Neo Geographia

An International Journal of Geography, GIS & Remote Sensing
(ISSN-2319-5118)

Volume I Issue II
October 2012

Neo Geographia is a refereed journal.
Published by: Barloni Books, for Interactions Forum, Pune.
Printed By: Barloni Books, MIT Road, Pune-411038

Official Address:
Anand Hanumant Londhe,
Interactions Forum,
19, Bhosale Garden, MIT Road,
Near Hotel Pooja, Kothrud, Pune,
Maharashtra-411038

Email: neogeo.if@gmail.com
Website: www.interactionsforum.com

Welcome to Interactions Forum!!

Pune based Interactions Forum (IF) is established formally in the year 2010 with the objective to provide an integrated platform for intra-disciplinary and interdisciplinary research in various disciplines and to provide free access to the knowledge produced through this research. Today's formal organization was preceded by an informal group of young research scholars who were very enthusiastic, besides their own fields of research, about the new and ongoing research in various branches of the knowledge tree.

At present we are focusing on providing the researchers a space to publish their research. We, in future, intend to organize informal and formal seminars and conferences which would deal with the important themes in intra-disciplinary and interdisciplinary research across the various streams of knowledge.

Subscription Fees for Neo Geographia

For Individual Member: Rs. 1600/- (1 Year) including postal charges
For Library: Rs. 2000/-(1 Year) including postal charges
Price of Single Issue: 400/- including postal charges

Those interested in subscription please contact us through email:
neogeo.if@gmail.com

CONTENTS

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, October 2012

Human Resource Development in Kolhapur District of Maharashtra: A Geographical Analysis

Dr. A. H. Nanaware[1] Navanth K. Bansode[2]

Abstract

Human Resource Development is the framework for employees develop their personal and organized skills, Knowledge and abilities. In economic terms, it could be described as the accumulation of human capital and its effective of human capital and its effective investment in the development of an economy. Human resource plays a very important role in the regional development. Therefore attempt is made here to analyze human resource in Kolhapur district the paper is based on secondary data sources. The six indicators of human resource are taken into consideration. To analyze and indentify the human resource development the tahsils of lower human resource development the M.G. Kendalls (1939) ranking coefficient method is used. The study reveals that the tahsils of Chandgad, Ajra, Bhudargad, Radhanagari , Gaganbavda and Shahuwadi are identified as tahsils of low human resource development.

Key wards: Indicators, Human Resource Development

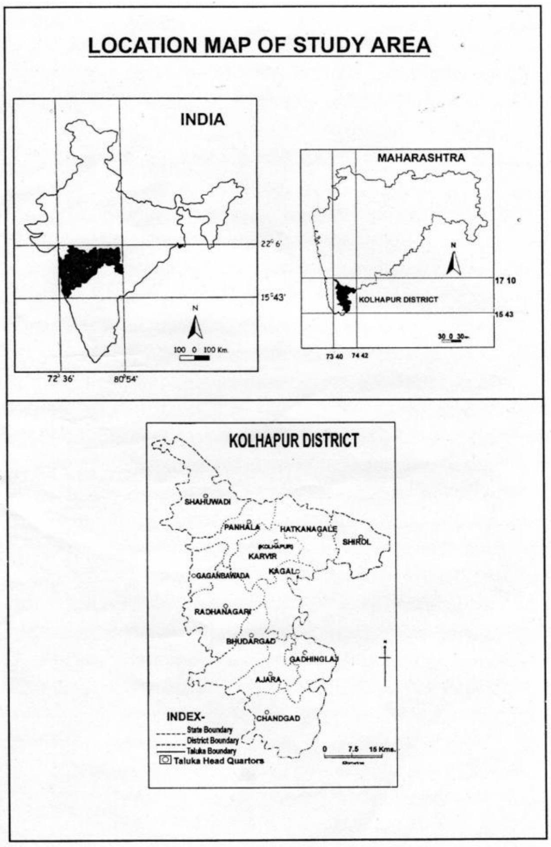
Introduction

The development of any region or any country as based on quality of two types of resources i.e. human resources & natural resources. Human resources are also important as like natural resources. Man is known as a consumer of resources and also producer of resources (Mali, 1996). Human Resource Development is the framework for employees develop their personal and organized skills, Knowledge and abilities. According to Haribison and Myers (1964) Human resource development may be defined as " the process of increasing the knowledge, the skills and the capacities of all the people in a society. In economic terms, it could be described as the accumulation of human capital and its effective of human capital and its effective investment in the development of an economy. The latest definition of HRD is "a set of systematic and planned activities designed by an organization to provide its members with the opportunities to learn necessary skills to meet current and future job demands". Human resources development is based on technological, Social, Cultural & economic elements (Saptarshi, 1996). Human resources are also important in terms of quality & quantity (Dixit,1996). India has no bright future without effective Human resource development. For effective organization natural as well as for economic and social growth Human Resource Development is very important. Human resource plays a very important role in the regional development. Therefore attempt is made here to analyze human resource in Kolhapur district

Study area

Kolhapur is the most developed district of southern western part of Maharashtra. It lies bet 15^o 43'& 17^o 17' North Latitude and 73^o 40'& 74^o 42' East Longitude. It is surrounded by Sangli district to the north and to the east, & by Belgaum of Karnataka to its south and Sindhudurg district to the west.

The Sahyadri ranges to the west and Warna river to the north forms the natural boundaries of the Kolhapur district. The Geographical area of the district is 7685.00 sq.km. and the population of the district is 35,23,162 according to 2001 census. The district is divided into 12 Tahsil for administrative purpose. The mean monthly maximum and minimum temperature ranges between 38^o and 14^{o}C with annual average precipitation 115cm.



Objectives:

The main objective of this paper is to analyze the tahsil wise human resources and to indentify the tahsils of lower of human resources development.

Data base and Methodology:

The present Study based on secondary data sources. The six indicators of human resource i.e. health centers, density of population, growth of population, literacy rate, number of educational institutes, and sex ratio are taken into consideration. The data regarding these indicators of human resource development are collected and used for the year of 1991 to 2001. The data has been collected from district census handbook of Kolhapur district 1991 and 2001.

The collected data are processed. To analyze and indentify the human resource development the tahsils of lower human resource development the M.G. Kendalls (1939) ranking coefficient method is used. On the basis average of ranks the tahsil of Kolhapur district are grouped into three regions.

Discussion

1. Density of Population

According to census of 2001, the density of population of Kolhapur district was 455 persons per sq.km.Which is higher than the Maharashtra State, due to the urbanization, industrialization, transport facility, availability of fertile soil in the river basins. But tahshil level analysis varies from tehsil to tehsil

The high density of population i.e.>736 is found in the tahsils of Karveer and Hatkanangale, due to development of surface irrigation facilities and fertile soil which leads to higher development of agriculture, high origination, development of handloom industries. Where as low density of population i.e.< 426 is observed in Panhala, Kagal, Gadhinglaj, Chandgad , Ajra, Bhudargad, Radhanagari, Gaganbavda, Shahuwadi tahsils due to undulating terrain, low quality fertile soil and poor irrigation facility.

2. Population Growth

The decadal population growth rate of the district during 1991 and 2001 is 17.85 per cent which is slightly below the Maharashtra State (22.73%). The high population growth rate is observed in Karveer and Hatkanangale tahsil due to agriculture and industrial development, while the low population growth rate observed in Gadhinglaj ,Chandgad ,Bhudargad,Radhanagari,Gaganbavda ,Shahuwadi tehsil

3.Literacy rate

A person who can both read and write with understanding in any language is to be considered as literate (census of India). Literacy is the base of development of any nation. Literacy rate leads the growth of

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, October 2012

knowledge, new ideas and technology, growth in research etc. which are necessary to improve the human resource development. The district as a whole has 76.93 per cent literacy rate. The male literacy rate was 87.47 per cent, while female literacy rate was 66.02 per cent as per census of 2001. The high literacy rate i.e. above 74.5 per cent is found in the tahsils of Karveer, Hatkanangale and Shirol due to urbanization, industrialization, agriculture development and good infrastructure. Which results into higher parent income and the high number of schools. Where as low Literacy rate is observed in Chandgad, Gaganbavda, Shahuwadi tahsil due to of lack of education facility.

4.Number of Educational Institutions

Education is the important aspect of a nation for its human resource development. According to Gupta's (1988)opinion, education is important for a nation's overall development. Gosal's (1967) have opinion that, due to education the peoples developmental change, Social and economic status are also changed.

The district as a whole has 49.25 number of educational institutions. The high education institutions i.e. above 360 is observed in the tahsils of Karveer, Hatkanangale and Shirol due to high economic development, government policy and political stability. Whare as low education institutions are observed in the tahsils of Gadhinglaj, Ajra, Bhudargad and Gaganbavda due to undulating terrain which results into lower economic development

Table-I

Human Resource Development Indicator Value

Sr.No.	Tahsil	Density of population 2001	Population Growth 2001	Literacy rate 2001	Number of Educational institutes 2001	Sex Ratio 2001	Health centers 2001
1	Karveer	1351	22.81	83.16	551	917	1835
2	Panhala	419	15.23	74.16	258	921	281
3	Hatkanangle	1164	23.12	80.25	420	911	802
4	Shirol	707	16.58	80.15	552	941	279
5	Kagal	453	16.5	73.58	206	949	283
6	Gadhinglaj	449	9.44	71.81	192	1016	324
7	Chandgad	190	13.17	66.67	262	1033	184
8	Ajra	221	14.09	69.37	155	1082	148
9	Bhudargad	225	13.61	72.92	200	995	193
10	Radhanagari	211	11.28	71.33	240	946	259
11	Gaganbavda	116	17.07	60.74	60	969	116
12	Shahuwadi	169	11.52	66.93	286	1049	221
	District	455	17.85	76.93	3063	949	4925
	MH	315	22.73	76.73	------	913	-----

Source : District census Handbook

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, October 2012

5. Sex ratio

According to census of 2001, the district as a whole has 939 sex ratio (females per thousand males) Which is higher than the Maharashtra State (913). But tahsil level analysis varies from tahsil to tahsil. The high sex ratio is observed in the tahisls of Chandgad and Ajra due to unfavorable geographical situation which results into out migration of males for better employment opportunities. The low sex ratio is observed in Karveer, Panhala, Hatkanangale, Shirol, Kagal and Radhanagari because of high economic development due to agricultural, industrial and tourism development results into immigration.

6. Health centers

The medical facilities play an important role in human resource development. It is a necessary that the country should have good health facilities.The high number of health centers is observed in only Karveer tahsil due to higher urbanization and high economic development as well as government policy.etc. whare as low number of health centers are observed in Panhala, Shirol, Gadhinglaj, Chandgad, Ajra, Bhudargad, Gaganbawada, shahuwadi and Radhanagari due to poor infrastructure, undulating terrain, poor education etc.

Human Resources Development in Kolhapur district

In the previous part the indictor of human resource development i.e. Population density, Growth rate, Literacy, Education, Sex ratio, Health centers, etc. are analyzed. Here attempt is made to make Human Resources Development Region on the basis of average of ranks of indicators and their mean and Standard deviation.

1. Tahsils with high human resource development

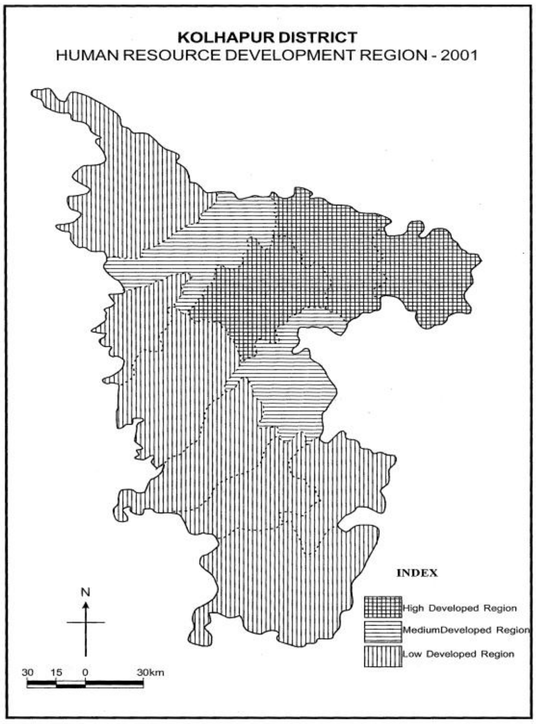
The high human resource development is recorded in the three tahsil i.e. Karveer, Hatkanangale and Shirol tahsils. Because of higher number of educational institutions, high literacy rate and health care centers due to development of transportation, irrigation, agriculture development and urbanization as compare to other regions.

2. Tahsils with moderate human resource development

The Medium human resource development is observed in the three tahsil i.e. Panhala , Kagal and Gadhinglaj tahsils.

3. Tahsils with low human resource development

The low human resource development is observed in the six tahsil. i.e. Chandgad, Ajra, Bhudargad, Radhanagari , Gaganbavda and Shahuwadi tahsils. Due to unfavorable physiography, poor industrial and agriculture development and infrastructure facility .



Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, October 2012

Table-2 Ranks of Indicators

Sr. No	Tahshil	Density of populati on	Populati on Growth	Litera cy rate	# of Educational institutes	Sex Ratio	Health center s	Sum. of ranks	Average of Ranks
1	karveer	1	2	1	1	11	1	17	2.83
2	panhala	6	6	4	5	10	5	36	6
3	Hatkanangle	2	1	2	3	12	2	22	3.67
4	shirol	3	4	3	2	9	6	27	4.5
5	kagal	4	5	5	8	7	4	33	5.5
6	Gadhinglaj	5	12	7	10	4	3	41	6.83
7	Chandgad	10	9	11	6	3	10	49	8.17
8	Ajra	8	7	9	11	1	11	47	7.83
9	Bhudargad	7	8	6	9	5	9	44	7.33
10	Radhanagari	9	11	8	7	8	7	50	8.33
11	Gaganbavda	12	3	12	12	6	12	57	9.5
12	Shahuwadi	11	10	10	4	2	8	45	7.5

Source: Compiled by Authors

Concluding remarks:

The forgoing analysis reveals that there is wide disparities in the human resource development in the Kolhapur district. The western part of the district have low development of human resource, due to unfavorable physiography and climatic situation which leads to poor education, health, transport facility in comparison to eastern part of the district. The southern part of district which is far away from industrial and urbanization shows low human resource development. Eastern part of the district shows good human resource development because of fertile soils, surface irrigation facilities leads to agriculture development, good infrastructure, urbanization, industrialization and irrigation.

The tahsils of Chandgad, Ajra, Bhudargad, Radhanagari , Gaganbavda and Shahuwadi are indentified as tahsils of low human resource development where attention should be pay for to establish industries, education facilities , healthcare facilities. Further more attention should pay towards the development of transportation facilities.

References:

Bhende Asha and Kanetkar Tara (1988): Principles of population studies, Himalaya publishing house, Bombay.

Chandana R.C. (1996): Geography of population, Kalyani Publication, Ludhiana.

Arya P.P. and tandon B.B. (1995): Human resource development, Deep and Deep publication, New Deihi.

Dixit K.R. (1996): Land and Human resource development, Maharashtra Bhugol shasra sanshodhan patrika, Maharashtra Bhugolshasra parishad. Vol.X, No.1, PP-69-81.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, October 2012

Mali K.A. (1999) Levels of human resource development in Amravati district, A spatial perspective, Maharashtra Bhugol shasra sanshodhan patrika, Maharashtra Bhugolshasra parishad. Vol.XIII, No.2, PP-153-161.

Haslinda Abdullah (2009) : Definitions of HRD : Key Concepts from a National and International Context, European Journal of Social Sciences, Volume 10, Number 4 PP- 486

Address of Author

1. Dr. Arjun H.Nanaware
Associate Professor
P.G. Dept of Geography & Research center,
Shri Shivaji Mahavidyalaya,
Barshi, Solapur.

2. Navanth K. Bansode,
Assistant Professor,
Department of Geography,
Bhogawati Mahavidyalaya,
Kurukali Kolhapur.

Impact of Bhima Sina River Joint Canal on Changing Agricultural Productivity in Madha Tahsil of Solapur District

Dr. N.G. Shinde, Mr. C.L. Hulsure, Mr. A.H. Londhe,

ABSTRACT

The canal construction is an art and science of artificial application of water to agriculture and different types of uses (industrial use, drinking water etc.) to develop and increase agriculture production. Canal irrigation has been practiced in one form or other in the arid, semi arid and in drought prone area. Madha tahsil is located in drought prone area. In India there are many canals constructed to solve the water problem in arid, semi arid and in drought prone area. The Bhima Sina River joint canal started at Kandalgaon (near Ujani Dam) and meets to Sina River near Kavegaon in Madha tahsil. The construction of canal was started in 1994-95 and completed in 2003.The measurement of production and input required for the production of that output is known as agricultural productivity. Agricultural productivity of micro and macro region is closely influenced by a number of physical (physiography, climate, soil, water), socio economic, political, technological factors. The present paper analyzes the impact of Bhima Sina River joint canal on agricultural productivity in Madha tahsil of Solapur district. It shows that the increase in agricultural productivity due to the availability of such an irrigation sources. Irrigation is the single most important input on which depends the success or failure of a crop. The patterns of agricultural productivity of Madha tahsil has been delineated with the help of Kendall's method.

***Key words**: Bhima Sina River Joint Canal, Agricultural Productivity, Kendaull's Method*

Introduction

The Bhima and Sina river basin are the important river basins in Solapur district. The Ujani dam is constructed on Bhima river and it plays agricultural and economic backbone of Solapur district. The Solapur district is located in drought prone area, so there is need of artificial canal irrigation. The Bhima-Sina river joint canal is successfully completed in 2003 and shows the development of agricultural production in Solapur district.There is a long standing demand for providing irrigation facilities to famine affected areas of Madha, Barshi, Mohal, Sangola, South Solapur tahsils of Solapur district. The irrigation facility is the single most important input on which depends the success or failure of a crop. The concept of agricultural productivity defined as the measurement of production and input required for the production of that output is called agricultural productivity. It is also called as input output ratio.

The agricultural productivity is a function of interplay of physical, socio-economic, cultural variables and it manifests itself through per hector productivity and the total production. The measurement of agricultural productivity helps in knowing the areas that are performing rather less efficiency in comparison to the neighboring areas. The present paper "Impact of Bhima Sina river joint canal on changing agricultural productivity in Madha tahsil of Solapur district" shows the village wise agricultural productivity change in 2009 year compare with the 2001 year in study area.

Study area

The Madha tahsil is located in the north of the Solapur district. The latitudinal extension is 75^0 N to 75^0 $41^/$ N and longitudinal extension is $17^0 4^/$ E to 18^0 $16^/$ E. The total geographical area is 1544 sq.km. The average rainfall of Madha tahsil is only 519 mm. The total population of study area was 292611 in 2001. In the study area sugarcane, banana, onion, etc. cash crops under area is increasing and it's productivity also increasing due to the availability of irrigation facilities.

Objectives

To study impact of Bhima – Sina river joint canal on changing agricultural productivity in Madha tahsil of Solapur district.

Data collection

The study is based on secondary data. The data collected from the Solapur district gazetteer, and from socio-economic review of Solapur district 2010. The village wise agricultural production data collected from Madha tahsil administrative office.

Methodolgy

The present paper work proposed to adopt the Ranking coefficient method of Kendall's. In this technique the component areal units are ranked according to the per hectare yields of crops and the arithmetical average rank called ranking coefficient for each unit is obtained. The component areal unit with relatively high yields will have low ranking coefficient, indicating a high agricultural productivity and vice versa. In other word if component areal unit was at the top of every list it would have a ranking coefficient have one and thus having the highest agricultural productivity and if it were of the bottom of every list it would have a ranking coefficient equal to total number of units considered, showing lowest agricultural productivity among the constituent units. The crop yield index represent the yield of all crop productivity in a village wise compare with average crop yield of each crop in the entire region. The comparative study of 2001 year and 2009 year crops productivity shows the ranks of coefficient increases in crops yield or productivity in region and it shows the how and where the agricultural productivity increase inparticular study area. The agricultural productivity rank consider as a very high, high, medium, low and very low in rank.

Analysis & Interpretation

The table no.1 and figure no.2 shows that village wise agricultural productivity changes in the 2001 year and 2009 year of Madha tahsil. In the Madha tahsil 116 villages are included. In the 2001 year the agricultural productivity shows the 18 villages are have the very high agricultural productivity. But in the 2009 year 30 villages have very high agricultural productivity; it shows that 12 villages are increased in number in high agricultural productivity pattern. The reason behind the increase in agricultural productivity is that the Bhima –Sina river joint canal. The availability of such irrigation resources plays the vital role in increase agricultural productivity. The village Barloni, Lave, Redhore , Chavanwadi etc. villages have the very high agricultural productivity pattern in study area. The high agricultural productivity pattern shows the increasing 9 villages in the year 2009 compare to 2009 year. In the medium agricultural productivity pattern only one village is increased in the year 2009 compare to the 2001 year. There is decline in number of villages 2001 in low and very low agricultural productivity pattern which is in number 10 and 12 villages respectively. Which shows that the increasing number of high agricultural productivity villages in study area. The villages like Wadachiwadi, Randivewadi, Sapatne, Chincholi etc. have very low agricultural productivity in 2001. So the Bhima-Sina river joint canal impact shows the high agricultural productivity in study area, makes the high regional development in study area.

Sr. No.	Agricultural Productivity Pattern	No. Of Villages		Change
		2001	2009	
1	Very High Agricultural Productivity	18	30	+12
2	High Agricultural Productivity	23	32	+9
3	Medium Agricultural Productivity	22	23	+1
4	Low Agricultural Productivity	24	14	-10
5	Very Low Agricultural Productivity	29	17	-12

Table No. 1

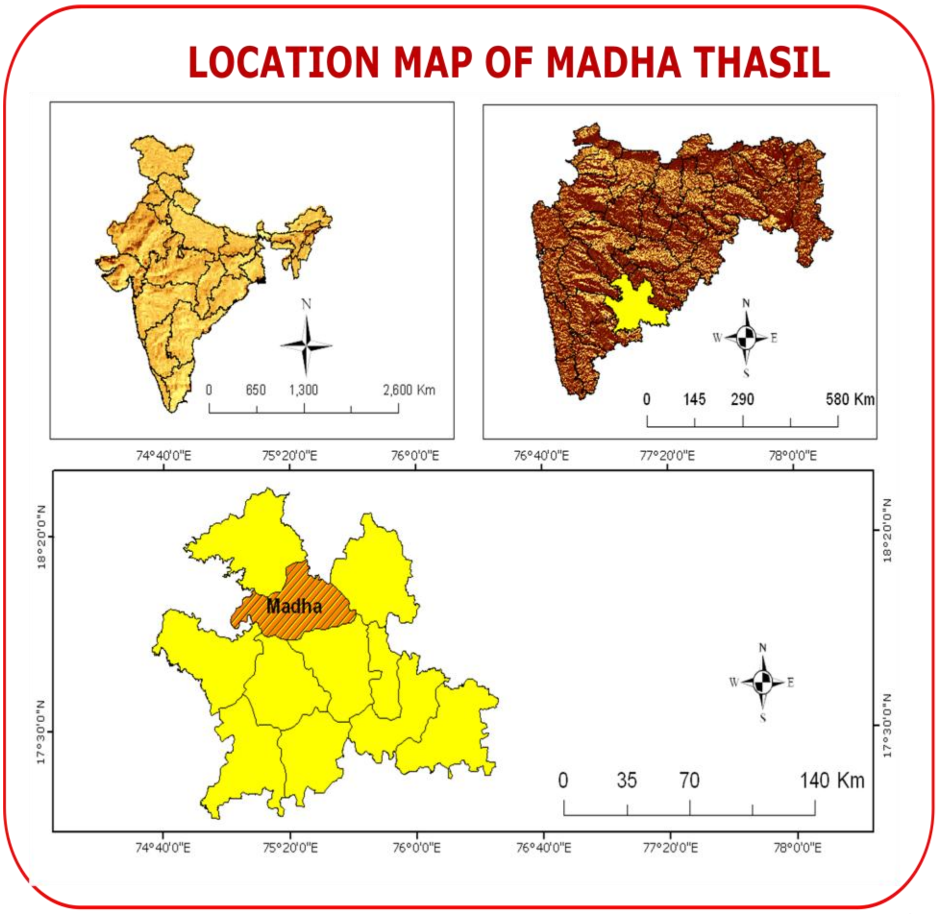
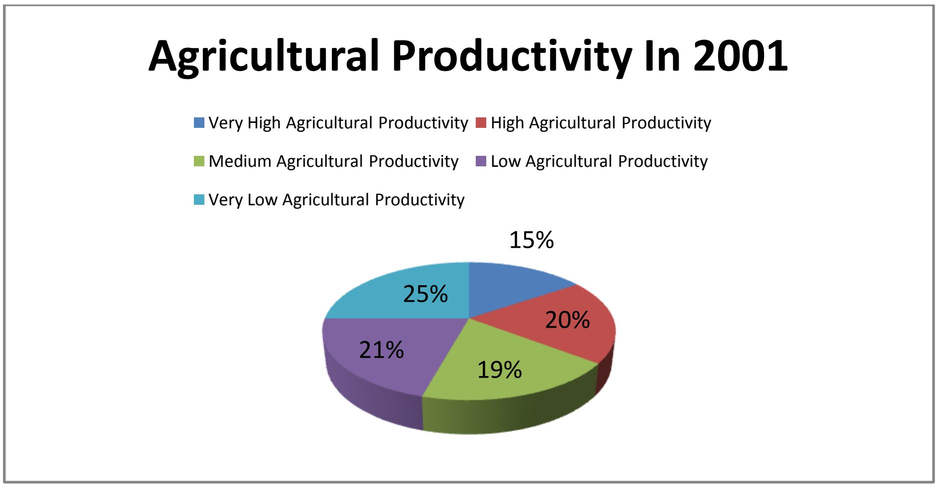
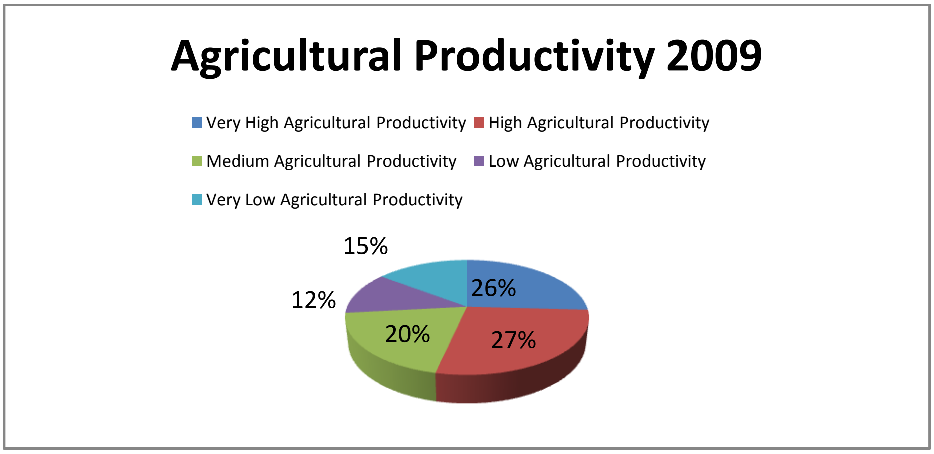


Fig. 1


Agricultural Productivity In 2001
Very High Agricultural Productivity
High Agricultural Productivity
Medium Agricultural Productivity
Low Agricultural Productivity
Very Low Agricultural Productivity
15%
25%
20%
21%
19%


Agricultural Productivity 2009
Very High Agricultural Productivity
High Agricultural Productivity
Medium Agricultural Productivity
Low Agricultural Productivity
Very Low Agricultural Productivity
15%
12%
26%
20%
27%

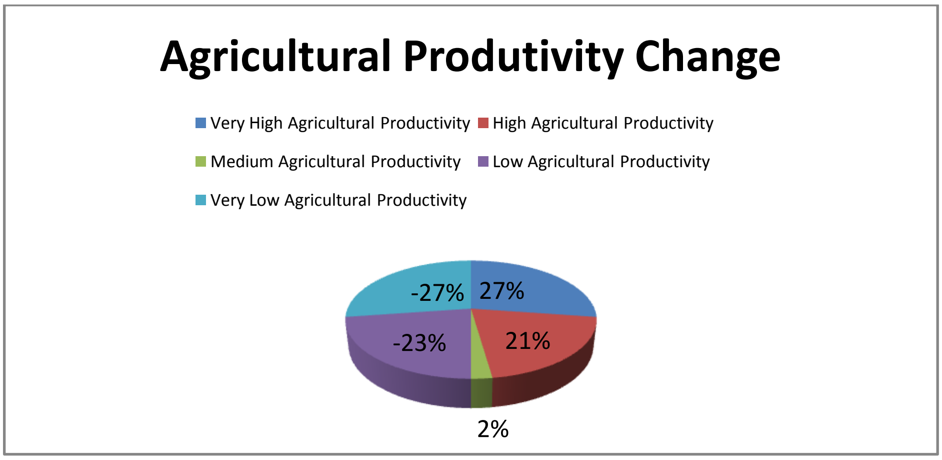

Agricultural Produtivity Change
Very High Agricultural Productivity
High Agricultural Productivity
Medium Agricultural Productivity
Low Agricultural Productivity
Very Low Agricultural Productivity
-27%
27%
-23%
21%
2%

Fig.2

Conclusion:

The present paper concluded that Bhima – Sina river joint canal project is impacted on the agricultural productivity development in Madha tahsil. The comparative study of 2001 year and 2009 year shows village wise change in the agricultural productivity in study area before canal project and after canal project. There are 44 villages which have been increases agricultural productivity in Madha tahsil due to the Bhima-Sina river joint canal.

References:

Bhatia S.S. (1967): A new measure of agricultural efficiency in India, Mehta publication, New Delhi.

Majid Husain (2005): Systematic Agricultural Geography, Rawat publication, Jaipur.

Safi M. (1972): Measurement of Agricultural productivity in India, Vishal publication, Kurukshera.

Socio-Economic Gazetteer of Solapur district (2010).

www.agriculturalefficiency.com

www.agriculturalproductivity in India.com

Address of Author

1. **Dr. N.G. Shinde,**
Head, Dept. of Geography,
D.B.F .Dayanand College of Arts& Science Solapur

2. **Mr. C.L. Hulsure,**
Research Scholar,
Solapur University, Solapur

3. **Mr. A.H. Londhe,**
Research Scholar,
Solapur University, Solapur

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Understanding Urban Housing and Its Implications in Mountainous Terrain Using GIS Techniques

Dr. S. K. Patnaik
skprgu@gmail.com

Abstract

Arunachal Pradesh is least densely populated state of India with sixteen townships with total urban population of 3134461 in 2011. Bomdila is one of the oldest settlement in Arunachal Pradesh and ranks thirteenth in rank among towns with a population of 6693. It is an administrative cum tourist town and is also a transit place for Tawang. Due to its mountainous topography, houses Government buildings were initially constructed on favourable places in terms of slope gradient, slope aspect, slope curvature, location relative to channel. Currently due to pressure on the limited space for ever growing population and demand for accommodation of floating population houses are being built on unfavourable places. Geommorphological parameters are analysed and integrated using GIS techniques to evaluate the current scenario of urban housing in Bomdila Town. It is found that Government buildings, school, colleges built earlier are constructed on flat or near flat area with south or south west facing convex slopes. In contrast to that the residential units belonging to individuals have been gradually built in unfavourable areas with slope more than 40percent, located in south-west and west facing slightly concave to concave slopes. Thereby these house clusters located in unfavourable locations are prone to hazards like health land slide. This unplanned growth need to be stopped with Government regulation and explore and use suitable land parcels for further growth in New Bomdila.

Introduction

India is the second most populous country of the world with 1210193422 persons as of 2011. United Nations Population Division has projected 1367225000 persons by 2020 and 1613800000 persons by 2050. Increase in population is associated with increase in demand for livelihood. Growth in industrial, technological and logistic sector coupled with advancement in education and entrepreneurship has put a substantial demand for urban amenities in India. India's urban population was 31.16 percent of total population in 2011 and there has been a substantial increase from 2001 urban population which was 27.8 percent.

According to Census 2001 Arunachal Pradesh had 1097968 persons including 227881 persons living in urban area i.e about 20.75 percent of total population. The annual exponential rate of growth of urban population was 8.73 between 1971 and 1981, 19.82 between 1981 and 1991, 7.22 between 1991 and 2001 and 3.19 between 2001 and 2011. In Arunachal Pradesh, urbanisation is not deep rooted. In 2001 there is no statutory town and 17 Census towns. However, the status has changed to 26 statutory towns and 1 census town.

Bomdila is a small Class V town in the District of West Kameng with a population of 6693 persons (2001) constitutes 8.97 percent of total population of the district. Divisional Head Quarters for Kameng Frontier Division was setup in 1953 at Bomdila. Currently it is an administrative cum tourist town of Arunachal Pradesh. It also serves as transit for Tawang, an important religious and tourist town of Arunachal Pradesh.

Physiographically Arunachal Pradesh is a mountainous state traversed by mighty Himalayas. West Kameng District, located in the western part of Arunachal Pradesh, is geologically a part of Sela range, Bomdila range and Chaku range and topographically it is a highly dissected mountainous area.

Bomdila the district head quarters is located slopping land facet with altitude ranging from 2900meter to 2000 meter located in Dikhang Watershed, at tributary of Kameng River.The growth of Bomdila town has been substantial through time due to intra state migration basically through recruitment by administration and for trade and commerce. This growth of population has added demand for dwelling units in the area. In the absence of any municipality, land record, building bylaws, Land use zone the town has grown in a randomly between Dikhang Kho and Shera Kho (River). The limited land between these two rivers has been fully utilised for administrative, institutional, residential and recreational use.

Growth of population and urban territory has been unplanned and the service provider, the Government is in a difficult position to provide basic services like water supply, power supply, residential streets, enough educational institutions, administrative work force to manage functioning of the towns How ever the growing population is exerting excessive pressure on utilisation of land thereby gradually the disadvantageous areas prone to hazards. The present attempt is an exercise to ascertain stress on urban land use by evaluating the geomorphological parameters of the area and provide a state of affairs urban land use.

Emerging Pattern of Urbanisation

Urbanization is an integral part of economic development. Urbanization is also a process of social transformation i.e. from traditional rural societies to modern urban communities. In Indian context the divide between urban and rural very large in terms of social communities, economic pursuits, access to amenities, investment by government sector for infrastructure and so on. To define any settlement as an urban unit Census of India has put few defining criteria like population threshold of 5000, non agricultural workforce threshold of 75percent and density of population threshold of 400persons per km^2. Urban population of India has increased from 25.8 million in 1901 to 62.4 million in 1951 and to 286.1 million in 2001. As of the last census of 2011 there are 377.1million urban dweller in India and shows there is a steady growth in urban population. The number of towns has increased from 1827 in 1901 to 2843 in 1951 to 4368 in 2001. In the census year of 2011 Census of India has identified 4041 statutory towns, 3894 census towns, 475 urban agglomerations and 981 out growths.

The rate of urban population growth slowed down during the 1990s despite the increased rate of rural to urban migration due to a significant decline in natural increase in urban areas (Bhagat et.al. 2009). The natural increase, net rural-urban classification and rural-to-urban migration are components of urban population growth (Bhagat, 2011). At the state level, the pattern of urbanisation is very diverse, but economically advanced states more or less show higher levels of urbanisation. Arunachal Pradesh stands 29th with a Gross State Domestic Product (GSDP) of 8233 for the Financial Year of 2010-2011 at Current Prices (as on 15-03-2012). The GSDP is growing an average high rate of 17.95 since 2007. But urban expansion data shows that for the whole state urbanisation process has slowed down. Study on urbanisation in India by (Shaw, 1999) observed ‘firstly the unevenness in the distribution of the new investment made in the country since the early nineties and second, its impact on the major cities’. A. Kundu (2001) had concluded that “The trends of population growth and migration in recent past years reveals that the growth rate of urban population in India is likely to slow down. This would be so despite the opening up of the economy and consequent boost to industrialisation." Despite these opinions, the ground reality is that Arunachal Pradesh has added ten towns between 2001 and 2011. The urbanisation process in a mountainous terrain has its limitations in expansion due to physical constraints of slope, aspect, curvature of terrain besides other geomorphological parameters. Arunachal Pradesh located in the Himalaya mountain range pose daunting challenges for providing a administrative and legal framework in facilitating urbanisation processes. This necessitates studying the housing options by the swelling urban households at various parts of the urban units. Construction of houses by the residents is simple task and availability of land is the only criterion. As most of the urban settlements are driven by the State Governments initiative to establish administrative centres, the initial colonisation is by the government functionaries. Thereafter, these administrative units attract others for provide as well as avail the services of the towns. This sequential process of urbanisation has led to a problem of site selection for the later entrants in to the town as the suitable areas have been occupied by the government for building its office, and residential quarters, schools, hospital and other utility services. As a result the native population who have migrated to the towns in Arunachal Pradesh find land in disadvantageous sites to construct their dwelling units.

Bomdila: an Urban Entity

The head quarters of the Kameng Frontier Division was setup in 1953 at Bomdila. Currently Bomdila is the district head quarters of West Kameng District, Arunachal Pradesh. It is a small class V town with a population of 6693 in 2001 that constituted 8.97 percent of district population. Census 2011 found two more towns Dirang and Rupa in the district. Total urban population for these three towns as of 2011 is 18395. It is an administrative cum tourist town of Arunachal Pradesh. It also serves as a transit for Tawang an important religious and tourist town of Arunachal Pradesh. (Figure. 1)

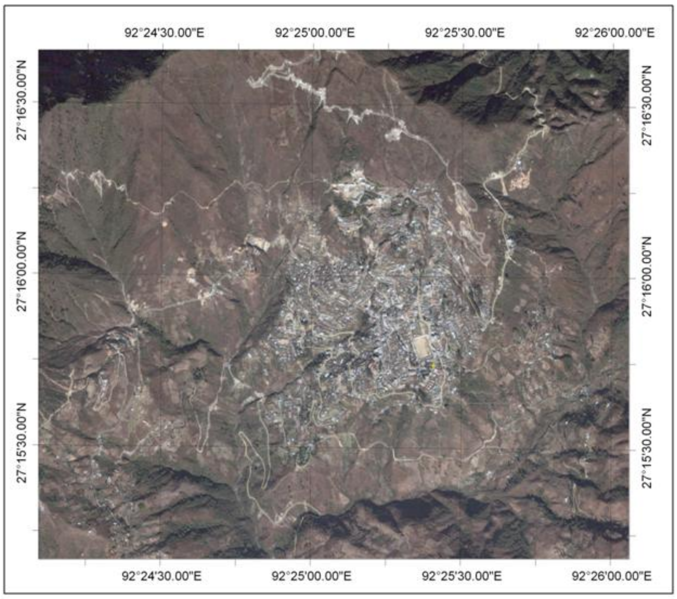


Figure:1. Bomdila Town and surrounding area. Source: Google Earth

This small township of Bomdila is growing at a faster rate and result is New Bomdila covering the western mountain facets of the adjoining river. Growth of urban houses in this picturesque town has been unplanned, uncontrolled and random. Government has no land record at cadastral level. However effort is going on for cadastral mapping and maintaining a land record. There is no guideline to build house or other buildings for private, public or corporate sector. There by individual land resources and choices are prime in building house in the town. This unplanned and uncontrolled growth of houses in the urban space has resulted in lack of proper access to houses, no residential streets for the residential areas. Government never cope up with the demand for basic amenities like water supply and power in the fast spreading localities. Additional demand for education institutions, health care centres, drainage and sewage facility are never met. Besides these drawbacks urban expansion continues in steep slope facets, along landslide prone facets and these houses are exposed to increased vulnerability to hazards.

Perceivable Hazards

Mountainous terrain is geomorphologically sensitive. These areas are prone to a variety of land hazard due to very active denudational processes. Geomorphological setup and environmental problems have been described in many texts including Coats (1973, 1978, 1985) Cooke and Doornkamp (1989), Costa and Fleisher (1984), Craig and Craft (1982), Fookes and Vaughan (1986), and Gregory and Walling (1981). Clague (1982) suggested that geomorphologists working with natural hazards have mainly concentrated on following five geological phenomena, using characteristic methods:

1. Floods: floodplain delineation, flood deposit recognition and dating, monitoring of changes in river channel position and pattern;
2. Mass movements: landslide mapping, interpretation and prediction, slope instability delineation;
3.Earthquakes: seismic landslide delineation, study of liquefaction potential, ground rupture and fault-scarp delineation and dating, study of disruption caused to drainage networks;
4. Volcanoes: lahar, lava flow, ashfall and tuff deposit studies, dating of events, erosion potential of weak volcanic deposits; and
5. Land degradation: studies of desertification and accelerated soil erosion.

In mountainous states of India like Himachal Pradesh, perception of natural hazard is high resulting from peculiar geomorphological condition, high relief of peripheral ridges and impact of monsoon winds (Sah et.al. 2007). Anthropogenic activities greatly induce environmental hazard in mountain landscapes. Linking cause and effect is especially difficult in mountain regions where physical processes can operate at ferocious rates and ecosystems are sensitive to rapid degradation by climate change and resource development (Marston, 2008). Besides natural hazards this highland inhabitants are also vulnerable to political-economic marginalization than populations elsewhere due to low concentration or population density and accessibility. Human ecological adaptation to natural hazard risk is far less than perceived threat from the hazard. Natural hazard risks are usually not hard to identify and can be made explicit by forms of microzonation in which geomorphological mapping is often an important ingredient

(Alexander, 1991). At a global scale the since year 1900, trend in disaster has sharply increased between 1996 and 2000 (Guha-Sapir D, 2012). Worldwide statistics as available with EM-DAT, The International Disaster Database shows that the geomorphology related disasters are very high in comparison to other disasters. In India between 1900 and 2011 there were 243 incidences of flood and disaster related to mass movements were on 43 occasions out of 604 reported disaster in the EM-DAT. Hazard assessments are mainly dependent upon geomorphological and geophysicall parameters. In general, such assessments comprise stages like mapping, modeling, prediction and management proposals, using field observations, photogrammetry, geographical information systems and remote sensing the zonation and mapping of different hazards is done (Irasema, 2002). In the mountain urban settlement of Bomdila the combined influence of geomorphological and tectonic instability, monsoon rainfall, anthropogenic activity has a tremendous impact on the houses built on the hazard prone areas. In the present context geomorphological and surface hydrological parameters have been used using GIS techniques to model and assess how the houses are exposed to hazards.

Methodology

Understanding dynamic phenomena such as urban growth requires land use change analyses, urban growth pattern identification and computation of landscape metrics. When urban growth over time is studied satellite images of different time frame forms the basis of analysis coupled with population and demographic data. When vulnerability is the main aim geomorphological and hydrological parameters for the urban area are the first requisite. Thereby the location specifications of buildings are more important and form a part of urban design. It is understood to include landscape as well as buildings, both preservation and new construction, and rural areas as well as cities. (Barnett, 1982, p. 12). City design is the art of creating possibilities for the use, management and form of settlements or their significant parts. Therefore, understanding the geomorphological and hydrological parameters and their relation to hazard forms the basis of this exercise. Parameters included in the model are: (i) Slope, (2) Aspect, (3) Curvature and (4) Distance from channel. To understand the relation between geomorphological and hydrological vulnerability, 827 different buildings covering or utility structures belonging to private, public and corporate ownerships have been identified and mapped.

Slope

Slope is a derivative of elevation. It is expressed as a ratio between difference in elevation and corresponding Euclidean distance between two points. Surface of earth being a three dimensional object has slope in two directions viz. along longitude and latitude. This is calculated using height differences in x and y directions. In directional filters DX and DY are used to calculate the height difference at an interval of pixel size. The derived values are used to calculate slope angle in radian using Euclidean Theorem. The slope is converted into percentage where 100 percent slope corresponds to 45^0 slope. DEM is derived from contour interpolation at 5m pixel and the same is used for calculation of slope. Slope categories have been derived using differential percentile breakup for the Bomdila town according to their suitability for construction of buildings or utility structures.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Table : 1. Slope categories.

Slope Class	Slope Limit Percent	Slope Limit Degree
Flat - Near Flat	10	5.71
Gentle Slope	20	11.31
Medium Inclined	30	16.70
Moderately Sloping	40	21.80
Moderately Steep	50	26.57
Steep	75	36.87
Very Steep	100	45.00
Hanging Slopes	>100	>45.00

Aspect

An aspect map shows to which side a slope is directed. It has great bearing on preferences for site selection for construction of dwelling units. Ubac slopes receive sunshine where as adret slopes remain under shadow of the hill itself. Bomdila is centred at about $27^0$16'N and $92^0$25'E, which is beyond Tropic of Capricorn. Thus sun shine received here is oblique throughout the year. Natural selection of site for housing is on the southern, eastern and western facets of the mountain range. Aspect is calculated using the DEM and directional filters and has a range from 0 to 360 degree. In the classified aspect map does not show the angle in radians or degrees but only a limited number of classes by designating aspect class as following:

Table: 2. Aspect Class

Aspect Class	Bearing Range	
North	0.0	22.5
North-East	22.5	67.5
East	67.5	112.5
South-East	112.5	157.5
South	157.5	202.5
South-West	202.5	247.5
West	247.5	292.5
North-West	292.5	337.5
North	337.5	360.0

Curvature

Earth is a three dimensional body with varying slope. An incremental slope will produce a convex form where as decreasing rate of slope will produce a concave form. This second derivative of slope is known as curvature. When DEM is used for the second derivative for slope shape in both X and Y direction, a negative value is returned by a convex terrain and a concave terrain will produce a positive value. Positive and negative curvatures correspond, respectively, to convergent and divergent topography and higher curvature corresponds to stronger convergence or divergence. This also corresponds to spreading out of surface runoff on convex plan form and concentration of surface runoff on concave plan form. The ranking of the landform elements from those with the highest erosion to those with the highest deposition in order will be: hill crests, faceted surfaces with no curvature, convergent foot slopes, level plains and river valleys. Houses located on positive curvature are safe as the dispersal of runoff and soil moisture. On the other hand houses on the negative curvature not safe as convergent flow of runoff and through flow affect stability of the house.

Table: 3. Curvature Class		
Curvature Class	Value Range	
Convex	<	-0.5
Slightly Convex	-0.5	0.0
Slightly Concave	0.0	0.5
Concave	>	0.5

Distance from channel

Rivers form life support system for settlement. Historically rivers have supported civilization in various parts of world. Rivers not only provide water for various requirements but also carve out plain areas by

- Fuzzy Algebraic Product : $\mu_{Product} = \prod_{i=1}^{n} \mu_i$
- Fuzzy Algebraic Sum: $\mu_{Sum} = 1 - (\prod_{i=1}^{n} (1 - \mu_i))$
- Fuzzy Gamma:

$$\mu_\gamma = (Fuzzy\ Algabric\ Sum)^\gamma * (Fuzzy\ Algabric\ Product)^{1-\gamma}$$

both erosion and deposition process viz. terraces, valleys, etc. In steep mountainous terrain channel banks are usually steep due to channel bed cutting. These areas are also prone to landslide due to convergence of flow close to channel and saturated bank slopes. Houses close to channel are vulnerable to rockslide, landslide and earth flow. Safe distance from river for house construction depends upon rock mass strength (Selby, 1980), which is expressed as a sum total of weights given for intact rock strength, magnitude of weathering, spacing, width, continuity and orientation of joints, presence of water. Or classifying slopes through Linear Discriminant Analysis provides a good estimate for stability or failure of slope that can be used as a factor for housing (In the hard rock terrain with steep slopes in Bomdila, horizontal distance of up to 50m, 100m, 200m and beyond are classed as most unfavourable, unfavourable, favourable and most favourable sites for construction activities. This layer has been generated using distance calculation from the rivers thereby creating a proximity area at various distances from rivers. Use of GIS for urban land evaluation and decision making processes dates back to early nineties. (Sui, 1992; Davidson, et.al.1994; Jankowski, 1994; Kliskey, 1995, Van der Merwe, 1997). Recently various models have been utilised to assess vulnerability for urban development (Nouri, et.al 2004; Verburg et al. 2004, Badenko, et.al 2004; Magliulo, et.al. 2008). For assessing suitability for settlement and housing in Bomdila, these four layers of geospatial data have been derived at spatial resolution of 5m. Each layer has a group of class intervals and these class intervals or land parcels have been given weights according to their suitability for construction of urban infrastructure and housing or on the basis as an adversity.

Table: 4. Fuzzy membership value as weights for all four parameters.

Slope Class	**Wt**
Flat - Near Flat	1.00
Gentle Slope	0.90
Medium Inclined	0.80
Moderately Sloping	0.70
Moderately Steep	0.50
Steep	0.50
Very Steep	0.80
Hanging Slopes	0.10

Aspect	**Wt**
North	0.10
North-East	0.25
East	0.50
South-East	0.75
South	1.00
South-West	0.80
West	0.70
North-West	0.25
North2	0.10

Curvature	**Wt**
Convex	0.70
Slightly Convex	0.90
Slightly Concave	0.80
Concave	0.10

Distance from River	**Wt**
Most Unfavourable	0.1
Unfavourable	0.25
Favourable	0.75
Mostfavourable	0.9

These four weight layers for the corresponding criteria are in value domain and are further processed for fuzzy sum and fuzzy product. For these parameters fuzzy algebraic sum ranges between 0.27 and 1.00 whereas Fuzzy algebraic product ranges between 0.00 and 0.90. As per the fuzzy modelling procedure the results are put for fuzzy gamma operation with a gamma value of 0.7. The result is integrated into one layer with gamma values ranging from 0.0299 to 0.9387 i.e. most unfavourable to most favourable sites occupied by these urban residential houses, non residential infrastructure and other utility buildings. The possible range of fuzzy gamma ranges from 0 to 1, thereby the ideal range is equally spread for four categories of site suitability viz. i) most unfavourable (0.00-0.25), ii) disadvantegious (0.25-0.50), iii) advantageous (0.50-0.75) and iv) most favourable (0.75-1.00).The buildings and other utility infrastructures have been mapped from Google Earth image and cadastral mapping by total station (Figure.2). Centroid (point layer) of each polygon is used for map integration so that each mapped unit (polygon) is represented only once when rasterised at the same 5m pixel size. The fuzzy gamma layer is map crossed with the suitability class layer that results in a cross tabulation of attributes for each residential, non-residential, other buildings in Bomdila Town.

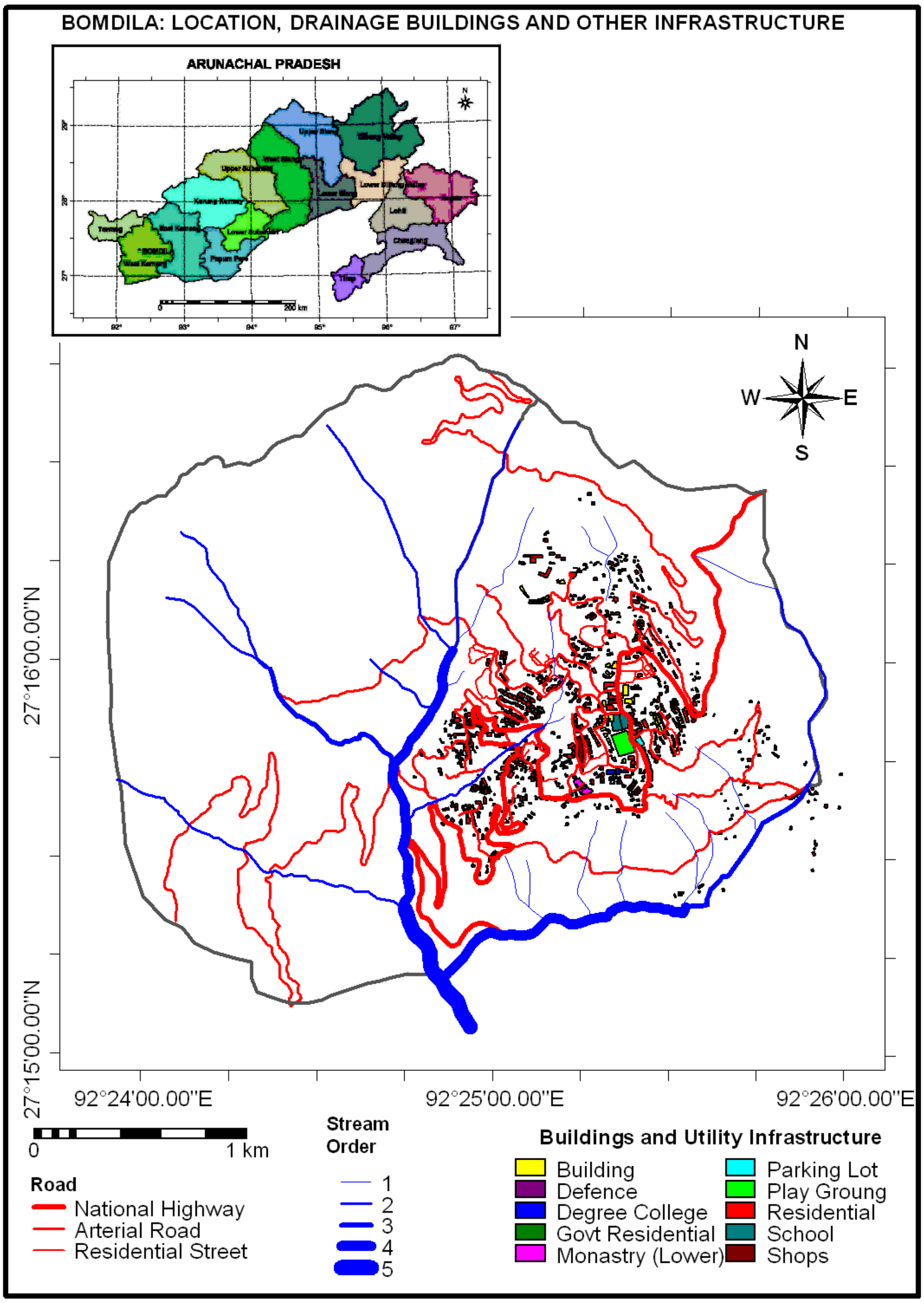


Figure 2 Bomdila: Location, Drainage Buildings and other Infrastructure.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Result and Discussion:

The derived results are in two dimension tabular form, where in each mapped unit acquires attribute from the control parameter. The result is tabulated as follows:

These cross tabulation results as follows. Each urban unit acquires the attribute of suitability class. There is not a single government residential or non-residential building in the unsuitable location of the town. There are 140 private residential houses, constituting about 17percent of total identified urban housing units constructed in the unfavourable location in the town

Table: 5. Slope v/s infrastructure

Slope	Building	Govt Residential	Residential	Total	Percentage
Flat - Near Flat	0	0	29	29	3.51
Gentle Slope	23	0	109	132	15.96
Medium Inclined	14	4	270	288	34.82
Moderately Sloping	4	1	295	300	36.28
Moderately Steep	0	0	23	23	2.78
Steep	1	0	50	51	6.17
Very Steep	0	0	4	4	0.48
Hanging Slopes	0	0	0	0	0.00
	42	5	780	827	100.00

Table: 6. Orientation v/s infrastructure

Orientation	Building	Govt Residential	Residential	Total	Percentage
North	0	0	6	6	0.73
North-East	0	0	0	0	0.00
East	0	0	12	12	1.45
South-East	1	0	65	66	7.98
South	16	1	181	198	23.94
South-West	19	4	364	387	46.80
West	6	0	133	139	16.81
North-West	0	0	19	19	2.30
	42	5	780	827	100.00

Table: 7. Curvature v/s infrastructure

Curvature	Building	Govt Residential	Residential	Total	Percentage
Convex	1	0	41	42	5.08
Slightly Convex	30	3	482	515	62.27
Slightly Concave	11	2	227	240	29.02
Concave	0	0	30	30	3.63
	42	5	780	827	100.00

Table: 8. Distance from Channel v/s infrastructure

Distance from channel	Building	Govt Residential	Residential	Total	Percentage
Most Unfavourable	0	0	90	90	10.88
Unfavourable	7	3	169	179	21.64
Favourable	14	1	348	363	43.89
Mostfavourable	21	1	173	195	23.58
	42	5	780	827	100.00

Table: 9. Fuzzy class v/s infrastructure

Fuzzy Suitability Class	Building	Govt Residential	Residential	Total	Percentage
Most unfavourable	0	0	12	12	1.45
Disadvantegeous	0	0	128	128	15.48
Advantageous	12	4	341	357	43.17
Most Favourable	30	1	299	330	39.90
	42	5	780	827	100.00

Bomdila town taken as a sample study to test this new model in analysing urban housing shows the urban growth is creating another dimension of anthropogenic vulnerability to hazard. When Government infrastructure and utility structures are following or have followed safe choice in site selection the private houses are constructed in vulnerable areas in the town which are also almost treated as no man's land as there is no land record system in the state. Urban growth is not only unplanned and random; it is unscientific in mountainous Arunachal Pradesh. These are clear alarm bells for the appropriate authority to evaluate and take urgent measure before it is too late. Buildings by laws or guidelines issued by Government at different level have missed in incorporating the new domain of knowledge in scientifically developing and expanding urban areas in mountainous area. While evaluating any site for construction, soil testing is done at best without considering the other aspect for safety and parameters that contribute to geomorphological hazard. With wide spread use spatial analytical tool through GIS site zoning for various purposes is the need of contemporary time for a mountainous state like Arunachal Pradesh. With growth of urban population in the state, this sort of uncontrolled growth and expansion is not only increasing hazard probability for infrastructure, but also forcing the occupants to health hazard.

References:

Alexander, D. (1991): Applied Geomorphology and the Impact of Natural Hazards on the Built Environment. Natural Hazards 4:57 80.

Badenko, V., & D. Kurtener (2004): Fuzzy Modelling in GIS Environment to Support Sustainable Land Use

Planning. 7th AGILE Conference on Geographic Information Science. PP. 333-342

Barnett, J. (1982) An Introduction To Urban Design. Harper & Row, New York.

Bhagat, R B. (2011): Emerging Pattern of Urbanisation in India. EPW Economic 10 & Political Weekly, XLVI, 34, pp10-12.

Bhagat R. B. & Mohanty S. (2009): Emerging Pattern of Urbanization and the Contribution of Migration In Urban Growth In India, Asian Population Studies, 5:1, 5-20

Coates, D. R. (ed.): (1973): Environmental Geomorphology and Landscape Conservation, Dowden, Hutchinson and Ross, Stroudsburg, Pennsylvania.

Coates, D. R. (ed.): (1978): Geomorphology and Engineering, Dowden, Hutchinson and Ross, Stroudsburg, Pennsylvania.

Coates, D. R. (1984): Geomorphology and public policy, in J. E. Costa and P. J. Fleisher (eds.), Developments and Applications of Geomorphology, Springer-Verlag, New York, pp. 97-132.

Coates, D. R. (1985): Geology and Society, Chapman and Hall, New York.

Cooke, R. U. and Doornkamp, J. C. (1989): Geomorphology in Environmental Management, (2nd edn) Oxford University Press, Oxford and New York.

Costa, J. E. and Fleisher, P. J. (1984): Developments and Applications of Geomorphology, Springer-Verlag, New York.

Craig, R. G. and Craft, J. L. (eds.) (1982): Applied Geomorphology, Unwin-Hyman, Winchester, Mass.

Davidson, D. A.; Theocharopoulos, S. P.; Bloksma R. J. (1994): A land evaluation project in Greece using GIS and based on Boolean and fuzzy set methodologies. International Journal of Geographical Information Systems 8(4), 369–384.

Fookes, P. G. and Vaughan, P. R. (1986): A Handbook of Engineering Geomorphology, Surrey University Press, London, and Chapman and Hall, New York.

Gregory, K. J. and Walling D. E. (eds.) (1981): Man and Environmental Processes, Butterworth, London.

Guha-Sapir D, Vos F, Below R, with Ponserre S. (2012 Annual Disaster Statistical Review 2011: The Numbers and Trends. Brussels: CRED.

Irasema Alca´ntara-Ayala (2002): Geomorphology, natural hazards, vulnerability and prevention of natural disasters in developing countries. Geomorphology, 47, 107–124

Jankowski, P.; Richard, L. (1994): Integration of GIS-based suitability analysis and multi-criteria evaluation in a spatial decision support system for route selection. Environment and Planning B: Planning and Design 21, 323–340.

Kliskey, A. D. (1995): The role and functionality of GIS as a planning tool in natural-resource management. Computers, Environment and Urban Systems 19(1), 15–22.

Kundu, A. (2001): Urban Development, Infrastructure Financing and Emerging System of Governance in India: A Perspective. UNESCO Discussion Paper No. 48 Volume 4, Number 15. http://www.unesco.org/most/kundu.htm. Date of Access: 17.11.2010.

Liu, Y. C., & C. S. Chen (2007): A new approach for application of rock mass classification on rock slope stability assessment. Engineering Geology 89, 129–143

Marston, R. A. (2008): 'Land, Life, and Environmental Change in Mountains', Annals of the Association of American Geographers, 98:3, 507-520.

Nouri, J & S. Malmasi (2004): Envrionmental impact assessment of urban development plan by vulnerability model application. International Journal of Environmental Science & Technology, 1, 1, pp. 7-15.

Sah, M.P. & R.K Mazari (2007): An Overview of the Geoenvironmental Status of the Kullu Valley, Himachal Pradesh, India. Journal of Mountain Science Vol 4:1. pp.003~023

Selby, M.J., (1980): A rock mass strength classification for geomorphic purposes: with tests from Antarctica and New Zealand. Zeitschrift für Geomorphologie 23, 31–51.

Shaw, A. (1999): Emerging Patterns of Urban Growth in India. Economic and Political Weekly, Vol. 34, No. 16/17 (Apr. 17-30,) pp. 969-978.

Sui, D. Z. (1992): A fuzzy GIS modelling approach for urban land evaluation. Computers, Environment and Urban Systems 16, 101–115.

Van der Merwe, J. H. (1997): GIS-aided land evaluation and decision-making for regulating urban expansion: A South African case study. GeoJournal 43: 135–151.

Verburg P.H., Ton C.M. de Nijs, J. R. van Eck, H. Visser & K. de Jong (2004): A method to analyse neighbourhood characteristics of land use patterns Computers, Environment and Urban Systems.28667–690

.

Address of Author

Dr. S. K. Patnaik,
Associate Professor,
Department of Geography,
Rajiv Gandhi University,
Doimukk, Arunachal Pradesh.
Pin 791112.
Mobile 9436042271

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Analytical Approach to Develop Geoinformatics Based Educational Information System for Pune University

Mr. S. V. Raybhan
suresh.raybhan@gmail.com

Abstract

University is the governing factor in education field. Pune University is one of the reputed Universities in India. It has several departments, colleges and number of courses. The mapping and database of Pune University will be beneficial to students, parents, teachers, administrators, and research community. Pune University has various educational institutes and colleges under its jurisdiction. Nowadays Geoinformatics is effectively applied in various fields like tourism, health facilities, utilities, navigation etc. Educational facility is one of the prime and important sectors.

Key-words: Remote Sensing, Geographical Information System,

Introduction

20^{th} century is known as Information Technology age and use of computer became obligatory. Internet has made this world smaller and bound together through its network. GIS is a tool that stores, analysis, manipulate and display the spatial and non-spatial data on the earth surface. Colleges and Universities are the main institutions that provide higher education. . A university is an institution of higher education and research, which grants academic degrees at all, levels (associate, bachelor, master, and doctorate) in a variety of subjects.

Aims and objectives

1. To develop information system for Pune University.
2. Create an educational database for Pune University.
3. To study the locational analysis and query base analysis for Pune University.

Study area

The study area of the project is Pune University and its jurisdiction which covers Pune, Ahmednagar and Nashik district.

The location of University is in the western part of Maharashtra. Pune University is expanded in 15 tahsils of Pune districts, 16 tahsils of Nashik district and 15 tahsils of Ahmednagar district. The study area lies between 73° 9' to 75°10' East longitude and 19°35' to 20°52' North latitude and has 48585 km^2area.

Data and methodology

The data is considered as a heart of the project. Data and Methodology are the important components of GIS. The selected topic for the study is Educational Information system; hence it contains variety of data regarding educational institutes. Name of the institute, its address, Name of Principal, offered courses, contact information etc are come under educational information.

A) Primary Data

- Questionnaire
- Personal Interview.

B) Secondary Data

- Cadastral Map of Pune University Campus
- Survey of India Toposheets.
- City Maps
- District census handbook of Pune, Nashik, and Ahmednagardistricts.

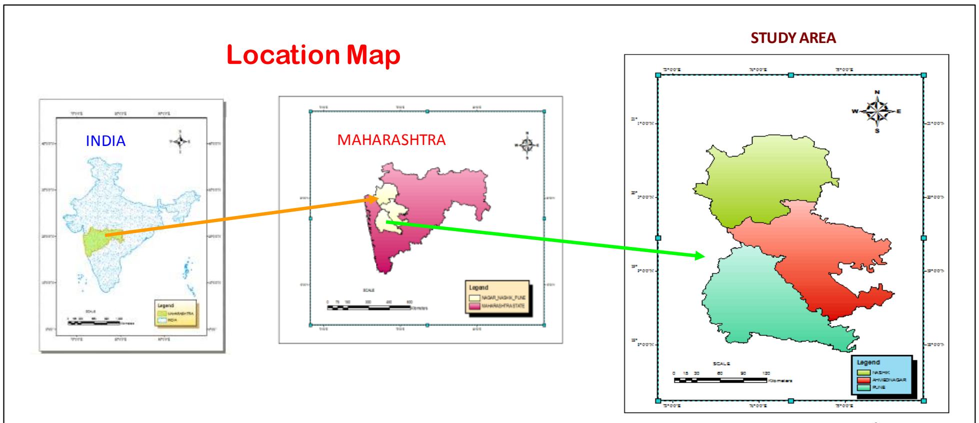


Fig.1

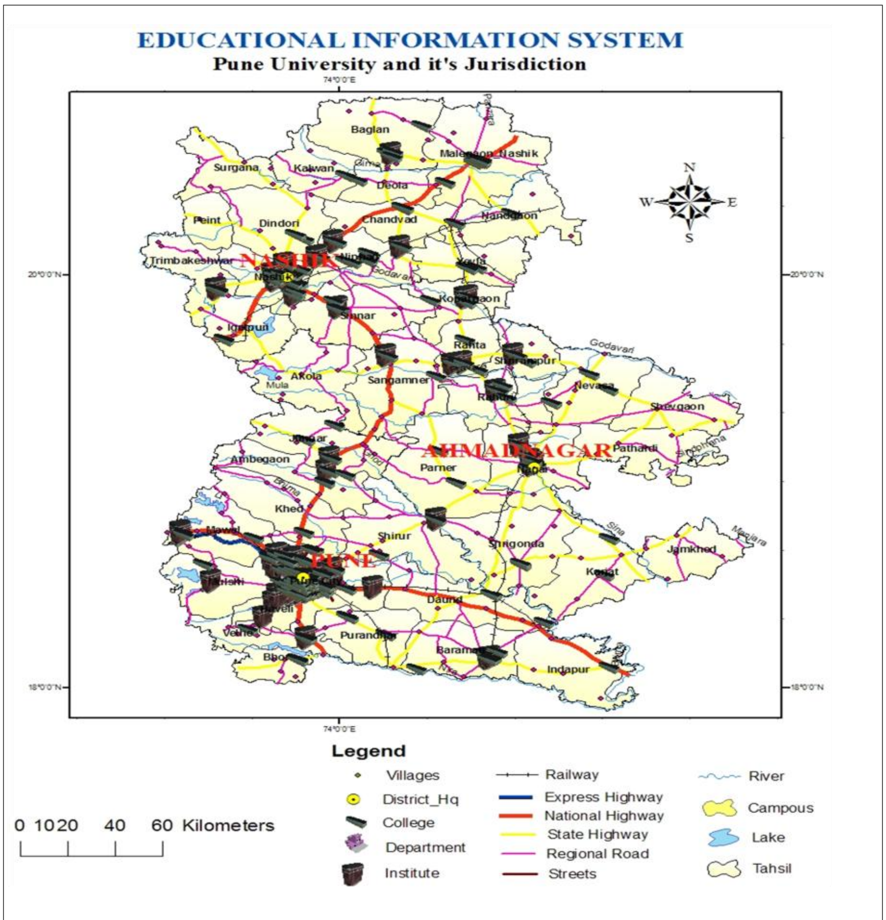


Fig 2 - Pune University Campus

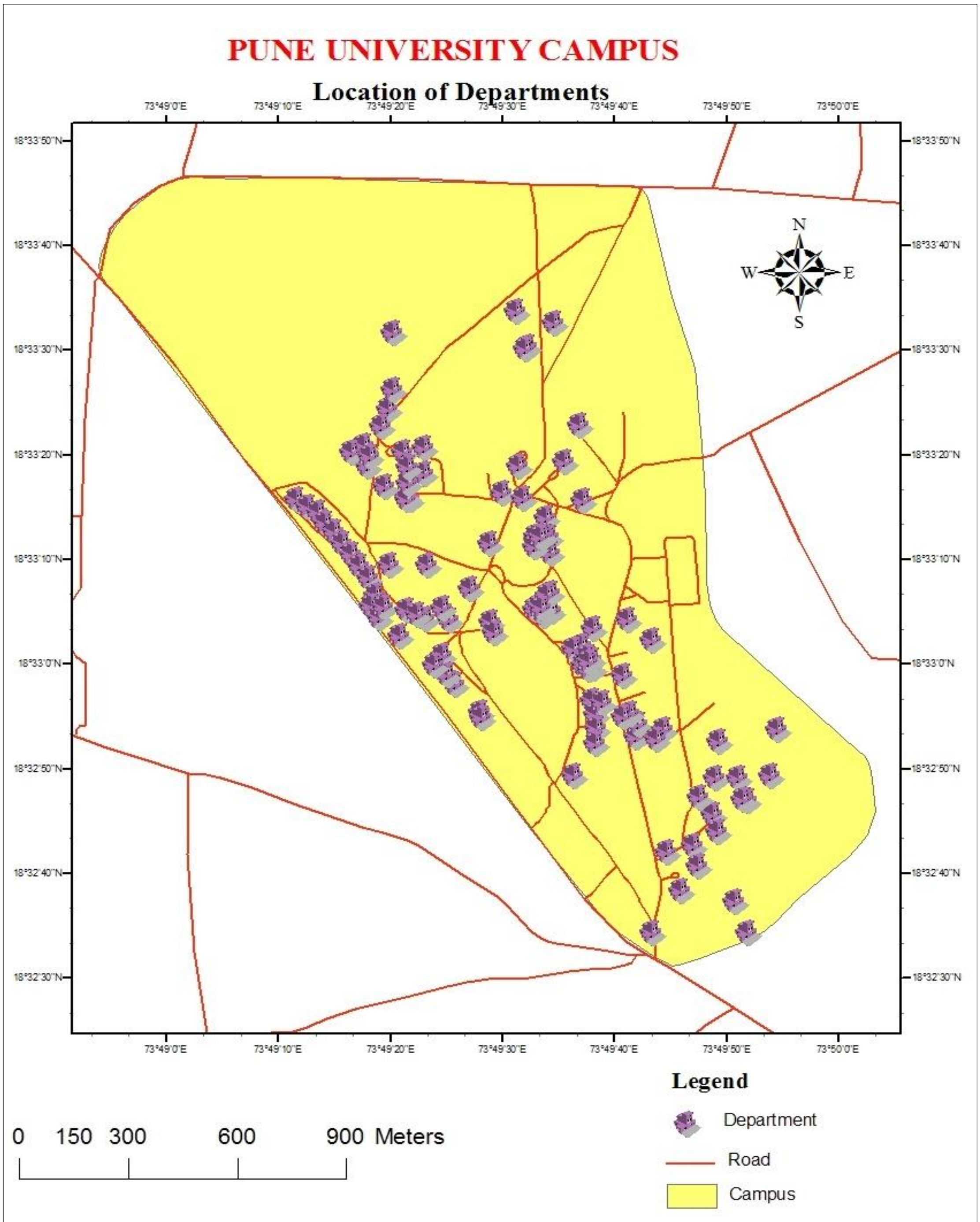


Fig.3 - Pune University Campus

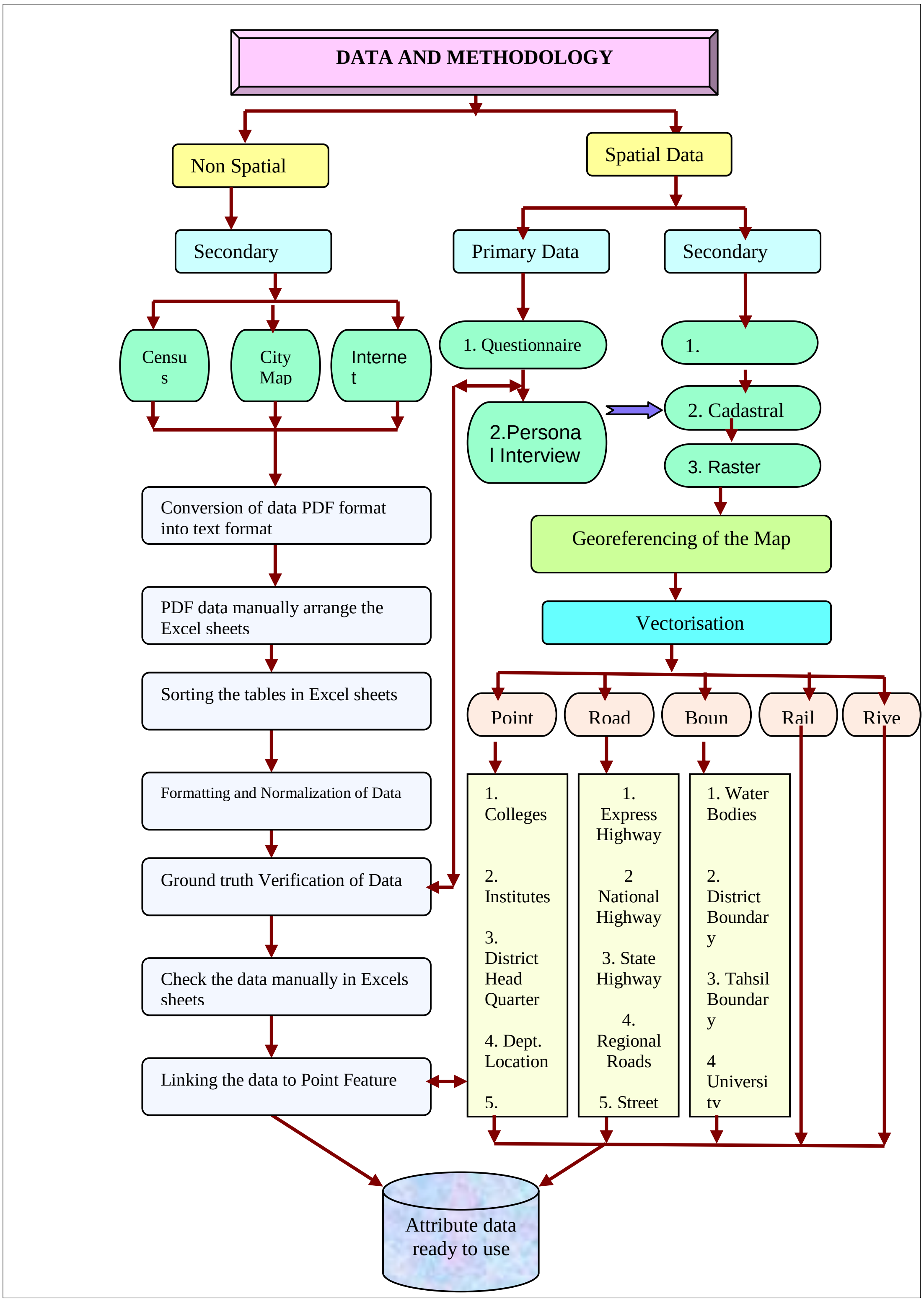

DATA AND METHODOLOGY
Non Spatial
Spatial Data
Secondary
Primary Data
Secondary
Censu s
City Map
Interne t
1. Questionnaire
1.
2.Persona l Interview
2. Cadastral
3. Raster
Conversion of data PDF format into text format
Georeferencing of the Map
PDF data manually arrange the Excel sheets
Vectorisation
Sorting the tables in Excel sheets
Point
Road
Boun
Rail
Rive
Formatting and Normalization of Data
1. Colleges
2. Institutes
3. District Head Quarter
4. Dept. Location
5.
1. Express Highway
2 National Highway
3. State Highway
4. Regional Roads
5. Street
1. Water Bodies
2. District Boundar y
3. Tahsil Boundar y
4 Universi ty
Ground truth Verification of Data
Check the data manually in Excels sheets
Linking the data to Point Feature
Attribute data ready to use

Fig. 4

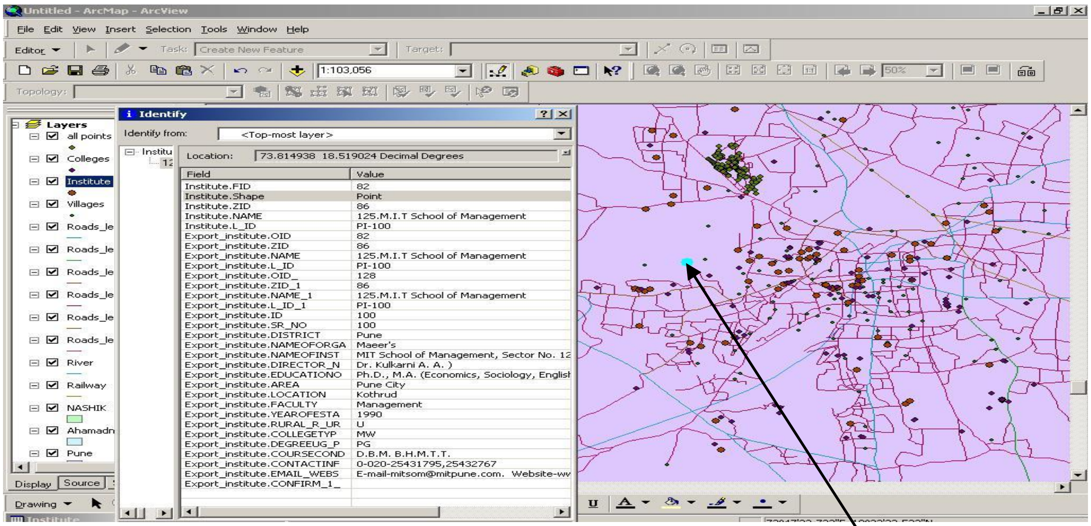


Fig. 5 - Educational center information of Institute

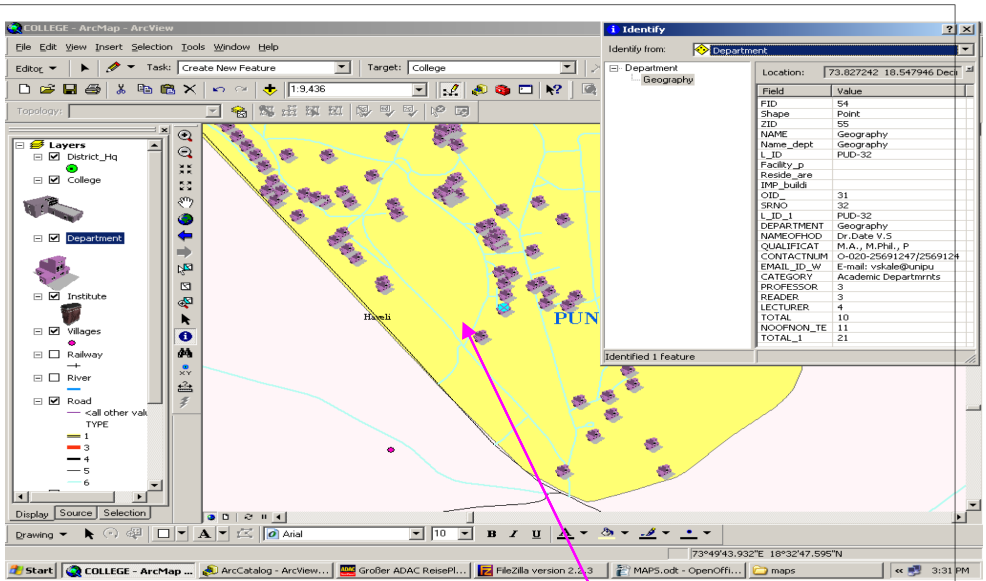


Fig. 6 - Department Information of Pune University Campus.

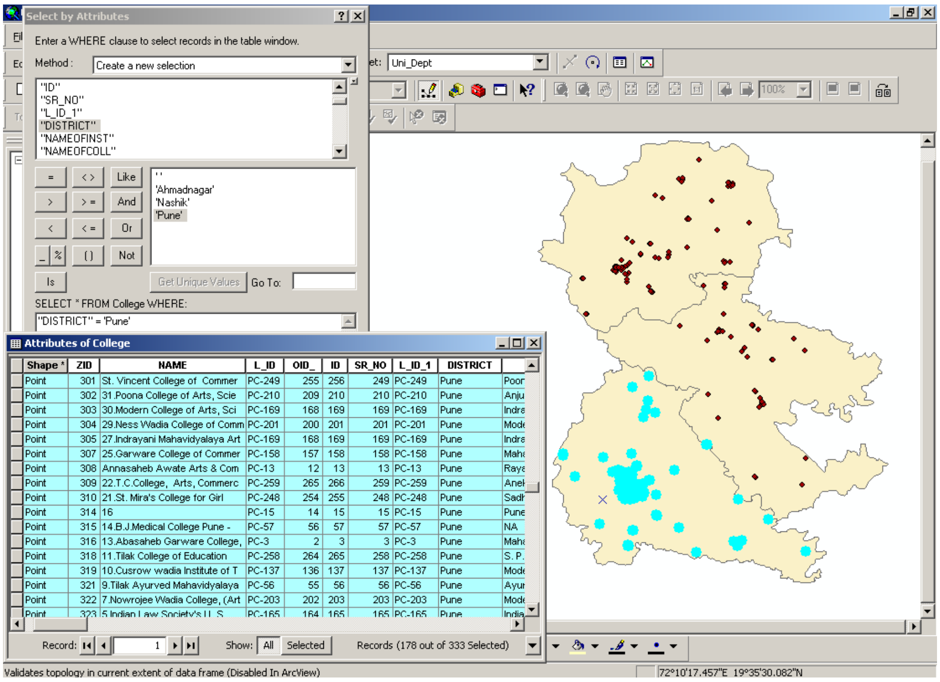


Fig. 7 - Colleges in Pune District

Result and discussion

Educational information of Pune University contains lot of information about educational centers in three districts. In this project both primary and secondary data is used. The analysis of collected data is done separately applying various tools as given below.

Using ArcGIS software, faculty wise distribution of colleges, Department Information's. The click based information system is showing the information about that particular educational center. The attribute data of that feature shows all related information like Name of College, Institute, Name of Head, Established Year, etc. All final maps are prepared with help of ArcGIS. The figure shows information of Geography department in Pune University campus. This is the basic information about that particular department. The name of department, name of Head of department, total number of Professors, Readers, Lecturers etc given as attribute information. The location of department is shown properly with its latitude and longitude reference. This figure is showing the Colleges in Pune district. Total University affiliated colleges are 333 within these Pune district is having 178 colleges it means approximately 50% of contribution gives Pune district. It is clearly shows that maximum numbers of colleges in Pune district.

Conclusion

The analytical approach to develop geoinformatics based education information system for Pune University is made for presenting educational centers and its important basic information as well as its location. To the Analysis of various educational institutes and collages under its jurisdiction in Pune, Ahmednagar and Nashik districts are come under Pune University. In Pune University jurisdiction there are total 530 colleges, 165 Institutes and 71 departments in University Campus. As per the Locational distribution there are 254 Rural, 276 Urban Colleges and 17 Rural, 148 Urban Institutes existing under Pune University.

This is a click base system which shows Information like Name of College / Institute, Name of Principal / Director, Year of Establishment, courses offered, etc. Some thematic maps like Road network, Drainage system, all colleges and Institute location, etc. are prepared for understanding its location as well as distribution. The analysis is done with help of maps and queries.

References

Burrough, P.A., (1986) “Principles of Geographical Information System for Land Resources Assessment”. Clarendon Press, New York.

Bernhardsen, Tor. (1999) “Geographic Information System: An Introduction”, John Wiley & Sons

Census of India, (1991) “District Census Handbook” – Pune, Nashik, Ahmednagar, Series 14

Address of Author

Suresh V. Raybhan
At-post - Gurudevnagar,
Sangola Road,
Near Ugale Hospital, Pandharpur,
Tal-Pandharpur,
Dist-Solapur pin-413304

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

The Geostatistical Approach in Soil Fertility and Mapping

Mr. S. Saikia & Miss. B. Medhi

Abstract

Farm managers are becoming increasingly aware of the spatial variability in crop production with the growing availability of yield monitors. Often this variability can be related to differences in soil properties (e.g., texture, organic matter, salinity levels, and nutrient status) within the field. To develop management approaches to address this variability, high spatial resolution soil property maps are often needed. Some soil properties have been related directly to a soil spectral response, or inferred based on remotely sensed measurements of crop canopies, including soil texture, nitrogen level, organic matter content, and salinity status. Pedologists want sound quantitative measures of spatial variation in soil, and they are turning increasingly to geostatistics to provide them. They are treating the soil's properties as the outcomes of random processes and characterizing their variation by variograms. Ordinary kriging is proving sufficiently robust for estimating values at unsampled places in most cases. More sophisticated technique is needed where there is evident trend; it includes universal kriging and restricted maximum likelihood (REML) to estimate the parameters of the underlying models. Simulation is needed to portray the full magnitude of the variation and to generate distributions in assessing risk and sampling effects. There is a correspondence between the geostatistical expression of variation and fractals, but whether variation in the landscape is fractal remains moot.

Introduction

Soil is a fundamental natural resource; it is the basis of human agriculture. Civilizations rise in regions blessed with rich soil; they fall when humans fail to treat soil with respect. Further, soil plays an essential role in the biophysical and biogeochemical functioning of the planet. On the continents, soil forms a porous boundary where the biosphere, hydrosphere, lithosphere and atmosphere interact. The processes of soil formation over landscapes, along with management-induced soil changes (e.g., accelerated erosion with tillage, compaction, etc.), have created soil variations within cropped fields that impact crop production. Yield monitoring has demonstrated to farmers that much of the yield variability within fields is associated with soil and landscape properties. Numerous soil properties influence the suitability of the soil as a medium for rooting. Some of these important properties include soil water holding capacity, water infiltration rate, texture, structure, bulk density, organic matter, pH, fertility, soil depth, landscape features (e.g., slope and aspect), the presence of restrictive soil layers, and the quantity and distribution of crop residues. These properties are complex and vary spatially and temporally within fields. The emergence of variable-rate application technology has generated a need to quantify these variations at relatively fine spatial resolutions. Statistically interpolating between sample points taken over a fixed grid has been used in the past; however, this approach is not always feasible due to the time and cost associated with sample collection. Thus, more emphasis is now being placed on the use of remotely sensed data to quantify differences in soil physical properties. To increase agricultural production in the country by increasing areas in no longer possible as left over cultivable land is only marginal. Further a considerable area under cultivation is being diverted year after year for industrial and housing purpose. Hence, self sufficiency in food lies in increasing crop yield per unit areas in time through adaptation of modern agricultural technology and appropriate nutrient management. The nutritional requirement of different crops i.e., plantation crops, cereals, fodder etc, could not be fully met with the use of organic manures viz. FYM and other bulky manures like Neem cake, Castor cake and Groundnut cake. So, there is a need for efficient use of chemical nutrients for enhancing farm productivity. Plants require 16 essential elements for their normal growth and development. Carbon, Hydrogen and Oxygen are naturally occurring nutrients and are major components of carbohydrate, proteins and fats. N, P and K are the three major/primary nutrients which are needed in large quantities by crops. Nitrogen is an integral component of many compounds including chlorophyll and enzyme essential for plant growth. It is an essential constituent for amino acids which is building blocks for plant tissue, cell nuclei and protoplasm. It encourages above ground vegetative growth and deep colour to leaves. Deficiency of nitrogen decreases rate and extent of protein synthesis and results into stunted growth and develops chlorosis. Phosphorus is important component of adenosine di-phosphate (ADP) and adenosine tri-phosphate (ATP), which involves in energy transformation in plant. It is essential component of deoxyribonucleic acid (DNA), the seat of genetic inheritance in plant and animal. Phosphorus takes part in important functions like photosynthesis, nitrogen fixation, crop maturation, root development, strengthening straw in cereal crops etc. The availability of phosphorus is restricted under acidic and alkaline soil reaction mainly due to P-fixation. In acidic condition it gets fixed with aluminium and iron and is alkaline condition with calcium. Potassium is an activator of various enzymes responsible for plant processes like energy metabolism, starch synthesis, nitrate reduction and sugar degradation. It is extremely mobile in plant and help to regulate opening and closing of stomata in the leaves and uptake of water by root cells. It is important in grain formation and tuber development; it encourages crop resistance for certain fungal and bacterial diseases. Out of 18 plant nutrients known to be essential for plant growth, 9 are required in small quality and that's why they are called micronutrients. Copper (Cu), Zinc (Zn), Manganese (Mn) and Iron (Fe) are considered most important cationic micronutrients as their deficiency can be severe in terms of stunted growth, low yield, dieback and even plant death. The DTPA soil tests of Lindsay and Norvell (1978) has been used to assess the status of available cationic micronutrients. The critical level of deficiency of Cu, Zn, Mn and Fe are given below, so that the corrective measures can be applied for overcoming micronutrient deficiency problem (Deb et al. 2009).

Nutrients	**Critical level in soil (mg kg^{-1})**	**Fertilizer sample**
Fe	2.5-5.8	Ferrous Sulphate
Mn	2.0-4.0	Manganese Sulphate
Zn	0.5-1.0	Zinc Sulphate
Cu	0.2-0.5	Copper Sulphate

Today's most concern in agriculture is the maintaining the sustainability in crop production. Recently a noticeable decline in production of many intensively cultivated areas has been observed. The yield decline is attributed to soil degradation through nutrient depletion and loss of soil quality. In future food production and its sustainability will mainly depend on soil fertility related issues relating to the adequacy and balanced supply of nutrients. Optimum productivity of any cropping systems depends on adequate supply of plant nutrients.

Soil fertility is an aspect of the soil-plant relationship. Fertility status of the soils is primarily and importantly dependently dependent upon both the macro and micronutrient reserve of the soil. Continued removal of nutrients by crop, with little or no replacement will increase the nutrient stress in plants and ultimately lower the productivity. The fertility status of the soils mainly depends on the nature of vegetation, climate, topography and texture of soil and decomposition rate of organic matter.

Reliable information on soil fertility may be obtained from soil resource studies. Soil survey provides a map of different soil orders, together with a record of measured observations for each sampling location. Spatial distribution of soil provided by soil survey is sufficient to make decisions for land use; more detailed information is needed for precision farming process (Eswaran and Kimble 2003). Precision farming is a management practice that has been enabled by Geospatial Information Technology (GIT) application and provides the framework within which arable managers can more accurately understand and control more precisely within which arable managers can more accurately understand and control more precisely what happens on their farm (Mc Cauley et al. 1997). Precision farming has become increasingly significant in the agricultural operation for the site-specific management. The management and manipulation of farming operation are vital decision-making process in improving crop productivity where there is a need to ensure efficiency in the management of agriculture. Information on soil properties in crop field/village level/block level/ or state level is very important and useful for fertilizer requirement and also to the specific management of the crop and soil. The availability of nitrogen, phosphorus, potassium, organic carbon and cationic micronutrients (Cu, Zn, Fe and Mn), whether in soils or plants is among of the most of the nutrient studied in precision farming concept.

In precision farming, the concept of 'management zone' was evolved in response to this large variability with the main purpose in efficient utilization of agricultural inputs with respect to spatial variation of soils and its properties (Franzluebbers and Hons 1996; Atherton *et al*. 1999; Malhi *et al*. 2001). The most important way to gather knowledge in this aspect is to prepare soil maps through spatial interpolation of point-based measurements of soil properties (Priyabrata Santra *et al*. 2008, Reza *et al*. 2010).

From an applied perspective, pedology and soil geography form the basis of soil survey, which remains the primary means by which information on the spatial properties of soil is collected, presented and archived in the USA and throughout the world. The United States Department of Agriculture (USDA), in cooperation with other federal and state agencies, began soil survey work in 1896. The combined state and federal government effort became known as the National Cooperative Soil Survey (Indorante *et al*., 1996). Its mission was to furnish private landowners, land managers and consultants with soil maps to aid in land-use decision making. More recently, however, soil maps have been used to provide chemical and physical data input within ecological and hydrological process models (Burrough and McDonnell, 1998: 163). The soil survey program was simply not designed to furnish data for such applications. The increasingly sophisticated use of soil data has led to a greater demand for data about soil properties than the conventional soil map can accommodate (Cook *et al*., 1996). Traditional soil survey concepts are based on qualitative recognition of soil properties in relation to landscape and environmental variables. Although these methods implicitly incorporate the expertise of the soil scientist, they do not make use of geocomputational technologies that are now widely available.

Technological advances during the last few decades have created a tremendous potential for improvement in the way that soil maps are produced (McKensie *et al*., 2000). Remote sensing and photogrammetric techniques provide spatially explicit, digital data representations of the Earth's surface that can be combined with digitized paper maps in geographic information systems (GIS) to allow efficient characterization and analysis of vast amounts of data. The future of soil survey lies in using GIS to model spatial soil variation from more easily mapped environmental variables. Predictive soil mapping (PSM) begins with the development of a numerical or statistical model of the relationship among environmental variables and soil properties, which is then applied to a geographic data base to create a predictive map (Franklin, 1995).

Geostatistical methods can provide reliable estimates at ensample locations provided that the sampling interval resolves the variation at the level of interest (Kerry and Oliver 2004). Spatial prediction techniques, also known as spatial interpolation techniques, differ from classical modelling approaches in that they incorporate information on the geographic position of the sample data points (Cressie 1993). The most common interpolation techniques calculate the estimate for a property at any given location by a weighted average of nearby data. A number of factors affects map quality including the nature of the soil variability (Sadler et al. 1998), intensity of sampling and method of interpolation. The variety of available interpolation methods has led to questions about which is most appropriate in different contexts and has stimulated several comparative studied of relative accuracy. Among statistical methods, geostatistical kriging-based techniques (Deutsch 2002) and among deterministic interpolation methods, inverse distance weighting (IDW) method (Nalder and Wein 1998) are the most often applied. Both models estimate values at unsample locations based on the measurement at surrounding locations with certain assigned weights for each measurement. From a theoretical stand point, kriging is the optimal interpolation methods(Issaks and Srivastava 1989); however, its correct application requires an accurate determination of the spatial structure via semivariogram construction and model-filling.

Geostatistics

It can be defined as the tools for studying and predicting the spatial structure of georeferenced variables, have been mainly used in soil science during the past two decades. The use of geostatistical tools in soil science is diverse and extensive. It can be for studying and predicting soil contamination in

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

industrial areas, for building agrochemical maps at the field level, or even to map physical and chemical soil properties for a global extent. The users of the output maps are going from soil scientists to environmental modelers. One of the specificity of Geostatistical outputs is the assessment of the spatial accuracy associated to the spatial prediction of the targeted variable. The results which are quantitative are then associated to a level of confidence which is spatially variable. The spatial accuracy can then be integrated into environmental models, allowing for a quantitative assessment of soil scenarios.

Geostatistics are one of the most popular tools of pedometrics (the application of mathematical and statistical methods for the study of the distribution and genesis of soils), as well as digital soil mapping which is defined as the creation and the population of geographically referenced soil databases generated at a given spatial resolution by using field and laboratory observation methods coupled with environmental data through quantitative relationships. In pedometrics, geostatistics are then exploratory tool for understanding the distribution and the genesis of soil whereas in digital soil mapping they have mapping as finality. Geostatistics are also valuable supplement to classical soil mapping since they allow for recovering data knowledge hidden in traditional soil maps.

Geostatistics has been applied in soil science for more than 20 years (Burgess and Webster 1980; Webster 1994; Zhang et al. 2000). It uses the semivariogram to quantify the spatial variation of a regionalized variable. The fitted function to the experimental variogram provides the expected squared difference between paired data values z(x) and z(x + h) to the lag distance h, by which locations are separated (Webster and Oliver 2001).

Where z (x_i) is the value of the variable Z at location of x_i, h is the lag distance and N(h) is the number of pairs of sample points separated by h. for irregular sampling, it is rare for the distance between the sample pairs to be exactly equal to h. therefore, the lag distance h is often represented by a distance band.

Using the model semivariogram, basic spatial parameters such as nugget (C_o), sill $(C + C_o)$ and range (A) was calculated which provide information about the structure as well as the input parameters the kriging interpolation. Nugget is the variance at zero distance, still is the lag distance between measurements at which one value for a variable does not influence neighbouring values and range is the distance at which values of one variable becomes independent of another (Lopez-Granadoz et al. 2002)

$$\gamma(h) = \tfrac{1}{2} E \left[z(x) - z(x+h) \right]^2$$

The usual computing equation for the variogram is:

$$\gamma(h) = \frac{1}{2N(h)} \sum_{i=1}^{N(h)} \left[z(x_i) - z(x_i + h) \right]^2$$

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Accuracy Assessment:

Accuracy of the soil maps was evaluated through cross-validation approach (Davis 1987). Among three evaluation indices used in this study, mean absolute error (MAE), and mean squared error (MSE) measure the accuracy of prediction, whereas goodness-of-predication (G) measures the effectiveness of prediction. MAE is a measure of the sum of the residual (e.g. predicted minus observed) (Voltz and Webster. 1990).

$$MAE = \frac{1}{N} \sum_{i=1}^{N} \left[z(x_i) - \square(x_i) \right]$$

Where $\hat{z}(x_i)$ is the predicted value at location i. small MAE values indicate few errors. The MAE measure, however, does not reveal the magnitude of error that might at any point and hence MSE will be calculated,

$$MSE = \frac{1}{N} \sum_{i=1}^{N} \left[z(x_i) - \hat{z}(x_i) \right]$$

Squaring the difference at any point gives an indication of the magnitude, e.g. small MSE values indicate more accurate estimation, point-by-point. The G measure gives an indication of how effective a prediction might be related to that which could have been derived from using the sample mean alone (Schloeder et al. 2001).

$$G = \left(1 - \frac{\sum_{i=1}^{N} \left[z(x_i) - \square(x_i) \right]^2}{\sum_{i=1}^{N} \left[z(x_i) - z \right]^2} \right) \times 100$$

Where z is the sample mean. If G= 100, it indicates perfect prediction, while negative values indicate that the prediction are less reliable than using sample mean as the predictors. The comparison of performance between interpolation was achieved by using mean absolute error (MAE).

Conclusion

Pedologists have made very substantial progress in applying geostatistics and in understanding the nature of soil variation. They now have the confidence to explore new situations and hitherto little known regions. The contributions that follow, largely describing the results of case studies, show that the spirit of adventure that got us started is alive and well. Let us also realize also, however, that we do not have technical answers to every question and that there are still problems to solve. Practice and theory need to advance together.

References:

Burrough P.A. 1983. Multiscale sources of spatial variation in soil. II. A non-Brownian fractal model and its application in soil survey. *J. Soil Sci.*, v. 34, p. 599-620.

Deutsch C.V., Journel *A.G.* 1998. *GSLIB:*

Geostatistical Software Library and User's Guide, second edition. Oxford University Press, New York.

Eswaran, H and Kimble,J.2003. Land quality assessment and monitoring: The next challenge for soil science. *Pedosphere* 13, 1-10.

Goovaerts P. 1997. *Geostatistics for Natural Resources Evaluation*. Oxford University Press, New York.

Kolmogorov A.N. 1939. Sur l'interpolation et l'extrapolation des suites stationaires. *Comptes Rendus de l'Academie des Sciences de Paris*, v. 208, p. 2043-2045.

Krige D.G. 1966. Two-dimensional weighted moving average trend surfaces for ore-evaluation. *J. South Afr. Inst. Min. Metall.*, v. 66, p. 13-38.

Lark R.M., Cullis B.R. 2004. Model-based analysis using REML for inference from systematically sampled data on soil. *Europ. J. Soil Sci.*, v. 55, p. 799-813.

Lark R.M., Webster R. 2006. Geostatistical mapping of geomorphic variables in the presence of trend. *Earth Surface Processes and Landforms*, v. 31, p. 862-874.

Matheron G. 1965. *Les variables regionalisees et leur estimation*. Masson, Paris.

Olea R.A. 1975. *Optimum Mapping Techniques using Regionalized Variable Theory*. Series in Spatial Analysis No 2. Kansas Geological Survey, Lawrence, Kansas.

Reza, S.K., Sarkar,D., Baruah, U. and Das, T.H. (2010). Evaluation and comparision of ordinary kriging and inverse distance weighting for prediction of spatial variabity of some chemical parameters of Dhalai district, Tripura. *Agropedology* 20, 38-48.

Webster R. 2000. Is soil variation random? *Geoderma*, v. 97, p. 149-163.

Webster R., Oliver M.A. 1992. Sample adequately to estimate variograms of soil properties. *J. Soil Sci.*, v. 43, p. 177-192.

Webster R., Oliver M.A. 2007. *Geostatistics for Environmental Scientists*, second edition. John Wiley & Sons, Chichester.

Zimmerman D.L. 1989. Computationally ancient restricted maximum likelihood estimation of generalized covariance functions. *Math. Geol.*, v. 21, p. 655-672.

Address of Author

Sailajanada Saikia
C/o Prof. B.K. Medhi
'SNEHANIKETAN', L.N.B. Road,
Ward No. 4
Mangaldai-784125, Darrang
Assam.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

A Geographical Study of Tourist Profile –A Case Study of Sinhgarh Fort in Pune District of Maharashtra

Mr. B. N. Konade, Dr. S. C. Adavitot, & Dr. R. J. Jaibhaye

Abstract

Tourism is one the largest and fast growing industries in the world today. The present paper aims to highlights the comprehensive nature of tourists profile of Sinhgarh fort which is located in Pune District of Maharashtra.For this purpose primary and secondary data has been collected and the collected data is analysed with the help of stastical and cartographic techniques. Due to the close proximity to Pune city the total 334 tourists were interviewed at the tourist destination with help of schedule. The study reveals that Sinhgarh fort is one of the historical places, the different types of tourists having different income group and more than 65 per cent of tourists belongs to educational group were visited

Introduction

Tourism is one the largest and fast growing industries in the world today. Tourism activity had been remarked as being the major source of foreign exchange and economic growth in many developing and developed countries. Tourism has wider implications encompassing not only economic benefits but also social and cultural as well. Cultural tourism is a fertile ground for exercising creative talents fostering special kind of relations between the visitors and the host populations. It encompasses economic, social, cultural, educational and political significance. The socio-economic and technological advancement of society have resulted infrastructural development and consequently improvement of standard of living.

Study region

Sinhgarh is located in Western Maharashtra. This study region lies in ‘Sinhgarh Ghera’ Grampanchat, Haveli Taluka of Poona district. The Sinhgarh it is triangular in shape with its base in the Sahyadri Mountains. The latitudinal extent of Sinhgarh is between $18^{0}21^{l}18^{ll}$ to $18^{0}22^{l}\ 12^{ll}$ North latitude and longitudinal extent is between $73^{0}45^{l}00^{ll}$ east to $73^{0}45^{l}54^{ll}$ east of Greenwich and covered approximately 2.5 sq km in area. Sinhgarh hill fort in the Haveli taluka situated about 25 km south west of Poona city. The Sinhgarh located on one of the highest point of the Sinhgarh Bhuleshwar range 4322 feet above sea level and about 2300 feet above the plain.

Objectives

The main objective of the present paper is to make comprehensive study of tourists’ profile of Sinhgarh fort.

Methodology and data sources

There are various sources of collection of data they are both primary and secondary was applied in this study. The secondary data are collected from government unpublished records, books, news papers, magazines, research papers, districts census hand-book.

The unpublished data have been generated by designing relevant questionnaire. The questionnaires includes nationality, age, gender, religion, education level, marital status, occupations, income group of tourists, frequency of revisit, purpose of visit, inspiration, sex group and satisfaction level.

The data collected through primary source and then formulated in tabulation and converted into percentage. This tabulated data were presented with cartographic techniques such as figure, charts, bar graphs etc. For other information the other references are used such as toposheets, maps, and quantitative techniques e.g. mean and computer techniques etc. The different approaches were studied and suitable cartographic methods were adopted in text for analysis and interpretation of various aspects of tourists in this paper.

Nationality:

The data shows that the tourists visiting Sinhgarh fort were belongs to Indian nationality.

State wise distribution of tourists

The state wise distribution of tourists has shown in Table 1.1. Which shows that the highest proportion (98.20 per cent) of tourists visits from own state i.e. Maharashtra. It is due to familiarity of the place, nearness and link with road ways. The proportions of the tourists from other Indian states are insignificant.

Administrative Division wise distribution of tourists

Division wise distributions of Maharashtraian tourists have shown in (Table no. 1.1). The survey has also accounted visitors visiting from 15 districts of Maharashtra. It is clear from this table that highest per cent of tourists came from Pune division and ranks first and it occupies 83.18 per cent, followed by Maratwada division tourists visit to Sinhgarh. The remaining Mumbai division shared very less that is 7.95 per cent of tourists visited to Sinhgarh

Age group and sex

The information regarding age group and sex of tourists has shown Fig.1.1. It reveals that young generations are more interested in tourism activity. Generally, people of all age-groups visit to Sinhgarh fort but dominating age group is 20-40 years (69.27 per cent male and 65.89 per cent female) followed by the age group 0-20 years (26.36 per cent male and 26.36 per cent female).This is indicative that more than 90per cent of the tourists are young adults.

Religion of tourists

The tourists study of Sinhgarh with respect to their religion wise classification given in Table 1.2. According to the facts of the survey, Sinhgarh had visitors of five different religions. Despite the monument being created by the rulers of the Pro – Hindu based kingdom.

The Hindus (96.21 per cent) constitute a dominant proportion among all the tourists and followed by Jain, Muslim and Christians. The least represented religion was Sikhism faiths only one lone visitor is noted that is 0.30 per cent.

Table No.1.1 State and Administrative wise tourist visited (Sinhgarh Fort)

Sr. No	State/ Administrative Div.	Number of tourist	Per centage of tourist
1	Maharashtra	327	98.20
2	Karnataka	3	0.90
3	Madhya Pradesh	2	0.60
4	Bihar	1	0.30
Administrative Division			
1	Pune	272	83.18
2	Mumbai	26	07.95
3	Maratwada	29	8.86
	Total	**327**	**100**

Fig. No. 1.1.Sinhgarh Fort

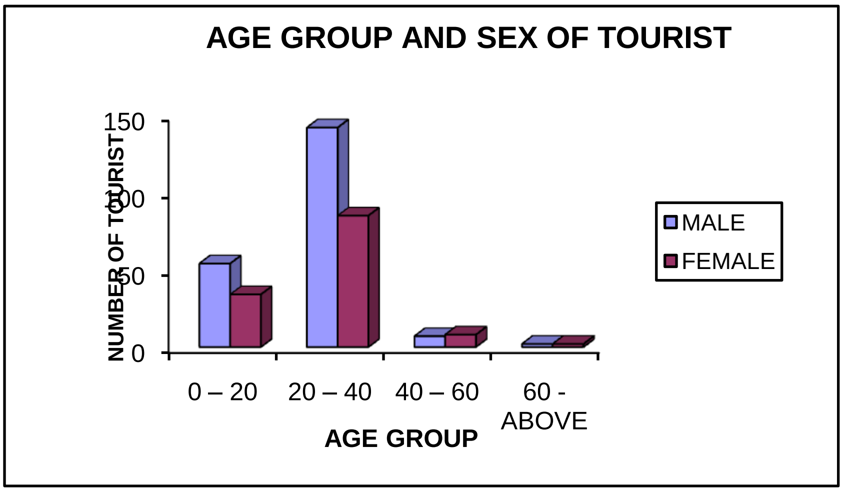


Table no.1.2 Sinhgarh Fort Distribution of tourists According to Socio- Economic and Cultural Determinants

Sr.No.	Socio-Economic, Cultural Determinate	Groups	Tourists	
			In Numbers	In Percentage
1	Age wise	0 – 20	88	26.34
		20 – 40	227	67.96
		40 – 60	15	4.49
		Above 60	4	1.19
2	Education	Primary	1	0.30
		Secondary	38	11.38
		Higher – secondary	42	12.58
		Degree – level	136	40.72
		P. G. & more	117	35.03
3	Religion	Hindu	323	96.71
		Muslim	03	00.90
		Sikh	01	00.30
		Christians	03	00.90
		Jain	04	01.20
4	Profession	Education & student	165	49.40
		Software industry	17	5.09
		Government employee	79	23.65
		Industry	18	5.39
		Agriculture	51	15.27
		Business	4	1.20
5	Income	< 50,000	86	25.75
		50000 to 100,000	20	8.38
		100,000 to 150,000	17	5.09
		1,50,000 & More	25	7.49
		No earnings	178	53.29
6	Purpose	Pleasure	101	30.24
		Friend & relative	86	25.75
		Health	60	17.96
		Study tour	35	10.48

		Historical importance	34	10.18
		Business	16	4.79
		Official	2	0.60
7	**Accompany**	Friends	202	60.48
		Own & other family	85	25.45
		Independently	20	5.99
		Tour operator	20	5.99
		Two reason	7	2.10
8	**Inspiration of tourist**	Friends & relative	161	48.20
		Books & journals	29	8.68
		Information center	15	4.49
		News paper and media	37	11.08
		Friends	71	21.26
		Self induced	21	6.29
9	**Frequency**	One	175	52.40
		Two	75	22.46
		Three	34	10.18
		Four & more time	50	14.96

(Source- Field Work 2010)

Education level of tourists

Education level is one of the important indicators of social as well as economic status. Higher the level of educational attainment higher is economic status. Education level of tourists has shown in the Table 1.2. It is generally found that the tourists are highly educated. As per the survey conducted it is found that there were 35.05 per cent of tourists are post-graduate and 40.72 per cent of tourists attained degree level education.

Other major noted levels of education are higher secondary level that was 12.58 per cent and secondary level educated were about 11.38 per cent of the total visitors, and only one tourist attained primary level education.

Marital status of tourists:-

The marital status of tourist shows that, out of 334 tourists 214 were unmarried. The proportion of unmarried is 64.07 per cent of total. It has been noticed that majority of tourists were youth. About 35.93 per cent of tourists were married.

Profession of tourists:-

The nature of occupation forms the basis of assessing economic status of the tourists. The information of the tourists about their profession has been studied with profession ranges. The profession ranges from Education and student, Software Industry, Government employee, Industry, Agriculture and Business. (Table no.1.2.)

Among these categories majority were student (49.90 per cent). The sharing of 23.65 per cent with government employees have second position in sharing look for relaxation away from the daily routine life. The least documented professional group was the group of independent business that is only four people noted (1.20 per cent). Farmers are also visited about (15.27 per cent) and industrial sectors about 5.39 per cent of tourist visited to Sinhgarh and nearly 1.20 per cent of the tourists have their own business.

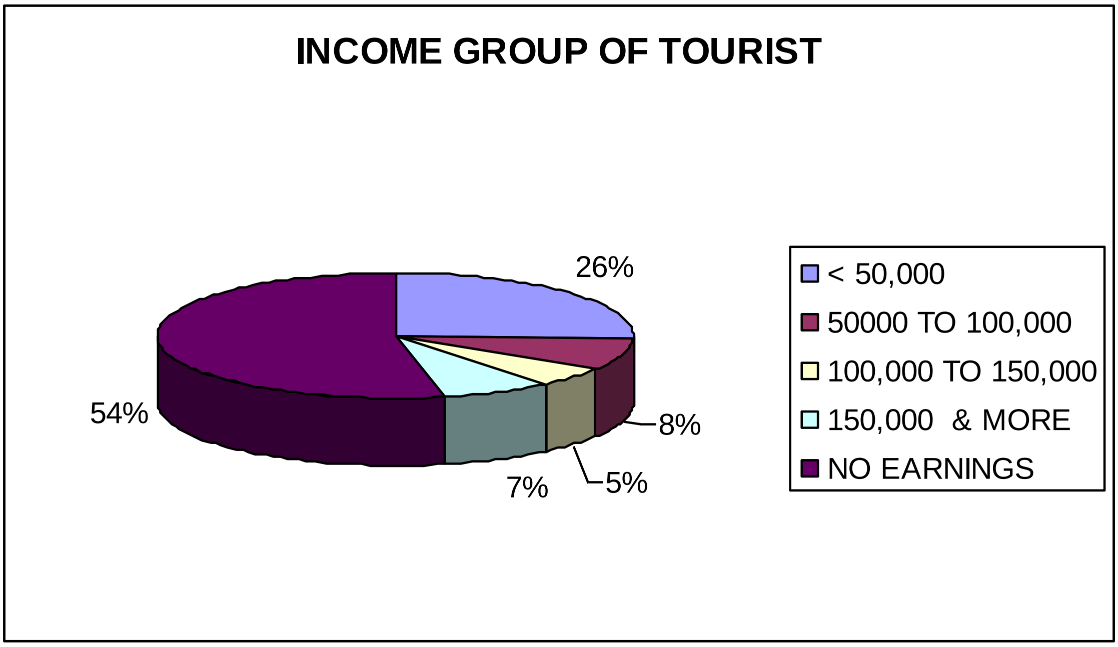
Income Group of Tourist:-

Income is linked with occupation and subsequently determines the economic status and spending capacity of the tourist. Information regarding income of tourist is given in Fig. 1.2. The student constitute the unemployed that account for more than half

(53.29 per cent) of the total and therefore their spending capacity would be minimal.

Among earning group members large section of tourist have an income below 50,000 rupees that is 25.75 per cent. Quite confounding income group above 1, 50,000 amounts 7.49 per cent of the tourist visitors and other income groups are 50,000 to 100000 there has 8.38 per cent visitors and between 1, 00,000 to 1, 50,000 income group 5.09 per cent tourists are noted.

(**Fig. 1.2**) **Sinhgarh Fort INCOME GROUP OF TOURIST**

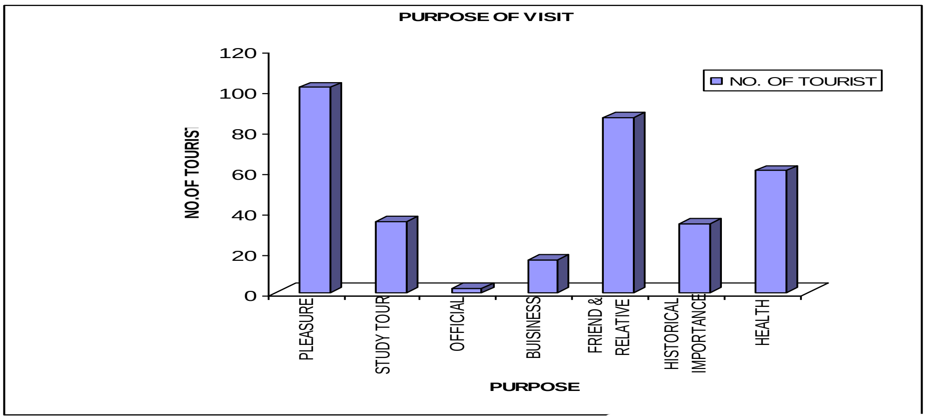


(Source- Field Work-2010)

Purpose of tourists:-

The purpose of the visit varies from person to person. It is difficult to classify tourists as the purpose is very subjective concept. The Fig 1.3 shows different purposes noted during survey. Due to high congested of city life most of tourists visit tourist destination for pleasure. About 30.24 per cent of the tourists have visited for pleasure purpose. Other has varied interests like student tours, accompany with friends and relatives and for health reason have found purposes for visits etc. It is disappointing that only 10.18 per cent of visitors noticed to visit the fort as an historical importance. Least common purpose has been business and official visit with a minimal account 4.79 per cent and 0.60 per cent accounts respectively. Visitors also visit for health purpose account 17.96 per cent. (Fig. 1.3)

Fig No.1.3Sinhgarh Fort Purpose of tourists



(Source: Fieldwork)

Visit to Sinhgarh with accompany:-

The study of accompanied persons was displayed in Table 1.2. This study reveals the nature of tourists who assisted to main tourists. Since the bulk of the people that have visited represent the local district it is inevitable that many have accompaniments with friends, that occupies 60.48 per cent of tourists and followed by with own and other family also well remark accompany that is 25.45 per cent of the visitors. Despite being a historical heritage site 5.99 per cent of the tourist feel the need of a tour operator. It categorically describes the fact that Sinhgarh is more popular with locals. There are also small proportions of tourist who are coming independently the sharing account is 5.99 per cent.

Information about the tourist's destination:-

Information about the tourist's destination can be a major consideration to visit to this tourist place. Table 1.2 clearly shows there different inspirational level for tourists. Sinhgarh is more popular through an oral source than any other media, which 48.20 per cent of the visitors draw inspiration from friends and relatives, followed by only friend about 21.26 per cent that is second rank.

Due to the publicity of Sinhgarh in news paper and news media account 11.08 per cent visitors inspired by this category. Other source for tourist inspiration the book and journals account 8.68 per cent, self induced account about 6.29 per cent and least account by tourist information center that account only 4.49 per cent visitors inspired.

Frequency of tourists:-

The attempt has been made to collect the information regarding how many times tourist have visited a tourist place. It has been clear with the help of data given in the table no. 1.2.

The data shows that most of tourists are visit Sinhgarh for the first time account 52.46 per cent. Due to close proximity with the township of Pune city most visitors are encouraged for second time visited. An astonishing about 14.96 per cent of tourist has visited the monument more than four times and followed by three times (10.18 per cent).

Concluding Remarks:-

The national tourists have observed that the mostly Indian tourists were visited during survey and minor per cent by

International tourists. 98 per cent of the tourists have visited to fort from origin of Maharashtra followed by Karnataka Madya Pradesh and Bihar. Due to the close proximity and the distance decay are the vital factors as the own representation of the Pune district is highest and other have been from the adjoining district. The age group of the tourist is mostly having 20 to 40 age group.As it is a hill top area out of the total tourist nearly 60 per cent tourist belongs to male. During survey high representation by Hindu tourist and other religion people have also visit this tourist place but in minor scale. Due to the close proximity of education center the survey indicated that nearly one- third of tourist have attained the degree and post graduation education. Due to the nearness of Pune city to the tourist place the high per centage is youthful stage and unmarried. Almost half of the tourists are from education field, student and government employee have noted due to metropolitan cities.

Income group shows the high gulf between rich and poor in the society. There were varied motives and incentives for visiting the monument, but more or less most of the people deluded with pleasure. Here is a growing trend that with mass tourism, most tourists have accompaniments with friends and visits with own and other family. The nearly half of the tourists have come in first time. Here point should be noted that nearly half of the tourist visited twice and more than that.

References

Adavitot S.C. (2007): "*The study of Behavioral Pattern of Pilgrim Tourist at Akkalkot in Solapur District, Maharashtra State*," The Deccan Geographer, Vol.45 No.2 December 2007, Pp.23-28.

Anvari Mahmoud Reza (2008): "*An Assessment of Tourist Behavior in Abyaneh Tourist Center (Iran),".*The Deccan Geographer, vol. 46, Pp 93-101.

Diddee Jaimala, Jog, Kale, Datye: " *Geography of Maharashtra*,"Rawat Publications, Pp9-10.

Funde Ravindra (2006): "*The Geographical Study of Chandpur Tourist Place*," Bhugolshashtra Sanshodhak, Jan-Dec, 2006 Pp. 59-69.

Ghanekar P.K. (2004): "*Sinhgarh*," Snehal publication, Marathi edition.

Kelkar Sunil Y. (2000): "*Geographical study of Matheran tourist hill station*" unpublished M.Phil dissertation, Pune Uni. Pune.

Address of Authors

1. Konade B.N
Asst. Professor
C.B.Khedgi College
Akkalkot,
Dist. Solapur

2. Dr. Adavitot S.C.
H.O.D
C.B.Khedgi College
Akkalkot,
Dist. Solapur

3. Dr. Jaibhaye R. J.
Assoc. Professor
Dept of Geography
University Pune,
Pune

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Analysis of Roads Network Connectivity in Solapur District

Mr. S.S. Raut & Dr. S.C. Advitot

Abstract

Transport network development is a considered to be one of the keys to rapid development of region. Transportation is a measure of relations between areas and therefore an essential part of geography [Ullman 1954]. Transport network is set of geographical locations inter connected in a systems by a number of routes [Kansky 1963].Roads are essential for the development of the region in general and Solapur District in particular. To address the issue, the aim of this research paper to study the transport network of roads in Solapur District of Maharashtra. The main idea is that transport connections are more important than others and the relationship can be realized from analyzing the structure of transport networks. To do this, graph theory indicators of alpha, gamma, beta parameters are used. The result shows with indicators of alpha, gamma, beta obtained meaningful picture. Talukas like N.Solapur, S.Solapur, Pandarpur, Akkalkot, Sangola, Barshi is highly connected on the other hand Mohol, Mangalwedha, Malshiras, Madha, Karmala have poor connectivity.

Introduction

No wonder that the transport system may be called as the sinews and life line in terms of economy and integration of a region. Transportation is the blood stream for any developed economic system (Hoyle 1973 and Morrill 1974). Among various means of transport, it has been well said that the roads are the main arteries for any region. Road network provides the most fundamental and cheap mode of transport. Roads play vital role in the economic development and also social and cultural development. The main advantages of roads is, it bringing villages into the main stream of economic life. The development of transport network, gives rise to economic activities and therefore contributed to increase in large settlements and productivity. Transport network keeps relation and makes integration among all other economic activities over space. It is presumed and observed that in any developed region, there is always high positive correlation between these development and transport network. So that roads and its network only considered in this paper.

Study Region

For present investigation Solapur District is selected as a study region. It is one of the southern District of Maharashtra. The Solapur District lies between $17^0$10'North to $18^0$32'North latitude and $75^0$42' East to $75^0$15'East longitude. It covers an area of 1489 Sq. Km. and has population 3849543. The region has 1150 inhabited villages and 10 urban centers, is administratively sub divided in to 11 tahsils. It located in the Bhima, Sina and Man basin just before the Bhima River leaves Maharashtra to enter in to Karnataka. The National Highways No. 9 and 13 and State Highways passing through Solapur, Mangalvedha, Sangola, Pandharpur, Karmala, Mohol, Vairag. (fig.1)

Objective

The aim of present paper is to identify road network connectivity in Solapur District.

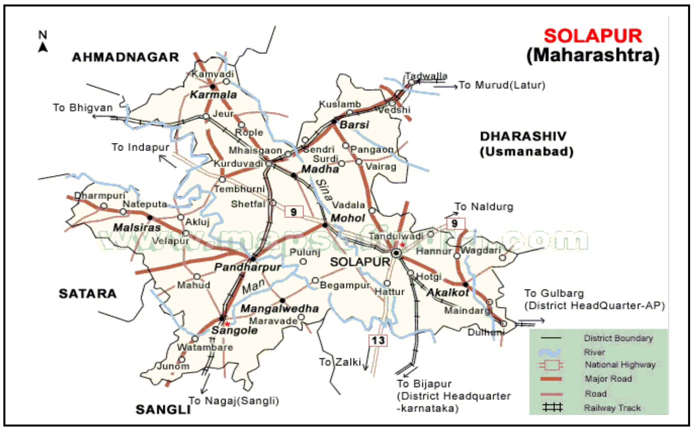


Fig. 1 :Solapur District

Database and Methodology

The present study is based on the secondary data obtained from Public Works Division. Zonal Offices of Solapur District. To analyze the connectivity Alpha Beta and Gamma indices developed by Kansky (1963) are applied. To generate alpha, beta, gamma indices there was the need to estimate number of nodes (v). Nodes related for road transport network has been identified on the basis of Urban and industrial centers, Administrative Headquarter, Regional market and settlement present on the route. The national and state highways, major district roads and other district roads are considered as edges (e). The result shows with the help of table and maps.

Alpha Index (α) =

Beta Index (β) = $\frac{e - v + 1}{2v - 5}$

Gamma Index (γ) = $\frac{e}{3(v - 2)}$

where,

e = No. of Edges

v = No. of Nodes

...........(Kansky, 1963)

Table1. The Degree of Connectivity in Solapur District

Sr.No	Tahsil	Alpha Index	Beta Index	Gamma Index
1	N. Solapur	0.41	1.71	0.62
2	S. Solapur	0.14	1.39	0.48
3	Akkalkot	0.22	1.40	0.48
4	Mangalwedha	0.19	1.33	0.47
5	Sangola	0.22	1.38	0.48
6	Malshiras	- 0.02	0.95	0.32
7	Pandharpur	0.32	1.57	0.56
8	Mohol	0.15	1.26	0.44
9	Madha	0.07	1.12	0.38
10	Karmala	0.16	1.26	0.42
11	Barshi	0.42	1.78	0.62
	Total: Average:	**0.21**	**1.38**	**0.48**

Analysis of Road Transport Connectivity Pattern

Roads connectivity pattern is an important aspect of transport geography because it involves the description of the deposition of nodes and their relationships with linkage of distribution. It gives measures of connectivity and also allows comparisons to be made between regional networks. In the present study, the National Highways No. 9 and 13 passing through Solapur, Mohol, Madha and State Highways passing through Mangalwedha, Sangola, Pandharpur, Karmala, Mohol, Barshi, Malshiras talukas. The following table shows the degree of connectivity.

Alpha Index:

As defined by K.J.Kansky (1963) alpha measure is the ration between the number of fundamental circuits and the maximum possible numbers of circuits. It is ranges from zero (Least connectivity) to one (highly connected).For Solapur District alpha index varied from (-0.02) to 0.42 and average is 0.21. S. Solapur, Mangalwedha, Malshiras, Mohol, Madha and Karmala having less than average index value inclining towards poor connectivity. On the other hand North Solapur, Barshi, Akkalkot, Sangola, Pandharpur more than average index value. North Solapur is district headquarter, so it is highly connected within region and between region. Barshi is the solo market centre in the periphery providing services to adjoining part of Osmanabad District. Pandharpur and Akkalkot are the pilgrim centres. Sangola Taluka shows high index value due to work of 'Rojgar Hami Yojana'. (fig.2)

Beta index:

The Beta index is very simple measure of connectivity which can be calculated by ratio of the total number of edges and number of nodes. The value zero ,indicates poor connectivity and higher than one represent greater complexity which include several circuits. In the Solapur District beta index range from 0.95 to 1.78 and average is 1.38. North Solapur, Barshi, Akkalkot, Sangola, Pandharpur, South Solapur show more than average index value of Solapur District. Mangalwedha, Malshiras, Mohol, Madha, Karmala Talukas denote less than average index value of total.(fig.3)

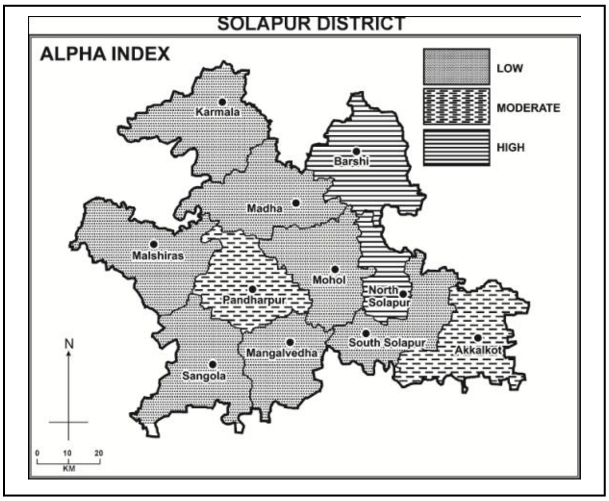


Fig 2: Solapur District Alpha Index

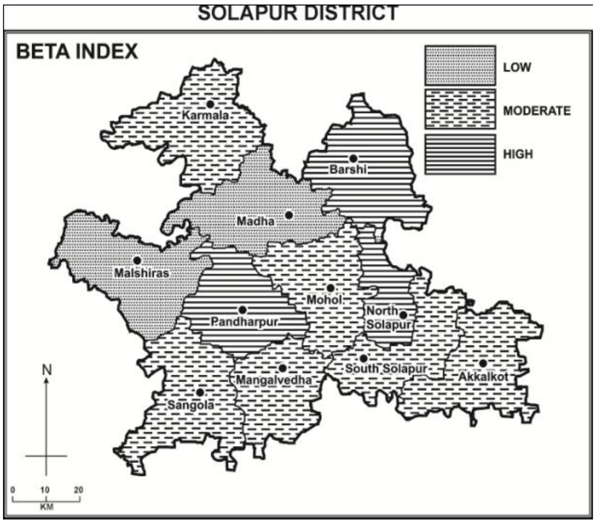


Fig. 3: Solapur District Beta Index

Gamma Index

The gamma index is the ratio of observed number of edges to the maximum possible number of edges. According to Taaffe and Gauthier (1973), when gamma index close to zero, it indicates incomplete connectivity. In Solapur District Talukas North Solapur, South Solapur, Akkalkot, Sangola, Pandharpur and Barshi show more than average index value, Mangalwedha, Malshiras, Mohol, Madha, Karmala talukas show less than average.

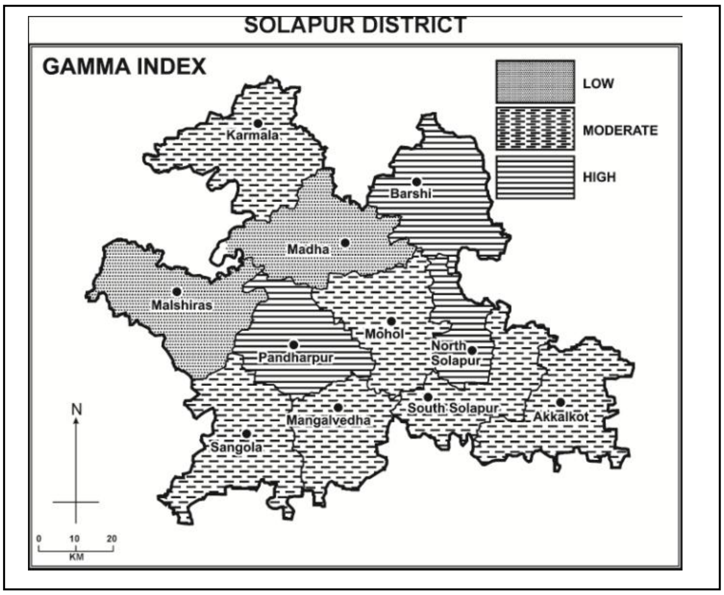


Fig.4: Solapur District Gamma Index

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Concluding Remarks

It is established fact that roads are arteries of the regional organs. Not only have the trade activities rather agricultural operations too need the road network in the modern age. Road transport is the cheap means of transportation. The study reveals that the Solapur District is backward in connectivity pattern.

1. The Alpha index is found highest in Barshi Tahsil (0.42) and lowest in Malshiras Tahsil (-0.02)

2. The Beta index is found highest in Barshi Tahsil (1.78) and lowest in Malshiras Tahsil (0.95).

3.The Gamma index is found highest in North Solapur Tahsil (0.62), and Barshi Tahsil (0.62) and lowest in Malshiras Tahsil (0.32).

References

Kansky K (1963), Structure of Transportation Network, University of Chicago, Department of Geography, Research Paper-84, P1.

Taaffe E.J. and Gauthier H.L. (1973), Geography of Transportation, Practice Hall, New Jercey.

Mhaske P. H. (2011), Analysis of Roads Network Connectivity in Ahmednagar District, Research Analysis and Evaluation Volume-II.

Bhendkar Sadhana (2011), Road Transport Connectivity Pattern and Economic Development in Vidarbha-Maharashtra, Research Analysis and Evaluation Volume-II.

Deshpande Sadhana (2007), Road Connectivity and Road Development in Vidarbha-Maharashtra, The Deccan Geographer, Vol. 45, P37-45.

Vinod R.V., Sukumar B., Sukumar A. (2003), Transport Network Analysis of Kasaragad Taluka Kerala using GIS, Indian Cartographer. P35-43.

Emmanuel Kofi GAVU. (2010), Network based indicators for prioritising the location of a new urban transport connection: case study Istanbul, Turkey, M.Sc. Unpublished Dissertation.

Hoyle B. S. (1973), Transport Developments in underdeveloped Countries, Macmillan, London.

Morrill R. L. (1974), The Spatial Organisation of Society, Duxburg, Massachusetts.

Address of Authors

Raut S. S.
Research Scholar,
Solapur University, Solapur.

Dr. Adavitot S. C.
Head Department of Geography,
C.B.Khedagis college Akkalkot, Dist-Solapur.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Growth Analysis of Pune City: Using GIS and Remote Sensing

Prof. S. A. Aher & Prof. R. S. Pawar

Abstract

The resent technique of R S and GIS are time and again proving that they are highly capable in urban studies particularly in urban management and planning. With these modern tools it is quite possible to analyze the spatial pattern of urban growth over different time periods and it can be systematically mapped, monitored and accurately assessed from remotely sensed data along with conventional ground data. Pune is experiencing high rate of population growth. Between 1976 and 1981, the population of Pune city grew by 16.7% and from 1981 to 1991 it grew by 30.2%. Between 1991 and 2001, the growth was more than two times i.e., 62.17%, where as Pune district has the growth rate of 30.58% and the state experienced the growth rate of 22.5%. This shows that the increasing population of Pune city exercise lot of pressure on available land in the city and city's limit had been pushed towards the adjacent villages.

Introduction

Pune (Maharashtra) is one of the many cities in India, growing at a very fast rate. In the patronage of kings and rulers, it has acquired a complex urban structure over the years. The city has gone through unusual changes from last 40 years in terms of economic, social and physical transformations. An attempt is made to prepare a Development Plan in duration of three years on a Geographic Information System (GIS) platform ensuring the connectivity and integration of core area with the rest of the city using spatial information obtained through remotely sensed data, city maps and Survey of India (SOI) topographical sheets.

Study area

Pune city situated on the 18^0 31' North latitude and 73^0 51' East longitude and cover an area of 243.96 sq.km. It has a strategic position in the valleys of Mula and Mutha, which join each other in the Pune city. In Pune city total 177 census wards are there where, more than 600000 households and more than 3.2 million people (according to Pune Municipal Corporation 2006). (Fig.1) Pune is one of fast developing urban agglomerations in Asia and ranks eight at national level (Census 2001).

It has grown quite haphazardly. The present growth is due to various factors such as industrialization, location of various Central and state Government establishments.

Need of study

Usually researches use technique and satellite data to see the changes of the growth of a city. In present work I am conducted the research with searching ground truth with the help of extensive fieldwork. To see the change occurred in economical activities of Pune city in last 30 years and how Pune city transform from small hamlet with only 15 huts in 613 A.D. to 1.3 million in 1981 and in 2001 the population has reached 3.5 million. City dwellers economically transform from fisherman to IT professionals. How spatial change occurred in different phases of Pune city and surrounding area with the help if people participation in the research.

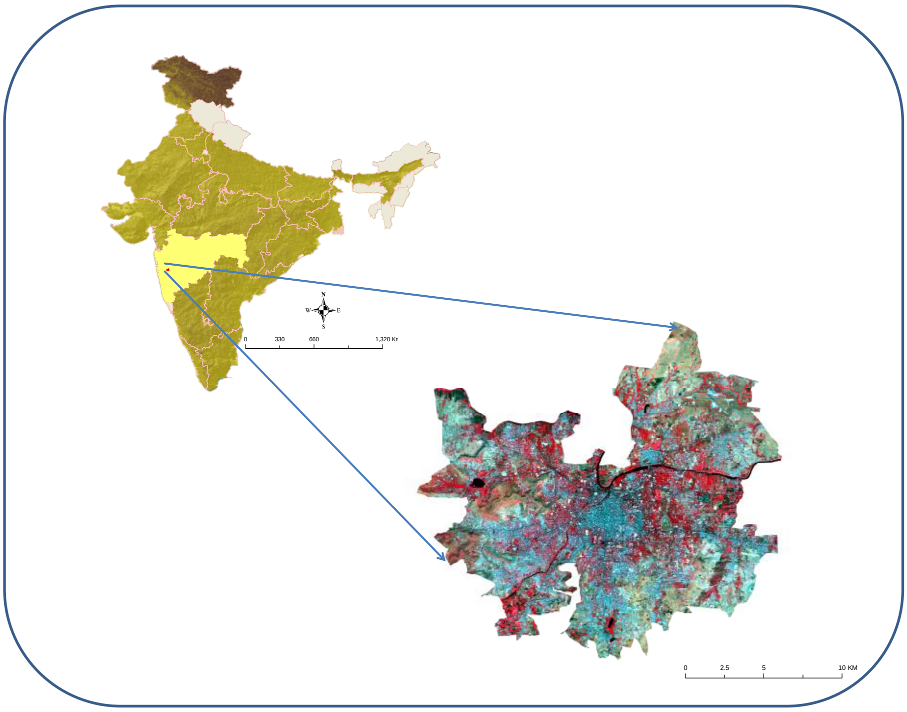


Fig.1 Location Map of the Study Area

Database

1. Collateral data: temporal population data from the government agencies, cadastral data from land records department and topographical sheets from Survey of India on 1:25000 scale 47 F/14.
2. IRS – 1C/ID, LISS- III - For 1997 and recent one. IIRS digital data.
3. Data related to Population of city, workers participation in different activities, Housing will be used from Census of India.
4. Random Sample Survey

Methodology

The digital remote sensing data was processed and geo-referenced in Erdas software. Initially the toposheets were scanned and geo-referenced and used as base for image registration. The geo-referenced FCC image was further enhanced by using necessary enhancement techniques. After that visual interpretation of image was done to identify the major land use classes. The enhanced image was classified on the basis of sample collected from different classes. Maximum likelihood classifier of supervised classification in Erdas was used to classify the image into major classes and again they remerged into two main classes as built-up and Non built-up area.

Hence, considering the built-up area as a potential and fairly accurate parameter of urban growth gives better knowledge for understanding the behavior of such growths. Therefore the classified image and the merged toposheets were brought into Arc View 3.2 environment and the toposheets and the area under built-up was calculated for further analysis.

Urban growth analysis

Urban growth over the period of 1970 to 2001 fig. 2 and Fig. 3 Almost a period of three decades was determined by computing

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

the area of all the settlements from the digitized toposheets and comparing it with the area obtained from the classified IRS ID image.

Classified Image of Pune City (1997)

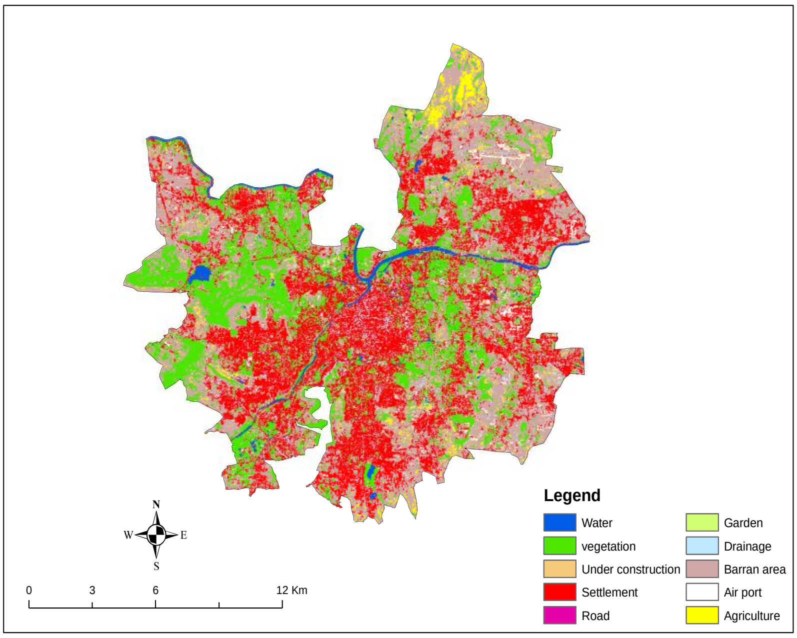


Fig. 2

Classified Image of Pune City (2007)

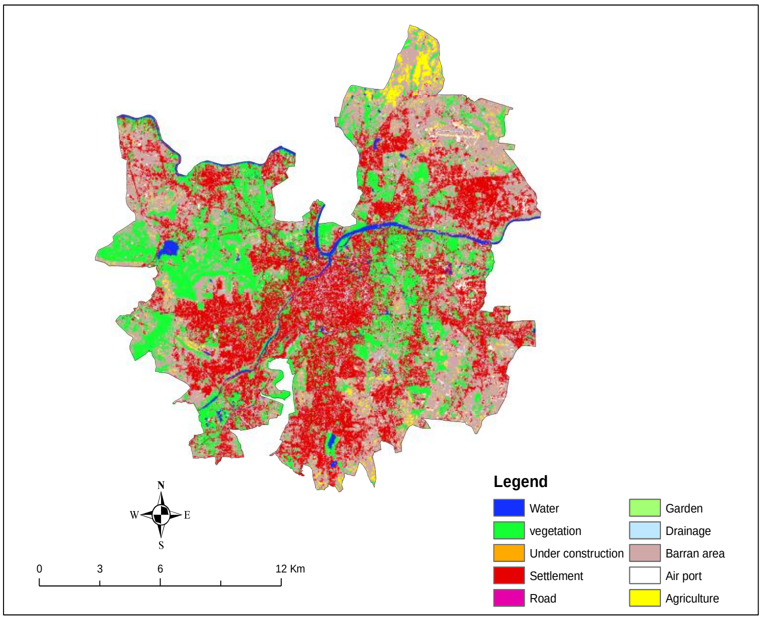


Fig.3

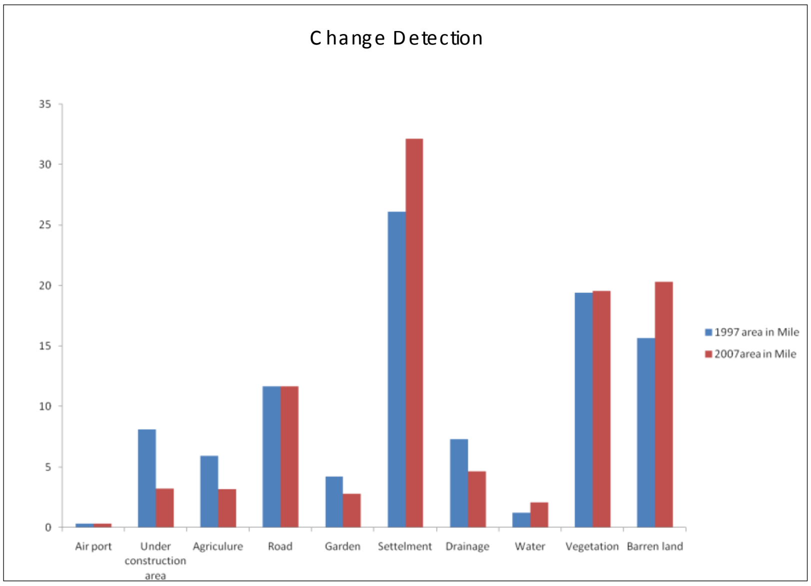


Fig.4

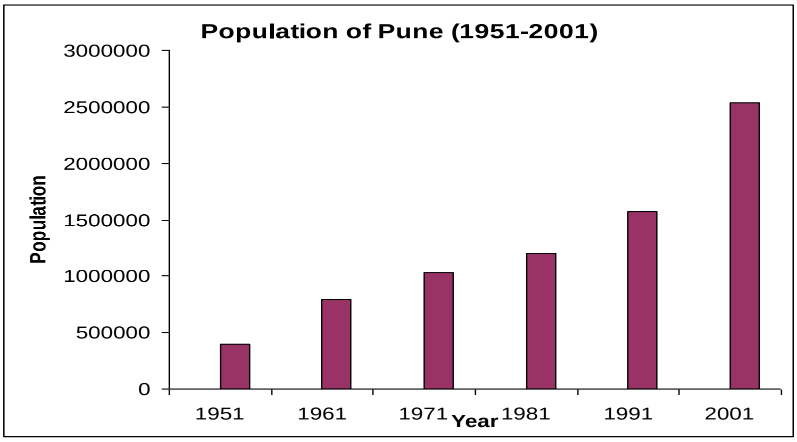


Fig.5

Population growth of Pune

Between 1976 and 1981, the population of Pune city grew by 16.7%, and from 1981 to 1991 it grew by 30.2%. Between 1991 and 2001, the growth has doubled to 62.17%. In comparison, Pune district has a growth rate of 30.58%, while the state is experiencing the growth rate of 22.5%. Fig 4 and 5.These trends are likely to persist in future. This shows that the larger urban agglomerations are getting over crowded and fast growing in a haphazard and unplanned manner. Therefore, it is necessary to assess the past and present growth trends of these rapidly growing cities, for effective urban management and sustainable development.

Results and Conclusion

Remote sensing and GIS are time and again proving that they are highly capable in urban studies particularly in urban management and planning. With these modern tools it is quite possible to analyze the spatial pattern of urban growth over different time periods and it can be systematically mapped, monitored and accurately assessed from remotely sensed data along with conventional ground data. Pune, is experiencing high rate of population growth. Between 1976 and 1981, the population of Pune city grew by 16.7% and from 1981 to 1991 it grew by 30.2%. Between 1991 and 2001, the growth was more than two times i.e., 62.17%, where as Pune district has the growth rate of 30.58% and the state experienced the growth rate of 22.5%. This shows that the increasing population of Pune city exercise lot of pressure on available land in the city and city's limit had been pushed towards the adjacent villages.This will show how much pressure has been given to the available land. Recently, 23 villages had been added to the old municipal limit and the total area of Pune city has increased from 145.92 sq.km. to 243.96 sq.km. The municipal corporation has also prepared the development plan for these villages. Our present study does not have any aim to analyse the development plan of fringe village. But to help the planners to identify the villages which have to be given more priority and where exactly the growth takes place and to understand the degree and intensity of such growth of better management. As the urban phenomena (residential, industrial, commercial, public and semi public uses… etc) has uniform reflectance throughout electromagnetic spectrum, it is not possible to identify delineate urban land use classes using digital analysis techniques as these techniques employ spectral characteristics of the objects for the classification.

This study shows that the city of Pune is experiencing a leapfrog pattern of urban growth due to the hills, and ribbon growth along the highways. With the integration of remote sensing and GIS, it is easy to implement in the study of Pune city and quite sure that the results will be definitely useful for implementing and managing the development plan of Pune.

References

Burrough P. A. (1986). "Principles of Geographic Information Systems for Land Resources Assessment", Clarendon Press, Oxford

Epstein, J., Payne, K., and Kramer, E., (2002). "Techniques for mapping suburban sprawl", Photogrammetric Engineering and Remote Sensing, Vol. 63(9): pp 913 – 918.

Hussain. M. (2003). Urban Geography, Anmol Publications Pvt. Ltd., New Delhi

Li, X. and Yeh, A.G.O. (2001). Zoning land for Agricultural protection by the integration of Remote Sensing, GIS, and Cellular Automata. *Photogramm. Engg. & Remote Sensing,* Vol. 67(4): 471-477. -43

Pathan, S. K., Jothimani, P., Pendharkar, S. P. and Sampat Kumar, D. (1989). Urban landuse mapping zoning of Bombay Metropolitan Region using Remote Sensing data. *J. Indian Soc. Remote Sensing,* 17(3): 11-22

Address of Authors

Prof. S. A. Aher (Arts, Sci & Comm College, Niphad**)**

Prof. R. S. Pawar (Arts. Sci. & Comm. College Kolhar.

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Calculation of Normalized Differences Vegetation Index for Adula River Basin Using Indian Remote Sensing Satellite Data

Mr. Vikas B. Nagare & Shingate R.M
vikasnagare@gmail.com

Abstract

The study area is located in semi arid region so initially it is required to investigate the spatial distribution of vegetation in Adula River Basin on a local scale for understanding of ecosystem. The purpose of this study is to analyze the spatial distribution of vegetation on a local scale. We defined the NDVI calculated from IIRS digital data as the potential of vegetation. From the results, it was obvious that where the green vegetation cover has increased from 773 Ha in 1997 to 858 Ha in 2000 though the rainfall decreased from 1197.45 mm in 1997 to just 819.5 mm in 2000.

Introduction

Adula River Basin is located in Akola Sangamner Taluka of Ahmednagar district. The area is under semi arid and barren of vegetation. The terrain is rugged and hilly. The average rainfall is around 500mm, but the area suffered from periodic drought, resulting in highly depleted ground water reserves. The agriculture in the area being primarily rain fed was a failure (Tripathy, et.al, 1996). Soil conservation being the main task in the successful implementation of a watershed development programme, (Sebastian, 1995) area treatments, drainage line treatments, aforestation and pasture development was extensively done in the area. To quantify the changes in remotely sensed satellite data has been studied covering the pre and post treatment period. This report brings out the remarkable changes in vegetation cover, which occurred between January 1997 and December 2000. The simplest of soil conservation methods is to plant grass or other vegetation, which will drastically reduce the removal of topsoil. Hence the ideal watershed should have a minimum of barren soil as seen in the field photograph (Fig.1), where small portions of the watershed still remain barren of any vegetation. Grass covered and stabilised soil has a much higher water retention capacity that leads to reduced surface runoff and higher and faster recharge of the aquifer.

Analysis of vegetation cover and detection of changes in vegetation patterns are keys to watershed resource assessment and monitoring. Green vegetation has a very distinctive interaction with energy in the visible and near infrared regions of the electromagnetic spectrum. In the visible regions, plant pigments cause strong absorptionof energy. There is lots of literature on Normalise difference vegetation index after 2010 Meliadis et al introduced Monitoring and analysis of natural vegetation in a Special rotected Area of Mountain Antichasia Meteora, central Greece. Rozhkov, et el (1997)

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Barren Soil cover in Adula Watershed

Fig.1

Study Area

The area lies between 19^0 32’ to 19^0 40’ North Latitude and 74^0 2’ to 74^0 10’East Longitude. Elevation in talukas varies between 450 and1600 m ASL. The location map of the study area is depicted in Fig. 2. River Adula is a tributary of Pravara River. It rises in north of Akole on the slopes of Patta and Mahakali. It flows for 24.14 km in an easterly direction between two ranges of hills which encloses the Samsherpur Valley; then falling into the rocky chasm some 45.72 m. deep and it winds between rugged and precipitous hill-sides for few km and when debouching into the plain of Sangamner, it turns south and falls into the Pravara three miles west of the town of Sangamner.

Methodology

Digital data from the Indian Remote Sensing Satellite IRS1C LISS III sensor for two dates (January 1997 and December 2000) was obtained, for the area covered by Survey of India’s Topographical map No. 47/ I/1, 2, 3, 6, 7, 10, 11, 14, 15. and 47 /E /10, 11,14,15,13 (Sangamner area), on 1:50,000 scale) , from National Remote Sensing Agency. The area of interest was extracted from the complete coverage and accurately georeferenced with the topographical map The individual bands of the satellite data were separated into files. Standard False colour composites were generated using IRS 1C LISS III bands 2, 3 and 4 (Fig 3 and 4). IRS 1C LISS III Band 3 and Band 4 data was used to calculate the Normalised Difference Vegetation Index (NDVI).

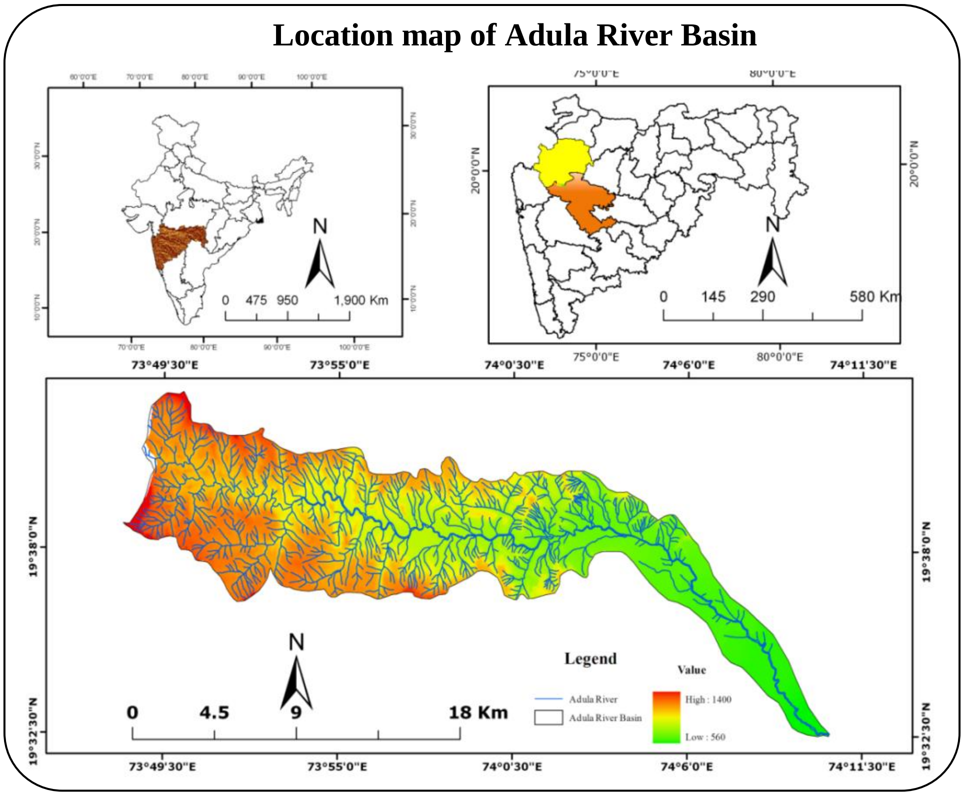


Fig.2

Adula River Basin IRS 1A LISS lll FCC, January1997

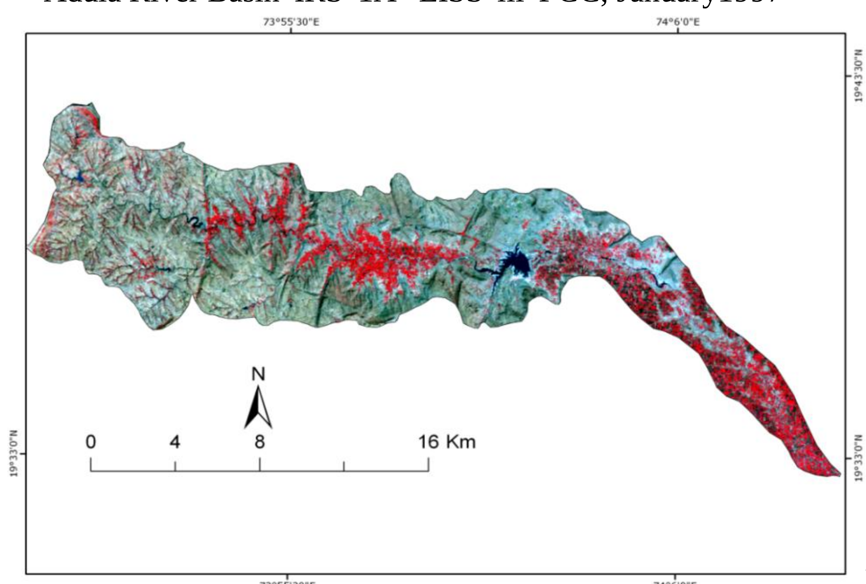


Fig.3

Adula River Basin IRS 1A LISS lll FCC, January 2000

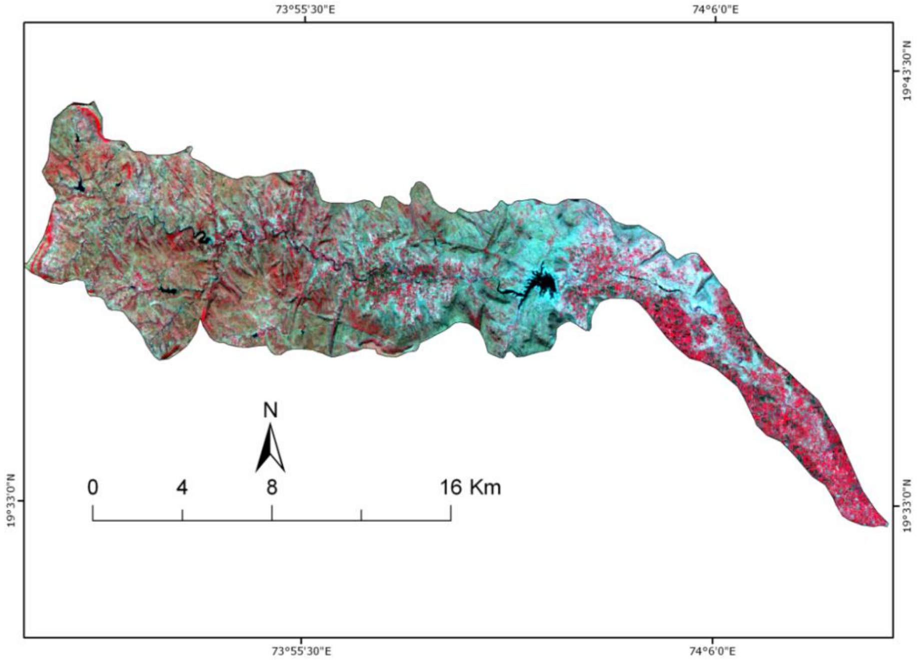


Fig.4

Results

* Normalised Differences Vegetation Index

The NDVI separates green vegetation from its background soil brightness. It is expressed as the difference between the near infrared and red bands normalized by the sum of those bands, i.e.:

NDVI = (Near Infra Red band – Red Band) / (Near Infra Red Band + Red Band).

= (Band 4 – Band 3) / (Band 4 + Band 3)

Inputs to calculation of the Distance-Based VI's are the red band, the infrared band, the slope of the soil line and the intercept of the soil line.

* NDVI Mask Images

Since Vegetated or grass covered areas have higher reflectance in the infrared than the red, the NDVI for vegetation will always be positive. Therefore, the bare soil pixels will have NDVI values less than or equal to 0. The 1997NDVI image has a range of values from -0.63 to 0.57 while the 2000 NDVI image has a range of values from –0.37 to 0.55. These two images were reclassified such that all values less than 0 were equated to 1 while all values more than zero were equated to 0. The two images, so obtained, bring out the areas, which are covered by barren soil and grass or vegetation (Fig. 4 and Fig. 5)

The two images thus generated for the two years viz. 1997 and 2000 are shown in fig 4 and fig. 5. The pseudo colours of fig.5 depict the percentage of vegetation in the area i.e. green is high chlorophyll content (vegetation) and as the colours shift towards brighter. Fig 6 and 7.

NDVI Image of the year 1997.

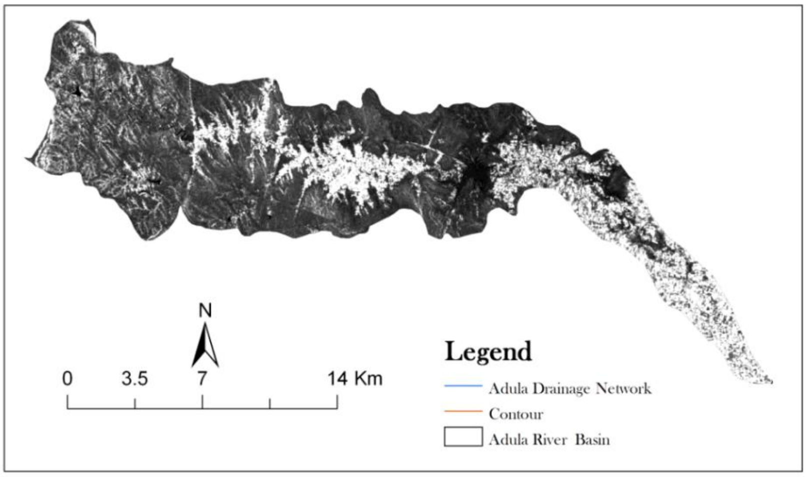


Fig.4

NDVI Image of the year 2000.

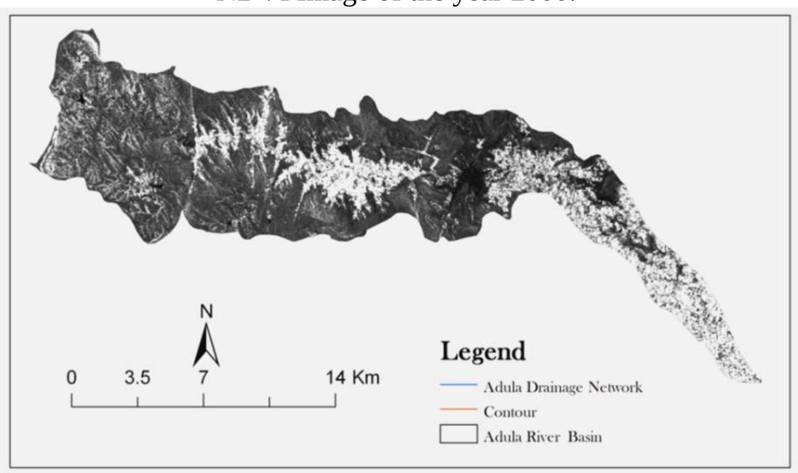


Fig.5

Barren soil Cover in 1997 and 2000

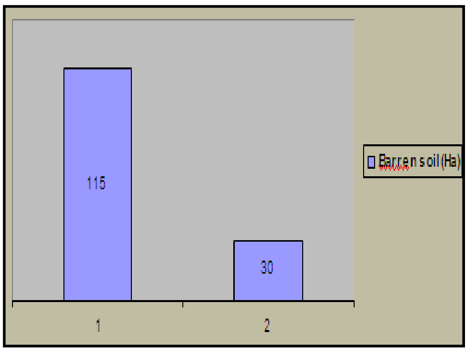


Fig 6

The Rainfall and green vegetation in 1997 and 200

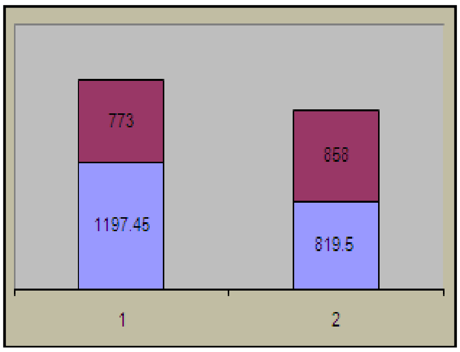


Fig 7

Conclusion

On quantifying the areas under the various categories within the soil mask images for 1997 and 2000 it is evident that the barren soil cover has reduced considerably (Joshi And Nagare 2009) after the watershed management programme was implemented in study area. This is very well depicted in the bar graph in fig 6. What is more laudable is that this positive change is seen even though the annual rainfall in 2000 was much less than that in 1997, and is graphically represented in fig. 7, where the green vegetation cover has increased from 773 Ha in 1997 to 858 Ha in 2000 though the rainfall decreased from 1197.45 mm in 1967 to just 819.5 mm in 2000.

References

Eastman, R.J., (1999). Guide to GIS and Image Processing, V-2, Clark Labs, Clark University, MA, USA.

Joshi V.U and Nagare V. (2010) Temporal Changes in the Land-Use / Land-Cover for the last one Decade along the Pravara River Basin, Maharashtra. Trans. Inst. of Indian Geographers, 32, 2, 183-192.

Sebastian, M., Jayaraman, V. and Chandrasekhar.M.G. (1995) Space Technology Applications for Sustainable Development of Watersheds, Technical Report, ISRO-HQ-TR-104-95,ISRO, Bangalore.

Tripathy, G.K., Ghosh, T.K., and Shah, S.D., (1996). Monitoring of Desertification Process in Karnataka State of India Using Multi-Temporal Remote Sensing and Ancillary Information Using GIS, International Journal of Remote Sensing, 17(12): 2243-2257.

Meliadis, I. Platis, P. Ainalis, A. and Miltiadis, M. (2010) Monitoring and analysis of natural vegetation in a Special Protected Area of Mountain Antichasia—Meteora, central Greece. Environ Monit Assess. Pp. 455-465.

D. G. Shchepashchenko, V. A. Rozhkov, and E. M. Naumov, "Forest Soils of the ortheastern Yakutia," Pochvovedenie,No. 12, 1510–1517 (1977).

V. A. Rozhkov, A. Z. Shvidenko, S. Nil'sson, et al., "Information Supply of the Boreal Forest Management and unctioning System," in Sustainable Development of Boreal Forests: Proceedings of the VII Conference of International Boreal Forest Research Association, Moscow,Russia, 1997(Moscow, 1997), pp. 92–97 [in Russian].

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Assessment of Urban Sprawl in Pimpri - Chinchawad Municipal Corporation using Remote Sensing & GIS Techniques

Mr. Santosh Bhailume [1], Dr. Virendra Nagarale[2]

Abstract

The rapid growth of urban area and extraordinary population growth are the most dramatic phenomenon associated with urbanization. This rapid and haphazard growth of urban sprawl and increasing population pressure results in the loss of productive agricultural land, loss of surface water bodies, green open spaces, besides causing air pollution, health hazards and contamination of water. Remote sensing applications with the availability of high resolution data from the state of the art satellites like IRS P6 accompanied with the image processing technique is an effective tool for identifying the urban growth pattern from the spatial and temporal data. Pimpri-Chinchwad in India is growing at a very fast rate. The central part or the core has gone through unusual changes in terms of social and physical transformations. On the above background, the precise aim of this present study is to find out urban sprawl of Pimpri-Chinchwad.

Keywords: Urban growth, Spatial Resolution, Non-spatial Data, Overlay Analysis, Normalization, Vectorization, Administrative Wards.

Introduction

Urbanization is a process of villages to be developed into towns and further into cities and so on. There is no universally accepted definition of urban settlement. Different countries adopt different criteria for defining the urban settlement. Urban places are not even similar in character. This can be distinguished on the basis of defined demographic characteristic and available infrastructures. Urbanization is the process through which the forests, fertile agricultural lands, surface water bodies are being irretrievably lost, (Pathan, 1991). In India the percentage of people living in cities and urban area almost doubled to 27.78% in year 2001, which is very low as compare to developed countries. However, the 28.53 crores urban population living in 27 metros, 396 cities and 4738 towns is more than the total population of developing and developed countries. This kind of uncontrolled, haphazard, low density settlements leads to Urban sprawl (Vinothkumar, 2005). The Maharashtra state is a highly urbanized with 42.40 % of the population in urban areas as against 27.78 % at all India level (Census, 2001). The PCMC (Pimpri - Chinchawad Municipal Corporation) 94.4 % was recorded highest growth of population according to 2001, census in Maharashtra, which is the part of Pune Metropolitan region. This is mainly due to the rapid growth in the Information Technology sector. Between 1991 and 2001, the population growth has doubled to 62.17 %. In comparison; Pune district has a growth rate of 38.58 %, while the state is experiencing the growth rate of 22.5 %. Therefore it is necessary to add the past and present growth trends of these rapidly growing cities, for effective urban management (S. Shekhar, 2005).

Table 1: Population Trends

Census Year	Total Population	Decadal Change	Growth Rate (%)
11951	488,419	-	
1961	606,777	118,358	24.23
1971	856,105	249,328	41.09
1981	1,203,363	347,258	40.56
1991	1,691,430	488,067	40.56
2001	2,538,473	847,043	50.08

Significance of the study

Advancement of information technology has provided wide arrays of new digital tools that can support the generic activity of geographical analysis and urban modal. In spatial decision-making and designing, in particular, these tools support different stages of the process which involve rapid and effective storage and retrieval of information, various kinds of visualization to inform survey and analysis, and different strategies for communicating information and plans to the affected community (Delaney, 2000). Ever since our society came to form urban agglomerations, there has been a constant manifestation of interest in the study of urbanization. Yet in geographic studies, urban geography has been regarded as less topical in comparison to the other more established fields (Carter, 1995).This can be explained partly by the nature of urbanization that comprises a number of elements from landscape modal to transportation networks to various socio- economic exchanges. In addition, as each element plays its own role in the formation of urban structure, every city possesses a unique structure with its own momentum, presenting entities that are occasionally regarded as too diverse for a single topical study. Nevertheless, "geography is not about the precise analysis of particular service areas... it is more concerned with the ways in which these relationships are reflected in the functional and physical structure of the town"

Selection of study area

Pimpri Chinchwad in India, growing at a very fast rate, acquired a complex urban structure over the years. The central part or the core has gone through unusual changes in terms of social and physical transformations.

Database & methodology:

Following table shows the secondary data collected from various sources. Methodology is one of the important parts of analysis. Output or results depend upon the methodology adopted for data processing and analysis purpose.

Role of remote sensing and GIS

The modern technology of remote sensing includes aerial as well as satellite based systems, allowing us to collect a lot of physical data rather easily, with speed and on repetitive basis, and together with GIS helps us to analyze the data spatially, offering possibilities of generating various options (modeling), thereby optimizing the whole planning process. These information systems also offers interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful.The satellite remote sensing has the ability to provide the accurate and reliable information to make a map and to monitor various facts of urban development.

Location and Extent of Study area

Pimpri-Chinchwad lies between 18^{o} 34' to 18^{o} 43' North latitude and 73^{o} 43' to 73^{o} 56' East longitude. Pimpri-Chinchwad (PCMC) area covers 171.59 sq. km composed of 105 general electoral wards according to 1997 which comes under 4 administrative wards of Pimpri-Chinchwad Municipal Corporation. The PCMC is situated in to the Northwest of Pune on the Mumbai-Pune National Highway at an average altitude of 530 to 566 m. from mean sea level. The east-west ridge running midway between Indrayani and Pavana rivers separate this area into two parts.

Administrative wise built-up area mapping

Pimpri Chinchwad Municipal Corporation (PMC) is divided in 4 administrative Committees. Administrative Committee areas have been obtained from SOI topographical maps and IRS satellite imagery. Mapping of temporal changes in built-up area of these committees were the important task of our study as the change in built-up area shows the trend of urban sprawl. SOI topographical map (1980) and current satellite imagery (2006) has been used for this purpose. Table 3 represents administrative committee wise built-up area changes. The rate of increase is high in all administrative committees which lie on periphery of city centre. In A, year 1980 only 13.93 % (0.31 sq. km) area was under built-up and now it has grown to 22.39 % (11.78 sq. km.) whereas B, 37.05 % (0.83 sq. km.) area under built-up has grown to 22.33 % (11.75 sq. km.), and C, committee shows the growth from 31.00 % (0.69 sq. km) to 34.64 % (18.24 Sq. Km). The D, administrative committee shows growth from 18.01 % (0.40 sq. km.) area under built-up to 20.64 % (10.87 sq. km.) The rate of increase in built-up area is very high in suburban areas. Migration of people towards urban area is high as they have tendency of staying in suburban areas because of industrialization and job opportunities. This is one of the important reasons of urban sprawl or horizontal growth of study area.

Percentage growth of Administrative Committee wise Built-up area

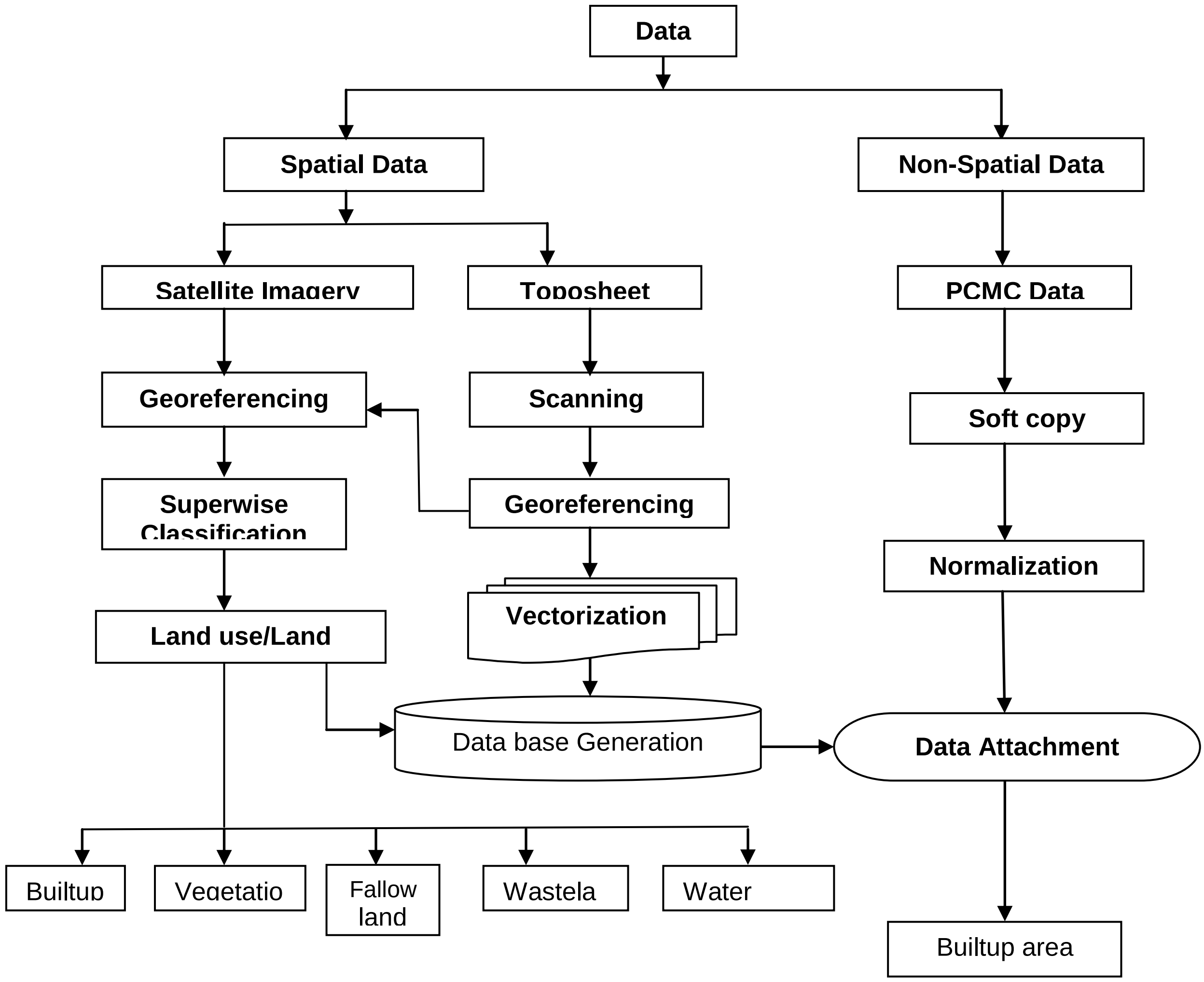
A study of urban sprawl is one of the important objectives of this study therefore such kind of study requires temporal data to get the trend of change in urban built-up area. In the present work SOI Toposheet map of year 1980 and high resolution satellite imagery of year 2006 has been used to detect the changes in urban built-up. These two temporal data shows the trend of changing pattern in urban built-up over a period of time. Urban growth has transformed most of the agricultural land into industrial, commercial and residential areas. Urban built-up area has increased from 2.23 sq. km. in 1980 to 52.63 sq. km. in 2006. Total increase built-up area is 50.40 sq. km. Maximum built-up has increased in all peripheral administrative committees namely A (22.39 %), B (22.33 %), C (34.64 %) and D (20.64 %).

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Table 2 - Various Data Sources

Segment	Type of Data	Centre
Spatial data	Topographical Map No. 47 F/10, 47/F/14	Survey of India, Scale 1:50000
	Satellite Imagery–LISS-III	National Remote Sensing Centre (NRSC), Hyderabad
Non-Spatial data	Ward wise data	Pimpri Chinchwad Municipal Corporation
	Population data	Census Year Book 2001

Flow Chart Showing General Methodology



Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

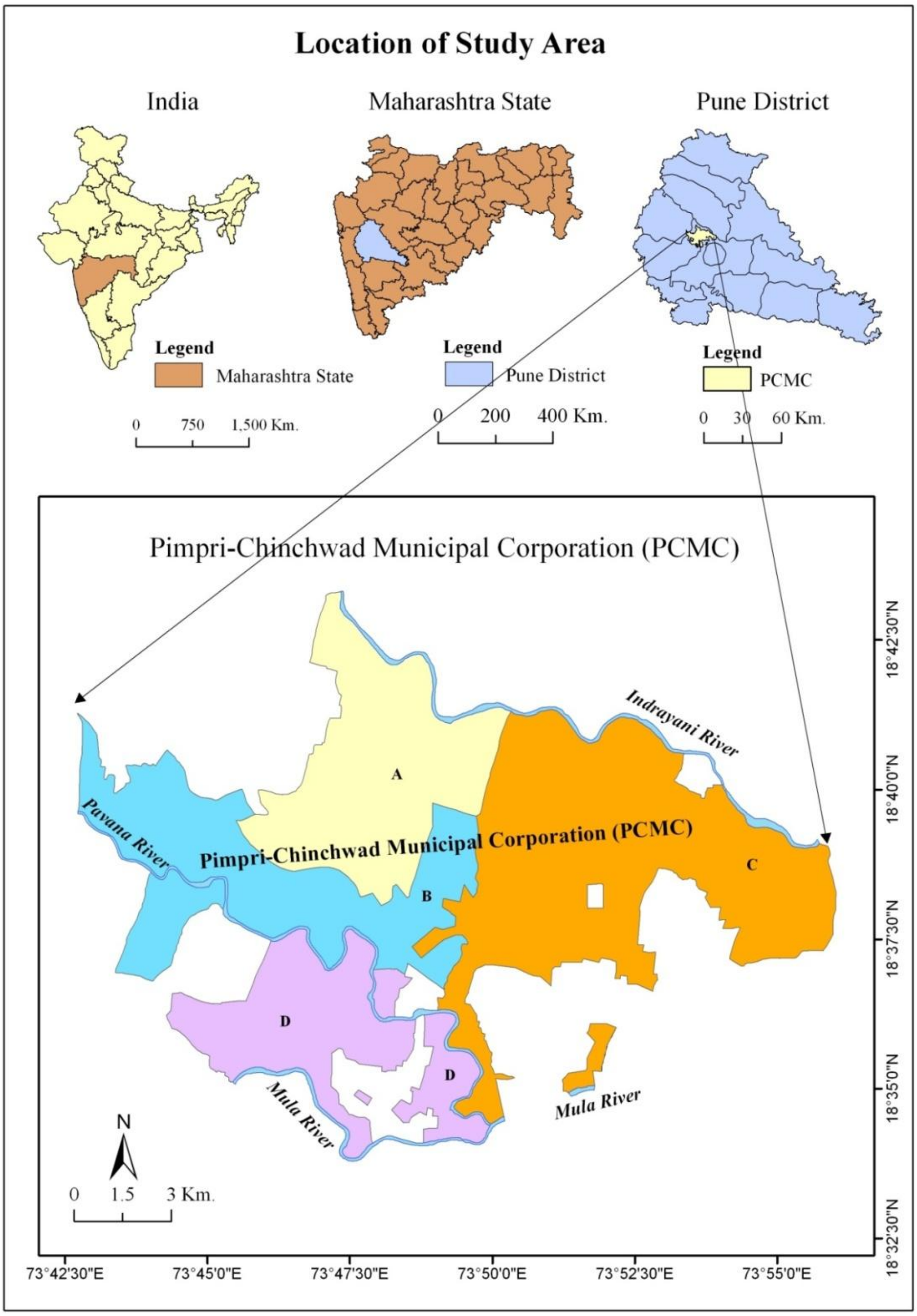


Fig.1 Study Area

Neo Geographia (ISSN-2319 – 5118) Vol. I, Issue. II, December 2012

Table 3: Administrative committee wise built-up area based on Toposheet and Imagery

Administrative Committee	TGA (Sq. Km.)	TGA Area (%)	Toposheet Built-up Area (Sq. km)	Toposheet Built-up Area %	Image Built-up Area (Sq. km)	Image Built-up Area %	Difference (Sq. km)	Difference %
A	36.01	20.99	0.31	13.93	11.78	22.39	11.47	8.45
B	39.54	23.04	0.83	37.05	11.75	22.33	10.92	-14.73
C	66.85	38.96	0.69	31.00	18.24	34.64	17.54	3.64
D	29.19	17.01	0.40	18.01	10.87	20.64	10.46	2.63
Total Area	171.59	100.00	2.23	100	45.51	100	50.40	0.00

(Source: Computed by Authors) ***TGA- Total Geographical Area***

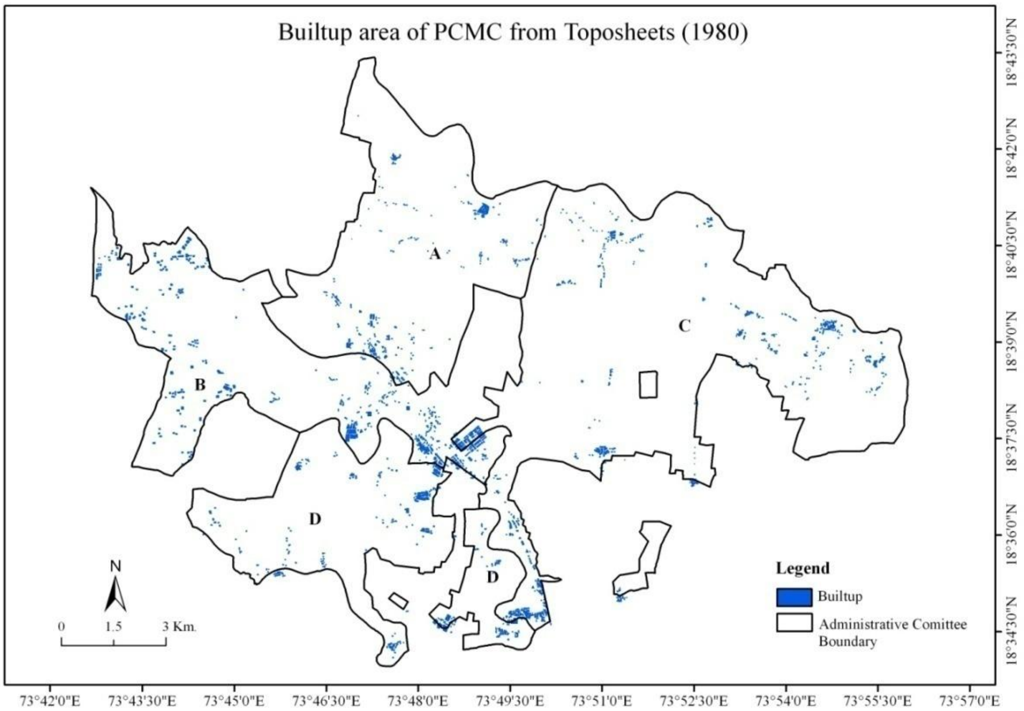


Fig 2. Built-up Area of PCMC from Toposheet (1980)

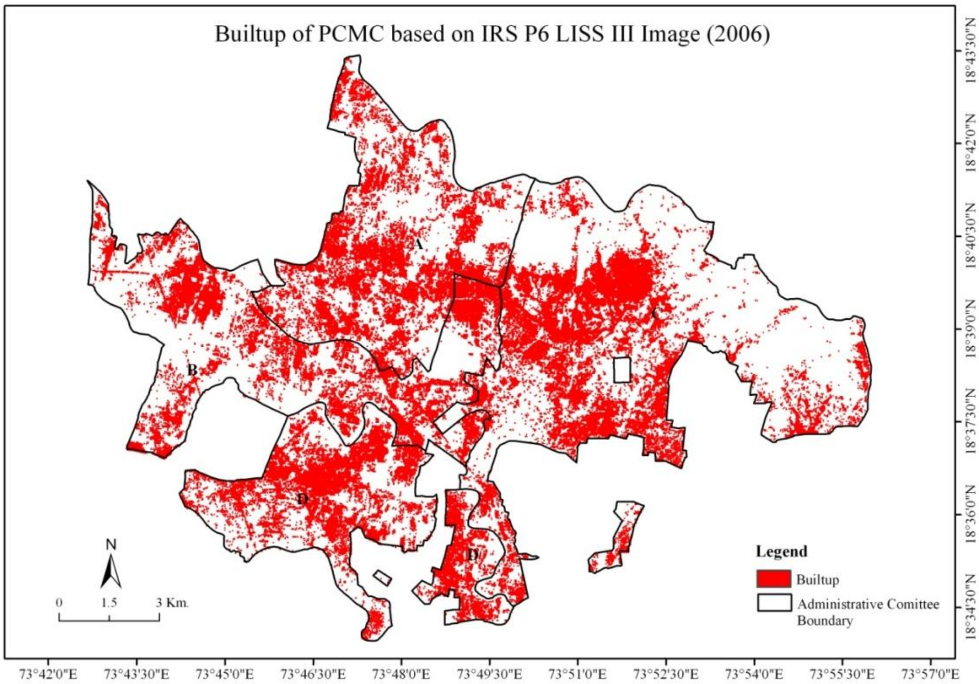


Fig. 3: Built-up Area of PCMC from Image (2006)

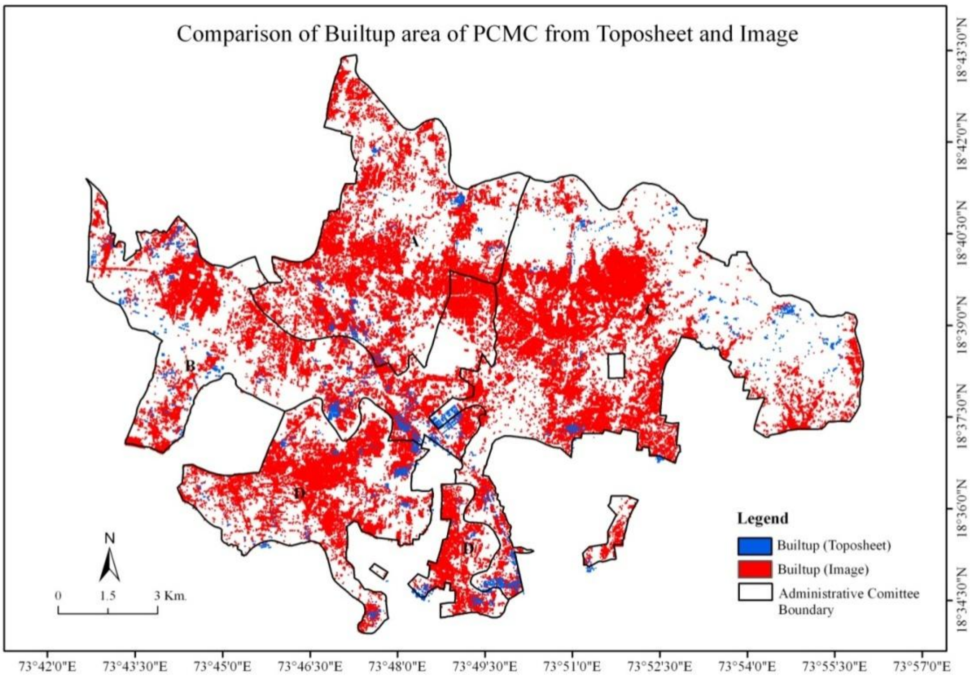


Fig. 4: Comparison of Built up Area of PCMC from Toposheet and Satellite Image

Conclusions

Urban growth has transformed most of the agricultural land into industrial, commercial and residential areas. Urban sprawl i.e. built-up area increased from 2.23 sq. km. in 1980 to 52.63 sq. km. in 2006. Total increase in built-up area is around is 50.40 sq. km. From the table and figures it is evident that the total geographical area in C, committee is merely 0.69 (31 %) having increased 18.24 (34.64 %) followed by A, committee 0.31 (13.93 %) to 11.78 (22.39 %), B, committee 0.83 (37.05 %) to 11.75 (22.33 %) and D, committee 0.40 (18.01 %) to 10.87 (20.64 %), built-up area.

REFERENCES

Bhailume S. A. & V. R. Nagarale, 'A Geographical study of civic amenities in PMC area using GIS Techniques' Indian Streams Research Journal, Vol.I, Issue-IV, July 2011, Pp. 187-191.

Bhailume S. A. (2008). "A study of Urban Sprawl and Utility planning of Pune City using Remote Sensing and GIS techniques", Unpublished M. Sc. Dissertation. Department of Geography, University of Pune.

Burrough P. A. (1986). "Principles of Geographic Information Systems for Land Resources Assessment", Clarendon Press, Oxford

Epstein, J., Payne, K., and Kramer, E., (2002). "Techniques for mapping suburban sprawl", Photogrammetric Engineering and Remote Sensing, Vol. 63(9): pp 913 – 918.

Hussain. M. (2003). Urban Geography, Anmol Publications Pvt. Ltd., New Delhi

Li, X. and Yeh, A.G.O. (2001). Zoning land for Agricultural protection by the integration of Remote Sensing, GIS, and Cellular Automata. *Photogramm. Engg. & Remote Sensing,* Vol. 67(4): 471-477. -43

Pathan, S. K., Jothimani, P., Pendharkar, S. P. and Sampat Kumar, D. (1989). Urban landuse mapping zoning of Bombay Metropolitan Region using Remote Sensing data. *J. Indian Soc. Remote Sensing*, 17(3): 11-22

Sokhi, B. S; and Rashid, S. M. (1999). "Landuse and landcover mapping in urban areas using areal photographs and satellite imageries of Jaipur (1983 & 1989)". Indian Geographical Quest, Vol.1 2011-2012, pp. 75-84

Address of Author

1. **Mr. Santosh Bhailume ,**

Assistant Professor,
Department of Geography,
S.N.D.T. Women's University
Pune Campus, Pune

2. Dr. Virendra Nagarale

Associate Professor & Head,
Department Geography,
S.N.D.T. Women's University Pune Campus, Pune