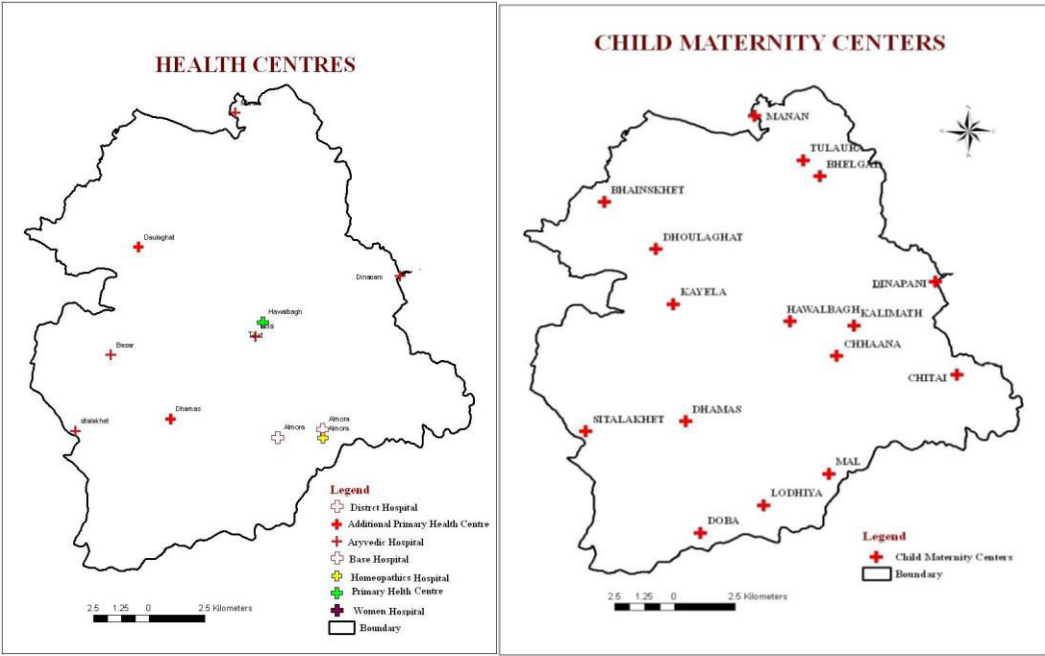


Fig.15: Spatial Distribution of Health Centers and Fig.16 Child Maternity centers of the Hawalbagh development block, district Almora.

**GIS of Roads**

The Block has a road network whose total length exceeds 197.39 km. In this block road facility are good (Table 7). Because Almora Urban area are situated in this block. Many roads connect the Almora Urban areas (Fig.17).

**Table 7: Lengths of different types roads of the Hawalbagh development block, district Almora.**

Road Name	Road Length in km.
National Highway	33.16
State Highway	34.65
Major District Road	8.52
Other District Road	121.06

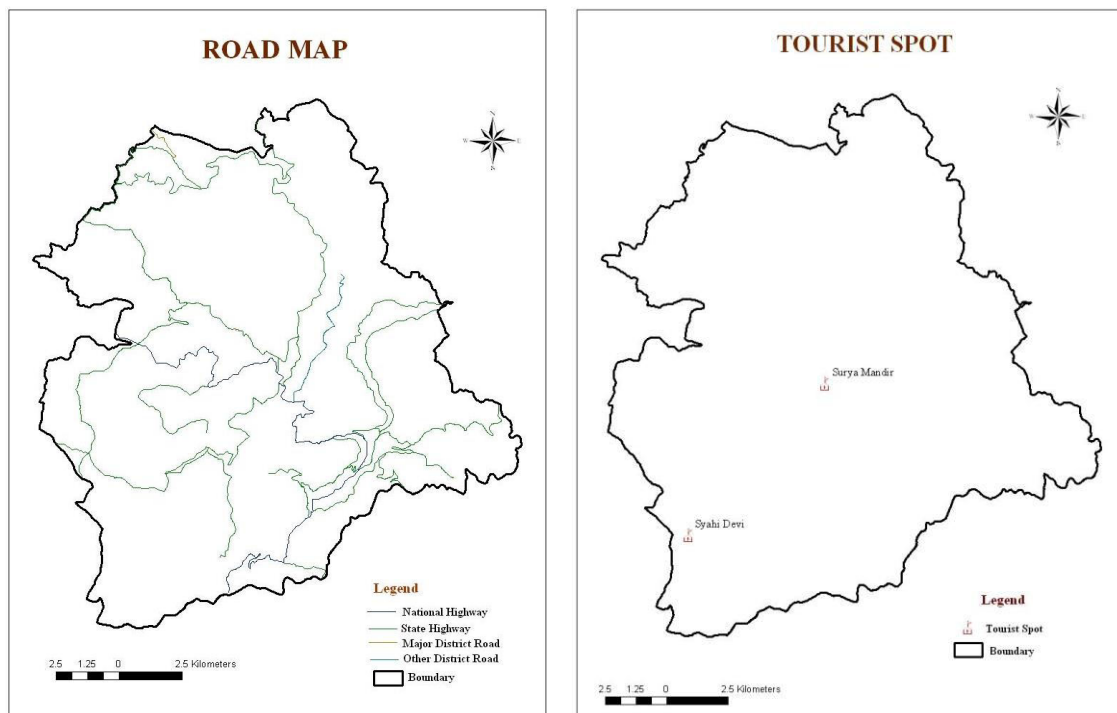


Fig.17 Road map and Fig.18 Tourist spot map of the Hawalbagh development block, district Almora.

### Tourist GIS

Figure 18 depicts the distribution of Tourist spot within the study area. In this Block major two tourist spot are important, firstly Surya mandir Katramal village. This temple under Aerschlogy Survey of India, because this is the oldest temple. This is the beautiful place. seconded is Syahi Devi temple. Syahi Devi temple situated in the highest height in this block.

### Conclusion

The fundamental objective of the present study is to create a model of Block GIS, which could be used for the Block Development Officer and stakeholders of the local level planning. Encompassing an area of 267.58 km<sup>2</sup>, the study area viz, the Hawalbagh development block was used a natural laboratory the develop Block GIS. The Hawalbagh development block lies in between 29° 32' 30"N to 29° 44' 23"N latitude and 79° 31'11"E to 79° 43' 50" E Longitudes lies in district Almora of the Kumaun Himalaya (Uttarakhand). Using Remote Sensing, GPS and GIS techniques, terrain analysis and study a land use/land cover pattern under different years .

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