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Analysis of Urban Growth and Its Impact on Groundwater Tanneries by Using Gis

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ABSTRACT
Urbanization is a progressive concentration of population in urban unit. At the moment, India is one among the country of low level of urbanization. In the last fifty years the population of India has grown two-and-a-half times, but urban India has grown nearly five times. In 2001, 306.9 million Indians (30.5%) were living in nearly 3700 towns and cities spread across the country, and it is expected to increase to over 400 million and 533 million by 2011 and 2021 respectively. At the moment, India is among the counties of low level of urbanization. As a result, most urban settlements are characterized by shortfalls in housing and water supply, urban encroachments in fringe area, inadequate sewerage, traffic congestion, pollution, poverty and social unrest making urban governance a difficult task. The high rate of urban population growth is a cause of concern among India's urban and town planners for efficient urban planning.

There are increasingly widespread indications of degradation in the quality and quantity of groundwater, serious or incipient, caused by excessive exploitation and/or inadequate pollution control. The scale and degree of degradation varies significantly with the susceptibility of local aquifers to exploitation‒related deterioration and their vulnerability to pollution. This project is based on the investigation or review of the situation in a substantial number of developing cities worldwide. It aims to raise the awareness among policymakers of hydro-geological processes in urban areas, to highlight key urban groundwater issues, to provide a framework for the systematic consideration of the groundwater dimension in urban management, and to formulate approaches for more sustainable management of groundwater resources in urban areas using remote sensing method.Urbanization on account of demographic and economic growth leads to the wide variety of environmental problems. The supply of infrastructure cannot cope with the demand placed by urban development. It results inadequacy of urban infrastructure, which leads to degradation of the quality of natural resources such as air, water, land, vegetation, marine life.

In addition industrial pollution in large cities causes effects to human life. The present study is aimed to analyze the growth of urban development and its impact on ground water. To analyze the growth of Dindigul town and its impact on ground water quality remote sensing techniques were used. Dindigul town spreads over an area of 14.01 km^2. Since 1970 the area was not increased but due to increasing population wards increased. For the assessment of ground water quality impact samples were taken in and around the town and analyses further. The results indicated that the samples nearer to the tanneries were exceeding the limits; mainly Begambur and Paraipatti compared to other locations.
KEYWORDS: Urban sprawl, Land-use and land-cover change, geographic information system, Change detection

I. INTRODUCTION

Planning is a widely accepted way to handle complex problems of resources allocation and decision-making. It involves the use of collective intelligence and foresight to chart direction, order harmony and make progress in public activity relating to human There is no universal definition for urban, it various from country to country.

Generally the area, which has a larger population, large density and great consideration of non-agricultural activities, is termed as urban. As the demand for ground water is increasing day by day, the need to assess and manage available ground water becomesvital. In hard rock terrain regions, groundwater is a prime source of potable water which needs greater attention for itssustainability and management.

Water pollution is a serious problem in India as almost 70% of its surface water resources and a growing number of its groundwater reserves are already contaminated by biological, toxic organic and inorganic pollutants. Groundwater plays a fundamental role in shaping the economic and social health of many urban areas in the developing world.

Urbanization is a process of villages to be developed into towns and further into cities and so on. There is no universally accepted definition of urban settlement. Different countries adopt different criteria for defining the urban settlement. Urban places are not even similar in character.

This can be distinguished on the basis of defined demographic characteristic and available infrastructures. In India, criteria of urban centers are more or less similar to the ones suggested by the United Nations. In Census of India (1961) has defined urban centers as “Places having a minimum population of 5000 with at least 75 percent of male workers being engaged in nonagricultural activities and the density of population should be 400 persons per square Kilometers”.

According to Trewartha, the level of urbanization is defined as the proportion of urban population to total population residing in urban places by shifting population from village to city and the process of transformation of villages into city is called urbanization.

Urbanization is broadly defined as a growth of towns and increasing ratio of urban to rural population of a country. The growth of a country’s towns and cities is conditioned by the natural, economic and social progress. The concept of urbanization as a set is related to the socio-economic process which implies a shift in focus from the city as a cultural aspect to process that leads to the expansion of cities and generate and diffusing element of urban life and culture.

Urbanization and modern civilization go together for in developing stage due to increasing economic specialization and advancing technology. The simplest and most common definition of urbanization is “Proportion of population living in urban settlement to total population”.

Geographers have studied urbanization as a process of concentration of population in larger human settlement either through multiplication or concentrated. However, urbanization is not merely a demographic phenomenon. It has its economic and other concomitant at the same time. It is a special concomitant phenomenon involving the complex process of change involving population

Today, industry is the most dominant factor of urbanization. It has accelerated the process of rural–urban migration and the creation of new and enlargement of existing urban centers. In a country like India, the level of urbanization is related to the degree of industrialization. Maharashtra State is one of the urbanized states in India accounting one third of its population lives in towns.

This stands in sharp contrast to 16.59 percent of its population living in towns; at the turn of the twenty first century. In fact the population living in towns today is more than that of total population of Maharashtra State in 1911. During the period from 1911-2001, urban population of Maharashtra has increased thirteen-fold and last two decades are critical where urban population of the state became double. More than half of the total urban population of Maharashtra state lives in three large towns, viz. Mumbai, Pune and Nagpur accounts for over 40 percent of Maharashtra’s urban population.

Improved management of urban groundwater resources is urgently needed to mitigate actual and potential derogation caused by excessive exploitation and inadequate pollution control. Unless groundwater is protected, in terms of both quantity and quality, there will be increased scarcity of water supply and escalating water supply costs with potential impacts on human health. Many industries require good quality and high reliability of water supply that if not available may cause them to locate elsewhere, thereby causing economic stagnation.

II. GROUNDWATER

Water is a renewable resource occurs in three forms viz., liquid, solid, vapour (gaseous), all these three forms of water are extremely useful to man. No life can exist without water. Since, water is an essential for life as like that of air, it has been estimated that in the human body two-third portion is constituted by water. The water is not only essential for survival of human beings, but also for animals, plants and other living beings.

2.1 TYPES OF GROUNDWATER DEGRADATION PROBLEMS

Thus, in a highly fractured aquifer where groundwater flow is easy and relatively rapid, contamination may become more widely dispersed in a given time than where flow is inter-granular, especially if the strata have only a modest permeability. Important issues when considering degradation are the use of water, the availability of alternative sources and the scale of impact on different users.

Degradation of groundwater often affects the poor most, as they are least able to afford alternative water supplies or to cope with changes in livelihood that deterioration may force upon them.

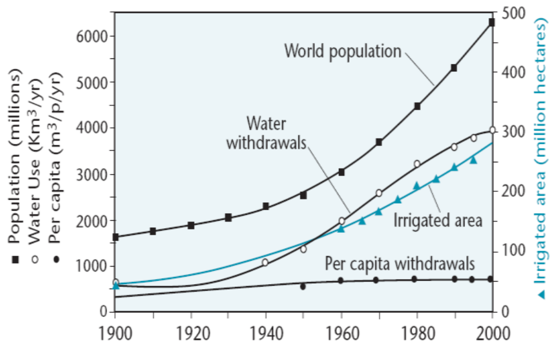

Fig 2.1 Global trends in water use (modified from Gleick, 1998)

2.1 GLOBAL WATER ISSUES THAT AFFECT GROUNDWATER

Some global trends affect all of Earth's freshwater reserves. Perhaps the three most far-reaching in terms of resource sustainability are those of salinisation, trends in withdrawals and climate change.

● *Salinisation* Salinity is the major threat to aquifer sustainability because it does not reduce naturally, and salinised groundwater can only be made fit for purpose by energy-intensive desalination or by dilution. Salinisation can occur as a result of poor irrigation practice in agricultural areas, and as a result of over-abstraction inducing saline intrusion.
The latter occurs usually, but not exclusively, in coastal aquifers. Mixing with just 3 to 4 per cent sea water (or groundwater of equivalent salinity) will render fresh groundwater unfit for many uses, andonce this rises to 6 per cent the water is unfit for any purpose other than cooling and flushing. Once salinised, aquifers are slow to recover. In intergranular-flow aquifers, the enormous volumes of water in storage have to be displaced, and in some fracture-flow systems where the matrix is also porous, it is difficult to drain relatively immobile water that has entered by diffusion from the fracture network.

● *Global trends in withdrawals* Freshwater use continues to rise, often at the expense of environmental requirements for the maintenance ofecological diversity. Although separate global figures are not available for groundwater trends, Figure 3 shows a six-fold rise in the total freshwater use between 1900 and 2000, which is not simply related to the increase in global population, as per capita withdrawals during this period only increased by about 50 per cent. Rather, it is theincrease in irrigated area and to a lesser extent the growing need for water for industrial uses and power plant cooling that has increased demand.

● *Climate change* Climate change in the 21st century will influence the sustainable management of all Earth's water resources including groundwater. The effects of climate change are likely to be far reaching and in general more severe the faster the rate of change.

III. ROLE OF REMOTE SENSING AND GIS

The pace and scope of development in most of the small island states have increased significantly in recent times, which is resulting in both visible and subtle changes in their landscapes. The common major concerns are: depletion of natural (forest, groundwater, mineral, etc.) and fishery resources, degradation of natural inland and coastal ecosystems, coastal erosion, safe disposal of liquid and solid wastes, land abuse, soil loss, increasing population density, etc.

ADD GIS DATA

Remote Sensing is an art of obtaining information about an object, without being in contact with the object under consideration. Remote Sensing has emerged as a powerful tool in planning. An ability of space technology for obtaining systematic, synoptic, rapid and repetitive coverage in different windows of electromagnetic spectrum and over large area form its vantage point in this space has made this technology unique and thus widened the spectrum of remote sensing applications in natural resource management.

Remote sensing has its application in various fields like geology and mineral exploration, geomorphology and modern geomorphic process modeling, nature mitigation studies, hazard zone mapping, eco system study in hills, plains, riverine, coastal, marine and volcanic landforms, forest and biomass inventory, fishery management and ocean applications, natural resources survey and management.

In these studies, remote sensing images have been analyzed by the visual interpretation technique, as this technique is economical, easy to learn and requires simple equipment as compared to the digital analysis technique. In addition, visual interpretation of remotely sensed data is an essential step to learn the technique for various applications, and subsequent to convert the interpreted maps into digital form for use in a Geographic Information System (GIS).

Integrated approach using Geographic Information System provide cost effective support in resources inventory including land use mapping, comprehensive database for resources, analytical tools for decision making and impact analysis for plan evaluation.

GIS accept large volumes of spatial data derived from a variety of sources and effectively store, retrieve, manipulate. Analyze and display all forms of geographically referenced information. Maps and statistical data can be obtained from the spatial integration and analysis of an area using GIS softwares.

IRS 1D LISS III imagery in hard copy has been used for the interpretation of Geology, Geomorphology, land use / land cover and lineaments on IRS 1D satellite data has clearly shown the presence of geomorphologic and landform characteristics of the study area.

3.1 TYPES OF DATA PRODUCT:

The remotely sensed data products are available to the users in the form of (a) photographic products such as proper prints, film negatives, dia-positives of black and white and false color composite in a variety of scales and (b) digital form as computer compatible tape (CCT), CD etc, after necessary corrections.

3.2 REMOTE SENSING APPLICATIONS:

1. Geology and geomorphology mapping: geology has a long history of remote sensing application and its useful in
1. Preparation of large-scale reconnaissance maps of unmapped, inaccessible areas
2. Updating the existing geological maps
3. Rapid preparation of lineament and tectonic maps.
4. Identifying features favourable for mineral localization etc.

IV. PROFILE DETAILS

4.1 CREDIBILITY OF GIS

Geographic Information System is defined as an organized collection of computer hardware, software, geographic data, and trained personnel designed to efficiently capture, store, update, manipulate, analyze and retrieve all forms of geographically referenced information.

Two very important aspect which characterize GIS are (Burrough, 1982)

1. Defining the absolute location of earth feature over a coordinate system like latitude/longitude and
2. Ability to relate the geographic information (like X, Y & Z coordinates) information that describe a feature.

General:

- Geo: Refers to the earth and
- Graphy: Indicates a process of writing so Geography means writing about earth.

Information:

- Refers well arranged data of particular object for decision making.

Systems:

- Refers to set of interrelated components may be physical or virtual (logical) performs to reach a particular task.
- Creation of Information System on various Natural, Physical, and human resources with reference to a geographic location.

The basic concept of water balance is:

Input to the system - outflow from the system = change in storage of the system (over a period of time)

The general methods of computations of water balance include:

(i) Identification of significant components,
(ii) Evaluating and quantifying individual components, and
(iii) Presentation in the form of water balance equation.

4.2 GROUND WATER BALANCE EQUATION:

Considering the various inflow and outflow components, the terms of the ground water balance equation can be written as:

$$Ri + Rc + Rr + Rt + Si + Ig = Et + Tp + Se + Og + \Delta S$$

where,
Ri = recharge from rainfall;
Rc = recharge from canal seepage;
Rr = recharge from field irrigation;
Rt = recharge from tanks;
Si = influent seepage from rivers;
Ig = inflow from other basins;
Et = evapotranspiration;
Tp = draft from ground water;
Se = effluent seepage to rivers;
Og = outflow to other basins; and
ΔS = change in ground water storage.

This equation considers only one aquifer system and thus does not account for the interflows between the aquifers in a multi-aquifer system. However, if sufficient data related to water table and piezometric head fluctuations and conductivity of intervening layers are available, the additional terms for these interflows can be included in the governing equation. All elements of the water balance equation are computed using independent methods wherever possible.

4.3 STUDY AREA

The study area is located at 10° 18' to 10° 25' N latitude and 77° 56'to 78° 01' E longitude, covering an area of 14.01 km2. There are about 80 tanneries spread within the four to 6 km radius in the south western part of the Dindigul town, TamilNadu, South India. About 50% of the tanneries have been in existence for 30 to 40 years .

Dindigul district was carved out of the composite Madurai District on 15.9.1985 and the first District Collector was Thiru.M.Madhavan Nambiar, I.A.S. Dindigul District had the names of Dindigul Anna , Quaid-e-Milleth and Mannar Thirumalai. Dindigul, which was under the rule of the famous Muslim Monarch, Tippusultan, has a glorious past. The historical Rock Fort of this district was constructed by the famous Naik King Muthukrishnappa Naicker. It is located between 10005" and 100 9" North Latitude and 77030" and 78020" East Longitude.

It is spread over on area of 6266.64 Sq. Km. It comprises of 3 Revenue Divisions, 8 Taluks and 14 Panchayat Unions, According to 2001 Census, its population is 19,23,014

Fig 4.1 Dindigul District Map

V. REMOTE SENSING SOFTWARE AND SYSTEMS USED

The primary data source is the town map of Dindigul town for the year 1981, 1991 and 2001 and ground water sample data collected from the field. The town map in the scale of 1:5000 was scanned and georeferenced using the latitude and longitudinal values and visually interpreted using the dataset in the map and projected as geographic wgs84 and datum wgs84.

For that line and polygon coverage were created and also errors were rectified using clean and build options. The cleaned coverage was further labeled by giving ids. Arc Remote sensing 9 software used for visual interpretation and layouts were prepared using Arc map 9 developed by ESRI. For the impact analysis of groundwater due to tanneries 21 samples were taken in and around the town using handheld gps and it was tested in the TWAD board laboratory and average mean values were taken for the final analysis.

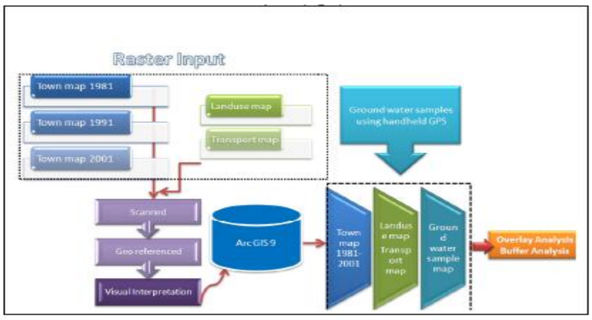

Fig:2 – Methodology adopted for the study

Fig 5.1 Methodology adopted for the study

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object. In modern usage, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation emitted from aircraft or satellites).

There are two main types of remote sensing's: passive remote sensing and active remote sensing.

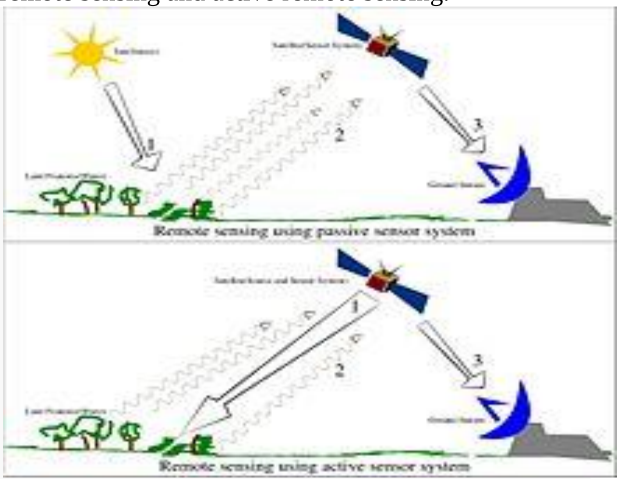

Fig 5.2 Remote sensing using Passive and Active Sensor system

Passive sensors detect natural radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target.

RADAR and LIDAR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

5.1 DATA PROCESSING:

Generally speaking, remote sensing works on the principle of the inverse problem. While the object or phenomenon of interest (the state) may not be directly measured, there exists some other variable that can be detected and measured (the observation), which may be related to the object of interest through the use of a data-derived computer model. The common analogy given to describe this is trying to determine the type of animal from its footprints. For example, while it is impossible to directly measure temperatures in the upper atmosphere, it is possible to measure the spectral emissions from a known chemical species (such as carbon dioxide) in that region.

SPATIAL RESOLUTION

The size of a pixel that is recorded in a raster image – typically pixels may correspond to square areas ranging in side length from 1 to 1,000 metres (3.3 to 3,300 ft).

SPECTRAL RESOLUTION

The wavelength width of the different frequency bands recorded – usually, this is related to the number of frequency bands recorded by the platform. Current Land sat collection is that of seven bands, including several in the infra-red spectrum, ranging from a spectral resolution of 0.07 to 2.1 μm. The Hyperion sensor on Earth Observing-1 resolves 220 bands from 0.4 to 2.5 μm, with a spectral resolution of 0.10 to 0.11 μm per band.

RADIOMETRIC RESOLUTION

The number of different intensities of radiation the sensor is able to distinguish. Typically, this ranges from 8 to 14 bits, corresponding to 256 levels of the gray scale and up to 16,384 intensities or "shades" of colour, in each band. It also depends on the instrument noise.

TEMPORAL RESOLUTION

The frequency of flyovers by the satellite or plane, and is only relevant in time-series studies or those requiring an averaged or mosaic image as in deforesting monitoring.

RADIOMETRIC CORRECTION

Gives a scale to the pixel values, e. g. the monochromatic scale of 0 to 255 will be converted to actual radiance values.

TOPOGRAPHIC CORRECTION (ALSO CALLED TERRAIN CORRECTION)

In the rugged mountains, as a result of terrain, each pixel which receives the effective illumination varies considerably different. In remote sensing image, the pixel on the shady slope receives weak illumination and has a low radiance value; in contrast, the pixel on the sunny slope receives strong illumination and has a high radiance value.

ATMOSPHERIC CORRECTION

Eliminates atmospheric haze by rescaling each frequency band so that its minimum value (usually realized in water bodies) corresponds to a pixel value of 0. The digitizing of data also make possible to manipulate the data by changing gray-scale values.

DATA REQUIREMENT:

The data required for carrying out the ground water balance study can be enumerated as follows:

1. Rainfall data:
   - Monthly rainfall data of sufficient number of stations lying within or around the study area should be available.
   - The location of rain gauges should be marked on a map.
2. Land use data and cropping patterns :
   - Land use data are required for estimating the evapo-transpiration losses from the water table through forested area.
   - Crop data are necessary for estimating the spatial and temporal distributions of the ground water withdrawals and canal releases, if required.
   - Evapo-transpiration data and monthly pan evaporation rates should also be available at few locations for estimation of consumptive use requirements of different crops.
3. River data:
   - River data are required for estimating the interflows between the aquifer and hydraulically connected rivers.
   - The data required for these computations are the river gauge data, monthly flows and the river cross-sections at a few locations.
4. Canal data:
   - Month wise releases into the canal and its distributaries along with running days each month will be required.
   - To account for the seepage losses, the seepage loss test data will be required in different canal reaches and distributaries.
5. Tank data :
   - Monthly tank gauges and releases should be available.
   - In addition to this, depth vs area and depth vs capacity curves should also be available.
   - These will be required for computing the evaporation and the seepage losses from tanks.

- Also field test data will be required for computing final infiltration capacity to be used to evaluate the recharge from depression storage.

6. Aquifer parameters:
   - The specific yield and transmissivity data should be available at sufficient number of points to account for the variation of these parameters within the area.
7. Water table data :
   - Monthly water table data or at least pre-monsoon and post-monsoon data of sufficient number of wells should be available.
   - The well locations should be marked on a map.
   - The wells should be adequate in number and well distributed within the area, so as to permit reasonably accurate interpolation for contour plotting.
8. Draft from wells:
   - A complete inventory of the wells operating in the area, their running hours each month and discharge are required for estimating ground water withdrawals.
   - If draft from wells is not known, this can be obtained by carrying out sample surveys.

Data processing levels

To facilitate the discussion of data processing in practice, several processing "levels" were first defined in 1986 by NASA as part of its Earth Observing System and steadily adopted since then, both internally at NASA and elsewhere; these definitions are:

Level	Description
1	Reconstructed, unprocessed instrument and payload data at full resolution, with any and all communications artifacts (e. g., synchronization frames, communications headers, and duplicate data) removed.
1a	Reconstructed, unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (e. g., platform ephemeris) computed and appended but not applied to the Level 0 data (or if applied, in a manner that level 0 is fully recoverable from level 1a data).
1b	Level 1a data that have been processed to sensor units (e. g., radar backscatter cross section, brightness temperature, etc.); not all instruments have Level 1b data; level 0 data is not recoverable from level 1b data.
2	Derived geophysical variables (e. g., ocean wave height, soil moisture, ice concentration) at the same resolution and location as Level 1 source data.
3	Variables mapped on uniform space-time grid scales, usually with some completeness and consistency (e. g., missing points interpolated, complete regions mosaic ked together from multiple orbits, etc.).
4	Model output or results from analyses of lower level data (i. e., variables that were not measured by the instruments but instead are derived from these measurements).

A Level 1 data record is the most fundamental (i. e., highest reversible level) data record that has significant scientific utility, and is the foundation upon which all subsequent data sets are produced. Level 2 is the first level that is directly usable for most scientific applications; its value is much greater than the lower levels. Level 2 data sets tend to be less voluminous than Level 1 data because they have been reduced temporally, spatially, or spectrally.

The modern discipline of remote sensing arose with the development of flight. The balloonist G. Tournachon (alias Nadar) made photographs of Paris from his balloon in 1858. Messenger pigeons, kites, rockets and unmanned balloons were also used for early images. With the exception of balloons, these first, individual images were not particularly useful for map making or for scientific purposes.

Fig 7.3 Systematic Aerial Photography

VI. REMOTE SENSING INTERNSHIPS

One effective way to teach students the many applications of remote sensing is through an internship opportunity. NASA DEVELOP is one such opportunity, where students work in teams with science advisor(s) and/or partner(s) to meet some practical need in the community. Working through NASA, this program give students experience in real-world remote sensing applications, as well as providing valuable training. (More information can be found on the NASA DEVELOP website.

Another such program is SERVIR. Supporting by the US Agency of International Development

Year	1901	19 1	192	193	194	1951	196	1971	1981	1991	2001
Populati on	2523	25 52	309 2	436 7	5627 5	7836	929 7	1284 9	1641 3	1824 7	1966 9
Variatio (%)	-	- 0.5	23.4	41.0	29.0	39.2	18.6	38.17	27.78	11.2	8.99

(USAID) and NASA, SERVIR provides students with valuable hands-on experience with remote sensing, while providing end-users with the resources to better respond to a whole host of issues. More information can be found on the SERVIR

6.1 LANDUSE PATTERN OF DINDIGUL TOWN:
Landuse depends upon the nature of the land, purpose of the usage and technological know-how and management.

Major economic activities are concentrated in the pockets enclosed by Taluk office road, Palani road, East and west car Street, Main road, South car street and Thadicombu road. Institutional activities are concentrated in and around the government hospital,

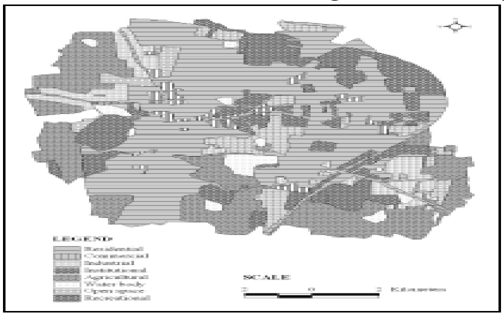

Fig 6.1 Location of the Town Landuse

Table 6.1 Pattern of Dindigul Town

Sl. No	Landuse	Area in ha	%to the total developed area	% to the town area
1.	Residential	486.72	63.60	34.74
2.	Commercial	24.65	3.22	1.76
3.	Industrial	50.07	6.54	3.57
4.	Educational	30.05	4.71	2.57
5.	Public & Semi Public	55.32	7.23	3.95
6.	Roadways &Railways	112.44	14.70	8.03
7.	Non – urban area	242.44	-	17.27
8.	Vacant	322.60	-	23.04
9.	Land under water	43.10	-	3.07
10.	Hillock	28.00	-	2.00
	Total	**1401.00**	**100.00**	**100.00**

Source: Town Planning Office, Dindigul

6.2 POPULATION GROWTH OF THE TOWN:
The population has grown from 25,132 in 1901 to 1, 96,619 in 2001. Population in each
Table 6.2 Population growth 1901 -2001
Total area of the town is about 1401 hectares (Table.1).

decade with decadal growth rate is show in the Table 2. The town has its highest decadal growth rate of 41.05 % between 1921 to 1931 and the lowest growth rate of 11.20 % between 1981 to 1991.There is a gradual decrease in growth rate after 1971 this may be due to exodus of population to other major cities mainly for economic opportunities. The central part of the town has the highest growth rate.

VII. GROUND WATER IMPACT ANALYSIS

Effluents from the tanneries are discharged into streams which drain into ponds, thereby polluting the ground watersources and cultivable land. These values are more than the permissible limits in and around the tannery cluster compared to other parts of the area.

The water-table is deep due to overexploitation for irrigation and tanning through dug wells, dug-cum- bore wells and bore wells. Various chemicals used in tanning include lime, sodium carbonate, sodium bi-carbonate, common salt, sodium sulphate, chrome sulphate, fat liquors, vegetable oils and dyes.

Table7.1 represents the ground water quality status and Fig:7.1 represents the location of the samples and Fig:7.2 represents the conductivity, salinity and pH level of the samples in the study area. According to Total dissolved solids, all the seven places are exceeding the limits.

Maximum amount of Total hardness are located in Neruji nagar, Nagal nagar, Annamalayar school, Paraipatti and R.M.colony. Among this Annamalayar school is having the maximum amount. The areas exceeding the Chloride limits are Neruji nagar, Begampur, Paraipatti, and R.M.colony. The maximum amount is located at Annamalayar school and the minimum amount is located in Bus stand. The areas exceeding the Magnesium limits are Y.M.R.Patti, Nagal nagar, Begampur and Paraipatti. The minimum amount is located in Neruji nagar. The areas exceeding the sulphate limits are Paraipatti, Neruji nagar, Nagal nagar and R.M.colony. The minimum amount is located in Begampur, and Bus stand Y.M.R.Patti.

The areas exceeding the % Sodium limits are Begampur and minimum amount is located at Y.M.R.Patti. The areas exceeding the Calcium limits are Begampur The minimum amount is located in R.M.colony. Figure 3-6 represents the conductivity, salinity and pH and it ranges from 1440 – 2920 micro/semen ; 1.44 – 2.92 deci/cm (Min-Bus stand and Max Begambur). And pH ranges from 17.5 – 8.2 maximum found in Bus stand and minimum in Neruji nagar.

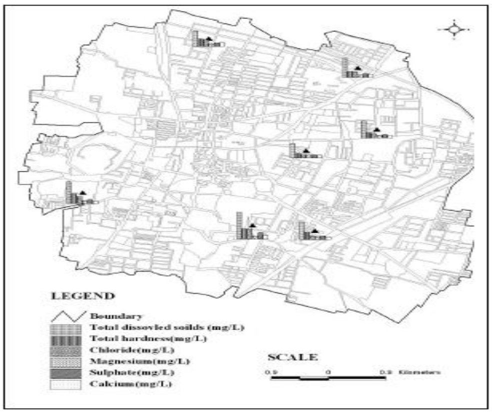

Fig: 4

Fig 7.1 Location of the Samples

Table 7.1 Water Sample Values Of different chemical parameters in Dindigul Town

Sl.No	Parameters	Sample Locations						
		Neruji nagar	Y.M.R. Patti	Bus stand	Nagal nagar	Begambur	Paraipatti	R.M. Colony
1.	Conductivity (micro/semen)	2010	1870	1440	1840	2920	2440	1625
2.	Total dissolved solids (mg/L)	1286.4	11222	909.20	1140.8	1839.6	1488.4	1135
3.	Total hardness (mg/L)	307	244	180	384	580	512	402
4.	Salinity (deci/cm)	2.01	1.87	1.44	1.84	2.92	2.44	2.01
5.	pH	7.5	7.9	8.2	7.6	7.8	7.8	7.7
6.	Chloride (mg/L)	270	141	108	126	560	387	320
7.	Magnesium (mg/L)	24.3	45.2	31.6	47.7	60.9	32.5	28.0
8.	Sulphate (mg/L)	125	94	56	122	31.2	144	105
9.	Sodium (%)	10.7	30.8	29.8	29.5	24.8	60.5	32.6
10.	Calcium (mg/L)	63.5	36.7	42.8	24.4	126.5	22.4	11.8

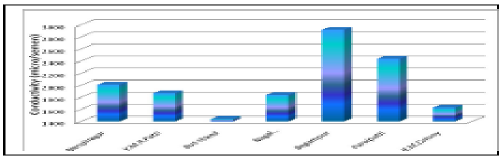

Fig: 5

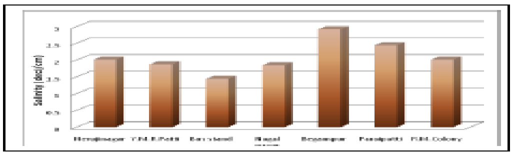

Fig: 6

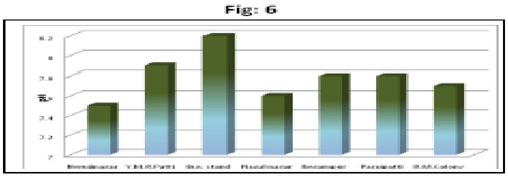

Fig: 7

Fig 7.2 Conductivity, Salinity and pH of the samples

VIII. CONCLUSION

Dindigul town has not been having physical expansion since 1981. Only wards are increased by enjoying the rapid growth of population. Total area of the town is 14.01 km^2. Town is having moderate literacy rate. Male working population is high. Slums are increasing tremendously because of the low income group. Dindigul town does not have a proper storm water drainage system.

There are about 80 tanneries spread within 4-6 kms radius in the south western part of the town. According to the ground water sample analysis near Paraipatti, Begambur and Annamalayar school ground water pollution is very high compared to other places. R.M.Colony is having the highest household wastages because of its vertical expansion so in those areas also pollution is high.

Y.M.R.Patti also having high pollution because it is a low class residential area and also slums are more. Improper maintainance and household wastage also larger in nature.In future work various thematic maps has derived out and conclude the real application of the tanneries and where it should construct with help of remote sensing technology.

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