ENABLING FLORA SUSTAINABILITY ALONG THE GOLDEN QUADRILATERAL STRETCH HIGHWAY IN KARNATAKA- AN ENVIRONMENTAL ANALYSIS

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Abstract

Present economic scenario across the nation necessitates addition of enormous infrastructural development including roads of all sorts. Since 1980's with the on set of economic liberalization and globalization in India both Central and State governments have resorted to enhancement of such infrastructure. One of such ventures is the development of Golden Quadrilateral National Highway (GQNH) connecting Delhi-Kolkata-Chennai-Bangalore-Mumbai-Delhi. It has a total length of 5952 kms., and in Karnataka it is between Mulabagal in Kolar District (East) and runs almost in the central stations in N-NW and S-SE direction to Nippani (NW) covering 737 kms. Though its construction has benefited the nation, it has certain negative environmental aspects in terms of loss of plants and biodiversity along its stretch. In the present study an endevour is being done to look into these issues of loss of flora along GQNH in Karnataka. Emphasis is given to, how to enable the whole stretch as a model for regeneration of avenue trees. Researchers hope and would like to initiate the debate and policy issues of such road infrastructure development. This initiative must be associated with compulsory planting of not ornamental plants but traditional, long life local trees. Certainly in these days of climate change particularly rise in levels of Co_2 world over including our environment we need to enhance carbon sinks, flora which can absorb Green House Gases (GHGs) along roads of all sorts.

Key words: Golden Quadrilateral National Highway, Colonial roads, Globalization,Carbon sink.

Introduction

In the recent decades (1980's and 1990's) there is a spurt of motor vehicles consequently their impact on roads. In order to accommodate growing vehicles of all sorts. There is increase in attempt of road construction particularly widening the existing roads. No doubt this kind of road development has become inevitable but the negative impact is on land and the natural vegetation of such stretches. In certain sections highways and roads passes through valuable agricultural land (irrigated tracks). Once there stood avenue trees on both the sides of the roads. A traverse along the major highways or state highways, even major district roads once can see immense loss of original avenue trees. This loss of trees is not only physical loss but also environmental loss too, on one hand, loss of habitat to birds and other fauna at the same time. Environmental loss is in the form of carbon sinks. It is needless to say that there is a virtual loss of even bio-diversity where ornamental trees and flowering plants of very short life have been adopted.

Study area

National Highway No.4 (GQL in Karnataka) which connects Mumbai with Chennai via Pune-Bangalore. At national level it connects Mumbai-Delhi-Kolkata-Chennai with Mumbai. It passes through almost in the heart of Karnataka in North Western - Southeastern and Eastern directions. It has a total stretch of 737 kms., in the state accounting for (12.38%) of the Golden Quadrilateral Highway of entire length where Golden Quadrilateral highway is a total length of 5952 kms., in the country. In Karnataka it starts from Kolar district with first town Mulbagal runs to west and touches state capital Bangalore metropolis. It goes almost North, North western direction through out the state. In this stretch from Bangalore, it touches Tumkur, Chitradurga, Davangere, Haveri, Dharwad and Belgaum like district headquarters and other towns in their districts in Karnataka. In all there are 105 towns of various sizes in the state along National Highway out of which 24 are on the Golden Quadrilateral Stretch. And they are experiencing rapid urban land use changes related to highways. Nippani is North Western most, town of Karnataka on Golden Quadrilateral.

Figure 1. Study Area.

Methodology

In the present study an effort has been made to gather information about the species of avenue trees from secondary sources like respective district Gazetteer of India. In order to get first hand information about the loss of avenue trees, sample field work has been undertaken along the Golden Quadrilateral stretch of Karnataka (NH-4). The field observation and the field work is concentrated between Mulbagal in the east and Tumkur in the west along the National Highway No.4. Secondary information has been collected and analyzed about the natural vegetation and even avenue trees planted along the NH-4. An effort has been done to prepare list of trees lost and at the same time as a strategy to grow avenue trees list of local trees with their botanical name has been identified. An Environmental Impact Assessment of such trees planting along Golden Quadrilateral stretch has been worked out.

Concept of tree planting along major highways

In India from time immemorial common good practices like planting avenue trees along a road, constructing wells, small tanks over the common features with the advent of British and introduction of automobiles and change of times has eroded this culture through Vana Mahothsavas that is afforestation measures by the department of forest. There is some amount of avenue trees planting across the state. However a traverse along any such newly planted avenue trees illustrate that since hardly there are locally suitable tree planting, many of these ornamental trees (Gulmur) have not yielded desirable results. There is a repeated attempts of tree planting, but rate of survival is not satisfactory. This may be due to lack of people participation on one hand and this being government venture. There is planting but watering and boost planting tree care is not at all satisfactory. However there is still repeated replanting and half hearted attempt increase their survival but there is a need for peoples participation and planting of environmental friendly species along the major roads and highways.

Present status of avenue trees along golden quadrilateral stretch of Karnataka

Before 1999-2000 present Golden Quadrilateral stretch of National Highway in Karnataka was National Highway No.4 (Madras- Thane). With the onset of economic liberalization (1989, 1990, 2000) in India there was enormous increase of automobile transportation in this highway. Subsequently, in 2002, at the instance of the then prime minister (Atal Bihari Vajpayee), this national highway started intermittent widening mostly into four lane highway. Many private builders in Karnataka (Soma enterprises, R.N.R.,

Punj Lloyd etc.) converted over the years this entire stretch of 737 km., national highway into four lane highway. However near urban limits this has been further widened into six lane highway often with some more service roads. This resulted into four lane highway widening upto 14 mts. width and six lane highway into 21 mts. width. Consequence of this widening of NH-4 like highways lost valuable trees which where hundred years of old planted on either side of former two lane highway. Some of these trees which have become remnants consisting of just less than 1% former their existence can be seen even now in the medians, prior to widening this kind of National Highway had traditional avenue trees (table 1).

Table 1. Species of Avenue Trees

Sl. No.	Local Name (Kannada)	English Name	Botanical Names
1.	Hunase	Tamarind	Tamarindus Indicus
2.	Beevu	Neem	Ayadirachta Indica
3.	Maavu	Mango	Mangifera
4.	Honge	Pongamia	Pongamia Glabra Jambosa
5.	Neerale	Jamoon Tree	Syzygium- Cumine
6.	Hippe	Indian Mulberry	Morus Indica
7.	Aala	Banyan Tree	Ficus Bengalensis
8.	Arali	Peepal Tree	Ficus Religiosa
9.	Atti	Fig Tree	Ficus Glomarata

Source: Gazetteer of India.

It was quite common to see trees on major roads like National Highways, now even State Highways, District roads having some extent of mostly Banyan trees, Neem trees, Tamarind trees as avenue trees. There is a virtual loss of all these trees along the Golden Quadrilateral stretch due to its widening, which became inevitable with the growth of increase automobile transport across India hence there is a total loss of vegetation or avenue trees in the entire stretch. There is an attempt to greening the highway median by some flowering bushy plants. However, this is now match to former lush green avenue trees, which were so huge not only in number but also in size. In past these avenue trees provided a sort of habitat for variety of birds, some extent fodder for animals and food for thousands of birds. These trees were great carbon sinks and emitters of life giving oxygen. Now it is a history and demands a renewal and conservation of vegetation along these highway stretches.

Sustainable development of avenue trees along the Golden Quadrilateral Stretch

The main objective of this paper is to investigate and highlight the aspect related to afforestation to be done on either side of Golden Quadrilateral Stretch. Of course these must be done scientifically without harming easy flow of vehicular transport particularly huge trucks. Researchers have observed that from the edge of existing four and six lane of golden quadrilateral. There is substantial amount of vacant land available for such avenue trees planting.

There is a need to plant conventional / traditional avenue trees listed in (Table 1.). These trees have been recommended because of their longevity over hundred years. Their fruits, leaves, twigs etc. have litter values which are environmental friendly. Trees like neem (Ayadirachta indica), Indian mulberry (Morus indica), they have fruits bearing oil seeds. They feed birds and their seeds are collected for oil traditionally. Across India several stretches of avenue trees provided valuable oil seeds, certain vegetative resources (fodder), even fire wood from their dried twigs. They were treated as common resources and protected for hundreds of years. They added environmental value while they had immense importance as inhabitants for areal fauna. Even their oil cakes they have immense value in these days of soil degradation by chemical fertilizers. National Highway Authority of India can introduce systematic collection of such products from avenue trees, which leads to generation of employment and revenue for villagers along with these, they have environmental value as immense of carbon sinks. It's certainly ensures on protection of local and global environment.

Potential Scenario of avenue trees along golden quadrilateral stretch in Karnataka

The main objective of these pieces of research is to provide the potential of Golden Quadrilateral stretch in having general avenue trees. In view of both economic and environmental value, Golden Quadrilateral must initiate the systematic tree planting (Table 2.), illustrates briefly the potential scenario of such avenue trees to be planted in the study area, in the remaining stretch of Golden Quadrilateral in Karnataka and also in the entire stretch of Golden Quadrilateral in India.

Table 2. Potential Scenario of A venue Trees along Golden Quadrilateral Stretch in Karnataka 2009-10

Sl. No.	Golden Quadrilateral Stretch	Distance (in Km.)	No. of avenue trees which can be planted/*
1.	Mulbagal to Tumkur i.e., Study Area	164 (28.6%)	164 x 90 = 14,760 (28.6%)
2.	Remaining stretch of Golden Quadrilateral in Karnataka	573 (77.7%)	573 x 90 = 51,570 (77.7%)
3.	Total Golden Quadrilateral Stretch in Karnataka	737 (12.4%)	73 x 90 = 66,330 (12.4%)
4.	Golden Quadrilateral Stretch in India (including Karnataka)	5952	5952 x 90 =5,35,680

* At the rate of 45+45 = 90 trees per Km.
Source: Compiled by research investigators, 2009-10.

Golden Quadrilateral stretch of National Highway in Karnataka accounts for 737 km., of distance in which present study area between Mulbagal to Tumkur accounts for 28.6% of highway distance in Karnataka. At the rate of 45 trees per km., on one side, accounts for 90 trees per km. On either side it is estimated that the entire Golden Quadrilateral stretch of Karnataka, which systematic planting will have 66,330 avenue trees which accounts for 12.4% of entire Golden Quadrilateral Stretch in India. The study are will have 28.6% of avenue trees in Karnataka.If systematic avenue tree planting, total 5,35,680 trees will be found along the Golden Quadrilateral. Being a tropical monsoon climatic region, it has not only year rounding growing period but also to a great extent access to nearby water bodies. Particularly water bodies (tank, wells, canals etc.), need to be utilized systematically in this direction. Though it involves some additional expenditure but from the view point of the economic and environmental value of avenue trees in the larger interest this project is viable and needs consideration.

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HIGH-RESOLUTION DATA IN MILITARY APPLICATIONS

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Abstract

Geographic information is a part of the overall requirement for intelligence by the armed forces. The right information at right time is crucial for successful tactical and logistical planning. The military command which acquires the information fast and uses it fast will be at an advantageous position in future wars as well as rescue operations. In this context remote sensing data plays a vital role. In the present study, very high resolution data (both panchromatic and multi spectral) having an additional advantage of multi-angular sequence was used to explore the military application in 3 D environment. Many methods have been devised for combining High resolution Panchromatic (HRP) images with low resolution multi spectral (LRM) images. The Ehlers fusion method was used to fuse LRMI with HRPI in order to get enhanced spatial and spectral characteristics on fused image. Erdas Virtual GIS module was used for exploring fused multi-angular data for military application because virtual GIS provided real time 3 D environment with fused images. The results are encouraging and provide hope for further refinements.

Key words—Low- resolution Multispectral Image, High-resolution Panchromatic Image, Data fusion,3D, Virtual GIS

Introduction

In general, data fusion is the process of combining the lower resolution pixels with the higher resolution pixels to produce a high resolution image. It aims for obtaining information of greater quality and to allow integration of different information sources may take advantages of the complementary spatial/spectral resolution characteristics typical of remote sensing imagery. A set of WorldView-2 multi-sequence images, including both 16 bit panchromatic and multi-spectral 8-band images of Rio de Janeiro (Brazil) forms the study area. These images were collected on January 2010 within a three minute time frame. The multi-angular sequence contains the downtown area of Rio, including a number of large buildings, commercial and industrial structures, the airport and a mixture of community parks and private housing. Since there are a large variety of possible applications, Defence Industrial application was selected as the research topic and few possible military applications were tried among them.

Need for study

Geographic information is a part of the overall requirement for intelligence by the armed forces. The military command which acquires the information fast and uses it fast will be at an advantageous position in future wars as well as rescue operations. The level, amount and detail of land related information required, depends on the level at which operations are being considered. There are personnel rights from field commanders to command staff. They need access to a geographic picture: map or photograph to help and assess a situation to carry out planned operations. In the present digital era, the remote sensing, GIS and artificial intelligence technologies can together be effectively utilized to develop intelligent systems for military applications. C4I (Command, Control, Communication, Coordination and Information) is one such system, where these technologies can be efficiently used. The areas where present military capability may be enhanced as a result of the employment of newer remote sensing systems are monitoring patterns and seasonal variation and location of other modifications and the ability to assess very quickly the digital difference between one image and another acquired at a later date. The geographic information requirement can broadly be divided into three areas, namely – Infrastructure information- primarily about man-made features but with a geographic location, air fields, ports and harbors, resources and utilities, transportation & communications, urban areas, civilian stores support, repair and maintenance, terrain intelligence, that is primarily concerned with the natural features of the terrain (such as vegetation, soils, geology, water features & beaches etc.) and Environmental data, such as climate and weather. The very high-resolution imagery provides a capability to conduct detailed reconnaissance and subsequent extraction of this

critical information. The use of geospatial intelligence in defense forces has revolutionized the way in which these forces operate and function. Geo spatial intelligence can be defined as the "Exploitation and analysis of imagery and geospatial information to describe access and visually depict physical features and geographically referenced activities on the earth". It is the merger of geospatial data with imageries so as to arrive at layers of information that depicts the physical and cultural features of the area of interest in three dimensions and allow users to visualize inaccessible terrain. Hence an attempt has been made with the very high resolution data which also has an additional advantage of multi angular sequence taken within a three minute time frame to create such geospatial intelligence. Getting the right information at the right time can change the fate of any war. In this aspect, this present paper tries to explore the data in 3D environment by using ERDAS processing, Virtual GIS. Virtual GIS supports dynamic visualization, flight sequences, and the management / assimilation of multiple geographic data types in a real-time (Virtual environment) 3D environment.

Methodology

The detailed methodology used in this study is as follows. The digital globe data was downloaded in ".tiff" format and imported to ERDAS Imagine 9.1. Similarly raster data of the study area was also downloaded for 3D analysis. The Panchromatic data was fused with Multi spectral data by using Ehlers fusion techniques after exploring various fusion methods. The multi angular sequence fused data was loaded in Virtual world editor along with elevation data and one virtual world file was created. The same was opened in Virtual GIS viewer for exploring the study area. The Created realistic 3D interpretations with IMAGINE Virtual GIS were beyond simple 3D renderings and basic fly-through, IMAGINE Virtual GIS allowed to fuse the data quickly and easily visualize the 3D environment. Vector GIS layers were added to create realistic views of study area. Since the military operations need updated data and information based on the data should be readily available for taking decisions at the field, Virtual GIS module could be an ideal choice for that purpose. The Arc GIS 9.3 was used to monitor the flight movements and ship movements. E-Cognition Developer Trial version was also used to classify the land use land cover data.

Results

The results are discussed in different sections as the image analysis progressed in the analysis.

Pan sharpening

Many methods have been devised for combining High-resolution Panchromatic (HRP) images with low resolution multi spectral (LRM) images. In general, varieties of data fusion techniques are devoted to merge LRM and HRP Images, which exhibit complementary characteristics of spatial and spectral resolutions. Such an application is known as pan sharpening. The data fusion methods include modified intensity-hue saturation (IHS), bravery transform(BT), principal component analysis (PCA), multiplicative transform (MT), wavelength resolution merge (WRM). Even though all these processes can improve spatial quality, among these methods the Ehlers method looks better than all other methods in terms of quality of spectral information, along with better spatial quality.

The various steps involved in Ehlers fusion are intensity-hue saturation(HIS), fast fourier transform(FFT), lowpass filter(LPF), Highpass filter (HPF) Inverse (FFT), lowpass filtered intensity, high pass filtered panchromatic band and at the end an inverse IHS transform which converts the fused image into the RGB domain. That's why Ehlers method gives the synthesized result closest to what the corresponding multi sensors would observe at the high resolution level. This combination of high spectral and spatial resolution is very effective in automated feature extraction. Hereafter, fused image of LRM with HRP will be described as Pan sharpened image and "Fused image" means the fusion of multi angular fused data.

Fusion of multiangular data in Virtual GIS

The Virtual GIS provided real time 3D environment with fused images. In the virtual GIS module, firstly Virtual world was created by adding all five multi angular data layers and Dem data. After processing the data in the virtual world editor, the virtual viewer was used to view the "Fused

data" in 3D environment. Three sets of data such as Pan, Multi spectral and pan sharpened images were similarly explored in 3D environment. The Ehlers pan sharpened image was more effective than other two sets of data in understanding the terrain conditions.

The Virtual GIS module also permits to create a movie based on the options given in the scene properties. The Movie created in this module can help the decision makers in the field and also an overall feel of the field of operation. There are ways to create movie file with two different formats. From file menu, we can create movie by start recording in ".mpg" format and from Virtual GIS module by using "create Movie" option, the movie will be stored in ".avi" format. Both the ways are helpful to apprehend the theatre of operation at different angles with different zoom level. Virtual GIS also permits to add vector layers in the virtual world editor and possible to view as on overlay in virtual Viewer in 3D environment. Hence the roads were digitized in ArcGIS 9.3 and the ".shp" file was brought into Virtual GIS environment. It was added to the Virtual World editor and viewed in Virtual GIS viewer.

Monitoring/Tracking of vehicles

The continuous data was helpful to monitor the changes within the 3 minutes frame work in the Gulf area. In general by using world view data one can identify all major naval vessels (combatants and support vessels), Ship repair activities and dockside activities and it also allows the analysts to determine repair cycles and preparations for mobilizing. In the given scene some vessels are seen clearly in dock yard and also mobilizing in various locations. By using different band combinations, we can identify some interesting features in the gulf area

Particularly some specific bands ranging from 400 to 690 nm (3) gave some interesting observation in the gulf area. One aircraft and some vessels are seen only in these spectral band combinations. This could be of some intelligent information may helpful for defense operations. The new spectral band of Worldview 2 such as Yellow-band is crucial for such combination to identify this information. The coastal blue band has also showed some vessels in the new location other than what were observed with other combinations of spectral bands in the given scene.

View-shed analysis

The terrain evaluation, observation, visibility and fields of fire are the important aspects of tactics and logistics. The availability of observations and visibility depend upon terrain features. An ideal field of fire is an open area of terrain in which the enemy can be observed and in which he has no protection from fire. Concealment is the protection against observation, whereas 'cover' implies protection from fire. The ideal defensive position is one affording concealment and cover to those within but not to enemy. In the Virtual GIS module, there is possibility of this analysis. The Aster data and the digital globe data used in Virtual GIS module's View shed analysis to evaluate the field of fire and the concealment.

Extraction of objects: Image classification

The military study of terrain involves the identification and mapping of the natural and cultural features of terrain. Therefore Image classification is an integral part of terrain analysis. The very high resolution data classification still remains as a major challenge because it requires sophisticated technology. As in our case E cognition (Trial Software) has been used to classify the image by using multi resolution segmentation.

Conclusion

Thus the Very high resolution data with its multi angular sequence imageries is very useful for military operations. This will help in tactical and logistical planning and monitor the troop movements. The virtual GIS are an effective module, highly suitable for defence applications and there is good scope for terrain analysis and view-shed analysis. ArcGIS and E cognition software also support to develop the geo spatial intelligence which is the need of the hour.

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LINEAR ASPECTS FOR MORPHOMETRIC ANALYSIS: A CASE STUDY OF RAMASANDRA LAKE BASIN

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Abstract

The earth's surface is structured into watershed. Watersheds analysis based on morphometric parameters is very important for watershed planning. The morphometric analysis of a drainage basin and their stream systems can be better achieved through measurement of linear and aerial aspects of drainage network. In the present study, we try to calculate morphometry of the watershed with using linear parameters such as stream order, stream length, drainage density, stream frequency, bifurcation ratio, drainage texture. Ramasandra lake is one of the important lakes, which is located in Bangalore Metropolitan Region. In the catchment area land and water resources are not utilized effectively by the inhabitants. To improve the livelihood & socioeconomic conditions of the inhabitants of the catchment these need defended study of the lake, hence the research work was carried out. Topomap, GPS points are used as data sources for the analysis. Horton, Schumm, Strahler laws have been used to achieve the set goals. Arc GIS 9.2, Erdas Imagine 9.1 GIS software's & GPS have been applied here to arrive at meaningful findings. Ramasandra lake has 2.32 sq km catchment area and lake area is 6.54 hectare & its perimeter is 6.7 Km. Watershed ordering is one of the most important aspects of planning for implementation of its development and management programs. The present study demonstrates the linear parameters for morphometric analysis.

Key words: Morphometric Analysis, Catchment Area, Linear Parameters.

Introduction

The earth's surface is structured into watersheds. Hydrologists and Geomorphologists are interested in the study of spatial variability throughout a watershed. The quantitative analysis of morphometric parameters is of great utility in lake basin evaluation, watershed prioritization for soil and water conservation, and natural resources management at micro level.

Morphometric analysis provides quantitative description of the basin geometry to understand initial slope, structural controls, geological and geomorphic history of drainage basin (Strahler 1964).The Morphometric analysis is mathematical calculation of the parameter like stream order, bifurcation ratio, and drainage density and so on. It is the measurement and mathematical analysis of the configuration of the earth's surface, shape, dimension of its landforms (Clarke, 1966). Morphometric analysis requires measurement of linear features, gradient of channel network and contributing ground slopes of the drainage basin (Nautiyal 1994).Morphometric analysis is a significant tool for prioritization of subwatersheds even without considering the soil map (Biswas et al., 1999).

Fluvial morphometry includes the consideration of linear, areal and relief aspects of a drainage basin. In these aspects linear aspects are very important, hence the linear aspects of the basin morphometry of Ramasandra lake watershed in Bangalore Metropolitan Region has been chosen for the research. The linear aspect includes the hierarchical orders of streams, numbers and lengths of segments and various relationships among them such as drainage density, stream frequency, bifurcation ratio, drainage texture.

Ramasandra lake is one of the important lakes, which is being used for many purposes. In the past lake was used for drinking, agriculture and domestic purposes by surrounding villagers and agricultural fields. In the catchment area of Ramasandra lake land and water resources are not utilized effectively by the inhabitants. To improve the livelihood & socioeconomic conditions of the inhabitants of the catchment these need defended study of the lake. Rapid growth of Human population, settlements, industries & sewage water are the chief factors for the degradation of Ramasandra lake.

Main objectives of the research paper is to identify the hierarchical orders of the streams & their nature and also investigate the linear characteristics of Ramasandra lake watershed. The methodology followed for the research is that, GPS data are used to collect the latitude, longitude and altitude. Erdas

Imagine Processing 9.1 software is used for georefrencing & projection. Arc GIS 9.2 software used for mapping. The base map of the Ramasandra lake watershed was prepared based on Survey of India Topographic maps on 1:50000 scale. The Ramasandra lake drainage network is delineated from rectified SOI topographic map No. 57H/5 on polyconic projection system with the help of GIS softwares.

The linear aspect for the delineated basin are calculated based on the formula given in the below table.

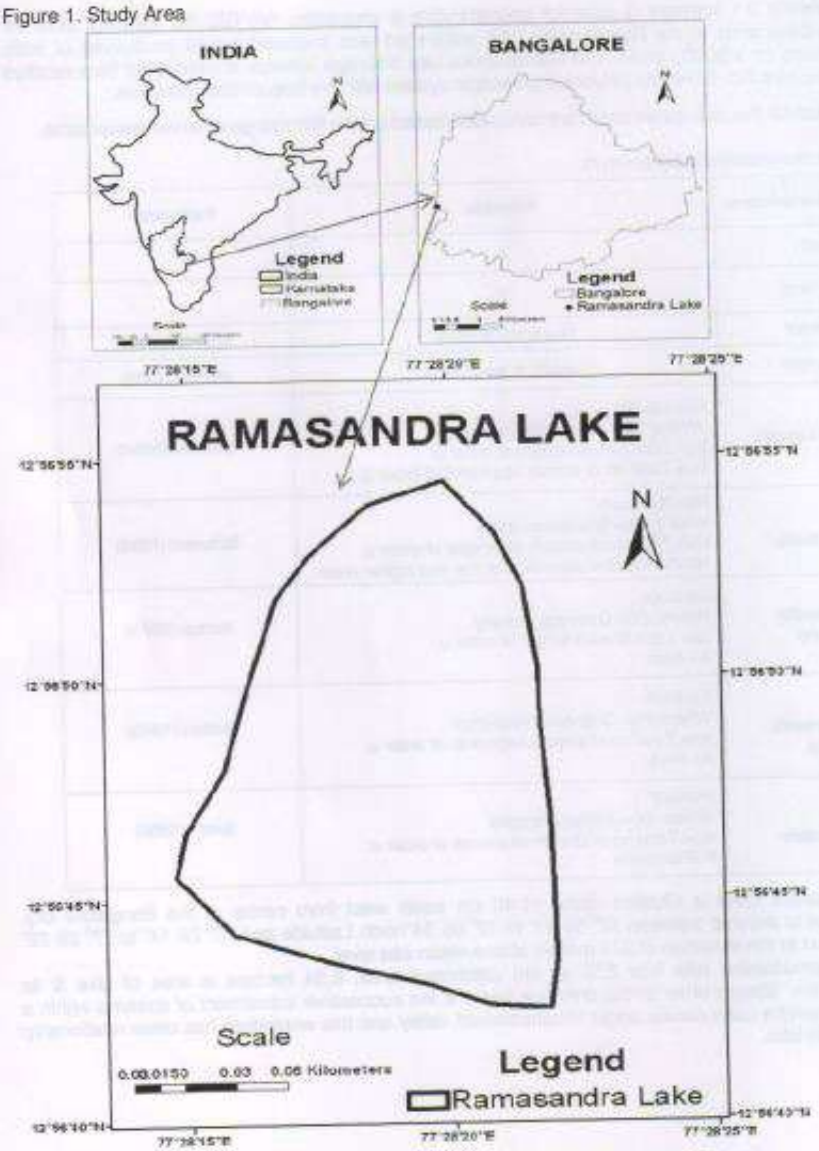
Table 1. Linear morphometric parameters

Morphometric Parameters	Formula	Reference
Area (km2)	A	
Perimeter (km)	P	
Stream Order	Hierarchical Rank	Strahler (1964)
Stream Length	Length of the stream	Horton (1945)
Mean Stream Length	Lsm=Lu/Nu Where, Lsm= Mean Stream Length. Lu= Total Stream length of order u. Nu= Total no of stream segments of order u.	Strahler (1964)
Bifurcation Ratio	Rb= Nu/Nu+1 Where, Rb= Bifurcation Ratio. Nu= Total no of stream segments of order u. Nu+1= Number segments of the next higher order.	Schumm (1956)
Drainage density (km/sq. km)	Dd=Lu/A Where, Dd= Drainage Density. Lu= Total Stream length of order u. A= Area.	Horton (1945)
Drainage (Stream) frequency	Fs=Nu/A Where, Fs= Drainage Frequency. Nu= Total no of stream segments of order u. A= Area.	Horton (1945)
Drainage texture	Ft=Nu/P Where, Ft= Drainage texture. Nu= Total no of stream segments of order u. P=Peri meter	Smith (1950)

Ramasandra Lake is situated about 11.46 km south west from center of the Bangalore city. Ramasandra lake is situated between 12° 56 41" to 12° 56 54"north Latitude and 77° 28 14" to 77° 28 22" east longitude and at the elevation of 974 meters above mean sea level.

The Ramasandra lake has 2.32 sq km catchment area, 6.54 hectare is area of lake & its perimeter is 6.7 km. Stream order of the drainage basin is the successive adjustment of streams within a drainage. Ramasandra Lake comes under Vrushabhavati valley and this watershed has close relationship with Manganahalli lake.

Figure 1. Study Area



Analysis

The various linear morphometric parameters of the Ramasandra lake basin were determined and are summarized in different tables. The analytical results of the linear aspect of drainage network such as stream order, stream length, mean stream length ratio, bifurcation ratio etc. have been presented in different tables are given below.

Figure 2. Stream Ordering map of Ramasandra Lake Catchment.

Above map shows the drainage network & stream ordering of the catchment area of Ramasandra lake. In this stream ranking map with the increasing stream order size of stream also increases.

Stream Order

In the drainage basin analysis, the first step is to determine the stream orders. Many stream order classification systems have been developed, but no single system has been universally accepted. One of the earliest methods developed, and possibly, the most commonly used method today, was developed by Strahler in 1952. In this system, the smallest headwater tributaries are called first-order streams. Where two first-order streams meet, a second-order stream is created; where two second-order streams meet, a third-order stream is created; and so on. In the present study also Strahler method was used.

Table 2. No of Streams in catchment area

Stream Order	No of Streams
1st order	63
2nd order	12
3rd order	3
4th order	1

Figure 3. Percentage of stream order

The characteristic of the study area it exhibits is a 4th order drainage basin (*Figure-2*). In this catchment area there are 63 first order streams, 12 second order streams, 3 third order streams and 1

fourth order stream are identified. In the selected watershed number of stream will decrease when the stream order is increasing. Drainage patterns of stream network from the basin have been observed as mainly dendritic type which indicates the homogeneity in texture and lack of structural control.

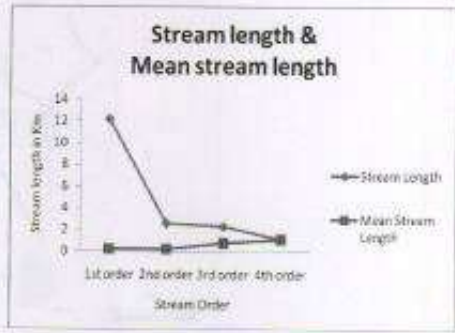
Stream length & Mean stream length

Stream length is the total length of streams in a particular order. Generally, the total length of stream segments decrease with stream order. The number of streams in various orders is countered and the total length of each order stream is calculated at watershed level with the help of GIS software.

Table 3. Stream Length & Mean Stream Length in Ramasandra Lake catchment area

Stream Order	Stream Length	Mean Stream Length
1st order	12.2 km	0.2 km
2nd order	2.6 km	0.2 km
3rd order	2.3 km	0.8 km
4th order	1.1km	1.1 km

Figure 4. Stream Length & Mean Stream Length in Ramasandra Lake catchment area



The stream length is computed based on the Horton Law. The number of streams of various order in the watershed counted and their lengths are measured. In this watershed 1st order stream has 12.2 km, 2nd order stream has 2.6 km, 3rd order stream has 2.3 km, 4th order stream has 1.1 km stream length. In the study area, total length of stream segments is maximum for first order and decreases as stream order increases. This is a normal trend and indicates that the terrain has low lying relief, gentle slope and has homogenous lithological structure.

The mean stream length is a dimensionless property, characterizing the size aspects of drainage network and its associated surface (Strahler, 1964). It is obtained by dividing the total length of stream of an order by total number of segments in the order .

Lsm=Lu/Nu

Where, Lsm= Mean Stream Length.

Lu= Total Stream length of order u.

In the present study mean stream length varies from 0.2 km to 1.1 km. In this watershed 1st order stream has 0.2 km, 2nd order stream has 0.2 km, 3rd order stream has 0.8 km, 4th order stream has 1.1 km mean stream length.

Bifurcation Ratio

The bifurcation ratio is the ratio of the number of stream segments of given order to the number of segments of next higher order. It is a dimensionless property and shows the degree of integration prevailing between streams of various orders in a drainage basin. Horton (1945) considered the bifurcation ratio as index of relief and dissertation. The Mean Bifurcation ratios characteristically range between 3.0 and 5.0. for watershed in which geology is reasonably homogeneous and no structural disturbances.

Schumm (1956) expressed by the following equation.

Rb= Nu/Nu+1

Where, Rb= Bifurcation Ratio.

Nu= Total no of stream segments of order u.

Nu+1= Number segments of the next higher order.

Table 5. Bifurcation Ratio in Ramasandra Lake catchment area

Stream Order	Bifurcation Ratio
1st order	5.25
2nd order	4
3rd order	3
4th order	-
Mean Bifurcation Ratio	**4.1**

In the selected watershed bifurcation ratio ranges between 3 to 5.25. The lower values of Rb indicate that the watershed has suffered less structural disturbances and the drainage pattern is not deformed. The mean Bifurcation ratio is 4.1 this indicates strong structural control over the drainage pattern while the lower values are indicative of not affected by structural disturbances.

Drainage density

Drainage density is one of the important linear aspect of the drainage basin. Drainage density is defined as the closeness of spacing of channels. It is expressed in units like km/km^2 or mi/mi^2. The measurement of Dd is a useful numerical measure of landscape analysis and runoff potential (Chorley, 1969). Drainage density depends upon both physical and climate characteristics of the drainage basin. Drainage density is affected by the initial relief, soil infiltration, and underlying rock type. Climate affects drainage density both directly and indirectly. The amount and the type of precipitation influence directly the quantity and character of runoff. It is a total length of all the streams in a drainage basin divided by the total area of the drainage basin.

Horton (1945) expressed drainage density by the following equation:

$$Dd=Lu/A$$

Where, Dd= Drainage Density.
Lu= Total Stream length.
A= Area.

Strahler (1964) noted that low Dd occurs where basin relief is low, while high Dd is favored where basin relief is high. Drainage density is measure of how well or how poorly a watershed is drained by stream channels. The watersheds can be grouped into four categories on the basis of drainage density as course where Dd<5 km length per km^2 area, medium where Dd=5-10 km km^{-2} area, fine where Dd=10-20 km km^{-2} area and very fine where Dd>20 km km^{-2} area. The Ramasandra lake catchment area has 7.8 km^2 drainage density. This means lake catchment area has medium drainage density (Strahler, 1964). This indicates that the lake basin has low relief, medium permeable subsoil material and less vegetation cover.

Stream frequency

Stream frequency is one of the important linear aspect for Morphometric analysis. The Stream frequency concept was introduced by Horton (1932). It is also called as a Drainage frequency and is shown by the symbol Fs. Stream frequency is the total number of stream segments of all orders per unit area. Stream frequency have close relation with the drainage density. It is observed that there is a decrease in stream frequency as the stream order increases. With higher Fs values show resistant/low conducting sub-surface material, sparse vegetation and high relief. Low Fs shows well education and low relief.

Horton (1945) referred the formula to calculate Stream frequency that is

$$Fs=Nu/A$$

Where, Fs= Drainage Frequency.
Nu= Total no of stream segments of order u.
A= Area.

Table 6. Stream Frequency in Ramasandra Lake catchment area

Stream Order	Stream Frequency
1st order	27.1
2nd order	5.2
3rd order	1.3
4th order	0.4
Mean Stream Frequency	**8.5**

In the selected watershed the value of stream frequency (Fs) for the basin exhibit positive correlation with the drainage density. Drainage frequency decreasing while stream order is increasing. Ramasandra watershed basin have medium level drainage frequency(8.5) this indicates presence of a permeable surface material and low relief.

Drainage Texture

The drainage texture is considered as one of the important concept of geomorphology which shows the relative spacing of the drainage lines. It is the total number of stream segment of all order per perimeter of that area (Horton 1945). The drainage texture (T) depends upon a number of natural factors such as climate, rainfall, vegetation, rock and soil type, infiltration capacity, relief and stage of development (Smith 1950). Low drainage density leads to coarse drainage texture while high drainage density leads to fine drainage texture (Strahler, 1964).

Smith, in 1950 has classified drainage texture into five different textures i.e., very coarse where Dt is <2, coarse where Dt is 2 to 4, moderate where Dt is 4 to 6, fine where Dt is 6 to 8 and very fine where Dt is >8.

Horton (1945) expressed drainage density by the following equation

T=Nu/P

Where, T= Drainage texture.
Nu= Total no of stream segments of all order .
P=Peri meter in km

Ramasandra lake catchment area has 20.5 drainage texture. This indicates that the catchment area has impermeable surface material, sparse vegetation, mountainous relief and as well channels are very close from each other.

Result & Discussion

The Ramasandra lake catchment is 2.32 sq Km, where as lake water area is 6.54 hectare. The catchment perimeter calculated to be 6.7 Km. The present study watershed has dendritic drainage pattern, which indicates the homogeneity in texture and lack of structural control. The characteristics of the study area exhibits a 4th order drainage basin. Number of streams and length of stream is decreasing while stream order increases, there is no need to wonder because this is the common nature of all the watersheds. The Ramasandra lake catchment Mean bifurcation ratio is 4.1 this indicates strong structural control over the drainage pattern while the lower values are indicative of not affected by structural disturbances. It has 7.8 km^2 drainage density, which indicates the medium drainage density which scenes the low relief, medium permeable subsoil material, less vegetation cover. In the selected watershed the value of stream frequency (Fs) for the basin exhibit positive correlation with the drainage density. Ramasandra watershed basin have medium level drainage frequency(8.5) which indicates presence of a permeable surface material and low relief. And the Drainage Texture is 20.5, which indicates the impermeable surface material, sparse vegetation and mountainous relief and the channels are very close from each other.

Conclusion

Ramasandra lake is one of the important lakes, which is being used for many purposes. In the past it was used for drinking, agriculture and domestic purposes by surrounding villagers and agricultural fields. In the catchment area of Ramasandra lake land and water resources are not utilized effectively by the inhabitants. To improve the livelihood & socioeconomic conditions of the inhabitants of the catchment these need defended study of the lake. Rapid growth of Human population, settlements, industries & sewage water are the chief factors for the degradation of Ramasandra lake. Hence local administration should take several steps to avoid the degradation of lake. The people of the catchment area also should think to save lake and they have to control sewage water which directly goes to lake.

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HYDROLOGICAL ASPECTS OF TIHAMA PLAIN

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Abstract
The republic of Yemen faces critical water shortages, that it could be categorized among the most water scares country in the world. The country experiences wide fluctuation of rainfall. It has predominantly arid to semi arid climate conditions with high temperatures prevailing all through years. These are a substantial imbalance between the available water resources and the need. In view of this, the authors tried to discuss surfaced run off, annual water returns, RI probability analysis, loss of water by natural parameters and also peak run off. For the effective results, many equations have been derived in this paper. The primary and secondary data have been used to analyze the facts.

Key words: Hydrological Aspects, Catchment area, Surface runoff.

Introduction

Even in the early 1970's when water survey projects were conducted for the purpose of irrigation, to fulfill the water scarcity areas. Government carried out several water projects especially by drilling wells in several areas of Yemen generally and Tihama plain particularly for the purpose of promotion of agriculture and in pursuit of attaining self-sufficiency in food production. Government projects during the said period aimed at diverting water streams and valleys into agricultural fields. Hydrological studies were not done effectively for area of Tihama plain. The observations obtained on the runoff for some valleys, which flow through Tihama plain, like Wadi Zabid, were done by TESCO company in 1960's. Their hydrological analysis was based on data and analysis done on similar valleys in neighboring areas. Rainfall pattern in Tihama plain's catchment areas has a definite trend. It declines as one proceeds from east towards the west. The mean annual rainfall at Zabid town is 188 mm, however, it is 636 mm at Yarim station towards the east. Altitude has an effect on rainfall also, for instance, the station of Ibb, located at an altitude of 2000 mts above sea level, receives an average annual rainfall of 1961 mm.

Catchment area and main drainage basins

Tihama plain embraces seven main catchment areas and other smaller ones. These catchment areas are endowed with huge quantities of rainwater compared to Tihama plain itself. Wadi Mawr's catchment area is considered as the largest and stretches over 7500 km^2. Wadi Mawza'a on the other hand is the smallest valley and has a catchment area of about 3000 km^2 (Fig. 1)

Surface runoff

Surface runoff denotes the water runoff on land surface that occurs when density of rainfall is considerable that all water cannot be absorbed or percolates. There are several factors that affect the surface runoff like average of evapo-transpiration during rainfall, moisture of soil and nature of land use. Besides differences in the nature of land surface and rainfall values, there are small depressions on the land surface that are to be filled (depression storage), which affect the surface runoff and they are influenced by the slopes, vegetation cover and nature of land use. A depression storage requires 2-5 mm to fill and this value goes up to ten-fold in case of contour cultivation where such depression storages become more substantial (Korly, 1978).

Surface runoff can be calculated by Snider equation (Fahmi, 1999)*. Table 1 shows the value of annual runoff volume (Mm^3) in the catchment area of Wadi Mawr. According to Snider equation, it has 5.3 Mm^3 due to it is having the largest catchment area of about 7500 km2. It is followed by Wadi Zabid; that is 5.1 Mm^3 for an area of about 4900 km2. While Wadi Mawza'a has the least value of 3.7 Mm^3 for its limited area of 1300 km^2.

R=C.S. ½ (L/W) n

Where:

R = Volume of annual runoff (Mm^3)
C = Fixed factor range between (0.25-0.35)
S = Slope factor (m/km)
N = Fixed factor (0.45)
W = Average of catchment area width (Km)
L = Tallest watercourse in catchment area.

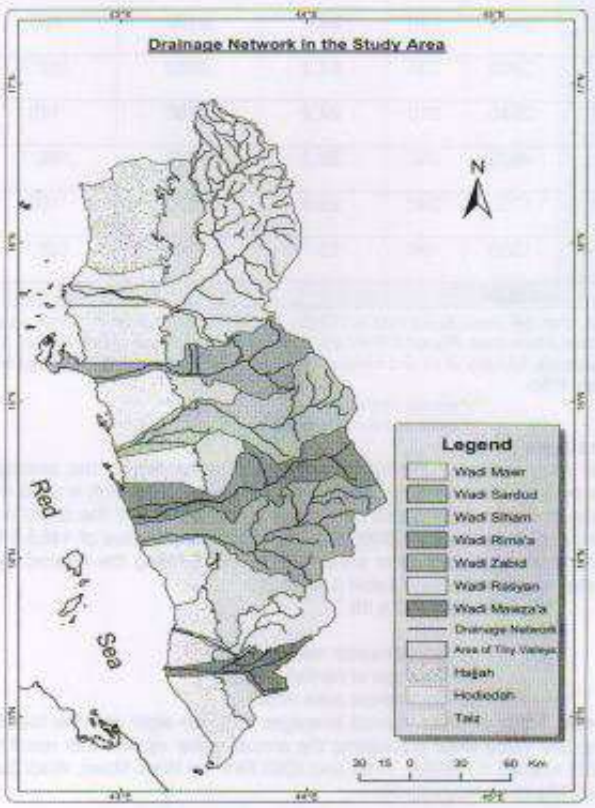

Figure 1. Study Area.

Table 1. Volume of Annual Runoff (Mm^3) in the main valleys for Tihama plain.

Valleys	Area (km^2)	Length of main stream (km)	Average width of valley (km)	Vertical difference (m)	Horizontal distance (km)	Slope (m/km)	R= surface runoff (Mm^3)**
Wadi Mawr	7500	300	39	3370	200	16.9	5.3
Wadi Sardud	2450	240	26.4	2130	160	13.3	4.5
Wadi Siham	3200	235	27.3	2250	156.7	14.4	4.7
Wadi Rima'a	2540	210	24.2	1700	140	12.1	3.9
Wadi Zabid	4900	250	32.2	2700	166.7	16.2	5.1
Wadi Rasyan	1750	240	25.6	1920	160	12	4.1
Wadi Mawza'a	1300	190	13.7	1140	126.7	9	3.7
Total	23640					13.4*	31.3

Source: J.A.M., Van der Gum, Abdul Aziz A. (1995), The Water Resources of Yemen: a summary and digest of available information. Report WRAY-35, Water Resource Assessment Yemen. T No, Delftz, The Netherlands, Ministry of oil and mineral resources, General department of hydrology, Sana'a Republic of Yemen, P.52

* Average of slope
** Computed by researcher

Annual water returns

Annual water returns refer to the value that is nearest to the average quantum of rainwater obtained over a period of time (Albiaty, 1990). Average of rainfall which is used in this equation equals the mean of average values in eight stations in the catchment areas of the study unit (Table 2). The annual water returns value of Wadi Mawr is 8385.8 Mm^3, and the least value of 1453.5 Mm^3 is in Wadi Mawza'a; this is due to the first's vast catchment areas, the second's being the second largest and Wadi Mawza'a having the smallest catchment area (Table 3 & Fig 2).

$$**T = (R/1000) \times C \times 10^6$$

Where:

T = Annual water returns (Mm^3)
R = Average of rainfall (mm),
C = Catchment area (km2)

The mean value of these rainfall averages in these eight stations has been determined at 1002 mm. substituting this value while calculating the annual water returns that result through the valleys gives 7515, 2455, 3206.4, 2545.1, 4909.8, 1754 and 1303 Mm^3 for Wadi Mawr, Wadi Sardud, Wadi Siham, Wadi Rima'a and Wadi Mawza'a respectively.

There is a direct relationship between surface runoff and annual water returns that substantial surface runoff requires a high annual water returns value. Therefore, meager rainfall would result in a shallow or rather dry runoff. Nonetheless, it is observed that runoff can become sparse in spite of good annual water returns; this is ascribed to many factors that affect surface runoff like reduced soil moisture and increase in water absorption where there are plenty of cracks, fissures and joints are located. The size of the catchment area is another factor that influences the quantum of runoff. Rainfall spread largely in a valley's catchment area, especially in the upper parts of it, drain substantial quantities of its quantity in those areas, in addition to the usage of that rain water by local farmers for agricultural purpose. Wild vegetations in the catchment areas play an important role in enhancing the soil's ability to absorb rainfall.

Table 2. Mean annual rainfall (mm) in stations of catchment area of Tihama Plain

Year / station	Al –Dalil Sumara	Al- Har	Al – Jerbah	Al – Udain	Ibb	Rihab	Yarim	Zabid Town
1970	1642.1	416.8	754.7	937..8	1050.0	446.0	367.6	132.7
1971	2436.6	138.8	480.1	799.8	1123.1	696.6	668.3	118.9
1972	2937.2	480.2	449.9	639.8	1325.3	736.8	462.5	94.7
1973	969.6	239.0	608.1	825.2	1156.0	461.3	396.2	92.5
1974	595.6	314.0	1134.2	791.0	1548.6	496.5	573.8	231.3
1975	1688.4	441.1	932.6	1399.9	1961.8	443.9	620.1	189.1
1976	1365.5	70..4	563.4	1042.0	2359.5	353.2	530.6	--
1977	1220.4	1190.7	854.9	1811.6	2541.4	709.0	715.7	294.9
1978	885.6	824.5	506.9	1690.4	2776.7	662.2	959.2	203.9
1979	1285.0	577.4	557.2	1498.2	1816.1	397.6	1626.5	117.8
1980	1163.8	416.2	173.1	1635.6	2309.8	267.0	1545.8	98.5
1981	1199.0	976.3	972.0	1714.8	2628.9	578.0	1716.6	181.3
1982	1432.3	745.7	940.2	1708.0	2277.9	604.6	705.4	235.8
1983	1045.1	513.4	843.2	1794.0	2920.0	615.5	570.5	194.5
1984	1109.8	406.8	351.8	1616.4	1931.4	556.0	569.4	145.5
1985	1617.6	481.8	780.6	1236.6	2052.9	427.9	533.3	241.5
1986	1148.0	758.5	848.6	1352.6	819.5	648.5	607.0	142.8
1987	1333.3	740.8	700.2	1546.0	1597.6	512.0	546.2	121.0
1988	1314.7	760.4	885.0	1339.0	1572.2	439.8	688.6	358.2
1989	1139.3	726.2	493.6	1662.0	1920.2	515.0	636.6	250.5
1990	1222.3	351.8	587.2	1718.0	1703.7	1259.0	396.2	144.7
1991	889.3	1114.5	285.0	1280.0	903.7	393.6	481.0	75.3
1992	1502.4	1862.6	1009.4	1701.6	1926.3	652.0	710.3	286.5
1993	1428.1	910.6	965.0	1309.0	2898.9	728.8	711.4	245.7
1994	1162.0	1013.0	934.9	1003.6	2264.3	662.9	562.6	166.5
1995	1429.2	1262.0	770.0	1956.0	3524.8	745.7	807.1	164.6
1996	1126.0	1450.4	935.4	2695.0	3328.9	536.9	613.5	192.0
1997	1937.1	734.0	1131.5	2479.8	2093.2	828.7	698.0	175.5
1998	1774.4	--	777.0	4875.8	2274.9	644.8	847.8	366.6
1999	1401.6	--	1252.0	4122.2	769.7	748.1	716.9	211.0
Mean	**1380.1**	**734.0**	**749.3**	**1672.7**	**1979.2**	**592.3**	**719.5**	**188.8**

Source : Ahmed sultan (2003), surface water hydrology and management of water resources: A case study of Wadi Zabid from Tihama plain – Yemen, unpublished Ph.D. Thesis, University of Pune, India.

Table 3. The annual water returns (Mm^3) for valleys in the study area

Velleys	Area (km^2)	Rainfall (mm)	Annual water returns (Mm^3)
Wadi Mawr	7500	1002	7515
Wadi Sardud	2450	--	2455
Wadi Siham	3200	--	3206.4
Wadi Rima'a	2540	--	2545.1
Wadi Zabid	4900	--	4909.8
Wadi Rasyan	1750	--	1754
Wadi Mawza'a	1300	--	1303
Total			23688.3

Source: Computed by researcher

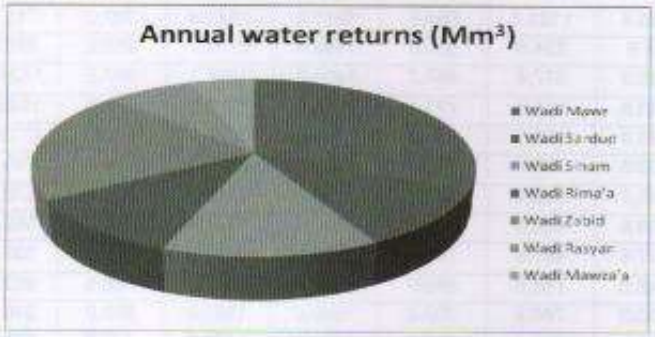

Figure 2. Annual Water returns in Mm^3

Recurrence Interval (RI) / Probability Analysis

Recurrence Interval (RI) is defined as the period of time in which a specific rainfall quantity is likely to recur (Hasan, 1985). The calculation of the Recurrence Interval (RI)* is based on the equation shown below (Hasan Abu Samoor, 1999). Probability** is a percentage value of the occurrence of the specific rainfall quantity within its recurrence interval.

Both the Recurrence Interval and Probability values are essential in several practical matters such as in the management of flood problems, soil erosion and in the capacity calculation of dams and water bodies that should accommodate rainfall values near to the average and with reasonable RI and good probability ratio.

* **T = N+1/M**

Where:

T = The expected period for repeat a specific rainfall quantity within.

N = Total of number for rainfall values

M = The rank of rainfall values arranged in descending order with highest value getting first rank and lowest one the last.

** Probability = 1 / Recurrence Interval (RI).

Table 4 shows eight different stations within the catchment area that have been selected to provide data for the calculation of RI and Probability of rainfall values over a period of 30 years and computed figures are as follow: Taking Al-Dalil Sumara station as an example, the average rainfall has been calculated at 1380.1 mm, the nearest rainfall quantities recorded above and below the mean value were 1401.6 and 1365.5 mm that occurred in 1990 and 1976 respectively. The mean values for the remaining stations of Al Har, Al Jerbah, Al Udain, Ibb, Rihab, Yarim and Zabid Town are 733.9, 749.3, 1672.7, 1979.2, 592.3, 719.5, 188.8 mm respectively.

The most likely rainfall value is one that is nearest to the average. For Al-Dalil Sumara station, the Probability ratio to repeat the quantity of rainfall of 1401.6mm, which is above the average, i.e., 0.4 and needs a Recurrence Interval of 2.6 years. The rainfall quantity of 1365.5 mm, immediately below the average, has a Recurrence Interval of 2.4 year and probability ratio is 0.4. The application of the RI and Probability equations in the data collected over a period of 30 years in the above stations leads us to conclude the following results:- There is an inverse relationship between rainfall quantity and probability ratio for a high rainfall quantity, the probability of it repeating itself within its RI becomes less. The RIs of rainfall values 2937.2, 1401.6, 1365.5, 595.6 mm of Al Dalil Sumara station are 31, 2.6, 2.4, 1.03 years respectively, while the probability ratios of the same rainfall values are 0.03, 0.4, 0.4 and 0.97 correspondingly matches. There is a direct relationship between rainfall and Recurrence Interval. Whenever rainfall increases, it requires a longer period to repeat itself. Therefore it is proved that there is an inverse relationship between probability ratio and Recurrence Interval and a large rainfall quantity that requires a long RI to recur, definitely has a less probability value of repeating itself within the calculated RI.

Table 4. Values of Return period and probability of rainfall in different stations within the catchment area.

Station	Status	Rainfall (mm)*	Return period (year)	Probability
Al – Dalil Sumara	Heaviest rainfall	2937.2	31	0.03
	Above Average	1401.6	**2.6**	**0.4**
	Avergage	**1380.1**		
	Low average	1365.5	**2.4**	**0.4**
	Least rainfall	595.6	1.03	0.97
Al – Har	Heaviest rainfall	1862.6	29	0.03
	Above Average	734.0	**2.1**	**0.5**
	Avergage	**733.9**		
	Low average	726.2	**1.9**	**0.5**
	Least rainfall	138.8	1.01	0..04
Al- Jerbah	Heaviest rainfall	1252.0	31	0.03
	Above Average	754.7	**1.7**	**0.6**
	Avergage	**749.3**		
	Low average	700.2	**1.6**	**0.6**
	Least rainfall	173.1	1.03	0.97
Al – Udain	Heaviest rainfall	4875.8	31	0.03
	Above Average	1690.4	**2.6**	**0.4**
	Avergage	**1672.7**		
	Low average	1662.0	**2.4**	**0.4**
	Least rainfall	639.8	1.03	0.97
Ibb	Heaviest rainfall	3524.8	31	0.03
	Above Average	2052.9	**2.2**	**0.5**
	Avergage	**1979.2**		
	Low average	1961.8	**2.1**	**0.5**
	Least rainfall	789.7	1.03	0.97
Rihab	Heaviest rainfall	1259.0	31	0.03
	Above Average	604.6	**2.1**	**0.5**
	Avergage	**592.3**		
	Low average	578.0	**1.9**	**0.5**
	Least rainfall	267.0	1.03	0.97
Yarim	Heaviest rainfall	1716.6	31	0.03
	Above Average	807.1	**5.2**	**0.2**
	Avergage	**719.5**		
	Low average	716.9	**4.4**	**0.2**
	Least rainfall	367.6	1.03	0.97
Zabid Town	Heaviest rainfall	366.6	31	0.03
	Above Average	189.1	**2.2**	**0.5**
	Avergage	**188.8**		
	Low average	181.3	**2.2**	**0.5**
	Least rainfall	75.3	1.03	0.97

The assessment of RI and Probability ratio is helpful in estimating expected rainfall values that have reasonable recurrence intervals and good probability ratios of occurring which would aid in planning acute water harvesting policies for domestic as well as agricultural purposes.

Loss of water by nature

In order to know the annual water returns of a catchment area in Tihama plain, it is necessary to assess the magnitude of evaporation in watercourses and estimate the quantity that dissipates by percolating through the soil. It is possible to know the waste of surface runoff by evaporation by adopting Kienitz equation (Hamdan, 1997)*. Clearly states by applying the said equation on streams in the catchment area of Tihama Plain, that Wadi Mawr and Wadi Zabid have higher values due to vast catchment areas compared to other valleys. Their surface evaporation is 46.04, 34.53 mm3/year, respectively (Table 5). Generally speaking, evaporation in valleys of the study area is less due to three causes: firstly, streams are narrow and deep in the upper ranges, which allow less exposure to heat and subsequent evaporation. Second cause is that because of human agricultural activities extending between the courses and mountains, with course's sides being reinforced with embankment made of stones to protect terraces from erosion, which reduces the width courses. Thirdly, lengths of valleys are small compared to rivers:

* **Ts = LxAxK/Z**

Where:

Ts = The average of surface evaporation from stream in m3/s. The value in the study area is 2179.2mm3 = 2.2m3
L = Length of stream
A = Width of stream
K = total annual evaporation
Z = Period year/s

Table 5. The Average of Evaporation (Mm3/year) from Valleys in the study area.

Velleys	Area (km^2)	Length of main stream (km)	Average width of valley (mts)	Average evaporation from valley (m^3/s)	Average evaporation from valley (Mm^3/year)
Wadi Mawr	7500	300	78	0.004	4604
Wadi Sardud	2450	240	54	0.002	23.02
Wadi Siham	3200	235	55	0.002	23.02
Wadi Zabid	4900	250	66	0.003	34.53
Wadi Rasyan	1750	240	53	0.002	23.02
Wadi Rima'a	2540	210	49	0.002	23.02
Wadi Mawza'a	1300	190	29	0.001	11.51

Source: Computed by researcher

Peak runoff Records of runoff for main valleys in Yemen are rarely available; Wadi Sardud only has one record of data compiled in 1984 (600m3/s). However it is possible to identify the peak runoff for the other valleys by the equation (Jac A.M., 1995)*

$$* Q = 1.3xCx(0.385xA)^{0.935x}A^{-0.048}$$

Where:

Q = Quantity of runoff within flood peak

C = Fixed factor valuate with 25 according to Yemen positions

A = Size of catchment area.

Table 6 highlights the estimation of values of runoff during flood peaks for the seven main valleys of the study area. Such estimations can be employed in establishing precautionary measures when floods pose risks with regards to soil, agriculture and settlements; these valleys can represent a real danger during some years. Flood peaks give an ideas about water quantities that can be preserved in different forms like check dams, pools, ponds... etc.

Table 6. Volume of Runoff (Q) during flood peaks

Valleys	Area (km^2)	Q (m^3/s)
Wadi Mawr	7500	4171.29
Wadi Sardud	2450	2655.94
Wadi Siham	3200	2974.92
Wadi Rima'a	2540	2697.52
Wadi Zabid	4900	3538.62
Wadi Rasyan	1750	2290.25
Wadi Mawza'a	1300	1999.32

Source: Computed by Researcher

Valleys which have expansive catchment areas record high flood peaks. Wadi Mawr and Wadi Zabid record the highest values of 4171.29 and 3538.62 m3/s respectively. Wadi Mawza'a, on the other hand, has the least value of 1999.32 m3/s due to the small size of its catchment area. Though the equation above doesn't take into consideration rainfall data and its distribution has a spatio-temporal variation. The researchers felt that yet it can be considered as an alternative in the absence of direct measurements.

Findings and conclusion

The water scarcity in the plain has greatly been affected the development at process. Looking at the vibrancy, the agricultural activity had witnessed in the plain hardly before one century and the efficiency of water use that characterized irrigation practices by the ancient Yemenites, solutions must be sought to reduce the depletion of water resource in the country and circumvent the grave effects of droughts in the different parts of the Yemen. As effective intervention in the problem entails a multi – pronged programme directed at its various aspects, various scenarios have been suggested for the same.

The annual surface runoff in the study area ranges between 3.7 Mm3 in Wadi Mawza'a to 5.3 Mm3 in Wadi Mawr. This is attributed to an annual water returns in their catchment areas which are 1453.5 Mm3 and 8385.8 Mm3 for the above mentioned two valleys respectively. The total annual water returns within the catchment area of the study unit is estimated to be about 23688.3 Mm3. Hence, there is shortage of 23657 Mm3. The most likely rainfall value to occur is one that has a good occurrence probability ratio within a reasonable recurrence interval (RI). These recurrence interval (RI) and Probability ratios obtained from rainfall data within the catchment area of the study area reveals the precarious conditions which require a proper monitoring and planning. The RI of the rainfall values 2937.2, 1401.6, 1365.5, 595.6 mm in the showery Al Dalil Sumara station are 31, 2.6, 2.4, 1.93 respectively. While the probability ratio of the same rainfall values are 0.03, 0.4, 0.4 and 0.97 correspondingly. The middle two represent values nearest to the mean value of rainfall data collected which should be adopted in planning policies for water harvesting and specially for agriculture according to the variable demand / needs.

The average evaporation rate from valleys ranges between 11.51 Mm3 / year in Wadi Mawza'a to 46.04 Mm3 / year in Wadi Mawr. The daily runoff rate of Wadi Sardud recorded the highest rate of 11m3/s; the rate did not occur below 2 m3/s during the dry months of the year. Such a runoff is very less to sustain

agricultural practices in its basin. Floods occur in the valleys of Tihama plain and are characterized by their sudden occurrence and the danger they represent to live stock, soil erosion and also for human habitat. Average of flow during flooding was recorded at 87 m3/s in Wadi Sardud where a base flow rate of 1.1 m3/s is known to occur in the same valley. The peak runoff rates estimated for all the valleys in the plain ranges from 1999.32 m3/s in Wadi Mawza'a and 4171.29 m3/s in Wadi Mawr.

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POLLUTION RULES OVER KOLKATA CITY: A GEOGRAPHICAL APPROACH

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Abstract

According to Ansel Adams: "It is horrifying that we have to fight our own government to save the environment". Pollution is no more a sensation today; it is one of the foregone outcomes of our civilization that we have started paying heavily for. Pollution and cities are further inter-related to a great extent in the sense that both have to live in non-escapable co-existence and may be the ultimatum of that so-called co-existence can be well found in our beloved city-Kolkata. Kolkata has been totally down with the overwhelming omnipresence of pollution- may it be air, water, gaseous, noise or odour! The world authorities have already identified the city as one of the worst victims of present day ecological disaster. Kolkata has distinctly earned the honor of 'city of functioning chaos' or 'city of garbage'. In 1956, WHO (World Health Organization) has already rated Kolkata as one of 'the dirtiest cities in the world'. Therefore, strict laws should be enforced for a greener Kolkata and to feel the pinch of Kolkata's environmental degradation. Pollution rules are to be taken seriously as called for clearing pollution from the very root. Alarming levels of air, water and noise pollution, thus continues to plague the citizens of Kolkata, with the authorities turning a blind eye to the problem, making Kolkata, "the pollution capital of India".

Key words: Air, Water, Noise Pollution, environmental hazards, sustainable development, pollution control and management.

Introduction

Kolkata, as of today, provides a mixture of opportunities and problems. Environmental problems loom large over the city that raises issues in sustainability. Rapid urban growth has affected the population momentum and hence would prolong the unplanned urbanization and industrialization for quite sometime. This has resulted in acute air and noise pollution. Therefore, whereas the city core is affected by air and noise pollution, the fringe areas are affected by water contamination and frequent outbreak of epidemics.

Aim

This paper aims at analyzing the different types of pollution that ruins the sound development of Kolkata city and making it more environmental friendly.

Objectives

To study the different pollution that affects the city environment. To analyze the cause and effects of air, noise and water pollution. To suggest ways and means to control pollution and its ill effects. To study a sustainable approach towards the future environment of the city.

Methodology

The data sources are based on secondary data collected from different environmental journals, books, newspapers and magazines and the Pollution control Board (West Bengal). Primary data has been used in form of field photographs. Charts, graphs and maps have been used to show the dulling the different levels of pollution ruling the city. Squatters provide another act of problems encountered by the city. Globally, urban areas are growing at an alarming pace. Industrialization, rise in population etc. is leading to acute constraints such as lowering of the quality of the environment resulting into pollution of air, noise and water impacting upon health and welfare. Thus, Environmental Pollution is one of the major problems that the city of Kolkata continues to struggle with. Hence, Urban Greens is a necessity, which plays a pivotal role in improving urban environment.

Figure 1. The atmosphere pollution.

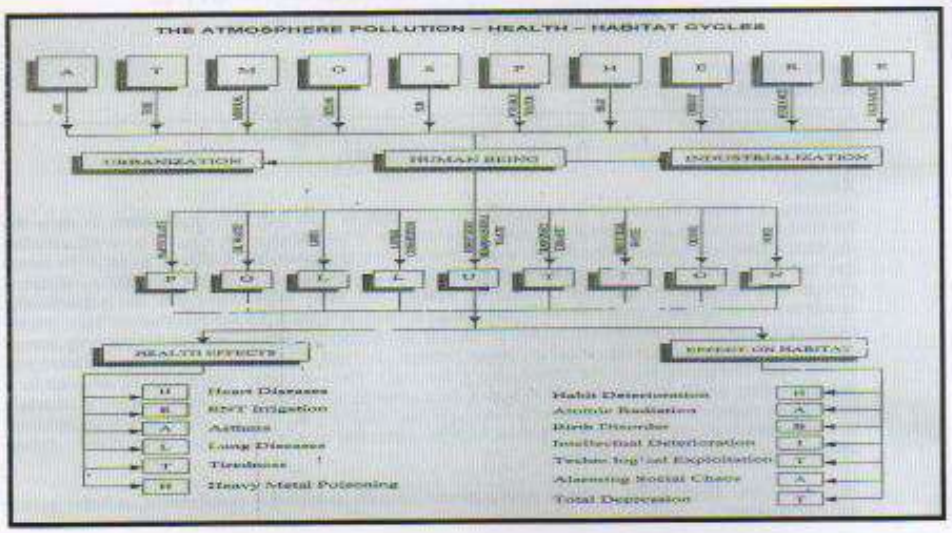


Table 1.1. Pollution concentration in ambient air of Kolkata.

Pollutant	Time Weighed Average	Concentration In Ambient Air		
		Sensitive Area	Industrial Area	Residential, Rural & other Areas
Repairable Particulate Matter (RPM) size less than 10.	Annual	50g/m3	120g/m3	60g/m3
	24 hours	75g/m3	150g/m3	100g/m3
Lead(pb)	Annual	0.5g/m3	1.0g/m3	0.75g/m3
	24 hours	0.75g/m3	1.5g/m3	1.00g/m3
Carbon Monoxide	Annual	1.0g/m3	5.0g/m3	2.0g/m3
	24 hours	2.0g/m3	10.0g/m	4.0g/m3

Source *: Pollution Rules over Calcutta by Anupam H. Haldar, 2008*

Air pollution

Kolkata even as the West Bengal Government is engaged in frantic efforts to phase out old vehicles, green activities claims that Kolkata is fast heading towards disaster due to abnormally high air pollution levels and needs a strong action plan to combat the menace. A study released by the Centre of Science and Environment (CSE)- a New Delhi –based organization, revealed that the annual average of Kolkata's repairable suspended particulate matter exceeded the national standards in 2007 by 1.4 times, and the trend is continuing.

According to the World Bank statistics, the pollution caused by diesel fuel (65%-vehicular population: 99%-commercial vehicles are diesel run) to the city air was more than 2.7 times than Delhi and

2.5 times of that in Mumbai. Thus, automobile emission is reportedly responsible for more than half of the air pollution load in Kolkata. As a result of high level of air pollution in Kolkata, some 70% of the people in the city of Kolkata suffer from respiratory disorders caused by air pollution. Children mainly suffer from breathing difficulties like asthma while elderly people are victims of lung cancer. Other sources of air pollution includes industrial emission in different manufacturing process, viz in meteorological plants, chemical plants, refineries, thermal power plants, mineral production and so on. In general, the urban areas are subjected to air pollution to the extent of about 60% total pollution load by automobile transport system. Stressing on a few measures to battle air pollution, CSEC (Centre of Science and Environment) study suggested that the vehicles converted to cleaner LPG fuel. Other preventive measures involve area planning, efficient engine design and grade of the fuel etc.

Water pollution

What Lord Byron said long ago, may become most timely calculation to all Kolkattans: "Till taught by pain, men really know not what good water's worth". In Kolkata, every citizen has given the share of 300 gallons of water per day, but half of this share is of polluted one. The metropolitan region suffers from clean water and from flooding, in periodic cycles, depending on the climate, topography and health of the river Hooghly. The Hooghly, tributary of the Ganges, flows through the Kolkata Metropolitan Area. It is the main source of portable water which is highly polluted. The industrial and domestic wastewater discharged into the river is the main source of pollution. It was estimated that 1400 million liters of sewage and 200million liters of industrial effluents were discharged everyday into the river. For supply of portable water, in areas not within reach for the riverside treatments plants, extraction of ground water is done through wells, as municipal supply. Ground water is also drawn in large volume for agriculture; such practice has resulted in depletion of water table and arsenic contamination in tapped aquifer, thus rendering this source as unsuitable for municipal water supply. Absence of sewage disposal systems in the unplanned settlements caused pollution of streams and rivers. As a result of high level of damage in the quality of portable water, the water scarcity is increasing day-by-day causing water pollution. Use of untreated water is responsible for a large percentage of waterborne diseases like cholera, typhoid and hepatitis. It is reported that 15 out of 1000 children born in the state die before the age of 5 from diarrhea caused by drinking polluted water. Thus, the success for sustainable water resource development depends on abatement of pollution with participatory governance and education.

Table 1.2. Health effects of the toxic ingredients of the drinking water in Kolkata

Ingredients	Safe Limit (mg/L)	Harmful concentration(mg/L)	Notable health effects	Remarks
Arsenic	0.05	Above 2/3	Skin eythrema, Pigmentation, Gastro intestinal and neurological disorder	May contain in drinking water.
Lead	0.10	High Dose	Chronic Lead toxicity. Loss of appetite, fatigue, and anemia.	Risk comes in drinking water from lead pipes.
Fluoride	1.05	Above optimum dose (8-20) High Dose(Above 20)	Causes dental flurosis in young children, bones changes from long-term exposure. A crippling of flurosis	Found in all general waters.
Nitrate	100 (of NH3)	------	Blood disorder in infants may cause gastric cancer	Principal ground water polluted
Iron	0.1	------	Gives astringent taste to water. High dose Causes vomiting and or linear damage.	In small dose, it is nutrient.

Source : *Pollution Rules over Calcutta by Anupam H. Haldar, 2008*

Noise pollution

The Compendium of Environmental Statistics, released by the Central Statistical Organization, states that noise levels in most metros – even in the residential and the designated 'silence zone'- have reached levels above the prescribed ambient noise standards.

Table 1.3. National ambient standards

Area Class	Day Time (Decibels)	Night Time (Decibels)
Residential	55	45
Commercial	65	55
Industrial	75	70
Silence Zone	50	40

Source: Ministry of Environment and Forest, 1991.

Day Time (6.00 a.m to 9.00 p.m-15 hrs); Night Time (9.00 p.m to 6.00 p.m-9 hrs).

Noise pollution is highest in Kolkata, both during the day and night. Noise levels in Kolkata's residential areas are much higher than in other metros, i.e. in residential areas, while the CPCB has prescribed an ambient noise standard of 55 Leqb B (A) during the day (between 6.00 a.m. to 9.00 p.m.), the noise level in Kolkata is 79 units, while in Mumbai it is 70 units, Chennai 66 units, Bangalore 67 units.

A number of agencies and institutions have monitored noise within Kolkata Metropolitan Area. This is presented in the table below:

Table 1.4 Summary of Ambient Noise Levels At Traffic Interactions By Zones

Zone	Leq 24	Maximum (Day)	Minimum (Night)
South Kolkata	83.72	87.54	82.06
Central Kolkata	84.74	88.55	82.47
North Kolkata	89.70	94.18	87.98
Standard(commercial)	-	65.00	55.00

Source : Calcutta Pollution Control Board, 2010.

The result of the studies conducted in Kolkata indicates that the average ambient noise level in residential, commercial, industrial zones as well as silence zone exceeded the prescribed limit both during day and night. In the silence zone, the noise level reached as high as 79 db (A) and 65 db (A) during day and night as against the limit of 50 db (A) and 40 db (A). Thus from the data available, Kolkata is seen as the noisiest city of the world.

Although no data is available to highlight the impact of high level of noise on public health in Kolkata area, but information provided by ENT specialist and psychiatrists indicate an upward level of cases reporting hear loss, psychotic mental disorder, anxiety etc.

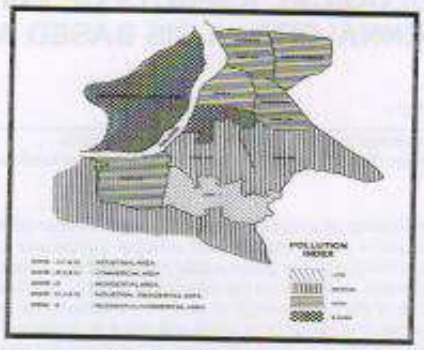
Conclusion

'Kolkata Greens'- A Necessity

India's Nobel Laureate, Rabindranath Tagore had said- 'trees are earth's endless effort that speak to the listening heavens".

As urban development proceeds on the world stage let its journey proceed in partnership with its green space.

Figure 2. Kolkata pollution zoning.



Source : KMDA (Kolkata Metropolitan Development Authority, 2009).

Key recommendations

The individual green assets (plants on terrace, terrace garden, indoor plants, and private garden/lawns) must be encouraged and enhanced in a large scale in the built up city area. Detailed environmental policy must be formulated and implemented for the household level. The maintenance of parks and gardens should receive much more attention from the citizens themselves. Apart from residents, Scholars from educational institutions in the neighborhood may be truly encouraged to play a active role in the maintenance of the green space. Data of the number of trees felled and the location and reason for doing so may be made available to all citizens on a regular basis from a common platform like the media. This would make them aware of the loss and inspire them to contribute for the regeneration of the same. Thus, enhancement and protection of the visible green assets with the aid of geospatial tools, enhanced community involvement and holistic urban planning will stabilize the beneficiary role of urban green space of Kolkata on urban environment.

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URBAN ECOLOGICAL ASPECTS OF PROPERTY CRIMES IN CHENNAI CITY: A GIS BASED APPROACH

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Abstract

The increasing complexities of analysing the relationships between spatial patterns has been greatly aided by multivariate techniques – factor analysis and principal component analysis. They have been immensely helpful in revealing the variation in urban social characteristic, a field of study that has become known as factorial ecology. Several studies on urban ecological aspects of crime have been made in recent years by social scientists. One of the shortcomings of most of the earlier urban ecological studies is that no distinction is made between place of occurrence of crime and place of residence of criminals. Therefore, in the present study, the place of occurrence of crime and place of residence of criminals were taken. In an effort to further our understanding of spatial aspect of crime, the present factor ecological study investigates the spatial pattern of crimes and demonstrates that the occurrences of crimes and residence of criminals can be explained by a relatively small number of variables pertaining to specific characteristics of various census divisions of Chennai city. The purpose of this study is therefore to understand the basic ecological factors which explain the distribution of crimes and criminals residences. Such ecological factor in large cities quite often exhibits a spatial structure which is known as the ecological structure. the ecological structure is often a function of certain more general characteristics of society concerned. Therefore, another purpose of the study is to analyse the structural patterns of ecological dimensions produced by factorial ecology of crime.

Key words: Urban Ecology, Factor Analysis, GIS, Spatial Pattern of crime

Introduction

Several studies on urban ecological aspects of crime have been made in recent years by social scientists. One of the shortcomings of most of the earlier urban ecological studies is that no distinction is made between place of occurrence of crime and place of residence of criminals. Therefore, in the present study, the place of occurrence of crime and place of residence of criminals were taken. In an effort to further our understanding of spatial aspect of crime, the present factor ecological study investigates the spatial pattern of crimes and demonstrates that the occurrences of crimes and residence of criminals can be explained by a relatively small number of variables pertaining to specific characteristics of various census divisions of Chennai city. The purpose of this study is therefore to understand the basic ecological factors which explain the distribution of crimes and criminals residences. Such ecological factor in large cities quite often exhibits a spatial structure which is known as the ecological structure. The ecological structure is often a function of certain more general characteristics of society concerned. Therefore, another purpose of the study is to analyse the structural patterns of ecological dimensions produced by factorial ecology of crime.

Previous studies

Ecology, as defined by Michelson (1970), is the science dealing with the patterns of relations between organisms and their environment. Urban ecological analysis is a method of a establishing and testing the degree of relationship among variables around the city. The ecological concepts have been borrowed by social scientists from biologists (Phillips). Studies of social pathologies (crime, slum, mental illness etc) follow very much the precedents of the roots of a classical ecology from which a torrent of individual studied cascaded out of Chicago. The format in which most ecological research is conducted has produced the tacit assumption that social and physical spaces are synonymous or at least isomorphic (Emrys Jones and Eyles, 1977). the early ecological of nineteenth century have concerned themselves with the relationship of crime to such socio – economic variables as poverty, literacy, occupational differentiation and urbanization questions similar to those asked by the later ecological sociologists (Pyle and other, 1974, P.15) in the United states, Shaw and Makey are the first to use the concepts of the '

Chicago School", that is the formulation and analysis of concentric urban zones by part. Burgess and McKenzie. Their study has revealed that delinquency and crime follow the pattern of the social and physical structure of the city with concentration occurring in disorganised, deteriorated areas. Their ecological or spatial model of urban has been replicated in different parts of the world today (Midgley, 1977, P.28).

Aim and objective

The prime aim of this study is to analyze the relationship between socio-economic characteristics and incidences of property crimes in Chennai.

Methodology

The division – wise crime and criminal rates used here as crime variables. The variables chosen for the present study (1) Theft, (2) House – burglary, (3) Picking - pocking, (4) Cycle theft, (5) Automobile theft, (6) Snatching, (7) offenders of Theft (8) offenders of House – burglary, (9) offenders of Picking - pocking, (10) Offenders Cycle theft, (11) Offenders of Automobile theft, (12) Offenders of chain Snatching. The factor analysis includes as much as 1,879 reported cases in the above crime categories, out of which, for 1292, the criminal residence location were taken, as far as criminals residence is concerned only the city limit offender's location were taken for the analysis. In order to determine the relationship between crime incidences and the basic physical, social, demographic and occupation structure of the community, 20 different variables for 155 census divisions of Chennai city have been selected and included as an integral part of the 8 property crimes variables. The sociological indexes which represent the most valid and reliable data available, have been derives directly from official report of the 2001 census.

As far as the physical and social variables are concerned, the population density, number of slum, illiteracy, literacy, housing density, workers, non - workers and Non-working population have been more commonly used in urban ecological studies of crime. Variables such as Road frequency have been less commonly used in ecological studies. The high frequency of roads and street intersections indicated by the number of roads enables the offenders to escape easily from the scene of crime. The occupational structure reflects the economic status of people. The comparative occupational distribution of people not only indicates their functional position in the economic structure but also reflects aspects of their social status. The economic segregation is expressed in the differential distribution of occupation groups. The 12 crime variables along with five socio- economic variables have been arrayed in 155 x 17 matrix and subjected to factor analysis. The next step is to determine the underlying social, demographic and occupational dimensions in the distribution of crime and criminals. In order to make the structure of factor loadings in factor dimensions more clear, the loadings greater than 0.400 have only been included in the interpretation since loadings of less than 0. 400 are usually regarded as insignificant. In a factor ecological study of this kind, it is not sufficient to determine only the basic dimensions of a large number of crimes and social variables for the city as a whole. It is also important to ascertain how these dimensions are related to the specific areas within the city. In order to ascertain this, factor scores (individual factor weightings) have been computed for 155 Census divisions for each of the 17 variables. The factor scores on the only retained factor, in which the crime variables are significantly represented, have been mapped. In order to simplify the interpretation, only positive factor scores are considered for the analysis.

Results and Discussion

The unique variances computed from the statistical analysis using factor ecology have given the variance each of the variables entered into the analysis explained. These variances of the individual variables, in effect, validate the membership of a variable within a given factor, retained in the analysis.
Also called communalities, the unique variances can be useful only if they are above and / or equal to 0.300 or 30 per cent. As such the variables that qualify for inclusion in the extracted, factor dimension of the crime study are only six namely, (Table 6.1) (rounded off to the next nearest whole number) incidence of theft (0.569), incidence of burglaries (0.396), incidences of cycle theft (0. 300), incidences of picking pocket (0.300), incidences of automobile thefts (0.300) and offenders of theft (0.302). Thus only crime variables have reasonably significant variances explained while social variables have only insignificant or small variances explained in the analysis.

Table 1. Communalities

Crime Variables (2004)	Communalities (%)
Incidences of theft	0.569 (56.9)
Incidences of burglaries	0.396 (39.6)
Incidences of picking pockets	0. 300 (30.0)
Incidences of cycle theft	0. 298 (29.8)
Incidences of automobile thefts	0.257 (25.7)
Offenders of thefts	0.302 (30.2)

Social and crime Dimensions of Property Crimes

On the contrary, 11 variables loading significantly on the only factor extracted have loadings grater than +/- 0.400. And the loadings are significant statistically so that the factor may be explained away by the eleven variables. Importantly, these variables connect with each other and there are close associations discernible from the social and crime variables. The six variables that have significant unique variances load on the factor retained are shown below:

Table 2. Crime variables in factor dimension retained

No	Variables	Factor loadings
1	Incidences of theft	0.754
2	Incidences of burglaries	0.629
3	Incidences of picking pockets	0.548
4	Incidences of cycle theft	0.546
5	Incidences of automobile thefts	0.507
6	Offenders of thefts	0.549
7	Offenders of picking pockets	0.476
8	Offenders of burglaries	0.460

Thefts are the significant events among the crimes, in statistical terms, among the property crimes. This is manifested in the highest of the loadings (Table 6.2) in the highest of the loadings (0.754), followed by burglaries (0.629), picking pockets (0.548), cycle thefts (0.546) and automobile thefts (0.507). The next in importance is that of the offenders of thefts (0.549). This is the only variable loading above 0.500. The six variables in fact constitute the significant among the eleven variables. The rest of the variables included in the factor dimension have smaller loadings but significant enough, statistically. The offenders of picking pockets get a loading of 0.476 while the offenders of burglaries get 0.460. With these all crime variables dominate the factor retained and thefts do so with all incidences of property crimes (thefts, burglaries, picking pockets, cycle thefts and automobile thefts, in that order) included in it make the factor crime - dominant the offenders of thefts, picking pockets, and burglaries, in that order) follow the crime variables a close second but with low loadings. Crimes rather than criminals dominate the factor extracted.

Table 3. Social variables

NO	Variables	Factor loadings
9	Non workers	0.464
10	Illiteracy of population	0. 412
11	Density of population	- 0.419

Social variables, and that too, a small number of them, have even smaller loadings (Table 6.3): Non-workers (0. 464) and illiterates (0.412) are with positive loadings while density of population (-0.419) with negative loadings. While crime and criminals may be associated with non - working and illiterate populations, it will be inappropriate to say so, categorically, for non – workers and illiterate are not necessarily offenders. Assuming they are may be far fetched conclusion. Density of population with its negative loading implies that the crimes are not significantly committed in densely populated areas. Dense areas are normally a deterrent to crimes and criminals is borne out by the negative loadings on the

variable. The factor retained accounts for a total variance of 21.41 per cent which is significant for the dimensions extracted.

The spatial pattern of property crime environment

According to the analysis, the most favorable property crime environment is found in Park Town and Parry's Corner where the important railway terminals are located; Port, Kothaval Chavadi, Flower Bazaar, High Court Area, M.B.K. Nagar, Anna Nagar West, Kolathur, Peravallur, Integral Coach Factory, Koyembedu, Ashok Nagar, Thiruvanmiyur, T.V.K Nagar and Mambalam. These areas are characterised by commercial, high income residential, industrial – cum- residential functions and CBD.

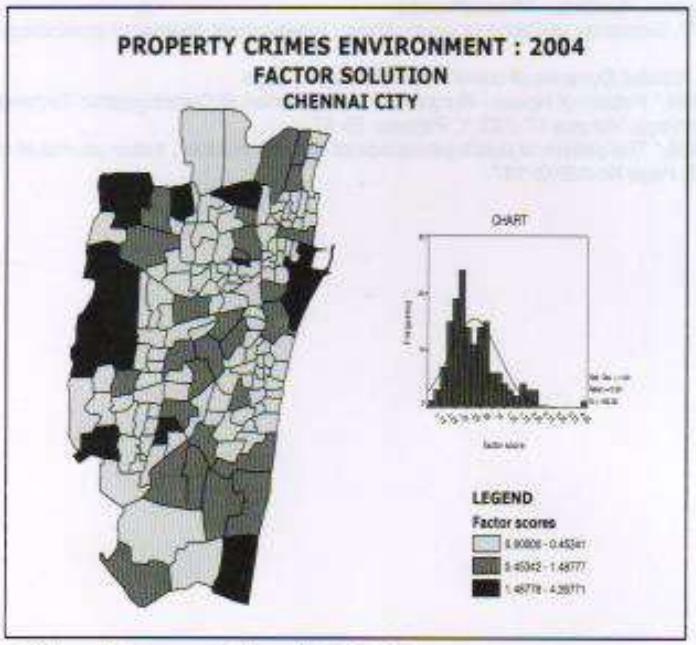

Figure 1. Property Crimes Environment. Chennai city. 2004.

The property crimes of variables natures occur in the city in a scattered fashion in that the city peripheries where densities are low or population less crowded are indeed areas of crime / criminal concentrations. However, the wards with high, positive scores support that the greater the population densities, the more deterrent are the localities of such population concentrations and the vice versa is true. Note that the chart inset depicting the distribution of scores is skewed towards negative factor scores with high, significant scores being assigned to a small number of wards identified as high concentrated of property crimes are also characterised by industrial / infrastructural activates.

Moderate positive scores are found amidst Thirumangalam, Arumbakkam, Vadapalani, Saidapet, Shasthri Nagar, Adyar, Foreshore Estate, Velacherry, Chepet, Thousand Lights, Thiruvotriyur, Nungambakkam, Kotturpuram, Egmore, Royapattah, Pandi Bazaar, Washermenpet, Seven Wells and R.K. Nagar. They provide high environmental opportunities for property crimes.

Conclusions

The factor ecological study shows that the places of occurrence of crime and the places of residence of criminals vary from one part of the city to another and that the differences in their distribution are reflected in the variations in a great variety of physical, social and occupational indexes across the Census divisions of Chennai city.

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APPLICATIONS OF GIS AND GPS IN NAVIGATION SYSTEM IN SEARCH OF POINT OF INTERESTS (POI) : A CASE STUDY OF BELGAUM CITY, KARNATAKA NEED FOR NEW TECHNOLOGY-BASED STUDIES

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Abstract

Geographical Information System (GIS) and Global Positioning System (GPS) technologies are expanding their traditional applications to embrace a stream of consumer-focused, location-based applications. Through an integration with handheld devices capable of wireless communication and mobile computing, a wide range of what might be generically referred to as "Location-Based Services" (LBS) may be offered to mobile users. The location-based service facility is able to perform spatial functions based on the user's location, generally with the aid of a Geographical Information System. The technologies and applications of LBS will play an ever increasingly important role in the modern, mobile, always-connected society. It "aims to provide specific, targeted information to users based on each specific user's location at any time". In this present study an attempt has been made to show Location Based Services available along the road network in Belgaum City by using GIS and GPS technologies. The study involves field survey to collect the primary data (i.e. POIs), through GPS, categorization of data, projecting of data on map by using Arc view and Arc GIS software in the Arc Map.

Key words: GIS, GPS, Navigation system.

Introduction

Geographical Information System (GIS) and Global Positioning System (GPS) technologies are expanding their traditional applications to embrace a stream of consumer-focused and location-based applications. Through an integration with handheld devices, capable of wireless communication and mobile computing, a wide range of what might be generically referred to as "Location-Based Services" (LBS) may be offered to mobile users.

LBS is defined as "any service or application that extends spatial information processing, or GIS capabilities, to end users via the Internet and/or wireless network" (*Koeppel,2000*), or in other words LBS are "geographically-oriented data and information services to users across mobile telecommunication networks" (*Shiode, Li, Batty, Longley, &Maguire, 2004*).

The location-based service facility is able to perform spatial functions based on the user's location, generally with the aid of a Geographical Information System. These include utility location information, personal or asset tracking, concierge and route-guidance information, to name just a few of the possible LBS. The technologies and applications of LBS will play an ever increasingly important role in the modern, mobile and always-connected society. It aims to provide "specific targeted information to users based on each specific user's location at any time" (*Benson, 2001*). Hence, security and safety are important considerations for a "mobile society". The second type of application is concierge services where location specific information on something nearby are sought. The requested information shall be related to points-of-interest such as hospitals, restaurants, cinemas, car parks, ATMs, Malls and so on. Such a service will provide information about the POI or route-guidance to find it.

In essence, LBS can only be provided through the integration of wireless communications and computing technologies with 'spatial elements' such as, positioning technologies and spatial data sets. These components form a network using wireless communication standards to transfer service requests and information between a mobile user and server. The location based service facility is able to perform spatial functions based on the user's location, generally with the aid of a geographical information system.

Objectives

This study is an attempt to collect POIs showing Location Based Services available along the road network in Belgaum City by using GIS and GPS technologies, and to get hands on expertise to experiment with different software tools like Arc view, Arc GIS & GPS and how these are being used in data collection, editing & quality control processes.

Data collected and data attached

Data is the backbone of this case study. The data is collected through different sources and different means. In this case study, the raw data mainly comes from GPS survey which is stored, processed and transmitted from one computer to another. The mode of data collection depends on factors such as budget, time span, accuracy required, skills in hand and vitally the aim of the study. The case study consists of two sets of data collection namely spatial and non spatial data (kept in Microsoft Excel, chart 1), which have been attached together. We have two different kinds of data, GPS data and Field Survey Data. Field Survey Data is digitized and attributes are entered, so we get a proper shapefile. The GPS data, in one hand we have spatial data with only POI name and on the other excel sheet having all information, so these both need to be attached.

Location of the study area.

Belgaum City (15^0 51' North Latitudes and 74^0 51' East Longitude), (Figure 1) is a crossroad of cultures due to its peculiar geographical location. Nestling in the foothills of the enchanting Sahyadris (Western Ghats) at an altitude of about 779 m, 100 km from the Arabian Sea with River Markandeya flowing nearby Belgaum is unique. Its natural beauty & environment are a world of contrast & harmonies with swift & kaleidoscopic change in topography, vegetation & salubrious climate (125mm rainfall) and proximity to the coast, Goa. Its hinterland offers a rich resource mix attracting people as tourists, settlers, job-seekers and entrepreneurs making it a veritable paradise or a "poor man's Switzerland". (*State Gazertter – 1981*)

Belgaum - A commercial hub of North Karnataka

Belgaum has always been at the forefront of industrial growth in India. With its inherent capabilities coupled with its enterprising citizens Belgaum provides the ideal choice for investment opportunities. Belgaum is one of the fastest growing cities with a very good industrial scenario in the northwestern part of Karnataka. It also provides an excellent opportunity for businessmen in almost all sections of the Society and thus is said to be an important industrial and business centre and is the commercial hub of north Karnataka. The geographical location of the city is an advantage since it is situated right in between Bangalore and Mumbai/Pune to support the major automotive and aerospace companies.

Methodology and Analysis

The methodology of the study involves collection of primary data, categorization of data, merging of data and projecting the data on map. The analysis of the study is as follows.

Field Survey, Data Collection and Transfer (Primary Data)

The primary data is obtained by researchers through the process of direct observation. This data has been collected with the help of GPS and by asking questions on the field itself. The POI name for the identification of the feature is typed in GPS and the other information is written in the survey sheet (*spatial and non-spatial data*). The survey sheet (Chart No. 1) consists of the POI Name, Address, Phone No., Website, E-Mail, Remarks etc. The primary data and information gathered and used here are current, relevant, reliable, accurate (2 to 3 mt. accuracy) and conceptually correct.

Categorization of data for Portal

The collected data has been categorized into basic layers which are of importance to Local Search Portal. The data has been categorized into 5 types, viz., Point of interest (POI), Building layer, Road Layer, Railway layer and Locality Layer. These all layers are prepared in the GIS software i.e. Arc Map. In this case study locality mainly refers to the fact or condition of having a location in time or space. It also refers to a particular place, situation or location. While Preparing the Locality layer it is necessary to

have certain reference, over here Building layer, Railway layer, and Road layers are for reference to draw a locality. These locality layers are used for different purpose. In this study it is a very useful layer since it would help in providing information regarding address.

Figure 1. Location map of Belgaum city.

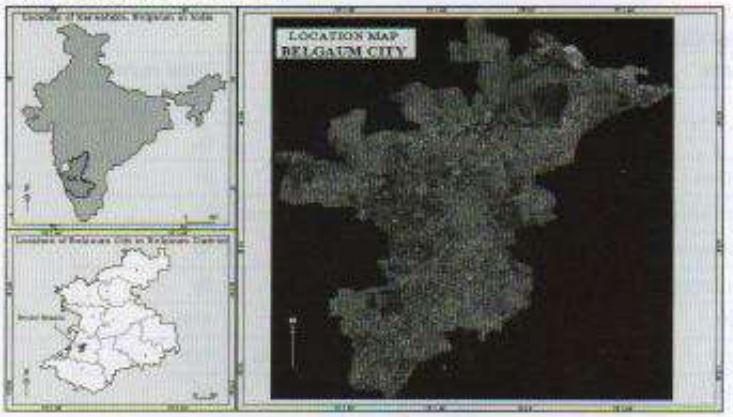

Chart 1. Survey sheet consist of spatial and non-spatial data

POI (Point of Interest)

FID	Shape *	POI_CODE	POI_TYPE	ATTRIBUTE1	ATTRIBUTE2	POI_NAME	BrandName	POI_X	POI_Y	CITY	STRT_ADDR
0	Point	IN13_1	Industrial Building			A V Hanvadate Industries Belgaum		74.520190	15.862411	Belgaum	Shivaji Nagar Main Road
1	Point	IN13_2	Hotel/Motel	District House		Apollo Lodge		74.520587	15.862305	Belgaum	Shivaji Nagar Main Road
2	Point	IN13_3	Pharmacy	Allopathic		Shriram Medicals		74.520353	15.862443	Belgaum	Shivaji Nagar Main Road
3	Point	IN13_4	Hotel/Motel	1 Star		Sweekar Hotel		74.520480	15.862491	Belgaum	Shivaji Nagar Main Road
4	Point	IN13_5	Public Transport Stops	Bus Stop	Local	Town Service Bus Stop		74.520572	15.862472	Belgaum	Shivaji Nagar Main Road
5	Point	IN13_6	Concert Hall			Sagar Bhavan		74.521404	15.862604	Belgaum	Shivaji Nagar Main Road
6	Point	IN13_7	Government Office	Municipality		Public Works Department Circuit House and Tees		74.522827	15.862957	Belgaum	Shivaji Nagar Main Road
7	Point	IN13_8	Cafe/Pub	Internet Cafe		Metro Computer Centre		74.523042	15.863055	Belgaum	Shivaji Nagar Main Road
8	Point	IN13_9	Pharmacy	Allopathic		Dhanvantari Medicals		74.522818	15.863019	Belgaum	Shivaji Nagar Main Road
9	Point	IN13_10	Hospital/Polyclinic	With 24-Hour Emergency		Kadapekar Maligud Clinic		74.522784	15.864079	Belgaum	Shivaji Nagar Main Road
10	Point	IN13_11	Petrol Station	Indian Oil	Petrol	Indian Oil	Indian Oil Corp	74.521584	15.864835	Belgaum	Shivaji Nagar Main Road
11	Point	IN13_12	Leisure Center	Beauty Saloon	Ganta	Sudarshan Hair Saloon		74.521558	15.865147	Belgaum	Shivaji Nagar Main Road
12	Point	IN13_13	Bank			Karnataka Vikas Grameen Bank		74.520669	15.86883	Belgaum	R T O Circle
13	Point	IN13_14	Cafe/Pub	Cafe		Sri Balaji Tea		74.520364	15.869580	Belgaum	R T O Circle
14	Point	IN13_15	Doctor	General Physician		Shri Shamnatri Clinic		74.520387	15.866235	Belgaum	Shivaji Nagar Main Road
15	Point	IN13_16	Place of Worship	Temple		Shankar Lingaiah Swamy Temple		74.520624	15.866389	Belgaum	Shivaji Nagar Main Road
16	Point	IN13_17	Place of Worship	Temple		Sri Ganesh Temple		74.521	15.866381	Belgaum	Shivaji Nagar Main Road
17	Point	IN13_18	Place of Worship	Temple		Sri Shanmukhaguruvara Temple		74.521445	15.865913	Belgaum	Shivaji Nagar Main Road
18	Point	IN13_19	Doctor	General Physician		Dispensary Clinic		74.521348	15.865786	Belgaum	R T O Circle
19	Point	IN13_20	Car Repair Facility	General Car Repair		N.G.Auto Sewage		74.520631	15.865842	Belgaum	R T O Circle
20	Point	IN13_21	Pharmacy	Allopathic		Meena Medicals		74.52052	15.865581	Belgaum	R T O Circle
21	Point	IN13_22	Public Transport Stops	Bus Stop	District	Belgaum Bus Depo		74.520678	15.864404	Belgaum	R T O Circle
22	Point	IN13_23	Public Transport Stops	Bus Stop	Local	R T O Circle Bus Stop		74.520093	15.865833	Belgaum	R T O Circle
23	Point	IN13_24	Hotel/Motel	Guest House		Rajpurohit Lodge		74.520063	15.866116	Belgaum	R T O Circle
24	Point	IN13_25	Pharmacy	Allopathic		Shree Shailesh Medicals		74.519966	15.86614	Belgaum	R T O Circle
25	Point	IN13_26	Place of Worship	Temple		Dattatri Temple		74.519907	15.86613	Belgaum	R T O Circle
26	Point	IN13_27	Hotel/Motel	1 Star		Diwan Hotel		74.519504	15.865208	Belgaum	R T O Circle
27	Point	IN13_28	Bank			Sri Siddeshwar Co-operative Credit Society Bank Li		74.519753	15.866145	Belgaum	Shivaji Nagar 1st Cross
28	Point	IN13_29	Cafe/Pub	Internet Cafe		Net Point		74.519694	15.866284	Belgaum	Shivaji Nagar 1st Cross
29	Point	IN13_30	School	Technical School		Modern Driving School		74.519335	15.865257	Belgaum	Shivaji Nagar 1st Cross
30	Point	IN13_31	Public Transport Stops	Bus Stop	Local	Shivaji Nagar Bus Stand		74.519429	15.865321	Belgaum	Shivaji Nagar 1st Cross
31	Point	IN13_32	Government Office	State		The Regional Transport Office		74.518139	15.868812	Belgaum	P B Road
32	Point	IN13_33	Parking	Auto Stand	Less Than 50	S.D.F.Ambedkar Auto Stand		74.518333	15.864908	Belgaum	P B Road
33	Point	IN13_34	Place of Worship	Temple		Sri Parvavatvar Surya Maruthi Temple		74.518682	15.865258	Belgaum	P B Road
34	Point	IN13_35	Industrial Building			National Trading Company		74.518121	15.865384	Belgaum	S P Office Road
35	Point	IN13_36	Car Repair Facility	General Car Repair		Car Air Conditioning Work		74.518103	15.8658	Belgaum	S P Office Road
36	Point	IN13_37	Car Repair Facility	General Car Repair		Punjabi Auto Matters		74.517972	15.865843	Belgaum	S P Office Road
37	Point	IN13_38	Car Repair Facility	Body Shop		Sri Maruthi Body Work		74.517928	15.865080	Belgaum	S P Office Road
38	Point	IN13_39	School	High School		German English High School		74.517726	15.86532	Belgaum	S P Office Road
39	Point	IN13_40	Police Station			Superintendent of Police		74.517631	15.863918	Belgaum	S P Office Road
40	Point	IN13_41	Concert Hall			Samadhana Bhavan		74.517631	15.870579	Belgaum	Hanamasheela Nagar Main Road
41	Point	IN13_42	School	Primary School		Government Kannada and Primary School		74.518864	15.870902	Belgaum	Hanamasheela Nagar Main Road

The POIs include Spatial as well as Non-Spatial Data. In this case study, a total of 2049 POI database have been recorded, of which about 36 POI types have been selected. This POI database has an associated POI name, geographic location and a chain database, which includes various attributes (chart No. 1). The Table No. 1 shows the total number of POI type and number of services available in Belgaum city.

Table 1. Types of POIs

S.No.	POI Type	Total number	S.No.	POI Type	Total number
1	Bank	134	19	Leisure Centers	170
2	Café	83	20	Library	05
3	Car Dealers	03	21	Museum	01
4	Car Repair Facility	14	22	Park /Recreational	12
5	Cash Dispenser	58	23	Parking	08
6	Cinema Theater	08	24	Petrol Station	32
7	Colleges	63	25	Pharmacy	175
8	University	03	26	Place of Worship	119
9	Concert Hall	22	27	Police Station	05
10	Condominium	122	28	Post Office	06
11	Courthouse	02	29	Public Trans. stops	42
12	Dentist	58	30	Railway Station	01
13	Department Stores	10	31	Restaurant	69
14	Doctors	220	32	Schools	96
15	Govt. Offices	57	33	Shopping Center	52
16	Hospital/Polyclinic	74	34	Sports Centre	22
17	Hotel/Motel	265	35	Stadium	03
18	Industrial Building	24	36	Supermarket	11

Categories in POI Type

POI database is a chain database which includes attributes, which have been categorized with the help of category attribute, where data of similar properties are grouped. For this purpose category list is used which has unique category name and category code (*Chart No. 1*). The following table (*table No. 2*) shows an example of non-spatial data or attributes of POI type.

Merge and Projection of Data

After categorization of POIs, the Shapefiles are there having names like Hotels, Banks, Hospitals etc. All the information that is collected through a GPS is merged and projected.

Uploading Field Survey Data

The maps on which entities are collected needs to be digitized and its attributes need to be entered. This is done with the help of ArcGIS software (*in the Arc map*). The base map layer is kept on, even their labels are kept on, to get an idea of the area. With reference to the base map and the hard copy map, a new Shapefile has been created and on that area points are digitized and attributes are filled for the same. Here non spatial data consists of the information brought in survey sheets and also the

materials collected by them, like visiting card. So, this is the process followed for making a softcopy of the survey data.

Table 2. Non Spatial Data or Attributes

POI Type	Non-Spatial Data or Attributes						
	POI Name	Place	Street	Land mark	PIN code	Phone	E-mail
Cash dispenser	Canara Bank	Bogarves	RMG	Near Old Public Library	590001	2481594	canarabm@gmail.com

Augmentation of Data

In this case study data is an integral part and as the days pass by new entities will emerge as search of the POI. The key functionality for the portal is the need to always update the data so that each and every entity of a place is covered.

Conclusion

Location Based Services (LBS) are gaining prime importance in our increasingly mobile and highly IT-enabled world. With modern legislation and interest in utilizing geo-spatial information, LBS provides and delivers practically useful information to its users in a highly selective manner by taking location and other context information into account. Implementing LBS platform may open a window of opportunities which in turn can be beneficial to the public. The openness of LBS architecture through standard technologies has made it possible to provide users with a standard data under one system. Creating location awareness to the public may help them to increase their decision making capabilities, thus help them to face unexpected situations. These technologies can be helpful to design and implement local search portal based on GIS data where an user can find results graphically on the map with other valid and useful information. The present study relates generally to the field of navigation, and more specifically to a system and method for collecting and conveying information of POI (point of interest).

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CHARACTERIZATION OF ADSORBENT FROM SUGARCANE BAGASSE AND COMMERCIAL ACTIVATED CARBON IN ADSORBING ZINC FROM AQUEOUS SOLUTIONS

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Abstract

This investigation deals with the study of comparative efficiency of carbon derived from sugarcane bagasse and commercially available activated carbon in adsorbing zinc from aqueous solutions. Nitric acid and Ortho-phosphoric acid was used as activating agent for producing different types of activated carbon from sugarcane bagasse .Different types of adsorbents applied in the study were Sugarcane Bagasse powder (SB) ,Control sugarcane carbon (CSAC),Nitric acid treated sugarcane carbon (NSAC) ,Orthophosphoric acid treated carbon (OSAC) and commercially available activated carbon (CAC) .To study the zinc removal efficiency of all the above mentioned five types of adsorbents different concentrations of zinc solution was treated with fixed dosage of the adsorbents. The metal adsorption yield was found to decrease with increasing zinc concentration for all types of carbons. It was also observed that nitric acid was the best chemical activating agent thus proving that the adsorptive properties of the carbons produced were controlled by the type of activating agent used for production of activated carbon.

Key words: Adsorption, Zinc , activated carbon ,sugarcane bagasse, heavy metals.

Introduction

Heavy metals are released into environment from natural processes and industrial activities. Industrial activities are responsible for increasing the level of pollution by metals, beyond the tolerance limit in the ambient environment.They are classified to be those metals which have specific gravity of 5g/cm^3 or greater. Hg, Pb, Cd, As, Cr, Zn, Cu, Mn, Fe, Se & Sb are kept in this group. The toxicity of metal ions are largely a function of their concentration; thus, certain elements such as Zn, Cu, Mn, Fe, and Se may be beneficial at low concentrations but become hazardous when present in amounts beyond. They are a class of pollutants that cause interrelated pollution problem. Once released into the environment they initiate a chain of environmental contamination. Whether released into water body or onto soil surface they contaminate both ground water and surface water, from there they find their way into aquatic and terrestrial plants and animals thus entering the natural food chain and ending up into human. Both ionic and compound forms of heavy metals are extremely toxic which can seriously affect plants and animals and cause large number of severe afflictions. Therefore the elimination of heavy metals from water is important for public health protection. A number of technologies for removal of these toxic metals from aqueous solutions have been developed. Adsorption of heavy metals from waste waters is one such technology. It is a process in which accumulation of solute from liquids occurs on to the surface of a solid medium. Activated carbon is the most common commercial adsorption medium and full scale processes based on this are in operation in developed countries. However use of activated carbon is not suitable for developing countries like India because of its high cost. Many researchers have worked on production of activated carbon from cheap and renewable resources, using low cost methods and materials with emphasis on decontamination of water in an environmental friendly manner. Materials such as coir pith carbonize husk and corn cob, agricultural by products, sugarcane bagases, enact husks, wheat bran, and waste tea, have been reported as efficient adsorbents of heavy metals. The main objective of the present study was to investigate the feasibility of using carbon from chemically treated waste sugarcane bagases for the removal of Zn(III) from aqueous solutions with different initial concentrations of Zn (III) and comparing its efficiency with commercially available carbon in removing Zinc from aqueous solutions.

Material and Methods

Preparation of Adsorption materials from sugarcane bagasse

Sugarcane bagasse, collected from local juice shops of Bangalore, was washed thoroughly under running water to remove any leftover sugar and any dirt. It was then dried in sun for 2 days. The material was cut into pieces measuring about 2-3 inches in size. These pieces were dried in hot air oven at 200 °C for about 1 hour to remove any left over moisture and grinded to fibrous powder. The powder sugarcane bagasse was divided into 4 parts out of which one part was used for adsorption as such(SB), second part was pyrolysed at 300 °C for 3 hrs in the "Table Top Muffle Furnace and was taken as control sugarcane bagasse carbon sample (CSAC) for all tests. Third part was soaked in 5% orthophosphoric acid for 30 minutes (OSAC) and last part was soaked in 5 % Nitric acid for 30 minutes (NSAC).Third and fourth parts were then washed with distilled water thoroughly and kept for drying in an electric oven at 120 °C for 6 hrs. These two samples were then pyrolysis at 300 °C for 3 hrs. in the "Table Top Muffle Furnace. All the three pyrolysis samples were cooled and powdered using a mortar and pestle. The fibers were sieved by 20 ASTM Mesh and were stored for further experiments. Fifth carbon sample was the commercially available sample (CAC) bought for laboratory use.

Characterisation of adsorbent from sugarcane bagasse

Preparation of Metal stock solution

An aqueous solution of 1000 ppm of Zinc was prepared by dissolving required amount of zinc sulphate in double distilled water. The samples of required concentrations for experiment were prepared by diluting the stock solution of zinc. A control sample was taken before each experiment to determine the exact metal concentration before contact with the different types of adsorbent.

Experimental process for metal ion adsorption on prepared adsorbents

Adsorption assays of the different metal ion concentration on different types of adsorbent were performed by batch experiments in which 100 ml Zinc solution of various concentration viz. 0.02 2ppm , 0.2 2 ppm, 2.27 ppm and 22.7 ppm, were treated with 1 gm of the five types of prepared adsorbents. The solutions were agitated in the "Rotary Shaker" at 100 rpm and 40^0 C for 30mins. All other parameters of adsorption like pH of the solution, shaking speed, temperature, adsorbent dosage and contact time of adsorbent and adsorbate were kept constant for all the sets of experiments. The treated samples were then digested in the microwave digester and analyzed for the remaining heavy metal concentration in Atomic Adsorption Spectrophotometer .The adsorption efficiency of all the five type of adsorbents was calculated according to the expression

Adsorption efficiency % = (Co-Ce)/Co × 100

Where Co is the initial concentration of metal (mg/l) and Ce is thefinal concentration of metal (mg/l)

Results and Discussion

Adsorption is the process by which a solute is transferred to the surface of another material.Adsorption efficiency is affected by the physical and chemical characteristics of both adsorbate and adsorbent. Adsorbent is the adsorbing solid medium used for removal of metal from aqueous solution, as in this case is activated carbon from sugarcane bagasse. Adsorbate is the substance to be adsorbed from the liquid like zinc in present study. Activated carbons are carbonaceous materials with highly developed internal surface area and porosity, sometimes described as solid sponges. The large surface area results in a high capacity for adsorbing chemicals from gases or liquids. During carbonization of raw lignocellulose material, a solid residue (charcoal) and volatile gases are produced .The methods for preparing activated carbons can be classified as chemical and physical activation methods. Chemical activation method consists of carbonizing a raw material after adding substances that restrict tar formation. In the chemical activation process the two steps are carried out simultaneously, with the precursor being mixed with chemical activating agents, as dehydrating agents and oxidants. Chemical activation offers several advantages since it is carried out in a single step, combining carbonization and activation, performed at lower temperatures and therefore resulting in the development of a better porous structure, although the environmental concerns of using chemical agents for activation could be developed. Besides, part of the added chemicals (such as zinc salts and phosphoric acid), can be easily recovered[16]. In this

present study chemical activation of waste was done using H_3PO_4 and HNO_3 and their efficiency in removing zinc from aqueous solutions was compared. Activated carbons made by chemical activation have a porous and very open structure, ideal for adsorption of big molecules[3].

Adsorption efficiency of Sugarcane Bagasse (SB)

Increase in adsorption efficiency of sugarcane bagasse was observed with increase in initial concentration of zinc from 0.022 mg/l to 0.22 mg/l. But thereafter again a fall was observed in zinc removal. Initial rise of adsorption efficiency can be attributed to the fact that the adsorption of a substance is its accumulation in certain surface because of which there is a formation of a liquid or gaseous film on the surface of a solid body. For accumulation on the surface the adsorbent and adsorbate should come in contact. Due to very low concentration of metal ion there is no contact between metal ion and the adsorbent material so there is no adsorption. Also 50% loss in water quantity was observed using sugarcane bagasse as it had absorbed the water.

Adsorption efficiency of Control sugarcane bagasse carbon (CSAC)

Control sugarcane bagasse carbon (CSAC) was obtained by heating Sugarcane bagasse at 300° C for a period of three hours. In this process heat was the only agent applied for production of activated carbon from sugarcane bagasse. Thus high temperature acted as a dehydrating agent and resulted in pore formation in the precursor material. The removal of the outer and less ordered carbon atoms leads to the creation of new micropores and/or the widening of their size, which results in an increase in their pore volume. But carbons activated only with heat are not as good as those produced from chemical activation as is evident from the results of the study. Figure 2 shows that CSAC was efficient in removing zinc only at high concentration. With increase in concentration of zinc from 0.0227 to 2.279 mg/l an increase in adsorption efficiency from 30%- 80% was observed. Whereas at lower concentration no adsorption of metal was observed. Again at concentration of zinc higher than 2.279 mg/l a fall of adsorption efficiency to 45% was observed which may be due to unavailability of adsorption sites at the surface of the adsorbent.

Adsorption efficiency of Nitric acid sugarcane bagasse carbon (NSAC)

NSAC was prepared by chemical activation process. The chemical activation process consists of mixing a carbonaceous precursor with a chemical activating agent, followed by a pyrolysis stage.The material after this stage is richer in carbon content and presents a much ordered structure and, after the thermal treatment and the removal of the activating agent, has a well-developed porous structure. As Figure 3 represents that at lower concentration there was 100% adsorption of Zinc on NSAC. But with increase in initial concentration of zinc to 22.79 ppm ,a fall in adsorption efficiency to 93% was observed.Decrease in adsorption efficiency is expected due to decrease in available free adsorption sites. It means that the adsorption is highly dependent on initial concentration of zinc ion. It is due to the reason that at lower concentration, the ratio of the initial number of zinc ion to the available surface area is low subsequently the fractional adsorption becomes independent of initial concentration. However, at high concentration the available sites of adsorption becomes fewer and hence the percentage removal of zinc ion is dependent upon initial concentration. Nitric acid is a strong dehydrating agent and hence results in production of better pores. Results showed that it was found to be better activating agent. Shunnian Wu and J. Paul Chen in a study conducted on "Modification of a commercial activated carbon for metal adsorption by several approaches" showed that Modification by nitric acid doubles the copper ion adsorption capacity. This is in consistence with the increase of surface acidic functional groups with oxidation of the carbon.Due to the presence of high negative charge the carbon possess excellent metal ion adsorption properties[10].

Adsorption efficiency of Orthophosphoric acid sugarcane bagasse carbon (OSAC)

As the result shows OSAC also showed 100% removal at lower concentration of zinc (0.02-0.22 mg/l).The phosphoric acid concentration generally influences the composition of the activated carbons obtained[3].The adsorption efficiency curve shows a smooth and continuous fall suggesting the fall in available free sites on the adsorbent surface. For fixed adsorbent dose, the total available adsorption sites are limited thereby adsorbing almost the same amount of sorbate thus resulting in a decrease in

percentage removal of the adsorbate corresponding to an increase initial sorbate concentration[8].Othophosphoric acid has been used commonly as a chemical activiating agent for carbon preparation by scientists across the world[3,18]. In the current study nitric acid activated carbon gave better results than orthophosphoric acid activated carbon. This can be attributed to the fact that orthophosphoric acid is a week dehydrating agent as compared to nitric acid and effects the pore formation in the carbon as it sticks to the surface of the precursor.

Adsorption efficiency of commercially activated carbon. (CAC)

As the graph shows that CAC is also efficient in removing zinc from aqueous solution but the adsorption efficiency falls with increase in initial zinc concentration . CAC efficiency in adsorbing zinc is low as compared to NSAC and OSAC. Preparation and activation method of commercially available carbon was unknown to the authors so nothing much can be said about its adsorptive properties.

Conclusion

Application of plant waste material as a precursor for activated carbon depends on its potential for generating high quality activated carbon, presence of minimum inorganics, volume and cost of raw materials and storage life of raw materials. The study reveals that Sugarcane bagasse can be used as an alternative and cheap source of activated carbon. Nitric acid was found to be the best activating agent. Making a comparison among various types of activated carbons it was proved that carbon from sugarcane bagasse treated with nitric acid was the best in adsorbing zinc from aqueous solutions. The investigation proved the following order of efficiency of carbon in adsorbing zinc from aqueous solutions: NSAC > OSAC > CAC>CSAC > SB.

Figure 1. Adsorption efficiency of sugarcane bagasse(SB)

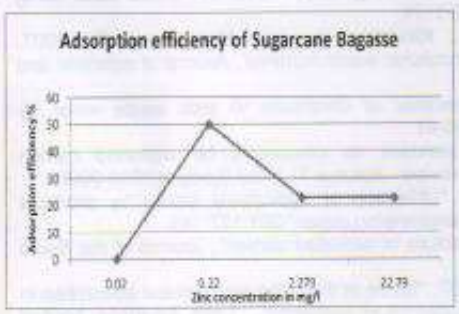


Figure 2. Adsorption efficiency of control sugarcane activated carbon (CSAC)

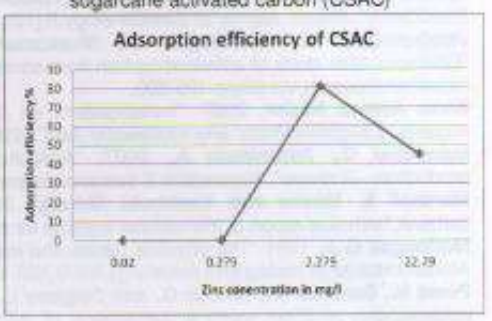


Figure 3. Adsorption efficiency of nitric acid treated sugarcane activated carbon (NSAC)

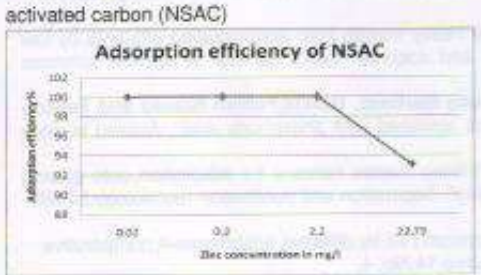


Figure 4. Adsorption efficiency of Orthophosphoric acid treated sugarcane activated Carbon

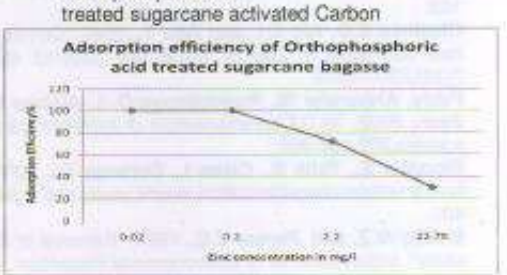
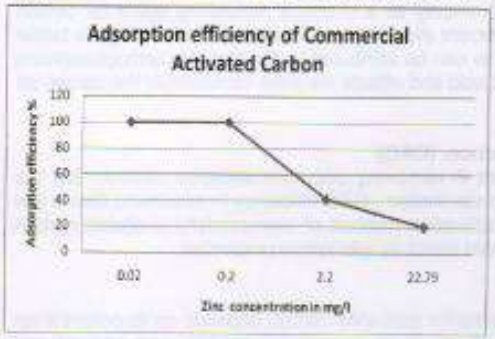


Figure 5. Adsorption efficiency of commercial activated carbon (CAC)



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CHANGING LITERACY SCENARIO IN DARJEELING: A GEOGRAPHICAL ANALYSIS.

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Abstract

Literacy is another qualitative aspect of demographic change. Literacy is defined as the ability to read and write at least a simple message in any language. It plays a very crucial role in the social and economic development in a country. There is a close positive relationship between education and level of economic well being. This study is exclusively based on the secondary data collected from different census reports of Darjeeling Main objective of this paper is to understand the changing literacy scenario of Darjeeling. *It examines the correlation between literacy rate and other indicators of demographic profile. Literacy rates difference with respect to males and females, at the same time it varies between rural and urban populations.*

Key words: Literacy, male female literacy, rural, urban.

Introduction

Literacy is another qualitative aspect of demographic change. Literacy is defined as the ability to read and write at least a simple message in any language. Literacy plays a very crucial role in the social and economic development in a country. There is a close positive relationship between education and level of economic well being. The Indian Census defines a person who would both read and write with understanding in any language is recorded as literate. Thus, literacy is that qualitative attribute of population which is a fairly reliable index of socio-economic development of an area. Lack of literacy on the other hand acts as a break on the social development, economic progress and political maturity of a society. A certain minimum level of literacy is, therefore, a basic requirement for the people to get out of ignorance and backwardness. Education is not only the fruit of contemplation, but an instrument of change also. Study of literacy in spatial perspective is not only a significant attribute to understand the socio cultural and economic personality of a region but also necessary for man power planning. It is in this context that in population geography literacy is considered as a fairly reliable index of socio-cultural and economic advancement. Literacy is essential for eradication of poverty and mental isolation, for cultivating peaceful and friendly international relations and for permitting the free play of demographic process. Illiteracy on the other hand takes away the dignity of man, perpetuates ignorance and hampers the social advancement, economic growth and political maturity. Literacy influences other attributes of population as fertility, mortality, mobility and occupations etc. No wonder the trends in literacy are considered as index of the place at which the socio-economic transformation of a society is taking place.

Study Area

Darjeeling district is the northernmost district of west Bengal. It is located on the lap of the eastern Himalayas of India and lies between 27°13'N to 26°27'N latitude and 88°53'E to 87°59'E longitude. The district comprises of four subdivisions namely, Darjeeling Sadar, Kalimpong, Kurseong and Siliguri. Siliguri is mainly characterized by the tarai and foothills of the district. The geographical area of Darjeeling district is 3,149 sq.km. The Terai is only 91 meters high above the sea level. . The area is bounded by the Sikkim himalaya in the north, the Bhutan himalaya in the east and Nepal himalaya in the west. The southern foothill belt is demarcated by a highly dissipated platform of terrace deposits extending along the east west axis. The exquisite scenic grandeur and invigorating climate in the area have earned the title of "Queen of the Hill Stations" (Chakraborti, P.K 1989.). River Teesta is the master stream in the area while the Rammam and Rangit are the two important tributaries of the Teesta. Besides, numerous rain fed rivulets in the hills become the most dominating factor of environmental control during rainy season. The climate of Darjeeling is especially noteworthy. Springs and autumns are the seasons most favoured by visitors. The

monsoon is a period of continuous rainfall while the winter after December is too cold and unpleasant. The local climate in fact depends largely on the elevation.

Objective

Main objective of this paper is to understand the changing literacy scenario of Darjeeling and to study the spatial variation of male and female literacy for the year 1981 & 2001.

Methodology

In the present study an attempt has been made to assess and analyse the sub-division wise literacy of Darjeeling district. The paper is based on the secondary data collected from Census of India 1981 &2001. The data collected have been classified, processed and presented in the form of tables, charts, maps and graphs.

Discussion

We shall briefly discuss the Sub-division wise rural-urban literacy rate & Spatial Pattern of Sex-wise literacy for the period 1981-2001 in the following paragraphs. Based on the discussion we would be suggesting our recommendation.

Sub-division wise rural-urban literacy

Table 1. Sub-division wise rural-urban literacy rate (1981 & 2001)

SUB-DIVISIONWISE RURAL-URBAN LITERACY RATE 1981-2011				
	1981		2001	
Sub-Division	Rural	Urban	Rural	Urban
Darjeeling	39.6	64.9	74.2	85.7
Kalimpong	30.4	64.8	70.5	86.1
Kurseong	37.0	70.0	72.1	88.1
Siliguri	28.1	61.7	58.1	79.7

Source: Census of India 1981-2001

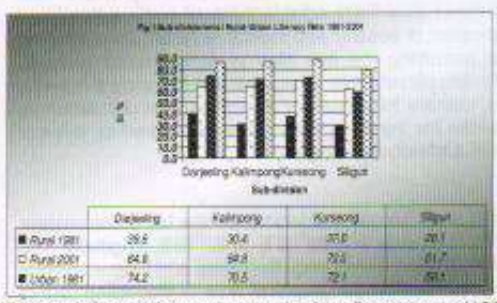

Figure 2. Sub-division wise rural-urban literacy rate (1981 & 2001)

The Table No.1 shows that the highest rural literacy rate during 1981 was in Darjeeling sub-division (39.6%) and the lowest rural literacy rate during 1981 was in Siliguri (28.1%). During 2001 the highest rural literacy was in Darjeeling sub-division (74.2%) and the lowest in Siliguri (58.1%). In 1981 the urban literacy rate was highest in Kurseong sub-division (70%) and lowest in Siliguri sub-division (61.7%). In 2001 the urban highest literacy rate was in Kurseong sub-division (88.1%) and the lowest in Siliguri (79.7%).

Spatial Pattern of Sex-wise literacy

The study of spatial distribution of objects of the surface of the earth is the central theme in geography. The purpose of the study is to know and understand and explain the spatial distribution of sex-wise literacy in the district.

Table 2. Sub-division wise Male & Female Literacy Rate (1981 & 2001)

	81				2001			
	Rural		Urban		Rural		Urban	
Sub-Division	Male	Female	Male	Female	Male	Female	Male	Female
Darjeeling	57.1	28.0	69.8	59.1	83.9	64.5	93.5	85.6
Kalimpong	68.3	27.9	72.0	56.7	78.5	62.0	91.5	80.3
Kurseong	48.6	24.8	78.6	69.8	82.4	61.8	92.9	81.9
Siliguri	37.4	17.2	66.2	55.9	69.4	45.7	83.9	74.8

Source: Census of India 1981-2001

The literacy rate in Darjeeling district was 42.6% in 1981 whereas in 2001 the literacy rate increased to 71.8%. One of the main attributes contributing to the increase in the literacy rate between 1981 and 2001 was the initiative taken by the government of West Bengal in increasing the number of educational institutions in the valley. The policy of the government to provide compulsory primary education has also contributed to the increase in the literacy rate. The general awareness of the benefits of education among the people of the valley has also resulted in more influx of female Scholars enrolling for primary and secondary education. It can be seen from Table No.2 that the percentage of urban female literacy rate during 1981 was 69.8% in Kurseong sub-division whereas during 2001 the urban female literacy rate has increased to 81.9% in Kurseong sub-division. Similarly during 1981 the rural female literacy rate in Siliguri sub-division was only 17.2% whereas during 2001 the rural female literacy rate increased to 45.7% in Siliguri sub-division.

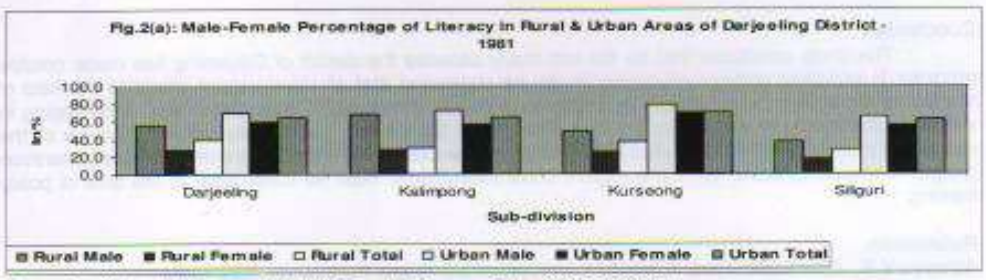

Figure 2.a. Sub-division wise Male & Female Literacy Rate (1981 & 2001)

It can be seen form Fig.2 (a) that during 1981, the male rural literacy rate was highest in Kalimpong sub-division (68.3%) whereas the male rural literacy was lowest in Siliguri subdivision (37.4%). During 1981 the female rural literacy was highest in Darjeeling sub-division (28%) whereas the female rural literacy was lowest in Siliguri sub-division (17.2%). The male urban literacy rate during 1981 was highest in Kurseong sub-division (78.6%) and the lowest was recorded in Siliguri sub-division (66.2%). The female urban literacy rate during 1981 was highest in Kurseong sub-division (69.8%) and lowest in Siliguri sub-division (55.9%).

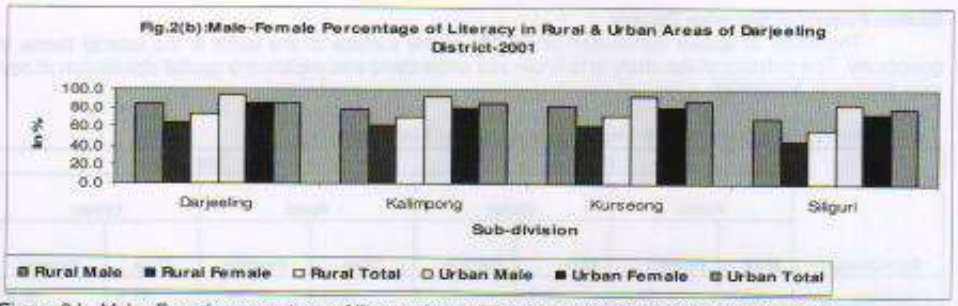

Figure 2.b. Male- Female percentage of literacy in rural & urban areas of Darjeeling Dist. 2001.

It can also be seen from Fig.2 (b) that during 2001 the male rural literacy rate was highest in Darjeeling sub-division (83.9%) whereas the male rural literacy was lowest in Siliguri subdivision (69.4%). During 2001 the female rural literacy was highest in Darjeeling sub-division (64.5%) whereas the female rural literacy was lowest in Siliguri sub-division (45.7%). The male urban literacy rate during 2001 was highest in Darjeeling sub-division (93.5%) and the lowest was recorded in Siliguri sub-division (83.9%). The female urban literacy rate during 2001 was highest in Darjeeling sub-division (85.6%) and lowest in Siliguri sub-division (74.8%).

Recommendation

Spread of literacy and education will facilitate early achievement of the socio-demographic goals. The present analysis would be incomplete without specific suggestions for actions plans that need to be implemented. Make school education up to age 14 free and compulsory, and reduce drop outs at primary and secondary school levels to below 20 percent for both boys and girls. Promote delayed marriage for girls, not earlier than age 18 and preferably after 20 years of age so that the girl child can devote time for better education. Achieve universal access to information/counseling, and services for higher education. Abolish child labour and ensure that the every citizen has access to the fundamental right bestowed by our constitution, the "Right to education".

Conclusion

The study concludes that for the last many decades the district of Darjeeling has made notable progress in providing primary education. It can be suggested that all development efforts in the field of literacy for Darjeeling district should be made according to demographic traits and needs, and keeping in mind the availability of the resources and ecologically fragile and geologically sensitive nature of the region. A separate literacy policy should be framed for the Darjeeling district. More employment generation programs should be launched in the region. Local participation must be considered at the time of policy framing.

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AN IMPACT OF IRRIGATION ON AROBELE COMMAND AREA-A STUDY IN REGIONAL DEVELOPMENT

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Abstract

For any kind of development, a region requires an adequate resources and the development of a region depends upon the resources that are available and how best they have been utilized for the benefit of mankind. The area selected for the study is Arobele Command area of Kanakapura Taluk. A small dam has been constructed across the river Arkavathi (a tributary to the river Cauvery) near Arobele village. The dam impounds 44.96 cubic meter of water to provide for irrigation facilities to an extent 6232 hectares of land in kanakapur taluk of Ramanagaram district. The present study is concerned with "Imprint of Irrigation on Arobele command area. The paper presents the characteristics of the study area, the agricultural conditions and the importance (water budget) of the water in the area of scanty and unseasonal rainfall. The Arobele command area consists of 36 villages and most of the villages depending on the Arobele reservoir for certain crops like mulberry, groundnut, coconut, ragi and vegetables. Recently the reservoir is polluted by the Bangalore sewage water and causes other problems in the command area. Water testing has been carried out to know the different parameters. Weaver's crop combination method has been applied. The overall study concludes that cropping pattern has been changed to cash crops and income per hectare has been increased considerably. The study also has been done on comparative analysis between irrigation and non irrigated area.

Key words: Irrigation Parameters, Regional Development, water budget, Cash crops, Potential Evaporation.

Introduction

Agriculture is one of the fundamental activities of the study unit. The economy of the region depends upon, how best the land is used for the agricultural purpose (Guptha, Sen P. et al., 1968). The output from the land depends on the physical parameters and amount of water supplied to it. The soil type, the use of fertilizers, pesticides and the use of improved machineries and other factors influence the agricultural output. Among these, water is the most important factor in the areas of scanty and unseasonal rainfall. Harnessing water is the only tool to overcome the scarcity of water for agriculture (Madan H.S. et al., 1974). All these differ from area to area. This variation has led to high inequalities. Development of a region can be achieved by increasing; per-capita income, educational standard (literacy), infrastructural facilities, the basic needs like food, shelter and clothing, reduction in infant mortality rate, standard of living, optimum utilization of land and water for cultivation (Ra S.C., 1984). In agricultural economy, how far irrigation helps for the development of a region? Is there any relationship between the resources (water for agriculture) and land-use for the regional development? These questions are attempted to be answered with the help of some geographical tools. Generally topography of the study unit is undulating with hillocks here and there. The natural drainage is normal. Climate is sub-tropical and semi-arid with more number of summer days. The average rainfall of the area ranges between 56 to 102 c.ms.

The study area

The area selected for the study is Arobele command area of Kanakapura taluk. It extends 77° 27'-77° 32' east longitudes and 12° 25'-12° 35' north latitudes. A dam has been constructed across the river Arkavathi (a tributary to the river Cauvery) near Arobele village. The dam impounds 44.96 cubic meters of water to provide for irrigation facilities to 6232 hectares of land with both right bank and left bank canals in the command area. The gross command area of gravity canal is 3953 hectares and irrigable command area is 3035 hectares. The right bank canal runs for a length of 22.5 km, to irrigate 1821 hectares. The gross command area of left bank canal runs for a length of 23 km, to irrigate 4554 hectares. To make the lift irrigation system more economical and viable perennial crop (mulberry) is proposed.

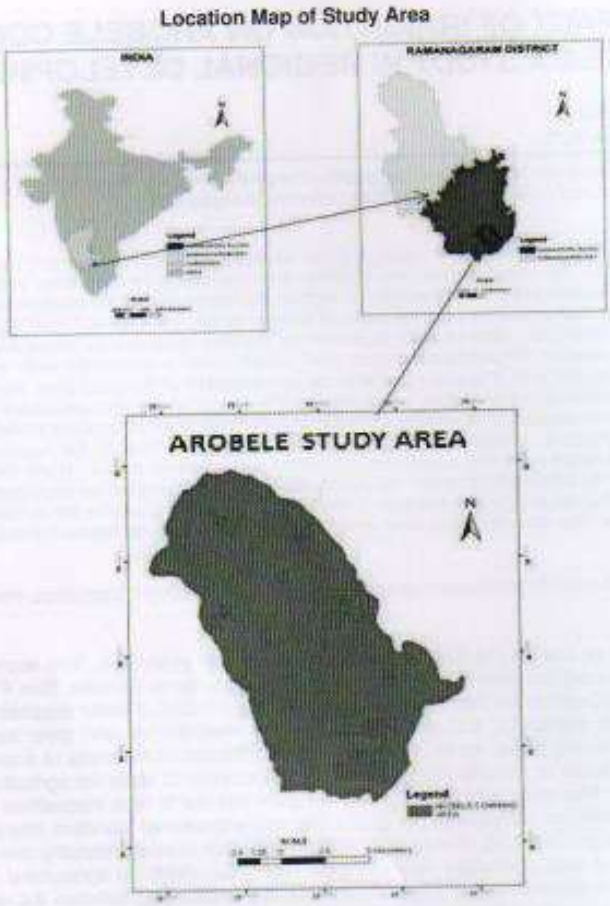

Figure 1. Location map of study area
Source: Survey Of India, Koramangala, Bangalore.

Objectives

The main objectives of the study are to understand the spatio-temporal changing cropping pattern, estimate the water budget, and to know the water quality in the command area.

Methodology

To give a quantitative view, Weaver's technique of Crop Combination method has been applied in the present study to compute crop ranking regions and to know the cropping pattern. While calculating the water budget, the soil moisture and storage capacity is assumed 100 percent (To calculate the water budget in the study area information has been collected from the Office of the executive Engineer, Arobele Reservoir Project-Arobele, located in Arobele Command Area). Some parameters have been used to test the water quality (Water quality tested in the department of environmental science lab, Bangalore University, Bangalore). Both primary and secondary data have been collected from Agriculture Center

Doddalahalli, Agriculture Office and taluk Office Kanakapura and through field study. Crop Combination Maps have been prepared using ERADAS software. On the basis of discussion results have been derived.

Spatio-temporal view of Cropping Pattern

In order to understand the cropping patterns in a particular region, a study of crop combination is imperative. The crop combination on the one hand gives an idea about the agricultural typology, agricultural economics and agricultural income of a region and on the other hand, it gives an insight into the cropping practices and rotation of crops which are quite pertinent for the maintenance of soil fertility and their health (Husain Majid, 1982). As per the Weaver's method five crop combinations are identified out of nine crops. The canal irrigation is practiced over seven grama panchayats. The main crops grown are ragi, groundnut, mulberry, paddy, pulses, jowar and vegetables. The Crop combination maps have been prepared for 1999 – 2000 and 2009 – 2010 (Fig.2&3). The number of crops grown in the village panchayats Doddalahalli, Uyyamballi, Nallahalli and Mullahalli has 4 crops combination and Hookunda, Inoregollahalli, Maralebekuppe has 3 crop combinations in 1999 – 2000, whereas 2009 – 2010 Uyyamballi, Hookunda, Mullahalli and Maralebekuppe has 5 crop combination. Doddalahalli, Iynoregollahalli, Nallahalli has 4 crop combination. The number of crops grown in the study area has been increased except Doddalahalli and Nallahalli. In the region, the area under Ragi leads the other crop with 2833 hectares and second being oilseeds 2722 hectares followed by sericulture 357.9 hectares, paddy 131 hectares, pulses 96 hectares, jowar 33 hectares, others 59.1 hectares in the year 1999–2000. The land under paddy, mulberry, pulses, and jowar is increasing in a decade, being 2365.92, 1908, 121, and 41 hectares, others 73.61 hectares respectively and the area under ragi and oil seeds has decreased to 912.77 and 809.7 hectares respectively by 2009 – 2010. In the region major crops grown are paddy, mulberry, ragi, groundnut, and pulses, the decreasing trend is found in the growing areas of other oilseeds, pulses and maize. The study area has a population of 46,041 persons (2001 census) and nearly 80 percent of them are depending on agricultural activities. Mixed cropping is practiced with the use of fertilizers, pesticides, modern iron ploughs and HYV seeds. This kind of practice is more in the irrigated part.

Using the following formula the variance values for each combination for all the seven panchayats has been computed.

Variance = $\sum d^2 \div n$ whereas, $(d=x-\bar{x})$ (x=Actual value, $\bar{x}$=Mean)

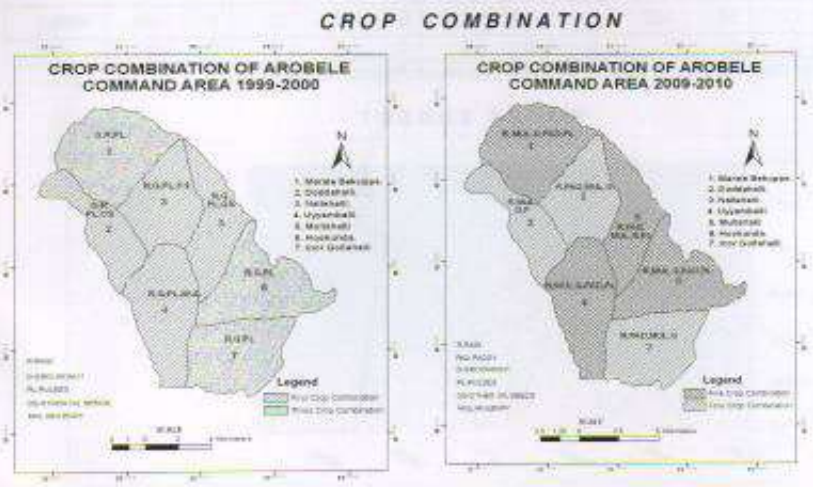

Figure 2.Crop combination 1999-2000 Fig-3.Crop combination 2009-2010

Source: Survey 0f India, Koramangala, Bangalore.

The development of any activity is considered by the "Locational advantage". The term location advantage is to be interpreted on the availability of water for irrigation. The growth and development of a region depends up on the optimum utilization of water and soil for the productive purpose (Herur P.V. et al., 1986.). A water budget reflects the relationship between input and output of water through a region (Oxford Dictionary). The importance of water is much in those areas whose economy is agro-based. The water budget graph shows precipitation and potential evapo-transpiration both as line graphs. Thus we have a direct comparison of supply of water and the natural demand of water. To bring out the clarity, water budget for the command area has been calculated (table.1) and found out that, though the region receives normal amount of rainfall in catchment area, the surplus is found only in later months of southwest monsoon (when P is greater than PE). The water deficit is 665.1 mm (when P is less than PE). The recharge of water to the soils is only in the months of May, August and September (Fig –4). The following terms will be used i.e., Precipitation (p): All moisture from the atmosphere, rain, snow, hail and sleet. Potential Evapo-transpiration (PE): All the water that could enter the air from plants and evaporation if present. AE=actual evaporation.

Following is a data of monthly and total compares of Precipitation and Potential Evapo-transpiration for Arobele Reservoir, Kanakapura.

Table 1.Water Budget of Arobele Reservoir (In the command area) (Figures in mm)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annually
P	0	0	60	3.5	183	21	3.6	164	279	0	0	0	713.9
PE	108	121	157	162	152	123	107	95	90	87	82	101	1385
P-PE	-108	-121	-97	-159	31	-102	-103	69	189	-87	-82	101	- 665.1
Dust	0	0	0	0	31	0	0	69	189	0	0	6.8	-
Stag	0	0	0	0	31	0	0	69	258	171	89	0	-
AE	0	0	60	3.5	152	21	3.6	95	90	87	82	6.8	-
D	108	121	97	159	0	102	103	0	0	0	0	94	-665.1
S	0	0	0	0	0	0	0	0	0	0	0	0	

Source: *Office of the executive Engineer, Arobele Reservoir Project-Arobele-2010*

Figure 4. Water Budget -2010

Water quality of River Arkavathi

Water quality refers to the chemical, physical and biological characteristics of water. Water is perhaps one of the most peculiar of our natural resource and it is essential not only for the sustenance of human life and activities but for the 'quality of life' as well (Agarwal. S. K. 2008). The quality of water is assessed on the basis of testing of sample waters collected from river stream and arobele reservoir and tested in the environment science lab. Table 2, shows the difference in the river stream and the reservoir of river Arkavathi. At the reservoir, the presence of chloride, calcium, total hardness, magnesium, sulphate, phosphate, Cod, SDS, TDS, FDS and turbidity are more than the stream water. The stream water is good and potable but in the reservoir the bed appears to be the pressure of sewage drainage. It is now impossible even to see the boulders and the sand; and the only visible thing is dark green and brown colored water. Arkavathi river water at Arobele indicate a class of 'C' quality of water in respect of dissolved oxygen and bio – chemical oxygen demand and this is due to untreated municipal waste (from Bangalore sewage) water discharged in to the river Arkavathi through the river Vrishabhavathi.

Table 2. Water quality of Arobele Reservoir and River Arkavathi

Arobele Reservoir	Arkavathi River water before joining Vrishabhavathi	Parameter
6.08 mg/L	2.88 mg/L	Total Alkalinity
211.98 mg/L	39.98 mg/L	Chloride
328 mg/L	120 mg/L	Total Hardness
81.6 mg/L	32 mg/L	Calcium Hardness
30.256 mg/L	9.76 mg/L	Magnesium Hardness
1.36 mg/L	0.24 mg/L	Phenolphthalein Alkalinity
1528.16 mg/L	64.94 mg/L	Sulphate
175 mg/L	35.7 mg/L	Phosphate
346.66 mg/L	213.33 mg/L	COD
1268 mg/L	764 mg/L	Suspended Dissolved Solids
8.75	8.28	pH
30.2° C	30.7° C	Temperature
1.26 µS	0.52 µS	Electrical conductivity
630 mg/L	260 mg/L	Total Dissolved Solids
1 NTU	1 NTU	Turbidity

Source: *Water quality tested in the department of environmental science lab, Bangalore University, Bangalore.*

Results

Agricultural development: In the year 1999 – 2000 there were only few tractors in the village panchayats, where as in 2009-10 the number of tractors has been increased even in the revenue villages also. These tractors are serving the farmer's requirements instead of traditional method. Modern iron plough is used instead of wooden plough. Use of pesticides, fertilizers has been increased in the decade. The yield has tripled by these along with irrigation; this highlights the impact of irrigation in the study area. Usually in the region double cropping is practiced. In khariff season farmer grow mainly Ragi, Paddy, Pulses, and maize. In Rabi season paddy, vegetables are important crops. Mulberry and cocoonuts are standing throughout the year. Mixed cropping is practiced both in khariff and rabi seasons. Hybrid variety of groundnut and mulberry with high yield has been introduced in the decade. Many farmers are changing their cropping pattern from food crops to cash crops like mulberry and vegetables. There is a great demand for both by the IT center of Bangalore. The percentage is calculated for the entire command areas wet cultivation to that of wet cultivation of each village.

Conclusion and Suggestions

The impact of irrigation on Arobele command area analysis reveals that the irrigation facilities impact on the farmers to grow few number and major crops depending up on the prices in the market and their demand. The agricultural practice is modernized with the use of modern equipments, fertilizers and hybrid seeds in the command area along with irrigation by the canals. Therefore Cropping pattern has

been changed to cash crops and income per hectare has been increased considerably. The Farmers are aware now about the agricultural development through Government, Service centers & NGO's. Incentives have been given to the farmers in the form of loans, fertilizers and seeds etc; to improve their economy. In process middle persons should be minimized while buying and selling their goods. Arobele reservoir water has become polluted by sewage water from Bangalore through river Vrishabhavathi which affects the command area (The farmers got skin disease because of polluted water). Transport facilities and open market to sell their goods are not sufficient and it should be provided to the command area people. Apart from small scale coir industries, agro-based industries should be established in the study area. Following suggestions may be considered for implementation: By digging tube wells sub-surface water can be used for khariff and Rabi season. Instead of discharging the effluent water to river directly, that could be discharged to lift irrigation tanks and canals, after carrying out necessary treatment. There is lot of scope for dairying in the irrigated areas.

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SOLID WASTE MANAGEMENT AND URBAN ENVIRONMENT - A CASE STUDY OF BARDHAMAN MUNICIPALITY, WEST BENGAL

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Abstract

Rapid urbanisation at some locations and population growth in India leads to the migration of people from village to towns and cities. The state of West Bengal is not an exception. More urban population means that they consume huge amount of resource and generate heap of waste and garbage which is not always properly managed by the urban local governing body like municipalities etc due to less adoption of new technologies, low circulation of existing facility in drainage, sewage, public sanitation and solid waste management. Bardhaman town, the heart of Bardhaman district of West Bengal is growing rapidly. Now Bardhaman is a very emerging town with an increasing number of people opting for better residential spaces and higher living standard. The existing facility of solid waste management does not suffice with the increasing population pressure and daily urban waste. The result is environmental pollution and reduction of the prosperity of urban health. Remembering this emerging issue, the present article is an attempt to analyse the present condition and problems of solid waste management in Bardhaman municipality, West Bengal. The whole study is completed using toposheets (73 M/15 and M/16) of Survey of India, District Resource Map of Geological Survey of India (GSI,2001), District Planning Map of NATMO (2001) and Ward map of municipality (2008). Census report and numerous literatures related to it are collected to prepare this article. The analysis reveals that Barddhaman municipality does not maintain its former healthy environment due to anthropogenic activities and improper treatment of pollution and waste. So Bardhhaman municipality should take suitable steps for the betterment of urban environment as well as the urban people and people are not aware of the segregation of solid wastes. Public awareness should be increased thorough the electronic media for proper management of solid waste.

Key words: Solid waste, Municipal solid waste, Urban environment,

Introduction

Rapid urbanisation and population growth in India leads to the migration of people from village to the cities or towns. West Bengal is not an exception. Present day urbanization of most of the Indian cities and towns is not well associated with the rapid improvement of urban socioeconomic facilities and urban governance. Increasing percentage of urban population does not always mean increasing level of urban development because, for example, more urban population means that they consume vast amount of resources and generate heave of waste and garbage which is not totally managed by urban local governing body due to various visible and invisible causes which have led many imprints on the walk of life. Coupled with the vast consumption of resources is the production of massive amounts of waste, much of which re-enters in the environment as pollution. Remembering this emerging issue, the current geographical study is focused on the emerging problems of urban environmental problems and solid waste management in Bardhaman municipality, Bardhaman district, West Bengal.

Objectives

The main aim of this study is to find out the present scenario of solid waste disposal and management of the study area and related environmental problems. So to achieve this goal the following objectives are considered:

Providing a brief outlook of ward wise population pressure and temporal growth of Population. To analyze the solid waste management scenario of the study area. How effectively municipality is doing solid waste management, any gap is there or not A brief look on environmental problem due to solid waste management.

Solid waste

solid waste means any garbage, refuse, sludge from a waste water treatment plant and other discarded materials including solid, liquid, semi solid or contained gaseous material, mining and agricultural operations and from community activities .

Municipality Solid Waste (MSW)

All types of solid waste generated by households and commercial establishments, and collected usually by local government bodies. Agricultural application of Municipal Solid Waste (MSW), as nutrient source for plants and as soil conditioner, is the most cost effective option of MSW management because of its advantages over traditional means such as land filling or incineration.

Solid Waste Management

Solid Waste Management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods. Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Environmental Problems from Municipal Solid Waste

Different types of environmental problems are created by the Municipal Solid Waste. These are like: local Climate Change, Air contamination, Surface and ground water contamination,Increased energy used,Increased contamination in the production stages,Fires and Explosions,Other Environmental Effects include truck traffic, noise, odours, litter, dust, attraction of rats, birds and insects and aesthetic concerns.

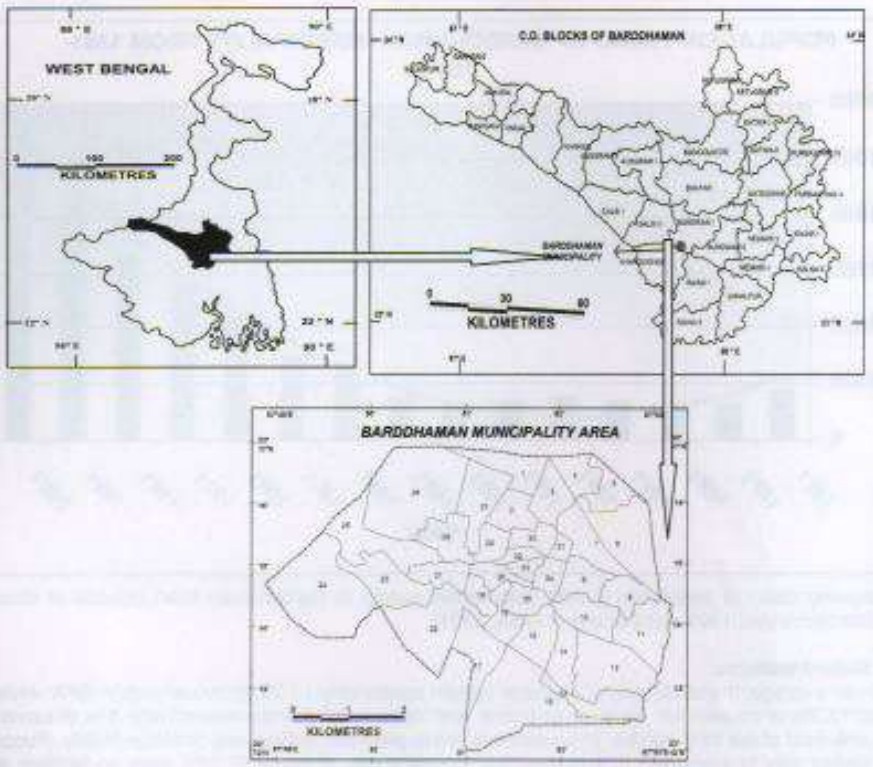
A Case Study of Bardhaman Municipality

Location of Bardhaman Municipality

The one of principal urban centres and civil stations of Southern West Bengal is more or less centrally located in the Burdwan or Bardhaman district. It is situated on the left bank of great river, the 'Sorrow of Bengal', Damodar River. Latitudinal extension varies from 23° 13' to 23° 16'N and longitudinal extension varies from 87° 49' to 87° 53'E. According to Census of India (2001) Bardhaman municipality has an administrative area coverage of 23.04 Sq km but now the town is expanded further (>27.00 Sq km). The town is situated within the boundary of Burdwan-I C.D. Block (figure 1). The Municipality of Burdwan was established in the year 1865. At that time the municipal area was just 12.8 sq. km. with a population of 39,818. As per 2001 census, the population and the area of Burdwan Municipality are 2,85,602 and 26.30 sq. km. respectively. At present the municipality has 35 wards. Burdwan is the principal town and civil station of the district.

Materials

The whole study is completed using toposheets (73 M/15 and M/16) of Survey of India, District Resource Map of Geological Survey of India(GSI,2001), District Planning Map of NATMO (2001), Ward map of municipality (2006), Census report and numerous literatures related to it.



Results and discussion

Population scenario which is also related to the topic

As per Census of India, 2001, Bardhaman district has a population of 68, 95,514 with a rank of 4 th among the district of the state. In 1951, the share of urban population was 14.8% which has gone up to 36.9% in 2001. Bardhaman Municipality with a population of 285,602 (2001) fall in class I M2 category. Bardhaman has an area of 23.04 km 2 and all total 59517 numbers of household are counted in Census of India, 2001. Among the total population of the town, 52.01% are males and 47.99% are females, having sex ratio of 922. Only 9.68% of population is remained as 06 age group of population. Population density of 2001 is 12396 persons per km 2 .Occupational shift from agriculture to urban based industry and services is one part of the change. At the same time, increased agricultural performance has also promoted urbanization as noticed in several top rice and wheat producing districts in the country (viz. the districts of Chengalpet, Krishna, Burdwan, Ludhiana or Kurukshetra). New industrial investments and expansion of the services industry in new location is also another factor. At first the whole town was subdivided into five wards in 1865 (the year of establishment of municipality) and in 1957 five wards turned into 25 wards. During 1961 the municipal area was 22.62 km 2 ; it is increased to 22.74 km 2 in 1981, 23.04 km 2 in 2001 and 26.54 km 2 in 2008. At the time of establishment (1865) the population was 39,618 and now the population is 2,85,602 (2001). The increasing urban population is considered as level and phase of urban development as well as burden on provision of urban facility. Then it is required to depict the trend of population from pre establishment (1861) of Municipality to 2001 (figure 2).

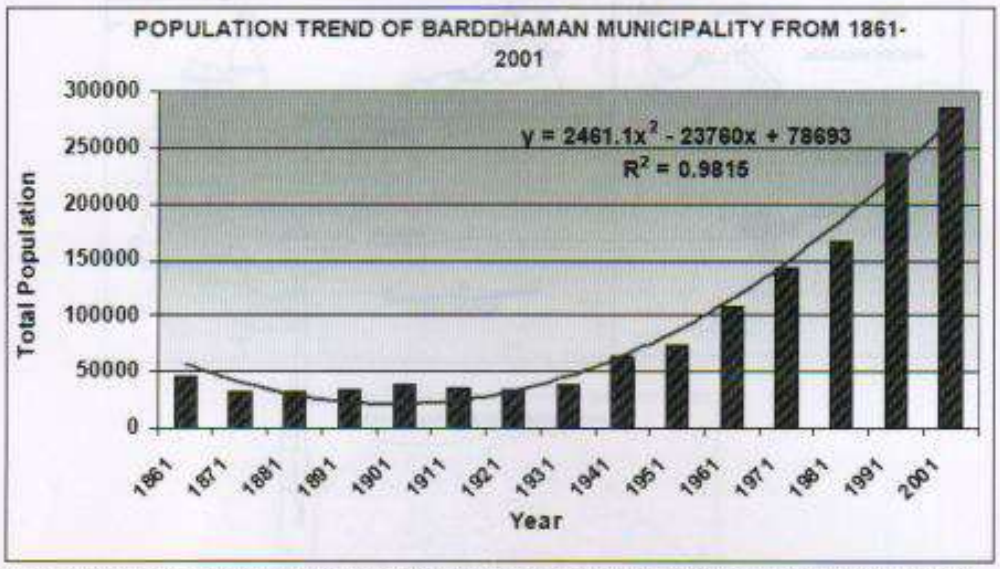
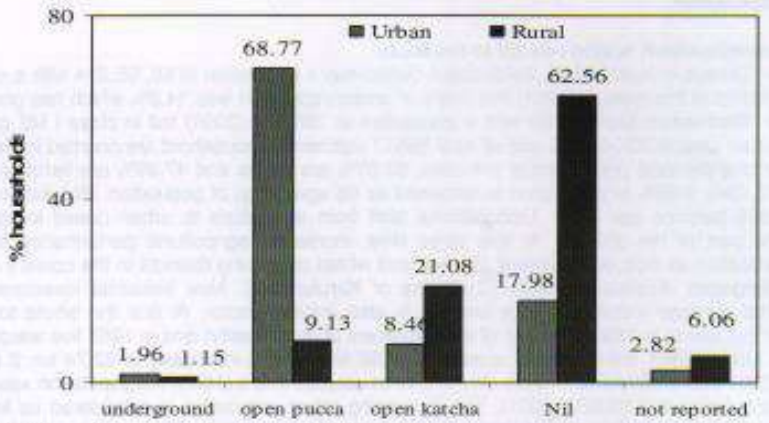


Diagram showing trend of population growth (polynomial curve) of Barddhaman town (source of data: Joytirmoy Bhattacharyya, 1992 and Census of India, 2001)

Drainage: Salient features

On an average, the underground drainage system covers only 1.75% of households in BPA; while 53.14% and 12.3% of households have 'open pucca' and 'open kutcha' drain respectively. It is observed that nearly one-third of the total number of households live in premises without any drainage facility. Pucca drains are limited only to average 9.13% households in rural areas, whereas 62.56% have no facilities at all.



It is learnt that more than 50% of the households, even in many urban locations are facing water logging. Most of the drainage channels are stagnant due to solid waste dumping. It is learned that more than 50% of the households, even in many urban locations are facing water logging.

Sewage Condition

Bardhaman town is basically a nonsewered town, but recently underground sewerage system has been installed in ward no. 21. Length of that sewerage line is only 0.02 km and it covers only 0.001 km 2 area. Most of the open surface drains are choked by solid waste (e.g. plastic, packets and aluminum cans). So, regular flow is very much hampered. This liquid waste is stagnated and it creates bad smell, germs and urban floods in Monsoon period. Only ward no. 11, 12, 16 and 29 are installed with total 2.30 km covered drain. Therefore, due to improper treatment of surface drains, high density of open drains (including 'Kuchha' drain) means possibility of liquid waste pollution. At present due to rapid expansion of town and increasing area of residential space, to minimize the current and future load the municipal governing body should adopt an underground sewage network.

Present Scenario of Solid Waste Generation and Collection

Solid waste is produced at every phase in the urban walk of life, including raw material extraction, processing and transportation; manufacturing, packing and shipping; and advertising and sales, as well as with the products themselves once they are spent and/or discarded. Solid waste, often called the third pollution after air and water pollution, is that material which arises from various human activities and which is normally discarded as use less or unwanted. Solid wastes of Barddhaman municipality may be classified based partly on content and partly on moisture and heating value. A typical classification of solid wastes of Barddhaman town (after S.V.S. Rana, 2007) is as follows:

Garbage

Refers to the rotten solid waste constituents produced during the preparation or storage of meat, wit, vegetables etc.

Rubbish

Refers to nonrotten solid waste constituents, either combustible (paper, wood, scarp, rubber, leather etc.) or noncombustible(metals, glass ceramic etc.).

Pathological Wastes

Dead animals, human waste and hospital waste constitute pathological masks etc.

Industrial Wastes

Chemical, paints, sand, metal ore processing, fly ash, sewage treatment sludge etc.

Agricultural Waste

Farm animal manure, crop residues etc. To depict the wardwise solid waste generation of the town, the following chart and tables (1 and 2) are provided.

Table 1. Present and Projected solid waste generation in Barddhaman town

Sl. No.	Year	Population	Generated waste (kg/day)
1	2001	285871	60333
2	2013	360050	75610
3	2025	434232	91189

Source: Barddhaman Municipality, 2008

Table 2. A brief picture of waste generation, drain density, runoff volume, slum population and number of households in the selected wards having different critical environmental situations:

Ward	No. of Households	% of Slum Population	% of vegetation cover	Generated waste (kg/day)	Gap in waste generation & collection (kg/day)	Open surface drain density (km/km^2)	Potential Annual runoff volume (m^3)
6	3259	7.6	1.56	5.8	5.6	4.17	869.85
12	3094	7.4	3.88	8.6	7.8	4.22	874.50
16	2155	29.1	2.85	2.6	1.94	2.14	934.92
21	1276	22.7	2.45	5.7	4.9	12.07	162.53
24	2267	26.0	1.8	4.6	5	2.50	1015.05
26	2180	29.1	6.9	1.9	1.14	1.94	1099.64
31	662	39.9	0	7.8	4.8	26.20	66.78
35	1437	14.7	0	6.4	3.8	11.82	155.82

Source: Census of India ; a report on solid waste management by Barddhaman city.

Disposal of solid Waste

The solid wastes in the study unit are collected by door to door by rikshaw, van and then it is dumped in hydraulic trolley, lastly in vats.

Salient features-Solid Waste Management

Only 18.21% of households are using the vats for disposal of solid wastes and majority of households are throwing the wastes either to road sides (42.69%) or open drains (2.32%), with 17.33% of them have no specific area for dumping. The solid waste produced in urban centers of BPA are of domestic origin and in the peripheral areas people are generating wastes from using cow dung, including domestic and other agricultural wastes.There is no systematic arrangement for the collection and treatment of solid waste except for the central town area. Road side dumping and burning of wastes are common. No specific sites are exclusively reserved for solid waste disposal and people are at liberty to dump wherever free and open spaces are available. Exiting system of solid waste management, suffers much, due to the unplanned and ill managed traditional practice of collection and transportation of solid waste.

To collect and transport the municipal wastes, the municipality has installed following people in specific works, equipments and vehicles. 240 persons (permanent, temporary and daily wages) are engaged in street sweeping, transportation and disposal of waste.120 persons are engaged in drain/toilet cleaning. All total 175 permanent dustbins. 11 truck and lorries. 135 tricycles. 175 hand carts for door to door collection. 3 Cesspool etc. But the reality shows that these are not enough to minimize the gap between waste generation and waste collection (including lack of daily treatment and monitoring of drains and dustbins). As the population is still rising, there is an urgent need to install more advanced techniques. The ward no. 6, 12, 18, 20, 21, 23, 24, 31 and 35 have generated approximately 4.6 to 8.6 tons of household solid waste per day (2008). Only the ward number 11 is not depicted here due to lack of availability of data. In those wards, there is a significant gap between waste generation and waste collection per day. Also due to lack infrastructure and working people there is increasing gap in between waste generation and waste collection in 35 wards of the municipality. So there is the chance of degradation of surrounding residential environment of those wards due to heap of garbage(plastics, vegetables, polythene, tree branches etc).

Conclusion

Solid waste disposal ground (landfill) near Gosainpara (2.5 km west of Barddhaman rail station, beside Kalna Road) is situated on Chuchura formation (GSI, 2005). Rain water and subsurface runoff carry the different toxic constituent from the garbage dump downward through subsoil to the unconfined aquifer and it may pollute the shallow ground water in future. Along with it there is an urgent need to relocate an alternative position for solid waste disposal sites. The municipality report shows that households of Barddhaman have produced approximately 85.8 metric ton solid waste per day in compared to other sources of waste. But the wardwise gap between waste generation and collection has aggravated the

worst living condition of residential areas, creating heaves of garbage. There is an urgent need to improve urban sewage condition by underground construction. Therefore, the above analysis reveals that Barddhaman municipality does not maintain its former healthy environment due to uncontrolled anthropogenic activities and improper treatment of pollution and waste. So Bardhhaman municipality should take suitable steps for the betterment of urban environment as well as the urban citizens and people are not aware of the segregation of solid wastes. Segregation is to separate municipal solid wastes into the groups of organic, inorganic, recyclables and hazaourdous wastes. So, Public awareness should be increased thorough the electronic media like Television, Radio, internet etc.

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REMOTE SENSING AND GIS FOR LAND USE AND LAND COVER MAPPING AND CHANGE DETECTION IN AND AROUND BELGAUM CITY.

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Abstract

The terms Land use and Land cover (LULC) is often used interchangeably, but each term has its own unique meaning. Land Use refers to the activity, economic purpose, intended use, and/or management strategy placed on the land cover type(s) by humans or land managers. Land cover-refers to the characteristics and surface cover of Earth's Surface, as represented by natural elements. Identification of land use and land cover established the baseline information for activities like thematic mapping and change detection analysis. This paper is an attempt to assess the changes in Land use and Land cover in and around Belgaum city on a spatio- temporal analysis over a period of three decades, i.e., from 1970 to 2010. Primary and secondary data has been used to bring out facts. The imageries were classified by applying Maximum Likelihood classification method. The results arrived highlight that the amount of changes that have taken place during thirty four years (1970-2004) has taken place just within a span of six years (2004-2010), which proved that the acceleration in the change of morphology of the study unit is highly impressive one. The increasing population and the anthropogenic activities are noted to be putting pressure on the available land resources. This paper also highlights the importance of remote sensing and GIS techniques in apprehending the change detection of LU/LC.

Key words: Land Use and Land Cover, Change Analysis, Supervised Classification.

Introduction

Land is the most important natural resource on which all human activities take place. While land cover and land use are often assumed to be identical, yet they are rather quite different. Land cover may be defined as the biophysical earth surface, while land use is often shaped by human, socio-economic and political influence on the land.(Wodeyar A.K. 2009) "Remote Sensing is the Science and art of obtaining information about an object, area or phenomena by a device that is not in contact with object, area or phenomena under investigation"(Lillesand and kiefer,1987).Remote sensing integrated with Geographical Information System, provides an effective tool for analysis of land-use and land-cover changes at a regional level. Land use and Land cover change is a key driver of global change (Gautam.NC, 1982). To understand how LULC change affects and interacts with global earth systems, information is needed on what changes occur, where and when they occur, the rates at which they occur and the social and physical forces that drives those changes(lambin,2003).

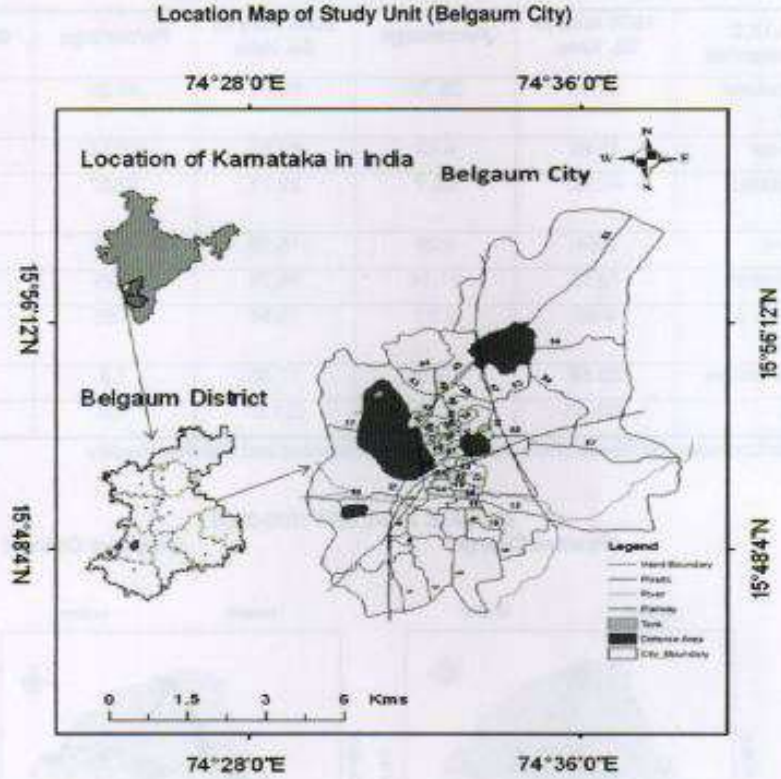
Study Area

Belgaum city is located at 15.87° N latitude and 74.5° E longitude (Fig.1) the northwestern part of the state of Karnataka, in the southern region of India. It is 710 meters above the mean sea level. It lies near the borders of the Indian states of Maharashtra and Goa. It is 502 km from Bangalore, 500 Km Southeast of Mumbai and 125 Km southeast of Goa. Physiographicaly the city is in the foothills of Sahyadri range (Western Ghats). The climatic conditions are pleasant and characterized by a general dryness except during the rainy season. The average annual rainfall varies from 776 to 1040mm.The relative humidity is about 85 percent and it is generally higher in monsoon season.

Methodology

The present study has been carried out broadly in five stages –literature and discussion, data collection of the study area by field survey, data processing, preparation of maps and presentation. ArcGIS 9.2 and ERDAS imagine 9.0 softwares have been used as tools to map the land use of the study unit. Supervised classification is used to classify the land use from Pan+Liss III satellite imagery. The purpose

of image classification is to label the pixels in the image with the real information(Jensen and Gorte.2001)Through classification remote sensing image, thematic maps such as the LULC can be obtained(Tos & Mather.2001)It is feasible to integrate spectral information from remote sensing and established data from GIS to set as the reference material for land use classification. The classification procedure must relatively fit in with true land use condition, and also have a great effect on land use classification. Through integrated database and parameters, the related uncertainty levels data has been classified.



\Figure 1. Study Area.

Land Use and Land Cover Change analysis and Findings (Phase Wise)

The present change analysis is carried out in two phases. Phase - I analysis the changes occurred during the period of 1970 to 2004. Phase - II analysis the period of 2004 to 2010.

Phase I - Change Analysis 1970-2004: The first epoch covers a period of Thirty four years (1970-2004).The dynamics of land use/land cover change pattern have been identified by analyzing the Survey of India Toposheets 1970 and Pan+LISS III satellite image of 2004 in a GIS platform. The study area covers an area of 231.51 Sq.Kms. During the phase –I (1970-2004) Positive changes are marked in Agriculture, Built–up, Roads & Railways and Others land use and Land cover categories (Fig 2). The total area under agriculture was 66.48 Sq.Kms in 1970 which increased to 86.35 Sq.Kms in 2004. Normally the trend for agricultural area shows negative growth as the built-up areas increases and occupies the

agricultural areas. But in my study unit along with the growth of built – up there is growth in Agriculture too. This is because the study unit is not confined to city limits it also covers forty villages around it. The Built – up area increased from 15.90 Sq.Kms in 1970 to 47.55 Sq.Kms in 2004. The major change is seen in the city. The city shows physical expansion. The Roads & Railways increased to 4% by 2004. The others category increased by 6%.

Table 1: Phase-I Change Analysis 1970-2004 (A Period of Thirty four years)

LULC Categories	1970 Area in Sq. Kms.	Percentage	2004 Area in Sq. Kms	Percentage	Change
Agricultural Land	66.48	28.72	86.35	37.30	+
Built-up	15.90	6.87	47.55	20.54	+
Vegetated Area	47.92	20.7	32.11	13.87	-
Others	0.64	0.28	15.39	6.65	+
Wasteland	72.10	31.14	16.78	7.25	-
Railway & Roads	4.88	2.11	13.54	5.85	+
Water bodies	23.59	10.19	17.36	7.5	-
Total	231.51	100	231.51	100	

Source: Computed by Researchers based on SOI Toposheet and Satellite imagery

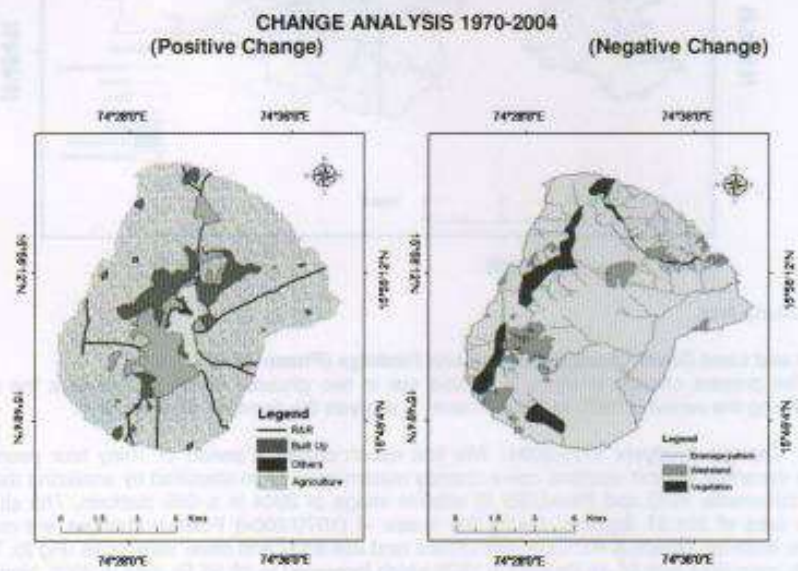


Figure 2. Change Analysis (Positive and Negative) 1970-2004.

The urban development has taken place predominantly in south west and north east direction, up to industrial estate along khanpur road on south west and on north east up to aluminium factory development on east has been conspicuously obstructed by the cantonment area where place of urban development is far slow. On the east of national high way. Vast areas of good agricultural lands have obstructed the urban development activities. In any urban studies negative change is inevitable. The fields of vegetation, wasteland and water bodies show negative growth. The vegetation cover was 47.91Sq.Kms in 1970 which decreased to 31.11 Sq.Kms in 2004.Most of the vegetated areas towards the north – western and southern parts have undergone change. Most of this area is occupied by the village people for agriculture purpose. Waste land also shows negative growth. The total area under waste land was 72.10 Sq.Kms in 1970 which decreased to 16.78 Sq.Kms in 2004(Table 1).The decrease in wasteland is considered as healthy sign as the waste land is utilized for one or the other purpose. The two main categories which occupies the waste land is built-up and agriculture. The water bodies also show negative growth. The water body cover decreased from 10.19% in 1970 to 7.5% in 2004.

Phase II - Change Analysis 2004-2010

The second phase studies the changes occurred during 2004 to 2010. This epoch of period follows the same pattern of changes as in the first epoch. Agricultural land, Built-up land, Roads & Railways and others show positive change and Vegetation cover, wasteland and water bodies show negative change (Figure 3). There is increase in Agricultural land .It was 86.35 Sq.Kms in 2004 and increased to 99.50 Sq.Kms in 2010. Built –up area was 47.55 Sq.Kms in 2004 it increased to 58.13 Sq.Kms in 2010(Table 2). The trend and extent of urban change is likely to continue with the rapid development of infrastructure. Roads & railways increased by 2% whereas others category increased by 1%. The comparison of land use and Land cover between 2004 and 2010 shows changes in terms of greenery loss and lake loss. Vegetation cover decreased from 32.11 Sq.kms to 16.22 Sq.Kms. It also depicts that the loss are converted into built- up environs, attributing to the urban sprawl and encroachments of urban built-up structures. Waste land occupied 16.78 Sq.Kms in 2004 and was reduced to 14.35 Sq.Kms in 2010. Water bodies covered 17.36 Sq.Kms in 2004 and decreased to 9.26 Sq.Kms in 2010. (Rita Basanna.2012)

Table 2. Phase-II Change Analysis 2004-2010 (For a period of six years)

LULC Categories	1970 Area in Sq. Kms.	Percentage	2004 Area in Sq. Kms	Percentage	Change
Agricultural Land	86.35	37.30	99.50	42.98	+
Built-up	47.55	20.54	58.13	25.11	+
Vegetated Area	32.11	13.87	16.22	7.01	-
Others	15.39	6.65	18.05	7.8	+
Wasteland	16.78	7.25	14.35	6.2	-
Railway & Roads	13.54	5.85	15.88	6.86	+
Water bodies	17.36	7.5	9.26	4.01	-
Total	231.51	100	231.51	100	

Source: Computed by Researcher based on Satellite imageries

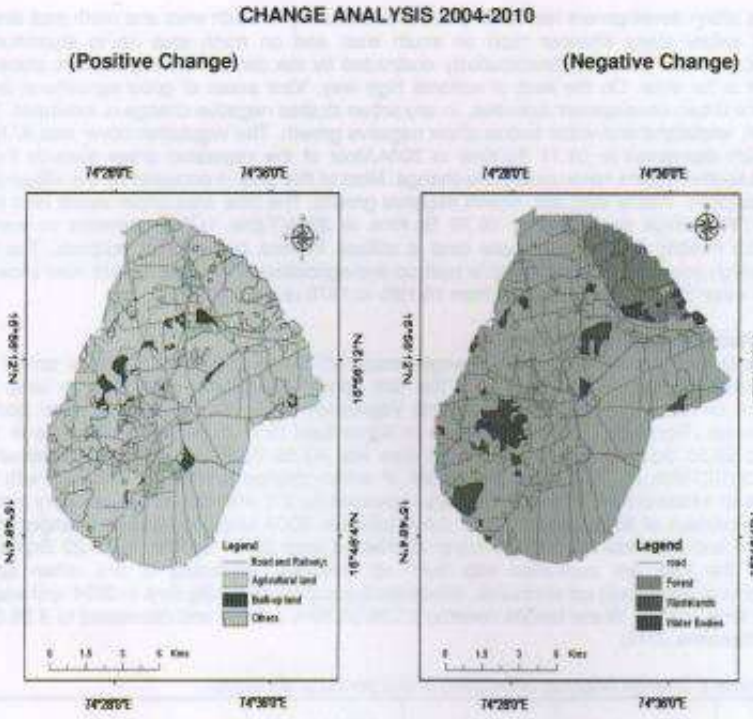


Figure 3. Change Analysis (Positive & Negative) 2004-2010.

Suggestions

There is likely going to be density brought by compactness in study unit in the coming years. It is therefore suggested that encouragement should be given to people to build houses towards the outskirts through the provision of incentives and forces of attraction that are available at the city centre in these areas. Some of the vertical developments are also expected. The Government and local bodies should respond adequately to public opinion and build consensus on key issues of development Promoting a culture of transparency and openness would help building public confidence and also improve the level of accountability and responsiveness. Change detection analysis aid to generate up-to-date information about every bit of the land and facilitates wise utilization of the natural resources in a sustainable manner. GIS tool also provides a technical support in planning and decision making using maps and other related statistical data. Therefore, the use of Remote Sensing and GIS coupled with geostatistical analysis used for the planning of appropriate resource utilization and strategy formulation which is crucial in urban planning in the study area, as a decision support for better design of city. Matching the land with appropriate land use/land cover and resource allotment is very important for sustainable land use management. The land cover dynamics is vital as it is the most important base line data in resource allocation and therefore should be used as one of the main inputs in land use planning.

Conclusion

Management and planning of urban space requires spatially accurate and timely information on land use and changing pattern. Monitoring provides the planner and decision-makers with information about the current state of development and the nature of changes that have occured. This study has demonstrated that the recent advancement in Remote Sensing and GIS techniques provide powerful tool for mapping and detecting changes in land use and land cover. The general trend observed in this study area is Agricultural land, Built-up, Roads and Railway and others show positive change and Vegetation cover, wasteland and water bodies show negative change. The results shows the amount of changes that have taken place in Thirty four years (1970-2004) is taking place just within six years (2004-2010) which means the acceleration of changes is faster every year.

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GEOLOGICAL HAZARDS INVESTIGATIONS IN ENVIRONMENTAL IMPACT ASSESSMENT

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Abstract

Geological hazards risk investigations are very important segments for the environmental impact assessment (EIA) study for any development project. Present study is focused to conduct the geology and landslide risks investigations for some of the mini hydropower projects in central highlands of Sri Lanka. The evaluation of general aspects of in-situ ground stability of the proposed location of the weir site, fore bay tank, penstock line and the power house have been investigated. The proposed locations to construct mini hydropower projects where moderate level of geological hazards and landslide risk exists can be recommended only with the applications of location specific guidelines and precautionary measures for the prevention of future geologic hazards and landslide risk. It is advised to adhere to some recommendations for the sound construction and operation of the proposed mini hydropower projects.

Key words: landslide risk investigations, environmental impact assessment, mini hydropower projects

Introduction

The general objective of a geological investigation is to assess the suitability of a site for the proposed purpose. As such, it involves exploring the ground conditions at and below the surface [1]. It is a prerequisite for the successful and economic design of engineering structures and earthworks. Accordingly, a site investigation also should attempt to fore seen and provide against difficulties that may arise during construction because of ground and/or other local conditions [2, 3]. The complexity of a site investigation depends upon the nature of the ground conditions and the type of engineering structure [2-5].

At present study was focused to conduct the landslide risk investigations for some of the mini-hydropower projects in the Central Highlands of Sri Lanka. Three mini-hydropower projects were selected in Matale, Kandy and Nuwara Eliya Districts in the Central Highlands of Sri Lanka. The proposed mini hydro power projects is situated at Gammaduwa (07° 42' 0.13" N, 80° 42' 0.01" E) in Matale district, Maliyadda (7° 02' 14.61" N and 80 54'38.90" E) in Nuwara Eliya district and Huluganga in Kandy district of the Central Highlands of Sri Lanka. Main structures of Gammaduwa mini hydropower project (M.H.P.) are to be set up on the right bank of the Kosgolla Oya which is a tributary of the Kalu Ganga, within a stretch of about 2 km. Main structures of Maliyadda M.H.P. is located in downstream area of the lower tributary of Uma Oya, called Helgran Oya. The proposed weir is about 2 m height and the length of the weir is 15 m approx., to be constructed at the downstream of Helgran Oya at the village of Pallewela near the bridge over Helgran Oya in Rupaha-Walapane road. Main structures of Huluganga M.H.P. are to be set up on the left bank of Huluganga, within a stretch of about 1.5 km (Fig. 1).

Study Methods

For the purpose of this geological risk investigations, the evaluation of general aspects of in-situ ground stability, existing surface and sub-surface geological conditions of the proposed locations of the weir site, headrace channel path between the weir and the fore bay tank, locations of the proposed fore bay tank, penstock line connecting the fore bay tank and the power house and locations of the power house of the projects were considered. Appropriate precautionary measures to mitigate anticipated environmental impacts due to unfavorable geological conditions were recommended.

Figure 1. Study area

Geomorphology around Gammaduwa mini hydropower project area

The project area is located in the North Western mountain range in Sri Lanka, namely the Gammaduwa and Karagahatanne mountains. It shows consequently a great diversity of geomorphologic features within a comparatively small area. The project area is mainly in the E-W Kosgolla Oya valley. This valley connects with several tributaries within Kosgolla Oya basins. Escarpments, deep slopes and narrow valleys are in fact a major landform in the massif, often reaching several small waterfalls flowing over them. The location at which diversion weir is proposed to construct, the stream flows in a relatively wide valley with U- strike shaped cross section having rather shallow river bottom. Some perennial tributaries can be observed upstream and downstream side of the weir.

The weir site, about 2m height and about 20m long, is proposed to cross the Kosgolla Oya. About 15m drop in the river was observed about 10 m from the weir site. The left and right bank of the river at the weir site and the pond areas show a gentle slope and average slope has an inclination varies from 25-35 degrees. The rock boulders were observed in the both side of the left and right banks of the weir site. The headrace channel is aligned along the SE-NW oriented mountain which is located at the right bank of the stream within a stretch of about 900m. This reinforced concrete channel has to pass initially a relatively gentle slope which is convex in shape and having an inclination ranging from 25-35 degrees.

The fore bay tank is proposed to be constructed on a more or less flat top of a convex slope having an inclination ranging from 10-30 degrees towards the N-E direction. The upper slope above the fore bay tank is straight showing an inclination of 20 degrees. The penstock is to be aligned along the NE directed slope which shows an inclination ranging from 20-45 degrees. The length of the penstock line is approximately 450 m. The power house is to be constructed on a slope which shows an inclination ranging from 10-15 degrees of the right bank close to Kosgolla Oya.

Geomorphology around Maliyadda mini hydropower project area

The project area is located in NE slopes of Central highlands, the catchments area belongs to the Uma Oya drainage basin and it is about 34 km^2. The upper boundary of the catchments extends up to Piduruthalagala Mountain and it is an elevation about 2110m. The project utilizes the waters of Helgarn oya, which is a tributary of Uma oya and flow along NW direction. The slopes are moderate and direct along the NW and SW in Helgran Oya valley and this valley connects with several tributaries within the basins. Escarpments, deep slopes and narrow valleys are in fact a major landform in the massif, often

reaching several small waterfalls flowing over them. The most cases the regular pattern of these scarps suggest that they are joint-controlled. The proposed weir is about 2 m height and the length of the weir is 15 m approx., to be constructed at the downstream of Helgran Oya at the village of Pallewela near the bridge over Helgran Oya in Rupaha-Walapane road. The average bed level at is 759 m M.S.L and the weir crest level is 760 m M.S.L. The estimated generation of power of electricity is about 1 MW.

Geomorphology around Huluganga mini hydropower project area

The location at which diversion weir is proposed to construct, the stream flows in a relatively wide valley having rather shallow river bottom. Some perennial tributaries can be observed in the upstream and also downstream side of the weir. Catchments area of the Huluganga above the weir point is 646 km^2. It consists of Knuckles reserves, tea plantations, scrub forests and bare lands. The right and left bank of the project area mainly compose of scrub jungle and bare lands. The Huluganga flows along the axis of the SW in a synclinal basin and eventually connects to the Mahaweli river at the Victoria reservoir.

The weir is proposed to cross Huluganga. A tributary of Huluganga, named Kukul Oya connects just above the weir along the upstream. The right bank of the river at the weir site and the pond area shows a gentle slope on average having an inclination varying from 15-25 degrees and the left bank shows a step slope ranging from 30-50 degrees. A major portion of the headrace channel in both projects, cross concave type of slope having an inclination ranging from 45-60 degrees and the direction of the slope varies at different locations towards the power house to weir site. The headrace channel crosses several streams (or valleys) along the N-S direction, formed along the fracture erosion. In addition, several valleys can be observed along the channel trace formed due to gulley erosion and accumulation of colluvial deposits due to old landslide.

Geology and Structure of the project area

Basic geologic analyses were carried out to obtain the overall geologic information. This area occupied high-grade lithologically and isotopically distinct, proterozoic metamorphic rocks, which belong to Highland Complex of Sri Lanka [6]. 1:100,000 scale Geological map (Matale, Nuwara Eliya and Kandy sheets) published by Geological Survey and Mines Bureau is used for the interpretation of Geological phenomenon in and around the project area. But general Geological data were collected during the field visit.General orientation of rock layers is aligned NE-SW direction. Major rock types are Garnet, biotite gneiss (+/- Hornblende), Biotite gneiss (+/- Hornblende), Crystalline Limestone (Marble), Quartzite, Khondalite, Charnockite and Undifferentiated metasediments (Fig. 2). Garnet, biotite gneiss (+/- Hornblende) is the major rock type, striking along NE-SW direction and dipping southerly about 50°-70°. Quartz (40%), Feldspar (25%), Biotite mica (20%), Garnet (10%), and +/- Hornblende 5-8%, are the major mineral composition of these gneissic rocks.

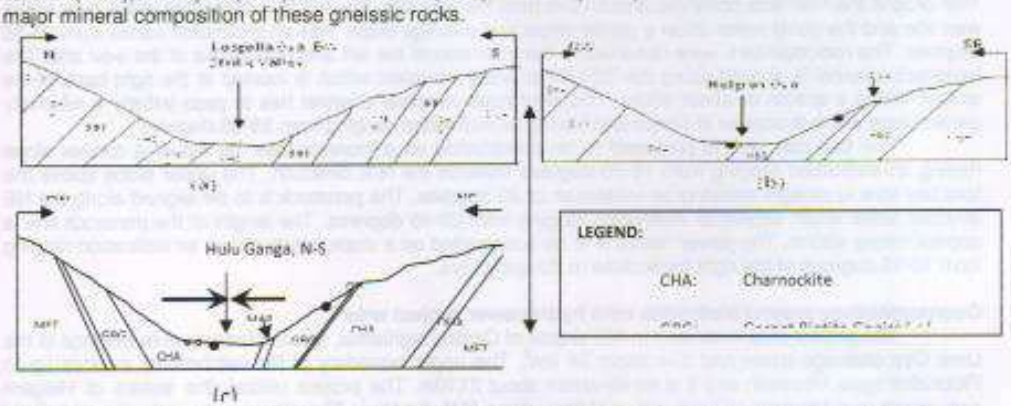

Figure 2. General Geology of Gammaduwa M.H.P. area (a), Maliyadda M.H.P. area (b) and Huluganga M.H.P. area (c), Length of Section , 1.5 km (approx.) along the weir location (A-B)

The major rock types at the weir section of Maliyadda M.H.P., are predominantly consisting of fresh Garnet, biotite gneiss and Biotite gneiss which are highly foliated and jointed, Whereas at the bottom part of the left bank, slightly weathered khondalite rock layers was identified. Slightly to moderately weathered impure crystalline limestone (marble) isolated outcrops are exposed at the 10-15 m away from the pool are along channel trace. Isolated outcrops of marble are exposed along the channel trace up to power house. In addition, some weathered quartzite was observed along the channel trace. Well foliated bedrock is exposed in the downstream section of the weir. There are major well-defined joints in Garnet biotite gneiss and Biotite gneiss below the channel trace, along the existing irrigation canal.

Overburden deposits

Major soil groups in the region are reddish and brown earth as residual and alluvial. The color of the surface *A* horizon is characteristics reddish/ yellowish brown with average thickness of 2-2.5m. The *B* horizon contains weathered rock particles in yellowish color with average thickness of 2m. The most of the soil profiles in the study area are in similar textural variations. The content of the organic matter in a soil is critical for retaining and cycling nutrients, for retaining moisture and for developing. Natural and human processes (eg. Land clearing, burning) which have low organic matter content and have a detrimental effects on the soil in its ability to sustain plant growth.

At the weir site of the Gammaduwa M.H.P., either side of the river bank, about 5-7m thick residual soil overburden resting on the highly weathered Garnet-Biotite Gneiss, Charnockite, Khondalite and slightly weathered undifferentiated metasediments and few meters thick pegmatite (intruded along the joint plane) were observed. At the some location of channel path of Maliyadda M.H.P., about 2-3m thick soil overburden resting on the highly weathered Hornblende-Biotite Gneiss and Charnockitic gneiss. Some in-situ rock blocks have been scattered on the slope of the channel path and covered by the natural vegetation. The thickness, soil type, soil moisture and cropping pattern within the drainage basin may be changed with the perennial and seasonal streams.

At the beginning of the channel trace of Huluganga M.H.P., about 3-4m thick residual soil overburden resting on the highly weathered garnet-biotite Gneiss and quartzite. As well as, some in-situ boulders composed of crystalline limestone, garnet biotite gneiss and biotite gneiss are located on the slope at the left bank of the stream. About ninety percent of the slope across which the channel trace is to be constructed consists of 3-4m thick residual soil overburden. Some in-situ rock blocks are scattered on the slope, which is covered by the natural vegetation.

Geological Hazard Situation of the Project area

Very old landslide or landslide prone areas were observed at the trace of the channel, weir site and power house. Colluvial debris created due to the slide has accumulated at the middle part of the valley across which the headrace channel is aligned and in the valleys located at middle part of the penstock line are the landslide prone areas due to extensive gulley erosion. Further a small slope failure can be observed close to the river bank at the Gammaduwa M.H.P.

At the left bank of the upstream of the weir site and at the weir site of the Huluganga M.H.P, U shaped unstable valleys formed due to gully erosions that indicate the risk of landslides or slope failures. In the valleys and U-shaped depressions created due to slope failures, located along the channel path, that are the landside prone areas due to extensive gulley erosion. At beginning of the penstock line is also another landslide prone area due to highly weathering of U-shaped depression. Alluvial deposits created due to river meandering and braided rivers and accumulated along the channel path. Aqueducts will be proposed to avoid disturbance of natural water path, instability of slope and avoiding landslide risks at the identified locations. Risk for landslides or landslide prone areas were observed at the left banks of Helgam Oya of the Maliyadda MHP, along the channel path and penstock line. In the steep valleys located along the channel path are the landside prone areas due to extensive gulley erosion. However, there is no landslide or slope failure occurred recently around the above three locations according to the information gathered from the people who are living around the area.

Soil erosion and siltation

The common problems associated with downstream hydrological changes, upstream flooding, sedimentation, after quality changes and adverse impact on plant and animal communities. Due to the

formation of a small pond area upstream of the weir, submergence of river bank will be occurred. And also fluctuation of the water level of the pond area can be anticipated during the rainy seasons. As a result, minor scale river bank failures may be expected unless proper measures are taken.

Due to the cultivation activities above the pond area and upstream intermittent land clearing may cause considerable erosion followed by siltation problem [5]. During the construction of the headrace channel, expected cut slopes are minimal. Therefore, frequency for soil erosion may be negligible. Tributary channels of the upstream and downstream are small but they bring sediment from slope erosion start moving downstream in appreciable quantities. As stream bank become higher, more and deeper flow is constrained to the channel, thus increasing stream power and causing the banks to erode. Improving land use is one of the methods for recovery and prevention from the erosion and also there are some instructive hypothetical hydrological applications with the aggradations of the flood plain and commensurate rising of the banks [4]. Landfill is often necessary for construction roads, buildings and other diverse development activity. The problems of unplanned, hazard landfill, however causes serious problems be destroying natural functions including bio-diversity and flood detention. Landfill should be done using prevention measures (eg. retaining walls) to minimize the soil erosion.

Impacts on bedrock stability

Although the bed rock exposures are well foliated and moderately jointed, the stability condition is favorable for the sound construction of the diversion weir. In-situ boulders and separated rock blocks may be encountered along the channel path. Several slope stability issues will be encountered when the proposed powerhouse will be excavated. Precautionary measures to be taken to stabilize the embankments of the area during excavation.

Conclusion

According to field observation, data collection and data analysis, following conclusion can be made subjected to the limitations mentioned above. Except headrace channel, all the other project area of Gammaduwa M.H.P. can be identified as moderately risk area of landslide hazard. Few locations along the channel path, at the FB tank of Maliyadda M.H.P., can be identified as risk area of landslide hazard. The concave shaped slopes and valleys along the channel path and at the penstock line had been created due to gully erosion or slope instability create the locations are in landslide prone areas. Except power house location of the Huluganga M.H.P., all the other project area can be identified as moderately risk area of landslide hazard or slope failures. The concave shaped slopes and valleys at the weir site, along the channel path at the penstock line had been created due to gully erosion or slope instability create the locations are in landslide prone areas. Since the bedrock at the weir site is highly foliated and moderately jointed, uncontrolled blasting of this location may open those joints. This may lead to water leakage in the reservoir. Initiation of slope failures may be occurred due to the disturbances made by the construction activities of the project. Obstruction of natural water paths and dry galleys due to construction activities may also lead to future slope failures.

In general the area across which the channel trace is proposed to construct different types of soil failures may be expected in unsupported slope cuts. Hence damages to the project elements may cause if adequate remedial measures could not be introduced at the very first stage of the construction works. Further these minor failures may lead to major failures in future with increasing ground instability in the project area. According to the existing conditions, construction of these projects will not bring significant impacts to the natural slopes in the area if engineered and regulated constructions are to be performed and long term proper maintaining system persist. Also minor failures can be avoided or minimized by applying appropriate engineered measures and by minimizing ground disturbances during construction.

Recommendations

On an appraisal of the analysis of data collected in the field and conclusion made based on the field observations, the proposed land area where moderate level of geological hazards and landslide risk exists can be recommended for the above project only with the applications of location specific guidelines and precautionary measures for the prevention of future geologic hazards.

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IMPACT OF URBAN LAND USE CHANGES ON PROPERTY VALUES IN BANGALORE METROPOLITAN

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Abstract

Change in any form and in any society is inevitable; it has become part of an urban growth. For the economic point of view urban land and buildings values continue to change. In the process, land rates change from a lower order to a higher order status to attain optimal use. Such changes result into land being allocated to its highest and best use culminating in higher economic returns. Data have been collected from the different sources like BBMP, leading news papers and from Bangalore Development Authority. Also, sampled field survey has been done to get primary data. Interpolation method has been applied to achieve the goal. Meeting and discussion have been made with many land and real estate developers. ArcGIS and ERDAS Imagine Processing software have been applied to know the land use impact and property values in Bangalore Metropolitan City. Findings show that remarkable changes have taken place in land use pattern in the city. In the process residential to commercial transformation has led to change in property values in the corresponding areas. The changes in turn have created problems such as traffic congestion, over stretching of infrastructural facilities and noise pollution. Therefore, adequate land use planning is to be done to avoid these problems. In addition, there need a monitoring of the process of land use changes to prevent negative effect on the environment.

Key words: Interpolation, Survey, Infrastructural.

Introduction

The term 'land' includes all physical elements in the wealth of a nation bestowed by nature; such as climate, environment, fields, forests, minerals, mountains, lakes, streams, seas, and animals. Perhaps the oldest form of collateral, land is still very attractive to lenders because it cannot be destroyed, moved, stolen, or wasted. All a lender needs is the borrower's clear title to it.

The term "Land" is a different thing to various people depending upon their way of looking on it and a kind of activity they does on it, and it is the sum of the natural and man-made resources over which the possession of the earth surface gives control. It is the platform of all human activities-economic, social, spiritual or recreation etc. The entire land area of a country can be broadly divided into urban and rural. Within an urban area, a rational pattern of land uses evolves. An urban area consists of a great variety of interdependent activities and the choice of location of any activity is normally decided by assessing the relative advantages of various locations for the performance of such activity. Therefore, in the long run, activities tend to locate in areas that give the greatest relative advantages. Thus, by a process of competition, activities seek out and segregate themselves in that area in which their optimum conditions (greatest relative advantage) are to be found and by virtue of which they are normally able to exclude other uses. The spatial differentiation of urban land use pattern becomes more marked and complex as population and degree of specialization increases. The economic factors of demand and supply of urban land also play a significant role in this process of land use pattern. Lean and Goodall (1966) attest that the pattern of land use in any urban area is a replication of competition for sites between various uses operating through the process of demand and supply. Similar pattern of land use emerge in different urban areas because of competition between different potential users for given sites. The person who is willing to pay the largest sum for a site is likely to be the person who will eventually occupy and use it. He will be able to compete it away from other potential users. By this mechanism, sites in urban areas tend to be used for that purpose from which the user makes the greatest net gain from alternative uses of that site. This would result in the highest and best use for that land.

The scenario above becomes a continuous process on one user giving way to a higher valued user where the optimum realizable could be attained. Bangalore Metropolitan City faces the same situation

as per the speculation. To test this hypothesis the impact of urban land use change on property values in Bangalore Metropolitan Region has been taken for the analysis.

Study Area

Bangalore lies in the southeast of the South Indian state of Karnataka. The city is in the heart of the Mysore Plateau, (a region of the larger Precambrian Deccan Plateau) with an average elevation of 920M (3,018 Feet). It is positioned at 12.97° N and 77.56° E and covers an area of 741 sq km. The topology of Bangalore is flat except for a central ridge. The highest elevation point in city area is Doddabettahalli, which is 962 m (3,156 ft). Bangalore is one of the smallest districts in Karnataka in area (2190 sq km). However, the study area covers 1200 sq km which includes BBMP, BDA and 111 villages. Population is the important factor for all the phenomena; it is related in all the respect in the entire field. The growth of the population clearly shows the changing trends in the field of the urbanization. Bangalore is the third most populous city in India and the 27th most populous city in the world. In India, Bangalore is the fastest growing metropolis after New Delhi. The population of the study area is 9588910 (as per provisional data) density is 4378 person per sq. km.

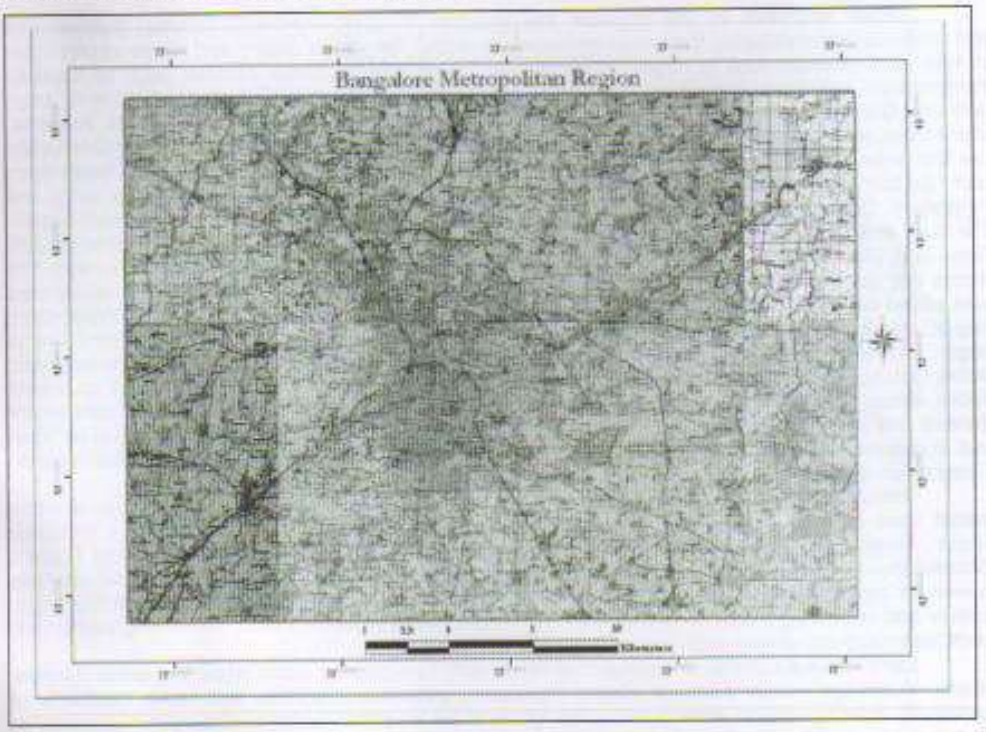

Figure 1. Study Area

Objective

The main objective of the study is to know how land use changes have made impact on land property values in Bangalore Metropolitan Region. Also, to understand the rate of increase and decrease of the land values in the study area. The factors affecting the land values and data sources are also taken into consideration.

Methodology

To get the meaningful result GIS and Remote Sensing techniques have been applied. Secondary data has been collected from BBMP, BDA, Karnataka Gazetteer and Census department. Toposheet and Cadastral maps have been collected from survey of India and Land Record Department respectively. GIS layers have been digitized by using toposheet and cadastral maps. Built-up area, drainage network and village boundaries have been created for further use. LISS –III and LISS IV Remote Sensing data have been collected from National Remote Sensing Agency, Hyderabad. Image processing techniques have been employed to identify the spatial changes in built up area during the study period.

The research takes a close look at the impact of land use changes on property values in Bangalore Metropolitan region. Land values of the Bangalore Urban areas for 1200 sq. km. have been collected from BBMP, BDA records and from local real estate agencies. Data regarding land values have also been collected from different places which have randomly distributed in the city. ArcGIS 9.3 Version used for the crating maps of the land values using interpolation method. ERDAS Image Processing software used for the analysis Change detections.

Urban Land Use

Urban land use is the physical manifestation of socio-economic, cultural, political and environmental factors shaping the use of land in urban areas. The spatial pattern and nature of proportion of land uses in urban area is largely influenced by the national and local policies, such as housing, transportation, industries, agricultural, information and technological policies play the main role in urban land use. Generally urban land is altered used for basic purposes like residential, commercial, industrial, recreational, transportation, and other uses. For the purpose of land use classification of Bangalore Urban five first order classifications has been done. This category are shown in using first order classification such as built-up area, water bodies, Greeneries (including parks, patches of agricultural land, and vegetation), Open land(not available for urban use), masked area (including airport and military bases). The study reveals that around 33% of the area is covered under built-up type of land use, followed by 30% Open land, 29% Vegetation and agricultural, 6% unclassified or masked area. And 3% water bodies. The factors like socio-economical, physical environmental, technical infrastructure, government policies and laws played the key role. Some of the suitable areas for the residential purposes in Bangalore Metropolitan Region are Shadashivanagara, Jayanagar, J P Nagar, R T Nagar, Manjunatha Nagar, Jeevana Bhima Nagar, Chandra Layout, Nagarabhavi, Basaveshwara Nagar, Vijayanagara, R T Nagar, Banasawadi, Dolors Colony, Matthikere, etc. Part of these residential areas exhibit commercial centers such as market places, shops, shopping complexes, offices and exhibition centers. Some of these commercial centers are planned and are not at all planned. The provisions of access roads both pedestrian and vehicular have lead to upspring of blocks of offices and shopping complexes along the access routes. This phenomenon is very much noticeable all over the BBMP, BDA and Bangalore Metropolitan Region.

Industrial land use provides for existing and future manufacturing establishment as well as other related uses such as warehouses. Industrial areas of Bangalore Metropolitan are Peenya Industrial Region, Rajajinagar Industrial Region, Dasarahalli Industrial Region, Bommasandra Industrial Region, Mahadevapura Industrial Region, Electronic city Industrial Region. Transportation land use provides avenue for movement from one place to the other. This comprises national highways, state highways, primary and secondary roads, feeder roads, intermediate roads, outer ring roads, inner ring roads, nice roads, service roads, railway lines, metro tracks and helipads.

Land Use is a complex phenomenon differs greatly from place to place. According to the planners causes of change include personal choice, legislation, government policies and plans, decisions of developers or transportation entrepreneurs, the nature of the land itself or the availability of technology to develop the land. Urban growth will also alter the pattern of land use and land values within an urban area as well as the intensity of site uses. Urban growth thus involves the twin processes of internal reorganization and outwards expansion. The increasing land value makes way to demolish or renovate old buildings for multipurpose. In the process residential buildings are converted into commercial complex. This in turn leads to traffic congestion and crowding in residential areas. As this continues, the entire city infrastructure needs to be rebuilt to facilitate urban emanates for changed scenario which requires huge fund.

Study Area in Square Kilometers: 1200 Sq Km.

Year	Built-up Area	Water Bodies	Vegetation and Agriculture	Open land	Unclassified or Masked Area	Total
2001	13.56	4.00	33.93	42.51	6.00	100.00
2003	18.15	3.95	33.76	38.14	6.00	100.00
2005	25.84	3.54	31.63	32.99	6.00	100.00
2008	28.97	3.23	30.84	30.96	6.00	100.00
2011	32.55	3.14	28.59	29.72	6.00	100.00

Table 1. Land Use Percentage in Bangalore 2001-2011
Source: ISRO/NRSC Sponsored RESPOND Project

Analysis and Discussion

Property values Refers to the market value of market price of a particular interest in landed property. The amount of money which can be obtained for the interest at a particular time from persons able and willing to purchase it. In other words, it means the worth of an interest in land and buildings assessed by the use of appropriate valuation methods. Various factors affect these property values; a few of such factors are examined.

Location is one of the vital factors which determine the property values. Before purchasing the lands buyer looks into the location and other factors. Buyer does not mind to pay even more if the land is located in prime places. Two adjacent sites differ in land values depending on may closeness to schools, hospitals on accessibility, physical terrain, water availability, etc. Lands in M G Road, Jayanagar, Indiranagar, J P Nagar consist high values as they have developed areas.

Accessibility evaluates the net economic cost of moving persons and goods between one place to another. It therefore, concerns both the distance traveled and the time taken to cover that distance. The availability of land for development can be enhanced by adequate transport network. With a given transportation system, movement would be concentrated along particular areas, thus bringing about difference in site values as a result of accessibility advantages. Sites close to a main transport route will have a relative advantage. Sites locate at route intersections will possess an even greater relative advantages, while the greatest relative advantage belongs to those sites located at the focus of the urban transport system i.e., the central business district. Proximity to good means of transportation or communication is a great advantage with virtually all property. The areas having the higher sites and land values are along the ring roads and intermediary roads. Near and closer to metro stations, Bus stations and bus routes.

These are physical structures and facilities that are developed or acquired by public agencies to enhance government functions and facilitate the achievement of common social and economic objectives. The availability of infrastructure attracts potential users to an environment. The availability of electricity to power machines, household facilities, roads for easy accessibility, communication gadgets to facilitate contacts, drainages and refuse disposal that enhance the livability of the environment etc lead to rise in property values in such environment. Demand for land and buildings in such area will be high and since supply is relatively fixed, value will rise.

Complementarily of persons is said to be one of the advantages of locating in an urban area. If a particular site is surrounded by offices or houses of any other particular use, this would determine what will be the highest and best use of that site. Complementarily beings about the clustering of like uses such as when one firm requires the by products of another as a factor input of requires the specialist service of other activities. Firms will be willing to locate in places where other beneficial firms congregate and thus

provide one another the advantage of complementarily. The high demand of such site increases property values.

The research takes a close look at the impact of land use changes on property values in Bangalore Metropolitan region. Land values of the Bangalore Urban areas for 1200 sq. km. have been collected from BBMP, BDA records and from local real estate agencies. Data regarding land values have also been collected from different places which have randomly distributed in the city. On the basis of the data collected from the Government and the Real Estate Agencies Bangalore Metropolitan Regions land values can be classified as very Low Land Values (Below Rs. 600, per sq. ft.), low Land Values (Rs. 601 – 1000, per sq. ft.), medium Land Values (Rs.1001 – 2000, per sq. ft.), high Land Values (Rs. 2001 -6000, per sq. ft.) and very High Land Values. (above Rs. 6000, per sq. ft.),

Very Low Land Values

This class has the land values of below 600 per sq. ft., the main areas comes under this class are Chikka Banavara, Huchanapallya, Nagaruru, Sivanapura, Kitanahalli, Kammsandra, Kurabarahalli, Hancharahalli, Hoskote, Bendaganahalli, Mimbakaipura, Kannamangala, Pujanan Agrahara, Mallasandra, Nadavathi, Valepura, Muthalhalli, Vaalegarahalli, Tindlu, Sampegehalli, Yellachikuppe, Gotegerepalya, Marasandra, Mitaganahalli. These areas are very low land values as they are underdeveloped. These regions fall under peri-urban regions. Urban infrastructure facilities yet to be provided in these regions.

Low Land Values

Sulekere, Sonnenahalli, Rampura, Kadabagere, Gajagadahalli, Dasanapura, Kadagodi, Whitefield, Channasandra, Yelahanka, Jakkuru, Kotegepallya, Nagarabhavi, Kenchanapura, Kannenahalli, Uttarahalli, Puttenahalli, Arkeri, Bilekhali, Gubal, Kotanur, Gubbi, K.R. Puram, Yamlur, Belur, Ramachandrapuram and Guddadahalli comes under the category. The land values for per sq feet in these areas 601 to 1000. These rates are given by the BBMP, Land Registration and Stamp Department of Karnataka. But the case is different in areas like Whitefield, K R Puram, Nagarabhavi and Yelahanka where lands values are more than above region. Because Whitefield, K R Puram areas are influenced by the Information Technological Parks and centers. At the same time government and private developers have shown interest to provide urban amenities to because of high demand.

Medium Land Values

Under this class land values vary between the Rs.1001 to 2000 per sq. ft., The main areas comes under this class are Batarayanapura, Gavipuram Guttahalli, N R Colony, Rajaji Nagar Industrial Area, Rayapuram, Krishnamurthy Nagaram, Hebbala, Bagikunte, Gundur, Kottur, Meganahalli. These regions close to central bus stand, railway station and main market. These areas have been occupied by middle class people. These regions have good infrastructure like market, educational institutions, banks, and offices.

High Land Values

Basavanagudi, Wilson Garden, Shanti Nagar, Yadiyur, Jayamahal, Timmber Yard, Malleshwaram, Kalasipalayam, Prakash Nagar, Tusker Town, Domlur, are the main areas of high land values. These areas having the land value between Rs. 2001 to 6000 per sq. ft. This areas have good road and infrastructure facilities. A part from these the areas have metro, bus stops, cinema halls, hospitals and multifunctional markets.

Very High Land Values

Gandhi Nagar, Rajbhavan Road, K. H. Road, K. G. Road, Jayanagara, Infantry Road, Indira Nagara, M. G. Road comes under very high land values regions. These are commercially built areas, Gandhi Nagar made as cinema city, K. G. Road, M. G. Road and Infantry Roads are High cultured and high class society living areas. These regions fall under the land values of above Rs. 6000 per sq feets. These regions have multinational markets and commercial hubs which made these places high in land values. Also accessibility from these places to other places is so close.

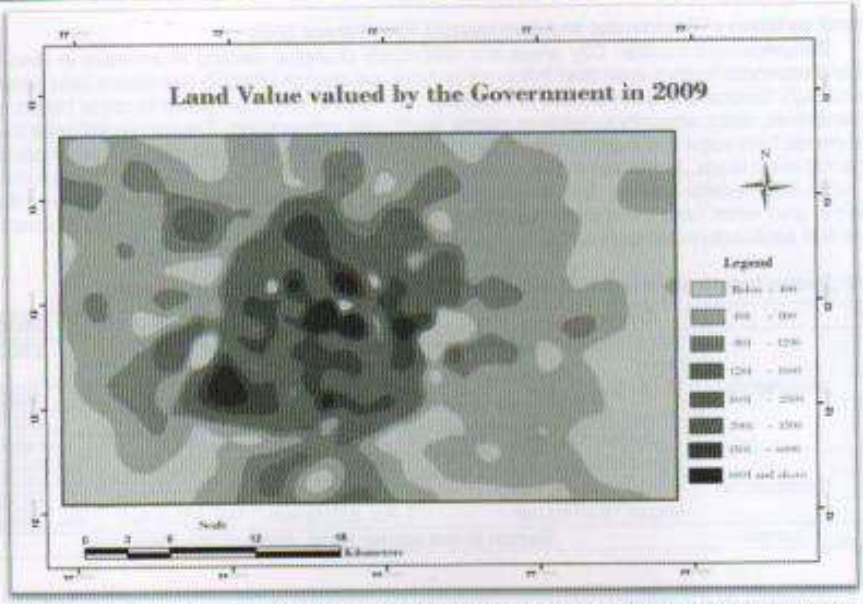

Figure 2. Map showing land value in Bangalore Metropolitan City by Govt – 2009
Source: Source: Karnataka State Gazetteer, Dept of Registration and Stamps

Figure 3. Map showing land value in Bangalore Metropolitan City by Real Estate - 2009
Source: Source: Karnataka State Gazetteer, Department of Registration and Stamps

Temporal variation of Residential and Commercial Rent Values 2009

Bangalore metropolitan City areas are continually changing leading to increase in land value. Social and economic factors exert their influence on land use change which in turn allows land rates to go high and high. Basically residential and commercial rent values vary from place to place based on the urban amenities, close proximity to working places, good road network, etc. The residential rates increase as one moves from edge of the city to core area. However, the commercial rent varies greatly from interior roads to the main roads. At the same time residents willing to stay closure to main road have to cough up more rents than interior places. In modern society, land resources usually earn a higher return or income/net gain when used for commercial or industrial purposes rather than for any other types of use which is well applicable to Bangalore city.

Table 2. Shows temporal variation of Residential and Commercial Rent Values 2009

Sl No	Class		2001	2005	2009
1	Residential	Small House (with out bed room)	Rs. 800	1200	2500
2		Single Bed Room	Rs. 1200	2500	4500
3		Double Bed Room	Rs. 2000	5000	8000
4		Triple Bed Room	Rs. 3000	8000	13000
5	Commercial	Below 400 sq feet	Rs. 7/sq feet	Rs. 9/sq feet	Rs. 12/sq feet
6		400 to 1200 sq feet	Rs. 8/sq feet	Rs. 11/sq feet	Rs. 15/sq feet
7		Above 1200 sq feet	Rs. 8.5/sq feet	Rs. 15/sq feet	Rs. 22/sq feet
8	Lands	Shown in the earlier table, depend upon the area			

Land use in Study Area – 2009

The Bangalore Metropolitan city in a small period of years took the tremendous changes. Bangalore has undergone with many phases of urbanization and industrialization continuously since past 30 years, which turned the city into an area of mixed use. Today the neighborhood is characterized by first class development of high-rise buildings towering the landscape. The table No. 4 indicates the determinants of the land use in Bangalore metropolitan City.

Residential properties are being converted into commercial uses, because of increase in the commercial land values. Middle class families converting their residential areas into commercial so as to get extra benefit, in the process residential streets are also transforming into commercial.

Table 3. Land Use Determinants in Bangalore Metropolitan City – Data collected through the Interview

Factors	Frequency	Percentage
Planning and Regulation	12	16.00
Demand	14	18.66
Infrastructural Facilities	10	13.33
Transportation and Communication	18	24.02
Complementarily (Surrounding Factors)	13	17.33
Accessibility	8	10.66
Total	**75**	**100.00**

Conclusion and Recommendations

The study with applying various techniques it is concluded that Bangalore Metropolitan City's land has undergone a substantial level of change. The city's land has been transformed from residential use to commercial which indicates that the land value is shooting up. Bangalore's built-up area is ever-increasing at the same time open areas, green-belt and agricultural lands are shrinking. The residential areas are being altered into many commercial areas. As a result there is sharp increase in both rental and capital

values of the properties on the city region. The increase in demand for commercial use in turn leads to increase in property values. The change in land use has lead to many problems like traffic congestion, shortening roads, waste generation, crowding and over stretching of infrastructural facilities. Change in any form and in any society is inevitable; it has become part of an urban growth. For the economic point of view urban land and buildings values continue to change. In the process, land rates change from a lower order to a higher order status to attain optimal use. Such changes result into land being allocated to its highest and best use culminating in higher economic returns. The City Planning Authority should also enforce planning laws to allow for balance in land allocation for various uses.

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SUSTAINABLE DEVELOPMENT OF A DEVELOPING ECONOMY: SOME VIABLE ALTERNATIVES

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Abstract

Sustainable Development is imperative in the current context especially owing to increasing population and the deteriorating environmental condition. Globalization, privatization and liberalization accelerated the problem of environmental pollution. The development had been adversely affected especially because their economic base is heavily centered on primary activities particularly agriculture. The present paper aims at focusing the viable alternatives which may be of tremendous importance in meeting the objectives of sustainability which has become the Sine quo non of development. The paper is based on the case study of Pratapgarh district which is one of the economically depressed districts of U.P.

Key words: sustainable development, liberalization

Introduction

India, which occupies 2.4 percent of the surface of globe, ranks second after China (1276.27 million) in terms of population. According to 2001 census India's total population was 1027 million* which is about 16 percent of the total population of the world. It is a developing country in global context which is evident by its 128th rank in Human Development Index. The pattern of development, however, is not uniform. Obviously there are pockets of more development followed by areas of less development. The map showing the pattern of Human Development Index clearly reveals how states of Uttar Pradesh, Madhya Pradesh, and Bihar have very low Human Development Index (see fig.1.1). Within these states there are some areas which are less developed. Such underdeveloped regions/areas are backward areas where the density of population is very high, the level of urbanization is extremely low and so is the case with literacy. The agriculture, which forms the major source of sustenance, is only at subsistence level and the industrialization is almost zero. The per capita income is also very low.

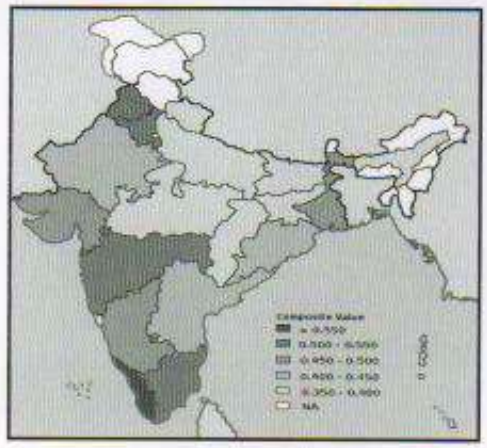

Figure 1.1 Human Development Index of India

As we all know how the subdivisions of landholdings have made agriculture uneconomic, soil-erosion is so common that its conservation is only a distant dream; the man-land ratio (population density)

surpasses the national average and it is exceedingly high; the natural water resources are disappearing fast and there is a danger lurking for water scarcity; the agricultural economy is of subsistence level and highly uncertain and natural and man made disasters have further exacerbated the problem.

This paper aims at focusing the viable alternatives which may help improve the situation in bringing about the sustainable development in the study area.

Study area

Pratapgarh, also called Bela, Bela Pratapgarh, Partapgarh or Partabgarh, is a city and nagar panchayat of Uttar Pradesh, India. It is the administrative headquarters of Pratapgarh district, part of the Allahabad Division. Sai and the Ganges are the main rivers flowing through Pratapgarh district. The district lies between the parallels of 25°34' and 26°11' north latitude and between the meridians of 81°19' and 82°27' east longitude extending for some 110 kilometres (68 mi) from west to east. It is bounded on the north by the district of Sultanpur, on the south by Allahabad, on the east by Jaunpur, on the west by Fatehpur and north-east by Rae Bareli. In the south-west the Ganges forms the boundary of the district for about 50 kilometres (31 mi). Separating it from Fatehpur and Allahabad and in the extreme north-east the Gomti forms the boundary for about 6 kilometres (3.7 mi). According to The Central Statistical Organization, India, the district has an area of 3,730 square kilometres (1,440 sq mi).

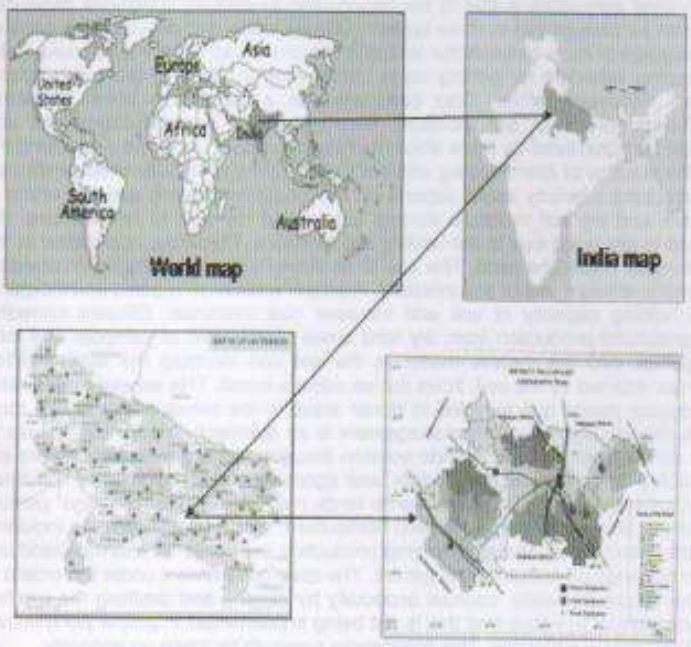

Fig 1.2 Location Map Of India

Sustainable development is an ideal situation which calls for environment friendly development which at the same time is economically dynamic and socially progressive. This is thus a multivariate problem and difficult to optimize. However, in the pages to follow an effort has been made to identify a few most prominent rather vulnerable parameters which may accelerate the process of sustainability and provide direction for sustainable development. These are discussed as under:

Assured Irrigation

In the area under study agriculture being the predominant source of economy irrigation plays the most important role. The only way to sustain, promote and diversify the agriculture with the objective of surplus production is the assured irrigation or availability of water. There are different methods of pulling water such as: tube wells (private and public),hand pumps (private and public) and canals.

The table 1.1 shows that ponds and wells have become quite insignificant and the major irrigation is done by canals and private tube-wells irrigated 103887 hectares whereas canal irrigation covered 85423 hectares. The irrigation by public tube-wells was confined to 812 hectares only.

About a decade ago tanks and wells were the major sources of irrigation. Ever since the new system of irrigation has been introduced, the ground water sources are drying fast and some areas such as Sangipur block is experiencing scarcity of water. The water scarce areas are expanding and, therefore, it has become essential to conserve the water and follow the water harvesting methods in order to enhance the recharging capacity. The only way which appears logical to provide assured irrigation during all the crop season is Drip- Irrigation. The technology may be a little expensive but there is no other way.

The dry land agriculture also needs to be introduced in a big way. Some of the salient characteristics of dry land agriculture are as follows, Crop varieties for dry land areas should be of short duration through resistant tolerant and high yielding which can be harvested within rainfall periods and have sufficient residual moisture in soil profile for post-monsoon cropping. planning for weather: Variation in yields and output of the dry land agriculture is due to the observation in weather conditions especially rainfall. An aberrant weather can be categorized in three types : delayed onset of monsoon, long gaps or breaks in rainfall and early stoppage of rains towards the end of monsoon season. Farmers should make some changes in normal cropping schedule for getting some production in place of total crop failure. Some probable measures are discussed below. Crop Substitution is a practice in which traditional crops/varieties which is inefficient utilizer of soil moisture, less responsive to production input and potentially low producers should be substituted by more efficient ones. In cropping systems, increasing the cropping intensities by using the practice of intercropping and multiple cropping is the way of more efficient utilization of resources. The cropping intensity would depend on the length of growing season, which in turn depends on rainfall pattern and the soil moisture storage capacity of the soil. In fertilizer use, the availability of nutrients is limited in dry lands due to the limiting soil moisture. Therefore, application of the fertilizers should be done in furrows below the seed. The use of fertilizers is not only helpful in providing nutrients to crop but also helpful in efficient use of soil moisture. A proper mixture of organic and inorganic fertilizers improves moisture holding capacity of soil and increase due tolerance. Efficient rainwater management can increase agricultural production from dry land areas. Application of compost and farm yard manure and raising legumes add the organic matter to the soil and increase the water holding capacity. The water, which is not retained by the soil, flows out as surface runoff. This excess runoff water can be harvested in storing dugout ponds and recycled to donor areas in the server stress during rainy season or for raising crops during winter. Watershed management is an approach to optimize the use of land, water and vegetation in an area and thus, to provide solution drought, moderate floods, prevent soil erosion, improve water availability and increase fuel, fodder and agricultural production on a sustained basis. All dry lands are not suitable for crop production. Same lands may be suitable for range/ pasture management and for tree farming and wet farming, dry land horticulture, agro-forestry systems including alley cropping. All these systems which are alternative to crop production are called as alternate land use systems. This system helps to generate off-season employment. The state government under the orders of High Court has been trying to restore the water sources especially by digging and desilting the existing tanks and ponds. It is, however, painful to notice that this is not being implemented in proper perspective. The whole thing is casual and marred by adhocism. This programme needs to be taken up seriously.

Table 1.1. Blockwise total area (hect.) irrigated by different sources in the district Pratapgarh 2006-07

Year / Block	Canals	Tubewell		Wells	Ponds	Others	Total
		Public	Private				
1	2	3	4	5	6	7	8
2003-04	72295	75	113395	183	2	0	185950
2004-05	81810	384	102906	6	16	0	185122
2005-06	85423	812	103887	126	728	1	190977
Blockwise							
1. Kalakankar	7226	53	2320	1	50	0	9650
2. Babaganj	9162	2	2810	1	42	0	12017
3. Kunda	10186	53	1664	3	55	0	11961
4. Vihar	10870	106	2394	8	64	0	13442
5. Sangipur	2742	11	11963	11	73	0	14800
6. Lalganj	4541	106	4661	4	72	0	9384
7. Lakshamanpur	4830	53	3524	36	40	0	8483
8. Sandwa Chandrika	6746	85	1994	18	45	0	8788
9. Pratapgarh (Sadar)	1033	21	6423	10	30	0	7517
10. Mandhata	5094	2	9406	6	28	0	14536
11. Magraura	2837	2	11508	2	40	0	14389
12. Patti	2642	2	7396	2	42	0	10084
13. Aspur Deosara	2230	2	9063	5	42	0	11342
14. Shivgarh	1352	21	5373	3	25	0	6774
15. Gaura	4603	116	11076	5	30	0	15830
16. Rampur Sangramgarh	7528	2	4611	5	30	0	12176
17. Baba Belkharnath	1540	21	7614	6	20	1	9202
Total Rural	85162	658	103700	126	728	1	190375
Total Urban	261	154	187	0	0	0	602
Total District	85423	812	103887	126	728	1	190977

Sources: - District statistical bulletin 2007

Searching New pastures in Agriculture

There are several allied agricultural activities which may be practiced as alternatives in view of lack of assured irrigation. These are: In Pisciculture- The species of fish which can be kept successfully in captivity throughout their lives from egg to adult is exceedingly limited in number. The various breeds of goldfish are familiar examples, but the carp is almost the only food-fish capable of similar domestication. Various other food-fishes, both marine and fresh-water, can be kept in ponds for longer or shorter periods, but refuse to breed, while in other cases the fish obtained from captive breeders will not develop. Consequently there are two main types of pisciculture to be distinguished: first the rearing in confinement of young fishes to an edible stage, and second the stocking of natural waters with eggs or fry from captured breeders.

Animal husbandry, also called animal science, stockbreeding or simple husbandry, is the agricultural practice of breeding and raising livestock. It has been practiced for thousands of years, since the first domestication of animals. Animal Husbandry is a state subject and the State Governments are primarily responsible for the growth of the sector. The Department of Animal Husbandry, Dairying & Fisheries has, however, been operating 30 Central Livestock Organizations and allied Institutions for production and distribution of superior germ plasms to the state governments for cross breeding and genetic up gradation of the stocks. Besides, the Department has been implementing 11 Central Sector and Centrally Sponsored Schemes for the development of requisite infrastructure and supplementing the efforts of the State Govt.s for achieving the accelerated growth of animal husbandry sector.Horticulture as classically defined is the subdivision of agriculture dealing in gardening, in contrast to agronomy which deals with field crops and the production of grains and forage and forestry which deals with forest trees and products related to them. Horticulture is the art and science of plant cultivation, crop production, plant breeding and genetic engineering, plant biochemistry, and plant physiology. The work particularly involves

fruits, berries, nuts, vegetables, flowers, trees, shrubs, and turf. Horticulturists work to improve crop yield, quality, nutritional value, and resistance to insects, diseases, and environmental stresses.

Horticulture involves eight areas of study, which can be grouped into two broad sections - ornamentals and edibles: Arboriculture is the study and selection, planting, care, and removal of individual trees, shrubs, vines, and other perennial woody plants. Floriculture (includes production and marketing of floral crops), Landscape horticulture (includes production, marketing and maintenance of landscape plants). Olericulture (includes production and marketing of vegetables). Pomology (includes production and marketing of fruits) ,Viticulture (includes production and marketing of grapes) and Post harvest physiology (involves maintaining quality and preventing spoilage of horticultural crops). Horticulture is practised in many gardens, "plant growth centers" and nurseries. Activities in nurseries range from preparing seeds and cuttings to growing fully mature plants. These are often sold or transferred to ornamental gardens or market gardens.

Sericulture is an agro-based industry. It involves rearing of silkworms for the production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. The major activities of sericulture comprises of food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving.It is often asked why we need to practice sericulture. There are very many reasons which are in favor of practicing sericulture and they are, high employment potential which provides vibrancy to village economics ,low gestation, high returns ,women friendly occupation and Ideal programme for weaker sections of the society.

Eco-friendly activity practiced in the following ways can also be helpful. For example as a perennial crop with good foliage and root-spread, mulberry contributes to soil conservation and provides green cover, waste from silkworm rearing can be recycled as inputs to garden, dried mulberry twigs and branches are used as fuel in place of firewood and therefore reduce the pressure on vegetation/forest being a labour intensive and predominantly agro-based activity, involvement of smoke-emitting machinery, developmental programmes initiated for mulberry plantation, mulberry can also be cultivated as intercrop with numerous plantations, mulberry being a deep-rooted perennial plant can be raised in vacant lands, hill slopes and watershed areas, currently, only about 0.1 % of the arable land in the country is under mulberry cultivation.

Satisfy equity concerns can also be one of the ways that can be beneficial.Benefits of sectoral value-addition primarily accrue to rural households. As the end-product users are mostly from the higher economic groups, the money flows from high end groups to low end groups.Cases of landless families engaged in cocoon production using mulberry contracted from local farmers are common in some states.

Jatropha, the highly drought-resistant species is adapted to arid and semi-arid conditions. Jatropha needs a minimum of 600 mm of rainfall. It does not resist to water logging or frost. It can survive long drought periods of 7 or 8 months. It also grows well in rainfall areas of 2000 mm and more. It occurs mainly at lower altitudes (0-500m) in areas with average annual temperatures well above 20oC but can grow at higher altitudes. It grows on well-drained soils with good aeration and is well adapted to marginal soils with low nutrient content.

Jatropha farming is yet another alternative which can be practiced as it has following advantages and characteristics of jatropha plant: Jatropha Curcas is resistant to drought and can be planted even in the desert climates, and it thrives on any type of soil, grows almost anywhere; in sandy, gravelly and saline soils. It needs minimal input or management. It has no inspect pests it is not browsed by cattle or sheep. It can survive long periods of drought. Jatropha Propagation is easy. Jatropha Curcas growth is rapid: forms a thick live hedge after only a month's planting. It starts yielding from the second year onwards and continues for 40 years. Jatropha Curcas quickly establishes itself and will produce seeds round the year if irrigated. Other than extracting Bio diesel from Jatropha Curcas plant, the leaf and the bark are used for various other industrial and pharmaceutical uses. Localized production and availability of quality fuel restoration of degraded land over a period of time. Approximately 31 to 37 % of oil extracted from the Jatropha Curcas seed. It can be used for any diesel engine without modification.

Oil has a very high saponification value and is being extensively used for making soap in some countries. Also, the oil is used as an illuminant as it burns without emitting smoke.The latex of Jatropha contains an alkaloid known as "jatrophine" which is believed to have anti-cancerous properties. It is also used as an external application for skin diseases and rheumatism and for sores on domestic livestock. In

addiion, the tender twigs of the plant are used for cleaning teeth, while the juice of the leaf is used as an external application for piles. Finally, the roots are reported to be used as an antidote for snake-bites.The bark of Jatropha curcas yields a dark blue dye which is used for colouring cloth, fishing nets and lines.Jatropha oil cake is rich in nitrogen, phosphorous and potassium and can be used as organic manure.Jatropha leaves are used as food for the tusser silkworm. The seeds are considered anthelimintic in Brazil, and the leaves are used for fumigating houses against bed-bugs. Also, the ether extract shows antibiotic activity against Styphylococcus aureus and Escherichia coli.It is significant to point out that, the non-edible vegetable oil of Jatropha curcas has the requisite potential of providing a promising and commercially viable alternative to diesel oil since it has desirable physicochemical and performance characteristics comparable to diesel. Cars could be run with Jatropha curcas without requiring much change in design.The De-oiled cake is excellent sources of plant nutrient.Jatropha flowers attract bees; it has a honey producing potential. The plant assists in the build up of soil erosion.

Development of cooperatives (primarily for supply of inputs)

Co-operation is a world-wide movement. It was introduced in India in the early years of this century in the wake of famines, which had resulted in economic hardship and an alarming increase in the indebtedness of the farmers to the moneylenders. Co-operative credit on easy terms appeared to be the best means of getting the farmers out of the vicious circle of indebtedness and poverty. The idea was to free the farmers from the necessity of having to borrow money on usurious rates of interest from Sahukars or village moneylenders. The Co-operative Societies Act, which was passed in 1904 envisaged the formation of village credit societies. In 1912, the Act was amended to enable formation of other types of societies for activities relating to sale, purchase, production, housing etc. This Act also provided for the creation of federations of primary societies and for supervision, audit, mutual control and overall development of the co-operative movement.

Co-operation was introduced in India mainly as a defensive organization for dealing with problems of rural indebtedness. With the acceptance and implementation of a planned economic development wedded to the ideas of socialism and democracy, co-operation became a dynamic economic instrument for achieving the social objectives of the National plan.

There are at present 5.04 lakh cooperative societies of different type with a membership of 22 Crores, covering 100 percent villages and 67 percent rural households. The transition from controlled economy to open competitive economy in the name of globalization or liberalization has thrown a whole lot of challenges to the cooperative sector.The district of Pratapgarh has 23 cooperatives which help in supplying the agricultural inputs such as fertilizers, HYV seeds, pesticides and insecticides etc. But these are inadequate keeping in view the number of villages which depend upon them. It is proposed that for each 20 villages there should be at least one cooperative. There are 2181villages and thus 204 cooperatives are required. These should be distributed keeping in view the spatial distribution of the villages /population for effective functioning.

Promotion of agricultural marketing

This is very important aspect of rural development. The agricultural surplus needs to be properly marketed so that the farmers get the full benefit of their agricultural product. This requires development of ***mandis*** where people can get competitive price for the product. This initiative needs to be taken by the government. Pratapgarh district has only few wholesale markets and it is mainly concentrated at the district headquarters. There is a need to decentralize as these ***mandis*** ought to be established at tehsil and block levels also. One of the weaknesses of the study area is poor distribution mechanism both in terms of ration shops and markets and hats. Both are very necessary for meeting the basic needs and for circulation respectively. But their distribution is highly unbalanced which may be seen from the map (see Table no.1.1)

Development of agro-based industries

Pratapgarh has great potential for horticulture and agro-based industries. The Amla based product has acquired international reputation. It is rich in vitamin C and is very helpful in curing all kinds of intestinal diseases. There are different products of Amla such chyawanprash, chutney, pickles and murrabah etc. which are produced in Mahuli market near Pratapgarh and sold and exported outside of the

district. Likewise there is a scope for industries based on oil seeds and food processing industries. The development of these may help in diversifying the economy. The area under study is very rich in the production of potatoes and potato products such as chips and papad are very common and can be promoted as household as well as cottage industries. Likewise mango based products such as pickles, chutney and amavat are also scope of commercialization. Mahua and mahua product and its seeds can be used for different kinds of products such as oil,wine and soap.

Avenues in tertiary sector

There are three sectors of economy-Primary, secondary and tertiary. The tertiary sector is related with commerce and trade, transport and services. The tertiary sector is the major source of urbanization in the backward economy. Unfortunately, however, this has not been properly explored in the area under study. Tourism for example has great scope in this region as there are several historical and religious sites which can be developed to boost the local economy. The religious places which may be promoted are Guisarnath ,Baba Belkharnath and Bela Devi. Likewise Raniganj Ajgara, Kaithola, Kalakanakar and Pratapgarh city may be developed as historical tourist sites. This is in turn will help in the development of hotels and restaurants which in turn will increase the employment potential and the infrastructural development which when take place will improve the socio economic conditions of the people and the place. Yet another important area of development in tertiary sector is technical education. This will not only help developed the human resource it will also generate employment. There is no engineering college or medical college although this is in great demand in view of increasing population. It is unfortunate that the district has not witnessed the development of rail network since 1904.There are only two rail lines one passes through Pratapgarh and connects Faizabad and the other passes through Kunda and Manikpur and connects Lucknow. There is a need that more rail lines are laid down in order to boost the local economy. The places which need to be connected by railroad network are through Lalganj Ajhara,Sangipur Patti Beerapur Atheha and Jethwara.

Caring of Environment

One of the major determinants of sustainable development is protection of environment. Caring the environment is therefore the most important aspect of development. There are several issues which need our attention such as preserving the water resources, afforestation especially in those areas where forests have degraded, reclamation of wasteland, proper disposal of waste in towns in towns like Bela Pratapgarh, Manikpur, Kunda, Katra, medniganj and Antu. Maintaining the damage and avoid the water logging treating the waste before throwing in the river and regulating the traffic of vehicles etc.

The study area has vast chunk of wasteland which needs to be reclaimed for productive purposes and in some of these areas afforestation may also be done by treating the soil. This may also prevent the soil erosion. The orchards and gardens where the trees have fallen have not been replaced. A large scale movement has to be taken in order to motivate the people to plant more trees. The problem of environment is a little more serious in towns. There are no drains and the management of waste is almost absent. This causes a very severe problem in the seven towns of the study area. This problem needs to be addressed much before this assumes serious dimension. This can be done by mass awakening movement, by educating people and promoting environmental education in schools and colleges. There is a need to constitute environmental protection committee at the level of each town and villages and this committee should be responsible for charting out the programmes of environment and development. People's participation is necessary to make the environmental caring programme successful.

Human resource management

As it has been examined earlier the population has been increasing rapidly and very large scale unemployment exists in the region. A great majority of the population is below poverty line. Agriculture is the major source of sustenance. It is almost a zero industry district because industrial employment is quite insignificant. This situation therefore calls for proper human resource management. Following steps may be undertaken to improve the quality of human resource.Enhancing the literacy and professional institution-The mission is not only to improve the literacy percent but to improve the quality of education as it is the quality of education which will produce quality human resource. Good educational institutions are, therefore, needed. Educational institution imparting the physical education may be located in each block.

As noted earlier there are no technical institutions except a polytechnic located at Bela Pratapgarh. If one or two engineering colleges and women polytechnics are established they can definitely change the scenario. In order to improve professionalism at least one pharmacy college may be established at the district headquarter or in Kunda or in Laganj tehsil headquarter. Effective implementation of rual development programmes-Unfortunately the implementation of rural development programme has Indian way of development. The rural development programmes **NREGA, PMRY, SSY** which are currently in vogue should be activated in each and every block to provide employment to the people. These steps may definitely improve the human resource potential of the people living in the study area.

Introducing vocational training courses-There is a scope for establishing the vocational training centers for pickle making, candle making, pottery, food processing, typing, computer education, carpentry, soap making, laundry services, beauty parlour etc. may be introduced to engage the young population and encourage the enhancement of small scale industries. In return this will improve the standard of living and quality of human resource.Creating Sustainability: small is beautiful, territorial closure strategy, people centered development, capillary mechanism, intellectual and spiritual development.

Selective spatial closure strategy

This strategy calls for self reliant development at relevant levels of territorial integration such as village, block, district etc. This means "rely less on outside aid and investment", to involve masses in development, to initiate a conscious process of social learning, to diversify production and to pool resources (Friedmann etal., 1979). People, education and organization are the three major elements in unfolding the development potential of a local area (Sundaram, 2004) and inorder to make the capillary mechanism of development active participation, formation and communication technology and polycentric institution or organizations are necessary (Sundaram, 2004). This strategy thus calls for strengthening the people's participation, enhancing their capability and skill by enhancing education and by strengthening the development institutions.

Conclusion

There are several strategies for developing the organizational efficiency of an area, and growth centre planning is one of them (for details see Misra etal., 1974). If the major central places such as Sangipur, Atheha, Raniganj, Manikpur, Kunda, Patti, Sagra –Sundarpur, Jethwara, Heeraganj, Jhingur are developed as growth points/growth centres by promoting some of the basic facilities such as cooperatives, post office, PCO, communication centres, data cells, cold storages, polytechnic to promote village/rural level artifacts along with the good network of transport system (both rail road network). The linkages will improve and dependency will be minimum and this will augment the process of development.

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