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REMOTE SENSING AND ENVIRONMENTAL ASSESSMENT WITH GIS INFORMATION IN CUDDALORE DISTRICT

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ABSTRACT

This article portrays the topography and the general features of environment in the Cuddalore District of Tamilnadu. Further, a detailed analysis is made on climate, soil type ground water potential and land use pattern. This information may help the researcher and policy makers to corroborate and/or juxtapose their research. The spatial in formations are sophisticated instruments to analyze our environment particularly here these information cautioning that the environmental condition worsening day by day in the district. It clearing shows worsening condition occurred due to influence and also man's climatic change. To Save the resources the efforts of promoting sustainable environmental development activities are badly needed. The fast growth in population, urbanization, change in land use pattern in developing countries have resulted in damage of historical, biological, archeological, aesthetic, visual impacts and pollution in land, water, air and noise. There are needs of a tool which can be capable of complex analysis and produce an alternative plan. Therefore Remote Sensing and Geographical Information System (GIS) are the latest technologies or support system or tool which will produce much more accurate results and perform various geographic analyses even in complex situations. Further, Environmental Impact Assessment (EIA) is a less accurate and time consuming because it has more dependant and independent variables which have to be taken in to account such as Land use, land price, population density, socio-economic level, road accessibility, railway accessibility, air quality, ground water quality, noise level, biological content, historical value, archeological and visual importance etc. Remote Sensing and GIS technique is more comfortable, easy and accurate and complete the EIA of any proposed developmental activity in less time. EIA require reports of potential impacts of any proposed activities. By utilizing GIS modeling tools, potential impacts can be predicted and included in the management and monitoring programs. GIS and remote sensing could be used in environmental monitoring for Land use / Land cover analysis, wetland assessment and ground water modeling, habitat mapping, disaster management etc. Thus, Remote Sensing and GIS techniques play a significant role in Environment Impact Assessment process for the proper management of environment.

Keywords: *GIS and Remote Sensing, Environmental Impact Assessment, Climate Change.*

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I. Introduction

The modern technology of remote sensing deals with the use of electromagnetic radiation as the medium of interactions. It refers to the identification of earth features by detecting the characteristic electromagnetic radiation that is reflected or emitted by the earth surface (Navalgand and Tamilselvam, 1998). It has many advancing and satellite images are relatively inexperience and readily available. Geographic coordinates are given on the images and repetitive multispectral cover can be made available, thus enabling changes to be monitored over a period (Venkataraman, 1992). The weaknesses of the remote sensing technology can be remedied by combining the same with ancillary information, especially in a geographical information system (GIS).

The greatest threat to sustainable development is the depletion of world's renewable resources; water, soils, forests and fisheries are all being pushed beyond their limits by the growth of human population and rapid industrial development. Insufficient freshwater is the most vexing problem in the developing world, over the next decade. Water tables are being drawn down at an alarming rate, especially in the most heavily populated areas (Radhakrishnan, 1998).Hence timely and reliable information on the extent, state and distribution of natural resources in spatial and temporal domain, is essential for decision making at various levels. Remote sensing data and GIS information has ability to provide synoptic, reliable and accurate information at frequency intervals even in inaccessible areas.

In order to save our natural resources and monitoring the environmental and ecosystems found solutions through space technology. In view of this, the Department of Remote Sensing of Anna University has adopted the following methodology to assess water and other resources in Cuddalore District. The researcher has used the same data to examine the available natural resources and assess the environmental implications in Cuddalore district in Tamilnadu.

Objective of the Study

To analyse the environmental impact of the study region with the help of Remote Sensing and GIS Information.

II. Methodology

a. Collection of hydrological / hydro geological and allied data from various states, central and other agencies.

b. Study of rainfall pattern and its intensity, to evaluate the runoff characteristics.

c. Collection of long term water level data, and analysis of pre and post monsoon water level fluctuations.

d. Correction of rainfall with water level fluctuations.

e. Analysis of the satellite data IRS-IC imagery visual interpretation for the preparation of following thematic maps.

I. Geological map

II. Geomorphological map

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III. Soil map (hydrological soil map)

IV. Lineament map

V. Land use map

f) Slope map is prepared from the Survey of India Toposheets

g) Following derived maps have been prepared

1. Depth to weathered zone

II. Runoff polygons

III. Water level fluctuation contour

IV. Drainage density (using SOI topo maps)

Above thematic and derived maps were digitized using ARC/INFO GIS software and a digital database has been created. The cost of the map is very high. Individual research could not afford it. Hence, the maps were not use in this study.

Analysis of Data

The thematic maps derived from the satellite data IRS IC, LISS III, FCC and the derived maps were digitized using ARC/INFO GIS software and were reclassified into four groups and assigned ranks one to four. Rank one is considered as most favourable zone for recharge and Rank four is considered as least favourable for recharge. These ranks are assigned for each these and all thematic maps are reclassified into four ranks each.

Weightages to various parameters are assigned based on important matrix and they are site specific. Various parameters considered, depending upon the formations available in the area.The above thematic maps were integrated by giving weightages for different themes and using GIS packages, and each 'Block' was classified into different zones of recharge.

Selection Criteria for Recharge

Since Cuddalore district is predominantly covered by sedimentary formations, weightage was given for factors viz. geomorphic units, and separate weightages were adopted for slope run off potential, soil characteristics, drainage density and depth to bed rock and thickness of weather and jointed zones of hard region.

Creation of Digital Database

Thematic maps and relevant derived maps were digitized using ARC/INFO GIS software and they are stored in a digital database. It can be retrieve whenever necessary from the database. This could be used as base-line information for future planning.

Data Products

The various data products used in the study are as follows.

1) IRS-IC, L1SS III, FCC of 50,000 scale

2) SOI Toposheets 571/14 and 15.58M/ 2, 3, 5, 6, 7, 8, 10, 11, 12, 13. 14 and 15.

III. Results and Discussion

Cuddalore district, which was formed during 1993 by bifurcating the erstwhile South Arcot district, is one among the twenty nine districts in Tamil Nadu with a population of 2605,914 - 2011 census). The total geographical area of the district is 3678 sq. k. Being an agrarian district, ground water is extensively used for agriculture purpose, through tube wells and dug wells. The net area sown in the district is 3,13,223 hectares. Out of this 55.53percent is under irrigation, by various sources. Out of the total irrigated area of 1,85,925 hectares, 56.07percent is irrigated utilizing groundwater. Apart from this, considerable quantity of ground water is pumped by Neyveli Lignite Corporation (NLC) to facilitate mining of lignite. Since Bay of Bengal forms the eastern boundary of the district, there is a possibility of saline intrusion in the event of over exploitation of ground water resources, especially along the coastal belt. Domestic water requirements are also met from ground water source, mostly through tube wells. Due to intensive cultivation, growth of population and rapid industrialization, ground water development is accelerated to meet the requirements of various sectors. Consequent on this, about 50 percent of the utilizable ground water resources is in utilization. The blocks level group water assessment in this district indicates that the level of extraction in block varies from 11 to 104percent of utilizable ground water potential.

Cuddalore district administratively divided into 10 Taluks viz. Cuddalore, Panruit, Viarudhachalam, Chidambaram, Tittaguid, Kattumannakoil. Bhuvanagiri kurinjipadi, Srimushnam, Sethiathoppu. These taluks are further divided into 13 blocks. Based on the level of ground water development, the blocks have been categorized as Dark, Grey and White. Out of 13 available blocks in Cuddalore district, two blocks fall under Dark category, 1 block fall under Grey category and rest of block fall water White category. The details of blocks and their categorization are given below.

Table - 1

Details of Groundwater Development in the District

Dark blocks (groundwater development more than 85percent of utilizable recharge)	**Grey blocks (groundwater development between 65percent and 85percent of utilizable recharge)**	**White blocks (groundwater development is less than 65percent utilizable recharge)**
Annagramam	Panruti	Bhuanagiri
Keerapalayam		Cuddalore

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		Kammapuram
		Kattumannarkoil
		Komaratchi
		Kurinjipadi
		Mangalur
		Nallur
		Parangipettai
		Vridhachalam

Source: Institute of Remote Sensing, Anna University.

In view of development activities in different sectors in this district, which involves ground water extraction to meet the requirements, there is a need to augment the aquifer system by means of artificial recharge. Cuddalore district is predominantly occupied by sedimentary formations of alluvium, tertiary and cretaceous formations. The land forms occurring in the area are also varied from pediplain to sedimentary plain/coastal plain in the eastern part. Hence a systematic approach to identify suitable area for recharge and to suggest appropriate recharge stucutures is necessary.

Physicography and Drainage

Cuddalore district, being a coastal zone, is mostly covered by plain terrain, without any high relief zone except some sedimentary high ground in Virudhachalam, Cuddalore and Panruti blocks. Entire district area is gently sloping towards eastern coastal region.

The district is drained by Gadilam and Poniyar rivers in the North, Vellar and Coleroon rivers in the South. All these rivers are ephemeral and floods during monsoon. The eastern coastal part new Portoonovo is characterized by lagoons and back waters.

Rainfall and Runoff

Within the district area the distribution of rainfall is fairly uniform with the maximum annual normal of 1398.2 mm (recorded at Portonovo) and minimum of 1039.5mm (recorded in Memathur). The long term average annual rainfall of the district is 1162.35 mm. Normally, coastal blocks receive high rainfall during North East monsoon period and it gradually declines towards west. The rainfall in the eastern part of the district is influenced by the adjoining Bay of Bengal, where cyclonic storms are originating during the months of October to December.Runoff being one of the vital components to arrive at the favoruable ground water recharge zones, was

computed with the available rainfall data collected from nine rainguage stations located at Kurinjipadi, Cuddalore, Kuppanattam, Kollidam, Sirkazhi, Lakkur. Manathur, Panruti and Virudhachalam. The runoff polygons were drawn using Theissen-polygon method and utilized for GIS analysis.

Geology

Archaeans

Cuddalore district is underline by the geological formations of varying age ranging from oldest Archaean to recent sediments. The archaeans, the oldest formation form the basement, over which the later sedimentary formations were deposited. The crystalline complex mostly of gneiss's covering almost the entire Tittagudi taluk and western part of Virudhachalam Taluk.

Cretaceous formations

Overyling the crystalline exposures, are the cretaceous formations, which occupy the area on the northern part of Virudhachalam, in a narrow belt of 3 to 5 km width trending roughly NNE-SSW. They are shallow marine origin. The rock type encountered are fossilferous, consisting of Argillaceous and calcareous sandstone and limestone. They also contain calcareous shale and clay. Within the calcareous, younger tertiary formation of Cuddalore sandstone are noted in the western part as outliers.

Tertiary formations

Overlaying the cretaceous formations are the Gopurapuram formations of Eocene age (lower tertiary) and they are marine origin. This formation consists mostly clay with limestone bands/lenses. These formations are seen as a narrow belt in between cretaceous and tertiary sandstone.The Cuddalore sandstone of fluvial origin, are exposed in major part of the district and are accruing in two discontinuous patches, dissected by Vellar river alluvium. The sandstones are - variegated in colour and are also ferrugenious. Lignite has been found to occur in association with Cuddalore sandstone in and around Neyveli, where mining operations are going on. Potential aquifers are noted below lignite bed which are under confined condition, with very good ground water potential.

Quaternary alluvial formation

Alluvial formations of this district were deposited in three different facies namely fluvial, fluvio marine and marine. Fluvial sediments occupies the flood plains of the Pooniyar, Gadilam, Manimutha Nathi, Vellar and the Coleroon rivers. It consists of sand, sandy loams or clayey loams or clayey loams. The thickness ot alluvium vary form few metres to 40 metres. Along the coastal track fluvio marine and marine sediments are noted.

Geomorphology

Geomorphology entire district can be broadly divided into following 3 zones.

I. Western pediplains of entire area covered by Mangalur and Nallur blocks. This area is occupied by denudational landforms like shallow buried pediment, deep buried pediment and pediments.

II. Central part of the district is characterised by sedimentary high ground (level II - elevation is > 80m) of Cuddalore sandstone of tertiary age. This zone occupy part of Virudhachalam, Kammpuram, Kurinjipadi, Cuddalore and Kattumannarkoil Taluks.

III. Rest of the area in the district is covered by eastern coastal plain which is predominantly occupied by flood plain of fluvial origin formed under the influence of Ponniyar, Vellar and Coleroon river systems. Marine-sedimentary plain is noted all along the eastern coastal region. In between the marine sedimentary plain and fluvial flood plains, fluvio marine deposits are noted, which consists of sand dunes and back swamp areas.

Alluvial formations

The unconsolidated quaternary sediments consists of laterites and the fluvial sediments and coastal alluvium which mainly consists of unconsolidated sands, gravelly sands, clays and clayey sands. Maximum thickness of alluvium is about 37m and the average thickness of alluvium is about 12m. Due to erratic nature of deposition, the hydrogeologic characteristics also vary widely in space Here, ground water occurs under water table condition and developed by means of dug wells and shadow tube wells.

In area underlain by cretaceous formations, groundwater occurs generally at bedding planes and joints of siliceous limestone and in the intergranular pore spaces of calcareous sandstone. Groundwater occurs both in water table condition and semiconfined to confined condition. Groundwater is tapped by means of dug-cum-bore-wells, bore wells and tube wells.

The tertiary formations are represented by Cuddalore sandstone of fluvial origin, which occupy most part of the district and in the eastern coastal region, they are deposited under marine conditions. The entire Cuddalore formation, can be hydro geologically divided into lower and upper Cuddalore. In upper Cuddalore above the lignite bed, (wherever lignite is occurring) groundwater occurs in semi-confined conditions: whereas in the lower Cuddalore, the groundwater occurs is confined conditions. Groundwater is developed mostly by means of medium and deep tube wells.In hard rock formations, groundwater occurs under water table conditions in weathered and fractured formations. Thickness of weathering is depending upon topography, mineral content of formation, and intensity of fracture of joints.

A correlative study was made between water level fluctuation and rainfall pattern. The water level data (1997 to 2006) collected from the observation wells maintained by PWD (groundwater) and the rainfall data from the rainfall stations located nearer to tire respective observation wells were considered. For this purpose 13 observation wells, representing different geologic and geomorphic environs were selected and hydrographic with rainfall histograms were drawn. It is generally observed that groundwater region in this district has not changed significantly with time. It is generally observed that water level starts raising during monsoon, and the decline in water lever on the long run is not conspicuous as observed in some of the western districts. Due to heavy pumping by Neyveli Lignite Corporation (NLC) at Neyveli, there is effective cone of depression around Neyveli region and this has reflected in wells located within its influence. However, much more study is needed to assess the impact on

the water table aquifer and the semiconfmed aquifer due to pumping by NLC.

Soil

The hydrological soil group 'A' with infiltration rate and low runoff potential is found in some areas of Portonovo blocks Kurinjipadi and Cuddalore town of this district.The hydrological soil group 'B' with moderate infiltration runoff potential is distributed comparatively in large areas in Nellikuppam, Portonovo blocks of this district.The hydrological soil group 'C' with slow infiltration and moderate runoff potential is comparatively found in greater proportion in Bhuvanagiri, Kammapuram, Keerapalayam, Komaratchi, Panruti, Virudhchalam, Kattumanarkoil, Kurinjipadi, Cuddalore blocks of this district.The hydrological soil group 'D' with slow infiltration and high runoff potential is found comparatively in large areas of Nallu; and Mangalur blocks of this district.

Table 2

Distribution of Hydrological Soil Groups - Cuddalore District

S.No	Black Names	Hydrological Soil Groups (Area in sq. km)				Total
		A	B	C	D	
1.	Cuddalore	9.93	18.88	194.69	32.14	255.64
2.	Kurinjipadi	15.30	48.55	363.51	-	427.36
3.	Portonovo	13.66	114.3555	125.75		253.76
4.	Bhuvanagiri	-	0.48	178.99	-	180.47
5.	Keerapalayam	-	8.82	204.42	-	213.24
6.	Komaratchi	-	15.53	170.32	-	185.85
7.	Kattumannar Koil		35.29	201.30	-	236.59
8.	Kammapuram		3.85	341.06	4.56	351.47
9.	Virudhachalam		7.23	267.37	25.69	300.29
10.	Nallur	-	70.50	184.06	95.92	350.48
11.	Mangalur	-	55.11	292.30	100.09 447 50	447.50
12.	Panruti	-	14.83	288.10	-	302.93
13.	Nellikuppam	-	79.38	70.71	19.77	169.86
	Total	38.89	474.80	2883.58	278.17	3675,44

Source: Institute of Remote Sensing, Anna University.

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Land Use

The various land use categories identified in the district are agricultural lands, water bodies, waste lands, settlements, forest lands etc. Major part of the district is covered under agricultural lands, water bodies and waste lands occupy a small portion of the block area, in almost all the blocks of the district. Forest lands are present in a portion of Portonovo and Kammapuram block.

Table 3

District Abstract Land Use

SI. No.	Name of the block	Agricultural lands		Forest Lands		Waste lands	
		Area in Sq. km	percent of the total block area	Area in Sq. km	percent of the total block area	Area in Sq. km	percent of the total block area
1.	Cuddalore	189.56	74	-	-	13.96	5
2.	Kurinjipadi	299.24	70	-	-	34.57	8
3.	Portonovo	193.27	76	18.65	7	-	-
4.	Bhuvanagiri	152.06	84	-	-	7.74	4
5.	Keerapalayam	194.87	91	-		-	-
6.	Komaratchi	156.60	84	-	-	-	-
7.	Kattumannar Koil	197.48	83	-	-	-	-
8.	Kammapuram	248.14	70	29.35	8	30.73	8
9.	Virudhachalam	238.15	81	-	-	13.16	4
10.	Nallur	274.32	78	-	-	21.76	6
11.	Mangalur	359.56	80	14.67	3	19.09	4
12.	Panruti	84.58	27	-	-	22.89	7
13.	Nellikuppam	147.09	86	-	-	-	-

Source: **Institute of Remote Sensing, Anna University**

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Slope

The terrain in the district is almost flat, with the sloping category varying between nearly level (0-1percent) and gently sloping (3-5percent) category.Major portion of the district falls within nearly level (0-1percent) sloping category. In blocks like Nallur and Virudhachalam, the terrain varies between nearly level (0-1percent) and gently sloping (3-5percent) category.

Water quality

Quality of groundwater is one of the important aspects for the studies of ground water recharge. Electrical conductivity is one of the important parameters, which is considered for groundwater recharge study. The other parameters which are play a major role in this aspect are Nitrate, Iron, Fluoride. The water quality data have been collected from various departments like Public Works Departments, TWAD Board, Central Ground Water Board.

The Electrical conductivity values in the district are ranging from 85 to 5710 micromhos/cm. The maximum EC value of 5710 was recorded as Tirunaralyar village of Komaratchi block (The high value of EC may be due to local communication). The maximum- EC value of 85 was recorded in kandrakkottai village of Panruti block. The nitrate value ranges from 2 to 93 in Cuddalore block.The maximum value of nitrate is noticed in ports of Portonovo, Komaratchi, Nallur, Mangalur blocks. The minimum value of nitrate is recorded in ports of Keerapalayam, Kattumannarkoil, Ammagramam, Panruti, Kurinjipadi, Cuddalore, Virudhachalam and Kammapuram blocks.The iron content is ranging from 0.3 to 3.8 and the fluoride content ranges from 0.2 to 0.7 in this district.

Integrations

By integrating various thematic layers such as geomorphology, geology, soil, land use and drainage density and also with the help of appropriate derived Maps, the block area has been classified into various recharge zones as High, Moderate, Less and Poor.In the light of above discussion, it could be concluded that the Cuddalore district is underlain by geological formations ranging to age from archaeans to the recent alluvium. Archaeans are represented by metamorphic rocks which is limited to Tittaguid and western part of Virudhachalam Taluk. Best of the area of the district is covered by sedimentary formations of cretaceous tertiary and recent alluvium.

Thematic maps on geology, geomorphology, soil, land use were prepared using satellite data and other derived maps were prepared using collateral data obtained from different agencies. By integrating above thematic layers using ARC/INFO/GIS software, the block area was divided into four zones of recharge namely highly favourable, moderately favourable, less favourable and poor.Field investigation and ground truth data conducted in all the blocks. During the field checks, in integrated zonation map was checked and the recharge possibilities in each zone were assessed.

In addition, in order to make the existing drinking water power pump schemes sustainable, recharge structures (whearevers feasible) were recommended nearer to the sources.The recharge structures suggested near the

power jump sources are expected to recharge the existing wells. But hydraulic continuity and the fracture pattern are the two factors which controls the movement of groundwater in hard rock areas. These aspects are to be studied in detail by applying appropriate techniques like geophysical profiling, before actual implementation.

Most of the district area is covered by sedimentary formations except the western part which is covered by hard rock formations. The block which are predominantly occupied by hard rocks are problematic, where aquifers are highly heterogenetic in nature. Taking various factors into consideration, suitable recharge structures have been suggested in these areas. In blocks covered by sedimentary formation groundwater condition is fairly encouraging and hence, more number of artificial structures are not recommended Moreover, the aquifer system is taken care by natural recharge through precipitation, canals and river system.

To above information are more scientific in nature with in the short span of time we can get reliability of the information from GIS and remote sensing. Come to the point these information clear shows that our environment situation worsening day by day and less activities of our people in the major causative factor for this condition due to increase in population urbanization, industrialization, mining activities, agriculture, construction. These activities have resulted in increasing demands for water and it has resulted degradation of land and forests, with the help of GIS and remote sensing we can get reliable information within the stipulated time we can take necessary steps in time.

IV. Conclusion

Environmental Impact Assessment can be defined as the systematic identification and evaluation of the potential impacts (effects) of proposed projects plans, programmes or legislative actions relative to the physical, chemical, biological, cultural and socioeconomic components of the total environment (Canter, 1996). EIA identifies measures also to minimize the adverse impacts to improve the project viability. GIS is an ideal tool for environmental monitoring. GIS is used to a much smaller degree as an active component of environmental monitoring systems. Environmental monitoring and GIS are more closely related. All in all, GIS will be a component of every environmental monitoring system within the next few years. GIS provides a valuable tool for information analysis, automated mapping and data integration. The GIS tools are easy access to large volumes of data. Remote sensing is the technique of deriving information about objects on the surface of the earth without physically coming into contact with them. The use of GIS in EIA process is common for scoping in terms of time and money relative to the time and budgets allocated for EIA preparation and especially for scoping studies. Most of the environmental issues can be handled properly with the use of GIS techniques (Schaller, 1990). The applications of remote sensing and GIS in Environmental Impact Assessments are numerous including environmental impact and compliance studies, site investigations and characterizations, natural resource inventory and management assessments, emergency planning, monitoring, transportation, telecommunication site, route and corridor selection and water and power plant site selection etc.

V. Suggestions

1. The developmental activities in different sector in Cuddalore district which involves more ground water extraction to meet the requirement so there is need to augment the suitable artificial recharge

aquifer system.

2. FOM types of hydrological soil/group identified in the distinct. This paper gives GIS and Remote sensing information on natural resources in Cuddalore district, Tamilnadu. The spatial information is a sophisticated tool for analyse our environment. Particularly these information and water quality cautioning water level in this district.

3. To save our natural resources the efforts of promoting sustainable environment development is badly needed.

4. The information's clearly shows worsening conditioning occurred due to man's influence and also climatic change.

Note

I.	GIS	-	Geographical Information System
II.	FCC	-	False Colour Composite Data
III.	IRSIC	-	Indian Remote Sensing Satellite

References

1. Ahmad, Y.S. and Sammy, GK. (1987), "Guidelines to Environmental Impact Assessment in Development Countries", *UNEP Regional Seas Reports and Studies*, No.85, UNEP.
2. Canker, LW. Choudhury, AK and Vieux, B.E.(1994). "Geographical Information Systems: A tool for strategic Ground Water Quality Management", *Journal of Environmental Planning and Management*, Vol.37:3, PP:251-266.
3. Deng, J.S. Wang, K.Deng, Y.H. and Qis, G.J. (2008), "PAC-based land use change detection and analysis using multi-temporal and multisensory satellite data", *International Journal of Remote Sensing*, 29(6), pp.4823-4838.
4. Joao, E.M (1994), "Using of Geographics Informations Systems for Environmental Assessment", *Environmental Assessment*, Vol.2(3): pp.102-104.
5. Khoshoo, B.L., (1992), Land and soils, Ed., By, T.N. Deaksha Fuly, Har-Anand Publication cankar, L.W.
6. Murthy, A and Patna, HS. (2005), Environmental Impact Assessment Process in India and the Drawbacks", Environmental Conservation Team Vasudhara, 15, Sahid Nagar, Bhubaneswar, pp.1-30.
7. Navalgund, P.R. and Tamilarasan, (1988). Remote Sensing for Rural Development, Journal of Rural Development, NIRD, Vol 17(3).
8. Radhakrishnan, K., (1998) Integrating space-based information in multi-level planning and management of natural resources for sustainable development of rural areas, Journal of Rural Development, NIRD, Vol. 17(3).

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