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LAND USE AND LAND COVER IN AND AROUND DEVARABELEKERE RESERVOIR USING REMOTE SENSING AND GIS

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Abstract: The present study deals with the land use / land cover mapping and change detection studies in and around the Deverabelekere Reservoir. The Studies Involves identifying the current land use pattern and changes occurred over a period due to the urbanization by adopting satellite remote sensing technologies and GIS tools. IRS-1D, LISS-III geocoded data of 2000 and IRS-P6, LISS-IV geocoded data of 2008 Satellite data and Toposheets from Survey of India (SOI) are acquired as primary and secondary data for analysis. Interpretation techniques are used to identify the land use/ land cover information by applying both pre- interpretation, ground truth and post visual interpretation of the satellite image layers like land use/ land cover such as agriculture, waste land, water bodies, forest etc. are prepared. The interpreted maps topology is created by linking the spatial data file and attribute data file. The overlay analysis was carried out to find out the changes in the land use pattern over eight years period. The images of the study area were categorized into five different classes namely vegetation, agriculture, barren, built-up and water body. The results indicate that during the last two decades built-up and land have been increased by 2.15% (10.72 km^2) and water bodies 0.95% (4.795 km^2). While agriculture, barren land and Forest have decreased by 5.62% (28.2 km^2), 0.70% (17.228 km^2) and forest area have unchanged respectively. The paper highlights the importance of digital change detection techniques for nature and location of change in and around the" Deverabelekere Reservoir.
Keywords: Land use; Land cover; Reservoir; Toposheet.

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INTRODUCTION

Only few landscapes on the earth are still in their natural state. Due to anthropogenic activities, the earth surface is being significantly wear and tear has altered in some manner and man's presence on the earth and his use of land has had a profound effect upon the natural environmental thus resulting into an observable pattern in the land use/land cover over time. Land use and land cover refers to the physical characteristics of earth surface, captured in the distribution of vegetation, water bodies, rock/soil, artificial cover and other physical features of the land, including those created solely by human activities (Louias and Antonio, 2001). Information on the land use and land cover in the form of maps and data is very important for planning, management, and utilization of land for agriculture, forestry, urban, industrial, environmental, studies and economic development (Roy and Giriraj, 2008).The timely accurate and up-to-date information on land use and land cover can be obtained from various Remote Sensing on a cost effective basis at the shorter possible time. Remote Sensing and Geographic information system (GIS) technique is one of the powerful tools in providing reliable information on various natural resources of a region from at land use and land cover (Roy *et. al.,* 1991). Remote Sensing and (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modeling. By understanding the driving force of land use development in the past, managing the current

situation with modern GIS tools, and modeling the future, one is able to develop plans for multiple uses of natural resource and nature conservation. The change in any form of land use is largely related either with the external forces the pressure built up within the system (Bisht and Kothari, 2001). Land use data are needed in the analysis of environmental problems that must be understood if living condition and standards are to be improved or retained at current level (Anderson *et. al.,* 1976). Since the origin of human civilization, human beings have been living in close relationship with nature. Large scale land transformation is presently witnessed in and around major cites of India. Grate pressure an of growing population increased demand for food, industrial revolution, urbanization and fodder have increased stress on the environmental which led to changes in land use land cover pattern particularly in developing countries. Planning for development of natural resource without endangering the environmental is a crucial facing the world today (Kachhwahan 1975, Sharma *et.al.,*1989).

Study Area

The Devarabelekere Reservoir is located between 75º43'48" to 75º56'24" E longitude and 14º26'24" to 14º14'24" N latitude and covering area 503.63 sq. km situated at 12 km, south west of Davangere city. The reservoir is built across the river Haridra, a tributary of Tungabhadra, catchment of river Krishna. The river originates at a height 700 m in Chitradurga District flowing in North Northwest direction before confluncing with river Tungabhadra in Harihar. The prime objective of the study is land use and land cover changes in the given area in and around Davangere city situated in and around 25.8kms for about 36 years. An attempt has been made to generate remote sensing based land use and land cover analysis (2006) to compare with the toposheets of 1970 SOI.

Table 1. Location of study area

Location	Longitude,75º43'48" Latitude14º26'24"
Mean sea level	602.5mts
Toposheets	48N/15,1:50,000 Scale
Distance from city	12 kms South west direction from Davangere City
Village	Devarabelekere
Taluka/ District	Davangere
Scheme merged	1970

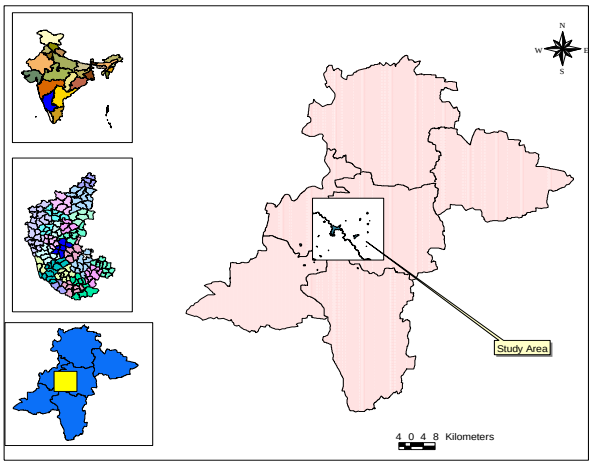


Figure 1. Location map of study area

EXPERIMENTAL

In the present study, satellite data of IRS 1C LISS III and LANDSAT ETM+ image of the year 2002 (March) and 2000 respectively were used for generation of thematic maps such as land use/land cover, hydrogeomorphology, soil, lithology and updating of drainage maps were done by using toposheet information. Later integration of different thematic maps in GIS mode using Arc View software to generate a composite agriculture and water resource unit which is the core of development strategy for sustainable development they have been described below.

Database used

The material used for preparing different resource maps and data base the data used are:

Primary Data: The Survey of India (SOI) topographical Maps (1970) 48 N/15, of 1:50000 scale, which covers the Davangere city to prepare the base maps and thematic map and IRS 1C LISS-III (Mar-2010) and LANDSAT ETM+ (2009) satellite imagery is used to generate and to upload various thematic maps.

Software

ERDAS: The ERDAS IMAGINE system incorporates the functions of both images processing and GIS. These functions include importing, viewing, altering, and analyzing raster and vector, into one system. The vector data structure in ERDAS IMAGINE is based on the Arc Info data model. For the present study the software used to rectify the toposheet and Satellite data.

GIS: Arc View, Arc Map, Auto Cad 2000. These three software's Arc GIS software's which are used here for digitization. Arc map composition software is used for some of the calculations. Auto Cad is for smoothing the digitization.

Methodology: Methodologies followed for the preparation of different maps, during the course of the present study are described below

Preparation of Base Map: A tracking sheet is over laid on the toposheet, covering the study area boundary of Devarabelekere Reservoir are extracted from the topographical map and base map is generated. Thus, a map having a above common land feature was used as a base map for preparing different thematic maps. Thematic maps are special purpose maps that symbolically depict some theme over laid upon a geographic region. During thematic mapping visual interpretation techniques were adapted to delineate land use/land cover, and lithology using remote sensing data and SOI toposheet on 1:50,000 scale.

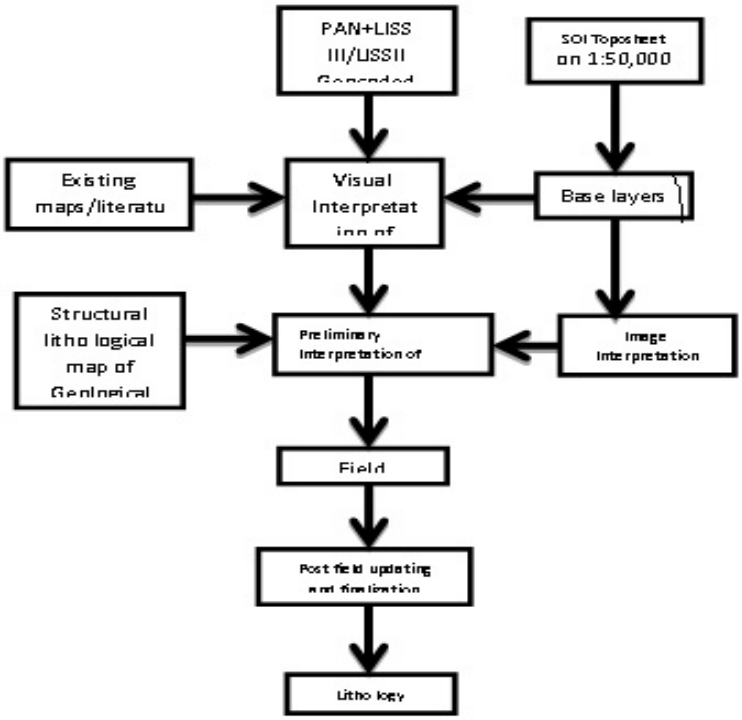


Figure 1. Methodology of preparation of Lithology Map

Lithological Map

Preparation of lithology map for the study is initially used the published Quadrangle map. The Karnataka State Gazetteer (1991) was used in the preparation of geology map as they provide and local information of all the districts in Karnataka. Geological Survey of India, Lithological map prepared on scale of 1:250,000. Lithological map of the study area thus clipped from quadrangle map was bowed up to 1:50,000 scale and has updated using satellite imagery with respect to the tonal variation which exhibits by different rock types. Along with structural elements like dykes were delineated keeping the SOI toposheets as base data. The dykes are identified by the variation in the total combination and were color coded for the differentiation of the geology and structural elements.

Table 2. Lithology Units of the Study area

#	Litho Units	Area (sq kms)	Area (%)
1.	Migmatites & Granodiorite	9.23	2.20
2.	Greywacke/ Argillite	351.32	82.82
3.	Meta Ultramafite	32.60	7.77
4.	Quartzite	0.83	1.22
5.	Volacanics	15.84	3.78
6.	Amphibolitics	9.29	2.21
	Total	**419.11**	**100**

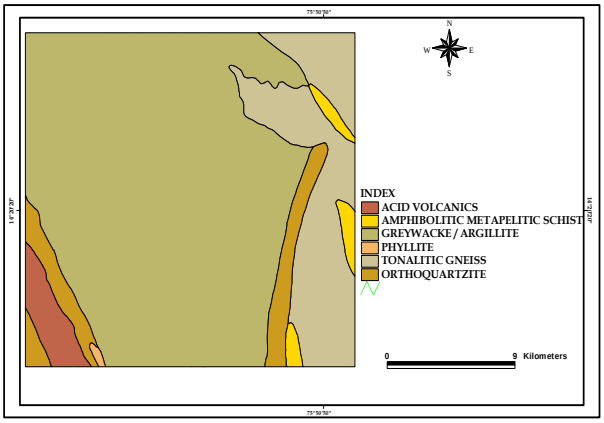


Figure 2. Lithology of study area

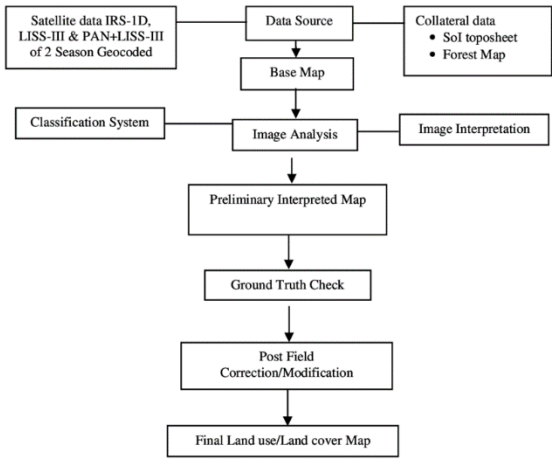


Figure 3. Methodology of Preparation of land use/land cover map

Remote Sensing and GIS Studies

Thematic maps such as land use/land cover, hydrogeomorphology, slope, soil, lithology, lineament, water bodies and drainage, transportation network and settlement location were prepared during course of the study. This was deduced using SOI toposheets and satellite data.

Transport Network Map

The transportation and settlement location map was derived from SOI toposheets No.48N/15, and updated using the satellite data and limited field check. The study area has a very good inter-network of roads connecting to all villages. In the study area 4 types of roads are identified are metalled, unmetalled, cart track and foothpath and a railway track.

Drainage and Surface Water Bodies Map

In the study area the drainage exhibits dendritic to sub parallel type of pattern. There is a good distribution and collection of runoff during the precipitation. The study area constituted of Haridra watershed region. The watershed comprises of 1st order drainages upto VII order drainages. Thematic maps such as land use/land cover, hydrogeomorphology, slope, soil, lithology, lineament, water bodies and drainage, transportation network and settlement location were prepared during the course of the study. This was deduced using SOI toposheets and satellite data. Satellite imagery of the study area is shown in Figure 5. The results obtained are interpreted below.

Settlement Location and Transport Network

The transportation and settlement location map was derived from SOI toposheet No. 48N/14, 48N/15, and updated using the satellite data and limited field check. The Haridra watershed area covers 26 villages includes revenue and hamlet villages and a city. According to the study, Davanagere is city and Kunibelakere, Budihal, Nandi Tavare, Ekkegondi, Belludi,, Bhuvanahalli, Lokikere Kundur etc., are the major settlements of the study area and these cover a major portion of the area, and these are quite developed compared to other villages (Figure 3). The study area has a very good inter-network of roads connecting to all villages. In the study area 4 types of roads are identified are metalled, unmetalled, cart track and footpath and a railway track (Figure 5).

Table 3. Settlement Location and Transport Network Map of the Study Area

Sub Type	Length of Transport Network	% of Transport Network
Cart Track	111.23	21.28
footpath	0.16	0.32
Metalled	108.34	20.66
Un-mettaled	288.97	55.29
State Highway	13.85	2.45
Total	522.55	100

Table 4. Stream units of the study area

Length	Area	Area (%)
Streams	561.74	98.02
Tanks	11.40	1.98
Total	573.14	100

Land Use/Land Cover Pattern

The existing land utilization, details of the study area is mapped by visual interpretation of IRS PAN+LISS III data. Various land use/land cover categories were identified and mapped. The

categories include agricultural land (kharif, plantation and fallow), forests (scrub forest), wastelands (stony wastes and scrub land) and water bodies (tanks). The description of various land use / land cover categories is described below.

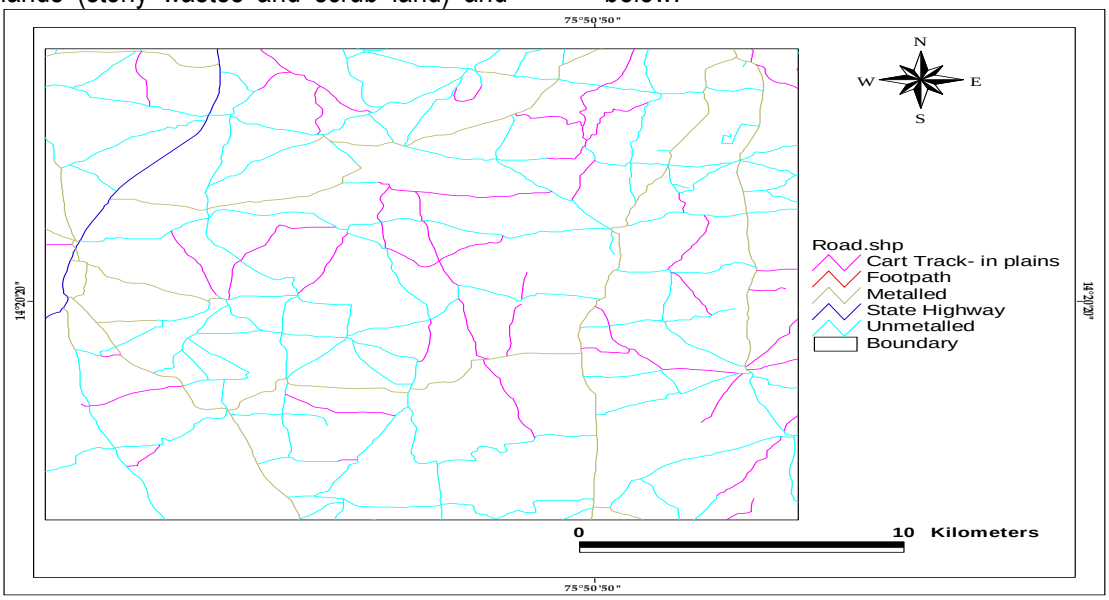


Figure 4. Settlement Location and Transport Network Map of the Study Area

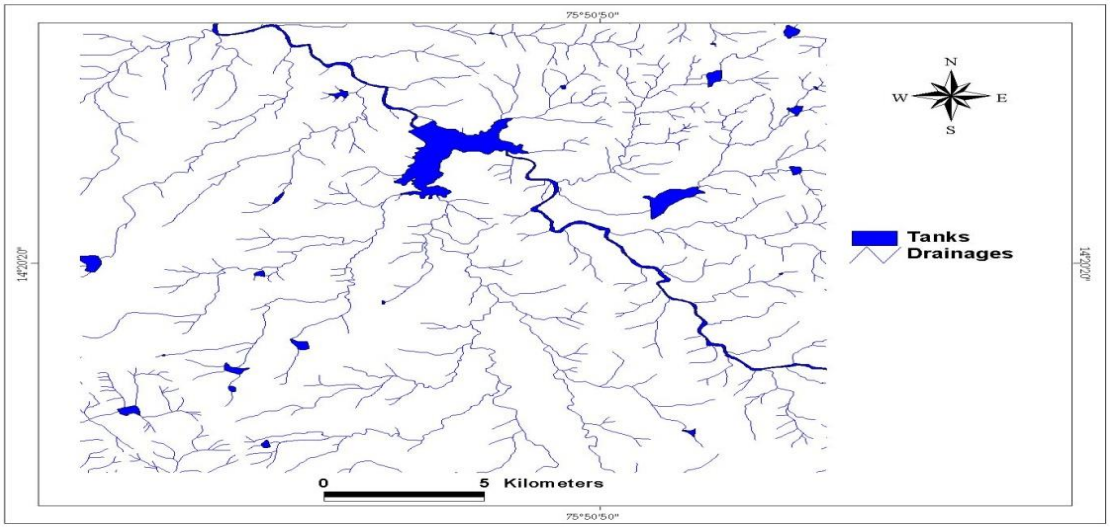


Figure 5. Water bodies of the study area

Built-up land: It is an area of human settlements developed due to lawn-agricultural use and has a cover of settlement. These settlements appear as steel grey tone with mottled texture on the imagery. In the study area we identified two types of built up lands are villages and town / cities.

Agricultural lands: Most of the lands in this area are mainly used to take the kharif crop, some percent of the land are mainly used as double crop and little part of the land is used as plantations growing Areca-nut, coconut, mango and agro-agriculture etc.,

Kharif Crops: Kharif crops area associated with rainfed crops under dry land forming with irrigational facilities the major crops grown area, maize, jowar, groundnut, ragi and cotton. This depends on the regularity of monsoon and to some extent the irrigation facility.

Double Crop: The double crop area associated with irrigational facilities from canal water. In this canal command area, the major crops grown are paddy and sugarcane. These propped areas depend on the irrigational facilities from canal.

Table 5. Land use and land cover distribution of in and around Deverabelekere area

Devarabelekere in 1970			Devarabelekere in 2006			
Level I	Area (sq. km)	%	Level II	Area (sq. km)	Total Area (sq. km)	%
Agriculture land	464.8	92.75	Double crop	363.36	436.6	87.13
			Kharif	44.65		
			Rabi	7.01		
			Agriculture plantation	21.56		
			Fallow land	0.02		
Waste land	20.83	4.15	Stony land	0.01	3.55	0.70
			Land with Scrub & Land without Scrub	3.54		
			Marshy	-		
Build up land	5.46	1.08	Town, city & village	15.66	16.18	3.23
			Industries	0.52		
Water bodies	6.16	1.23	River / Stream	0.85	10.95	2.18
			Canals	1.56		
			Lake / Tanks	8.54		
Forest	3.83	0.76	Scrub Forest	0.0007	3.83	0.76
			Degraded Forest	3.83		
Others	0	0	Grassland	1.18	1.18	0.23
Total	**501.08**	**100%**	**Total**		**501.08**	**100%**

Agricultural plantations

The study area betel nut leaf, coconut, areca nut and mango are the major plantation.

Fallow Land: The land which not cultivated for some years these lands are called as fallow.

Forest Land: Forest is an area which cover of plant species. The study area covers scrub forest, we identified the scrub forest, forest plantation and degraded forest.

Scrub Forest: Scrub forest is having a small type of bush trees and other species of trees.

The uncultivated and barren lands are the usual waste lands. In the study area found in two types namely, scrub land, salt effected land and stony waste.

Land with Or without Scrub: These lands belong to the typical wasteland categories and can be easily identified on the satellite imagery. There are generally prone to degradation. The land is irregular in shape with open ground covered by thorn scrubs.

Stony Waste: These areas with limited ability to support life, as they are rock exposures of barren land. These areas are covered with schist and granite occasionally with boulders with rock outcrops of land.

Salt Affected Land: The land which is formed by the action of water and chemicals. Salt affected land from over chemical fertilization used on the agriculture land.

Water Bodies: Water bodies are natural covers of land with water. During the rainy season water flows through drainages and reaches tanks. There are two types of water bodies identified, those are tanks and streams.

RESULTS AND DISCUSSION

Land use data are needed in the analysis of environmental problems that must be understood if living condition and standards are to be improved or retained at current level (Anderson *et al.,* 1976). Land use always in a state if continued change due to transformation resulting from either natural processes or human activities. Large scale land transformation is presently witnessed in and around major cities of India. Great pressure of growing population increased demand for food, fodder and fuel combined with industrial activities have essentially led to rapid change in land use and land cover pattern particularly in developing countries. Planning for development of natural resources without endangering the environment is a crucial issue facing the world today (Kachhwaha, 1985, Sharma *et. al.,* 1989). The land use change of an area is directly related with the level of techno-economic advancement (Whyte, 1961). Land use is a dynamic phenomenon and both its value and pattern changed spatially and temporally with varying efficiencies, priorities needs (Bisht and Tiwari, 1996). The information on land use and

land cover patterns, either spatial distribution and changes over a time scale are the prerequisite for making development plans (Dhinwa *et al.*, 1992).

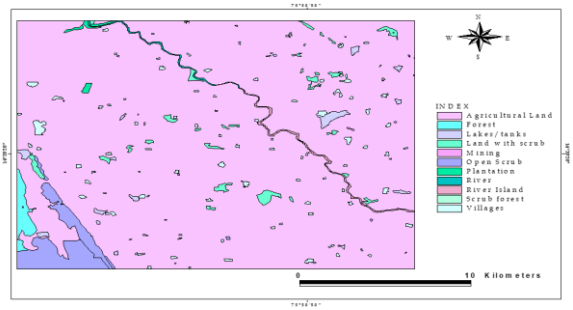


Figure 6. Land use / Land cover of Devarabelekere Reservoir 1970

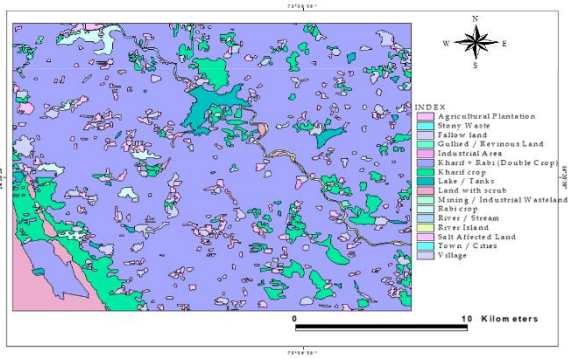
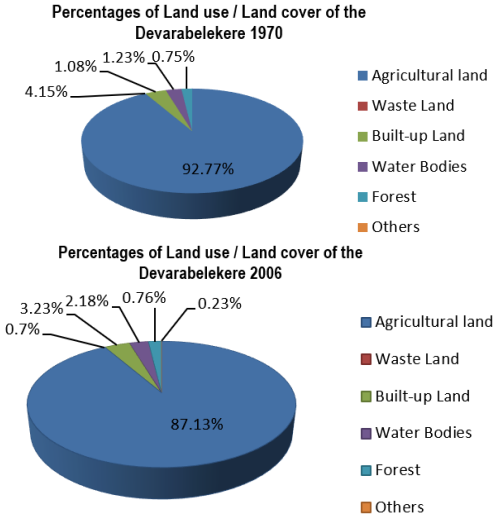


Figure 7. Land use and Land Cover of Deverabelekere Reservoir 2006



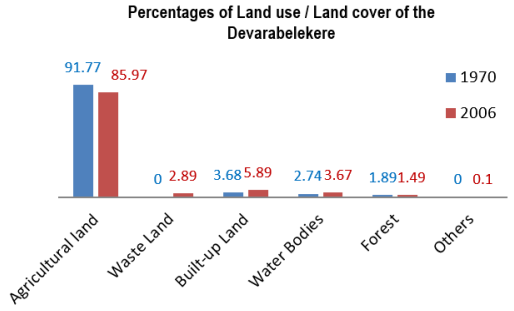


FIgure 8. Land use pattern of the study area

CONCLUSION

In the present study the GIS Technique has technically demonstrated the land use and land cover of In and around Deverabelekere reservoir of Harihara Taluk, Davangere District were the built up area has increased as per population has increased and the decrease of barren land forest land and agriculture land automatically has got decreased, this shows population has been reflected on Agriculture and barren land but the water bodies in the area has been increased shows that people are awareness of the water capacity in the area.

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