EVALUTATION OF AQUACULTURE IMPACT ON LAND USE CHANGES USING REMOTESENSING AND GIS :A CASE STUDY

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ABSTRACT

Land use considered as one of the most essential key elements as the variations of the vegetation and land use form one of the other act as an indicator of terrain condition. All applications of remote sensing and GIS requires Knowledge of land use land cover without this planning and management activities can not be effectively carried out. The present study on "Aquaculture impact on land use changes**"**. The study involves Remote Sensing and GIS tools besides Satellite data and Toposheets, from Survey of India.Visual image analysis is adopted to generate thematic layers like Land use / Land cover, geomorphology for different temporal environments. Aquaculture forms and cultivation has been increased along the coast line in recent years due to this water and soil quality is effecting due to in proper land use planning keeping this in view this study has attempted to proper utilization of economic zones of coastal area.

Keywords: Aquaculture, Land use/Land cover Remote sensing, GIS

INTRODUCTION:

The coast line of India over 6000 kms, India has an estimated total brackish water area of 1.2million hectares (mha).The maximum area is in west Bengal (0.4 mha)with Gujarat (0.37 mha) close behind Andhra Pradesh, with 0.15 mha, has a network of 172 brackish water bodies in 9 coastal districts. The total area under brackish water Aquaculture in Andhra Pradesh share is about 8,100 ha. Another additional 17,555 ha of Revenue, forest and private land is considered suitable for aqua farming. The major aquaculture activities are confined to Visakhapatnam, East Godavari, and Prakasam and Nellore districts. The hatchery units are located in coastal areas of Visakhapatnam district while the farming

units mostly along the creeks.In 1980, the state Government issued guidelines for allotment of land for aqua farming. The enterprising farmers in Kakinada, Bhimavaram and Nellore areas developed aquaculture on their land. The annual productivity of scientifically managed aqua farms range from 1000-2000 kg per hectare. Some aqua farmers in Nellore have achieved annual production of 3-4 tones per hectare. The small farmers using traditional methods are able to harvest on an average about 500 kg per hectare annually. The Coastal Regulation Zone Notification stipulates that no permanent structure is permissible within 200 meters of the high-tide line and within 500 meters only semi-permanent structures are allowed. But a number of hatcheries with masonry structures have been built within the inter-tidal zones. In addition, processing and packing plants have also been set up within this restricted area.The growing demand for seafood in developed countries gave momentum to aquaculture in India. The prospect of immediate and considerable financial gains spurred the proliferation of aquaculture farms. The high investments with equally high profits attracted multinationals. In the process, fertile agricultural land, wastelands and coastal areas were converted into aqua farms. However, improper survey inadequate transfer of appropriate technology, and avariciousness of investors led to a host of environmental problems as well as legal ones. The gullible and vulnerable small farmers were induced to lease out or sell their land to large investors. The dependence on under-qualified technicians and experts resulted in unscientific aqua farming with concomitant large-scale damage to coastal ecology.

The ecologically sensitive areas in Andhra Pradesh, like mangroves (Korangi, Kakinada) and estuaries (Nizampatnam, Krishna river), are gravely threatened by aqua farming. Estuarine mangroves have been destroyed on a large scale. The impounding of brackish and sea water in aquaculture ponds have polluted the subsoil water making it unfit for Human use.

Land use refers to "man's activities and the various use which are carried on land" covers refers to " natural vegetation,water bodies rock /soil artificial cover and other resulting due to land transformations" Although all land use is generally inferred based on the cover, at both the terms land use and land cover being closely related are inter changeable. Rapid human population growth, combined with increasing resource consumption, has resulted in the widespread transformation Of the Earth's land cover we use land to grow our crops, manage our livestock, and house our families. These worldwide changes in land cover may have profound impacts on environmental systems around the globe- including the linkages between land, water and air. Although the terms

land cover and land uses are often use is often used interchangeably, their actual meanings are quite distinct. Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other. Identifying, delineating and mapping land cover is important for global monitoring studies, resource management, and planning activities. The coastal line of Andhra Pradesh is about 1014 km long. Andhra Pradesh lies between 12^0 37' and 19^0 54' N latitudes and 76^0 46' and 84^0 46'E longitudes. The coastal zone is potentially a rich terrain from the point view of Agriculture, fisheries and commerce and communication. The coastline is long and smooth with inundation only in the extreme south (in the salt water lagoon of the Pulicat Lake) and between the Godavari and the Krishna deltas .

DISCRIPTION OF STUDY AREA

The Indukurupeta Mandal lies geographically between latitudes 14º 27´0" and14º 35'and the longitudes 80º 7' 30" and 80 15' 00"is covered in the survey of India. Toposheet number 66B/2SE and 66B/3NE. It's one of the Mandal in Nellore district.The Study area villages are Kudithipallem, Gangapatnam, Maipadu, Koruturu, Somarajupalle, and Pogadaduruvu Khandrika.

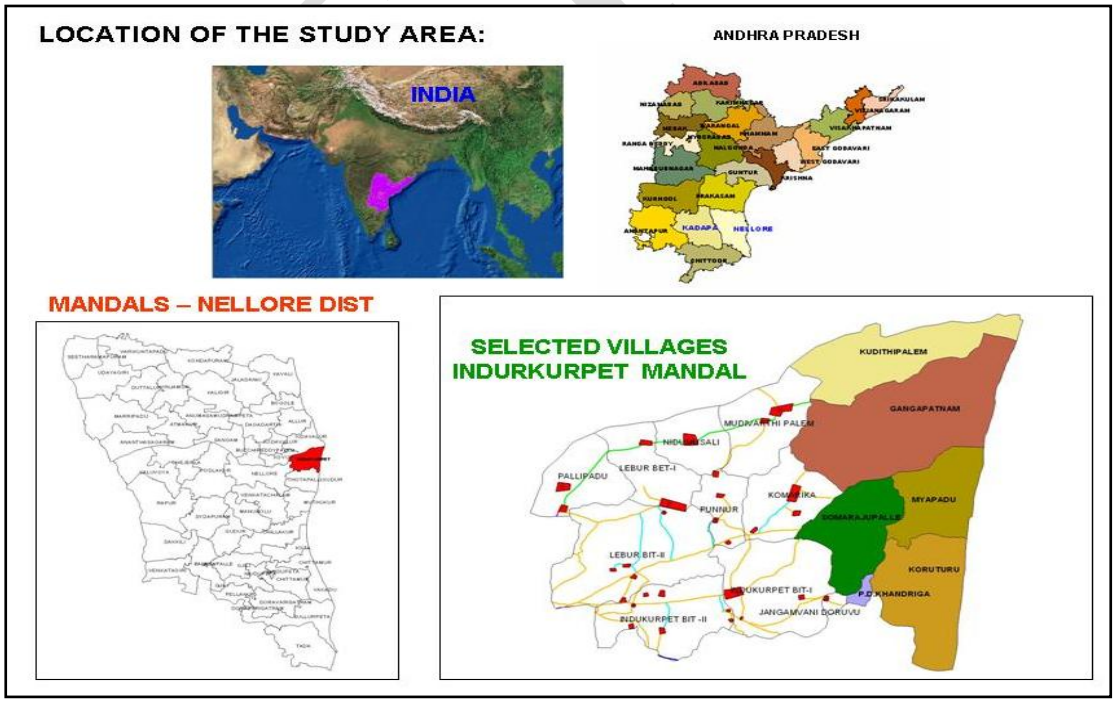

Figure 1: Location map of study area

Objectives

- To prepare the digital thematic maps namely Base map, village wise Land use/ Land cover for estimation of spatial distribution of aquaculture in village wise

and impact on environment using satellite data, collateral data and field data on ARC/INFO GIS platform.

3. Methodology:

3.1 Data collection:

Different data products required for the study include Survey of India (SOI) toposheets bearing with numbers **66B/2SE and 66B/3NE** on 1:25,000 scale. spatial data of LISS IV, IRS-P6 satellite imagery obtained from National Remote Sensing centre (NRSC),Hyderabad,India.

3.2 Database creation:

Satellite imageries are georeferenced using the ground control points with SOI toposheets as a reference and further merged to obtain a fused, high resolution and colored (R,G,B bands of LISS-IV) output in EASI/PACE Image processing software. The study area is then delineated and subsetted from the fused data based on the latitude and longitude values and a final hard copy output is prepared for the generation of thematic maps using visual interpretation technique. These thematic maps (raster data) are converted to vector format by scanning using an A0 flatbed deskjet scanner and digitized using AutoCAD software for generation of digital thematic maps using Arc/Info and ARCVIEW GIS software.The GIS digital database consists of thematic maps like land use/land cover, using Survey of India (SOI) toposheets and data of IRS-P6, LISS-IV satellite imagery.

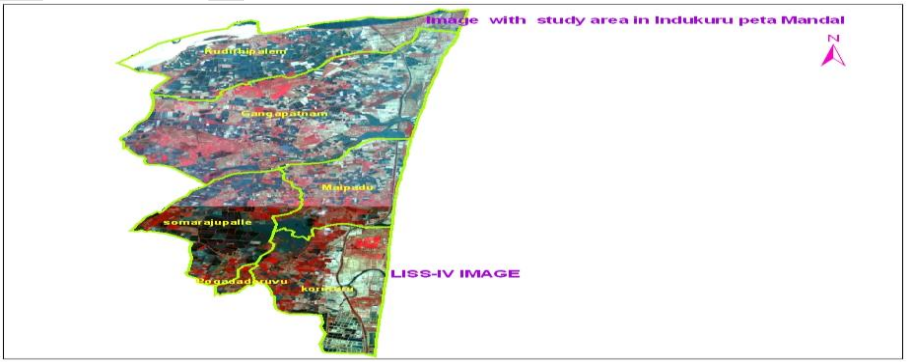

Figure 2: Satellite image of study area

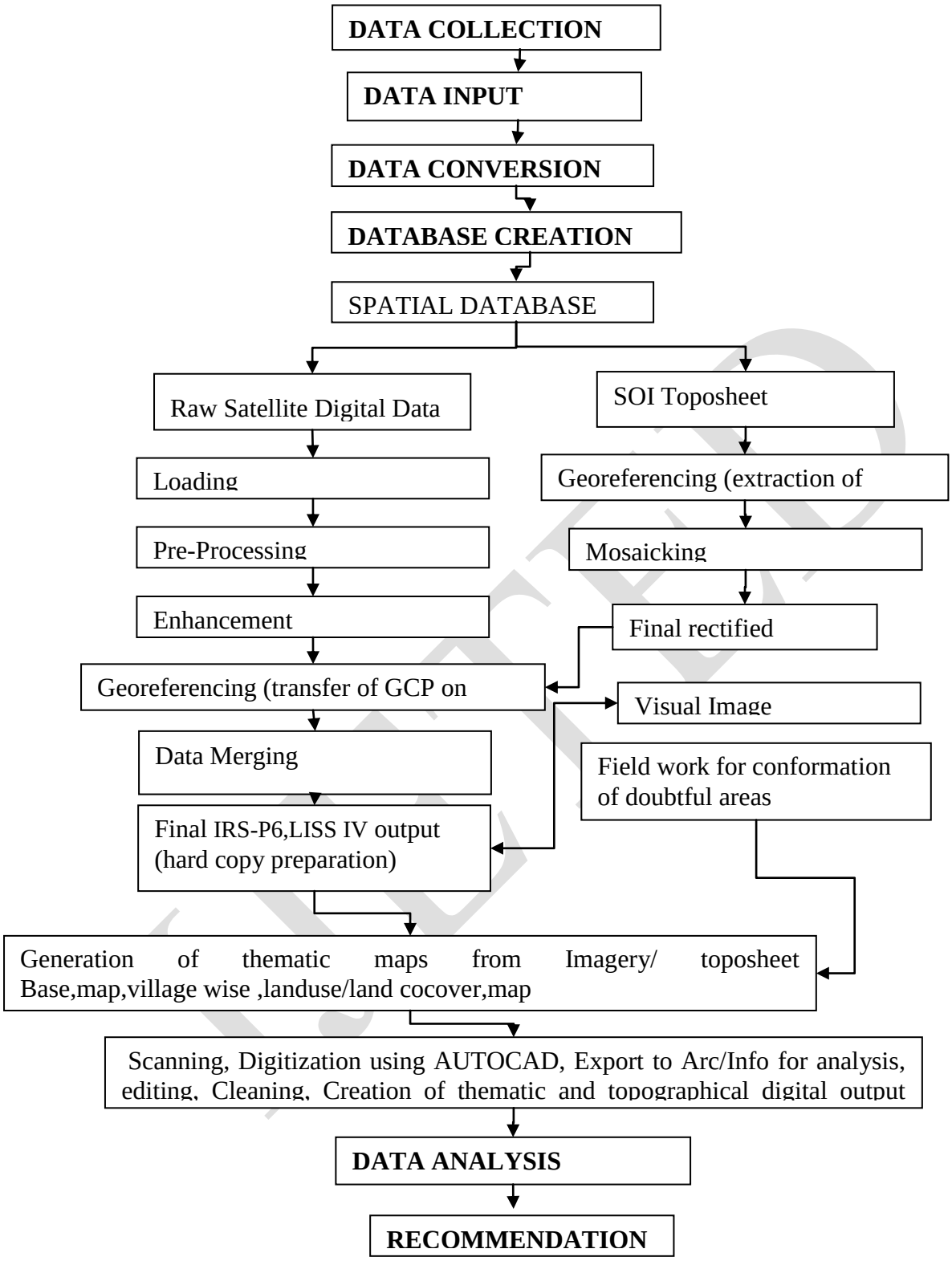

Figure 3: Methodology flow chart

4. RESULTS & DISCUSSION

4.1 BASE MAP

A Base map is the frame to which all ancillary data will be Registered. The base map allows all users to generate numerous data layers which will develop into an evolving spatial data base. The base map is prepared using Survey of India Toposheet 66B/2SE and 66B/3NE on 1:25,000 scale.A base map consists of various features like the road network, settlements, rivers, streams, canals etc, which are delineated from the toposheet. The map thus drawn is scanned and digitized to get a digital output. The major settlements in the present study area are Gangapatnam, Somarajupalle, Koruturu, Maipadu, Kudithipalem, Pogadadoruvu Khandrika.

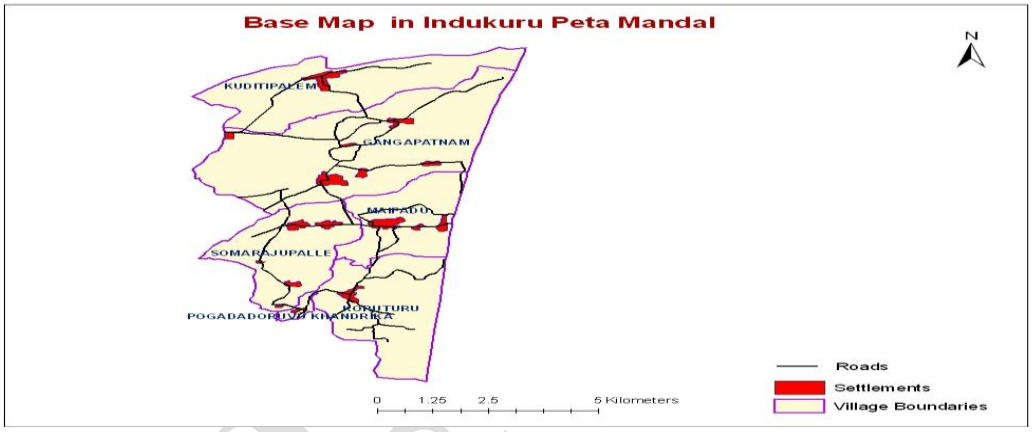

Figure 4:Base map of study area

4.2 VILLAGE WISE LANDUSE/LAND COVER MAPS

4.2.1 Interpretation of satellite data for preparation of land use land cover map:

The village wise Land use/Land cover maps(LU/LC) of the study area is prepared from satellite imagery using visual interpretation technique. This technique consists of a set of image elements, which help in the recognition or interpretation of various land use /land cover features systematically on the enhanced satellite imagery during the classification of features (Lillesand and Kiefer 1994). The land use/ Land cover classification system used in this study is the system, which is pioneered by United States Geological Survey (USGS) and is modified by National Remote Sensing Centre (NRSC) according to Indian conditions. A preliminary image classification key is prepared for the fused pictorial data and is used during interpretation process. The base map is overlaid on the satellite imagery. Then the features of LU/LC classes are extracted and transferred from the satellite pictorial data. The doubtful areas (due to similar spectral response and spectral

signature) identified during the preliminary image classification are listed out before ground verification. The doubtful areas are physically verified by field observation, based on which, corrections and modifications of misclassified land use/land cover details are carried out for preparation of final maps so as to extract the entropy or information content in accordance with the above thematic maps. Present land use/land cover map showing the spatial distribution of various categories and their aerial extent is vital for the present study. The spatial distributions of various land uses are interpreted based IRS-P6, LISS IV data. The different land use land cover classes village wise existing in the area over space and time are briefly discussed here in their dimension.

4.2.2 Kudithi Palem Village:

The land use/land cover categories such as Aquaculture ponds, Canal, Habitation with vegetation, Crop land, Marsh vegetation, Tanks, Sand area, Sand with vegetation, Scrub area, Beach in this categories major part of the study area has been occupied aquaculture(62%) sandy area(20%) is the second major class in this village The remaining classes are Mainer portion has been occupied in the **Kudithi Palem Village.**

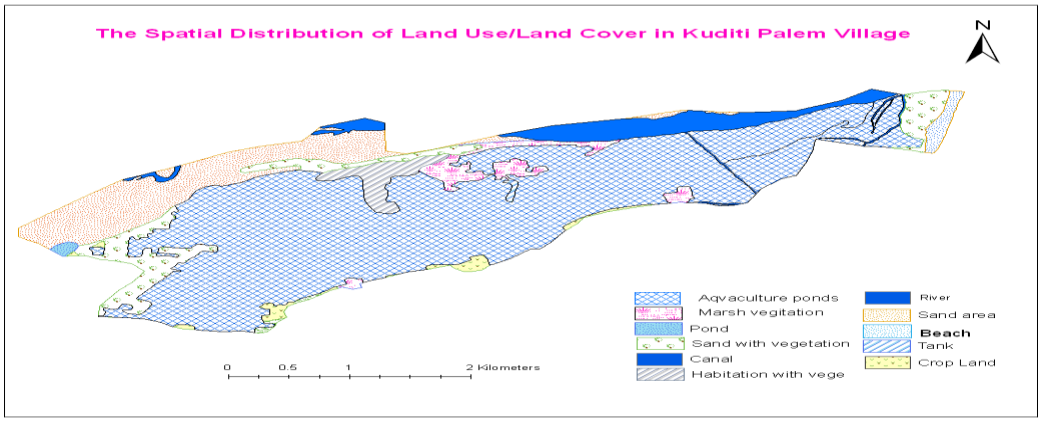

Figure 5: Land use/Land cover map of Kudithi Palem Village

The Land Use\Land Cover Spread of Kudithi Palem Village		
S.No	**Feature Name**	**Area in sq.mrs**
1	Aquaculture ponds	175
2	Canal	11
3	Habitation with vegetation	3
4	Crop land	5
5	Marsh vegetation	24
6	Tanks	1
7	Sand area	3
8	Sand with vegetation	55
9	Scrub area	3
10	Beach	1
Total		**281**

Table - I : shows the Land Use\Land Cover Spread of Kudithi Palem Village

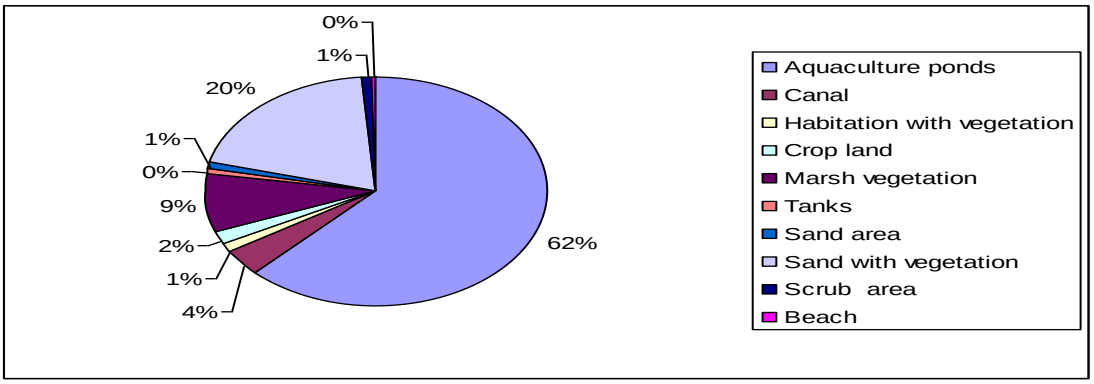

Figure 6: Pie Chart Showing Land Use / Land Cover Distribution in the Kudithi Palem Village

4.2.3 GangaPatnam Village:

The land use/land cover categories such as Aquaculture ponds, Canal, Habitation with vegetation, Crop land, Marsh vegetation, Mud with vegetation, Mud flat Sand area, Scrub area, Tanks, Beach in this categories major part of the study area has been occupied aquaculture(72%).crop land(12%) is the second major class in this village The remaining classes are Mainer portion has been occupied in the **GangaPatnam Village**

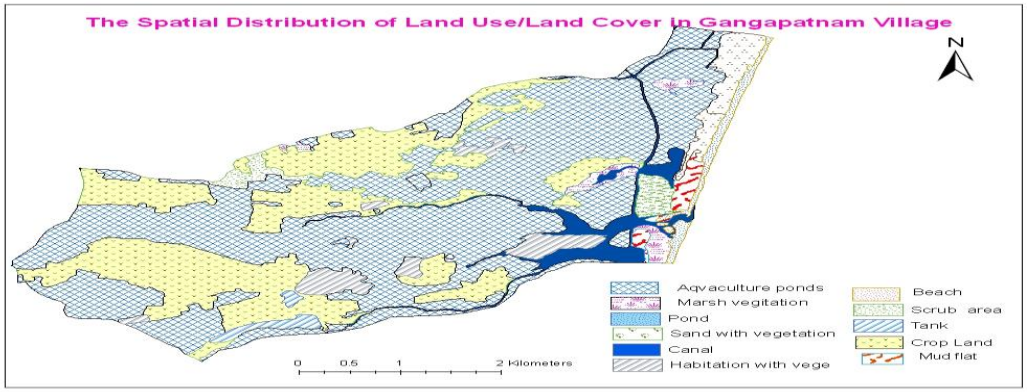

Figure 7: Land use/Land cover map of GangaPatnam Village

The Land Use\Land Cover Spread of GangaPatnam Village		
S.No	**Feature Name**	**Area in sq.mrs**
1	Aquaculture ponds	260
2	Canal	11
3	Habitation with vegetation	9
4	Crop land	48
5	Marsh vegetation	3
6	Mud with vegetation	2
7	Mud flat	2
8	Sand area	14
9	Scrub area	3
10	Tanks	2
11	Beach	3
Total		**357**

Table II: Shows the Land Use\Land Cover Spread of **GangaPatnam Village**

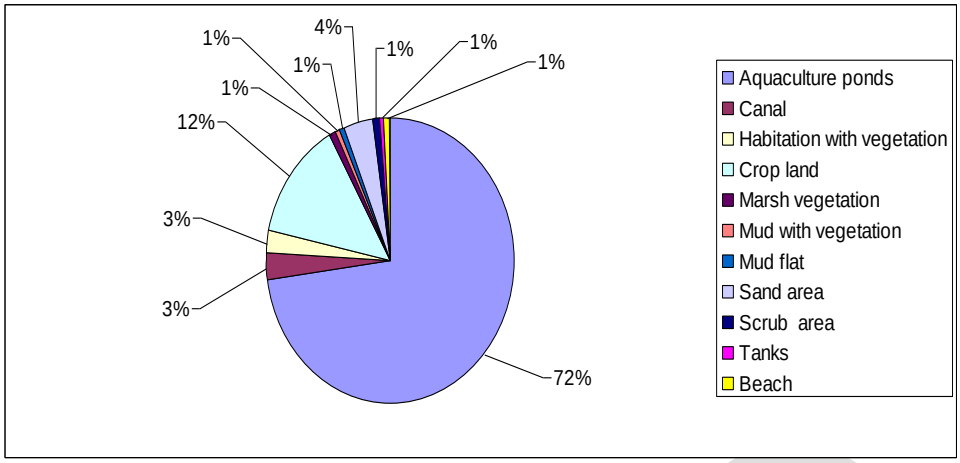

Figure 8: Pie Chart Showing Land Use / Land Cover Distribution in the GangaPatnam Village

4.2.4 Maipadu Village:

The land use/land cover categories such as Aquaculture ponds, Beach, Canal, Habitation with vegetation, Tanks, Crop land in this categories major part of the study area has been occupied Crop land (66%) Aquaculture ponds.(17%) is the second major class in this village due to in and around villages impact this village people also slowly they are converting their Crop land to Aquaculture ponds. The remaining classes are Mainer portion has been occupied in the **Maipadu Village.**

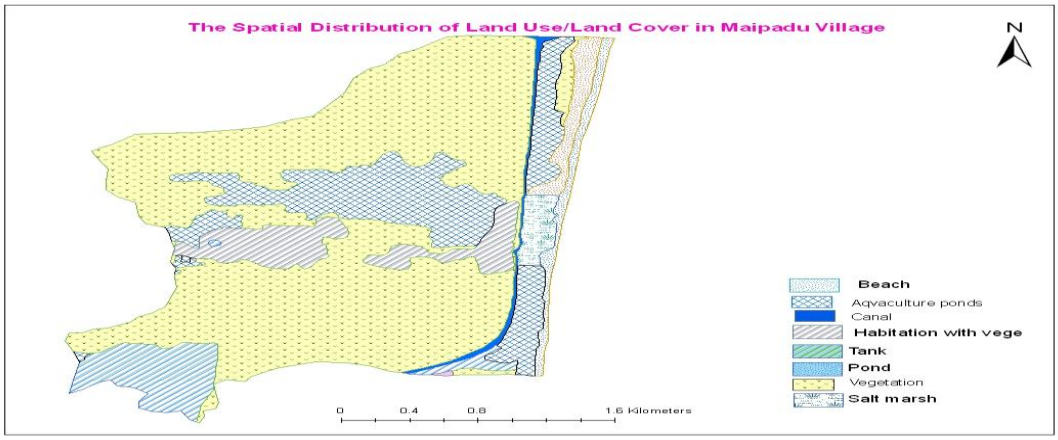

Figure 9: Land use/Land cover map of Maipadu Village

The Land Use\Land Cover Spread of Maipadu Village		
S.No	**Feature Name**	**Area in sq.mrs**
1	Aquaculture ponds	12
2	Beach	2
3	Canal	1
4	Habitation with vegetation	5
5	Tank	4
6	Crop land	47
Totatal		71

Table – III: Shows the Land Use\Land Cover Spread of **Maipadu Village**

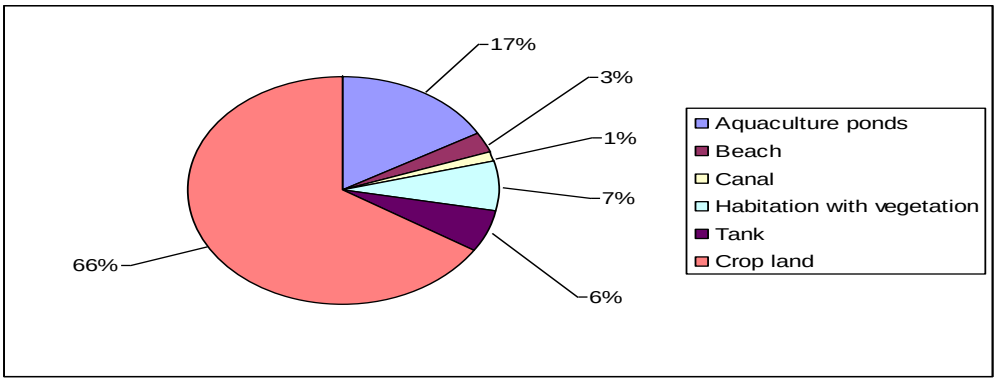

Figure 10: Pie Chart Showing Land Use / Land Cover Distribution in the Maipadu Village

4.2.5 Koruturu Village:

The land use/land cover categories such as Aquaculture ponds, Beach, Canal, Habitation with vegetation, Salt marsh,Tanks, Crop land in this categories major part of the study area has been occupied Crop land (66%) Aquaculture ponds.(20%) is the second major class in this village due to in and around villages impact this village people also slowly they are converting their Crop land to Aquaculture ponds. The remaining classes are Mainer portion has been occupied in the **Koruturu Village.**

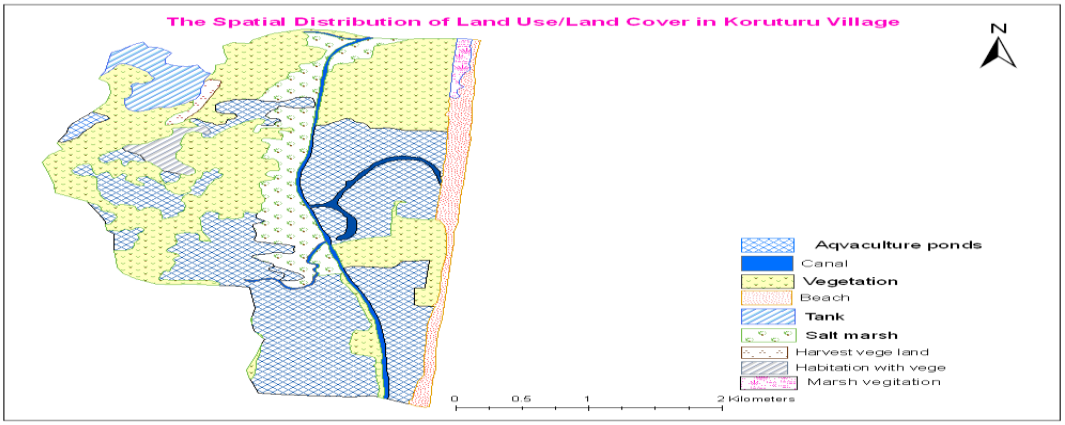

Figure 11: Land use/Land cover map of Koruturu Village

The Land Use\Land Cover Spread of Koruturu Village		
S.No	**Feature Name**	**Area in sq.mrs**
1	Aquaculture ponds	69
2	Beach	6
3	Canal	4
4	Habitation with vegetation	2
5	Salt marsh	25
6	Tank	12
7	Crop land	228
Totatal		**346**

Table – IV: Shows the Land Use\Land Cover Spread of **Koruturu Village**

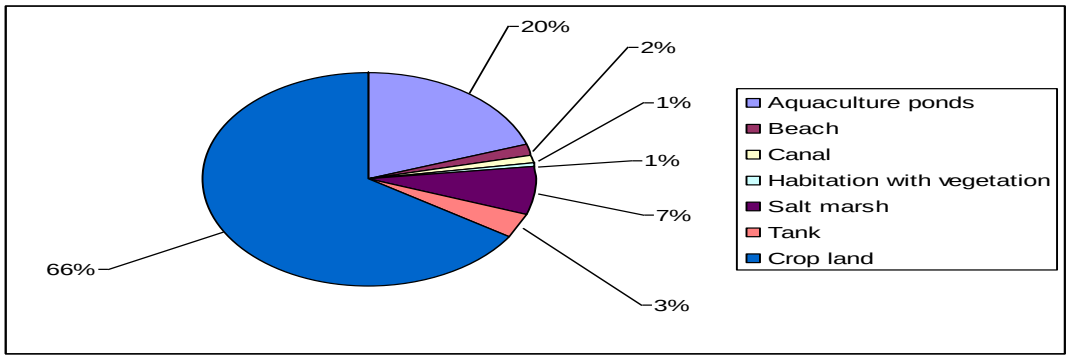

Figure 12: Pie Chart Showing Land Use / Land Cover Distribution in the **Koruturu Village**

4.2.6 Pogadarevu Khandrika Village:

The land use/land cover categories such as Aquaculture ponds,Habitation with vegetation,Crop land in this categories major part of the study area has been occupied Crop land (65%) Aquaculture ponds.(33%) is the second major class in this village due to in and around villages impact this village people also slowly they are converting their Crop land to Aquaculture ponds. The remaining class is very Mainer portion has been occupied in the **Pogadarevu Khandrika Village.**

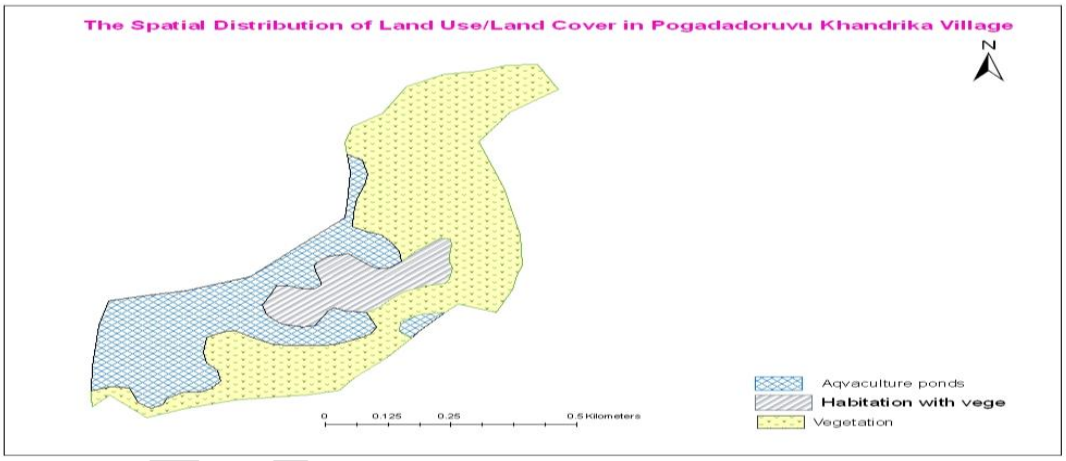

Figure 13: Land use/Land cover map of Pogadarevu Khandrika Village

The Land Use\Land Cover Spread of Pogadarevu Khandrika Village		
S.No	**Feature Name**	**Area in sq.mrs**
1	Aquaculture ponds	14
2	Habitation with vegetation	1
3	Crop land	28
Total		**43**

Table – V: Shows the Land Use\Land Cover Spread of **Pogadarevu Khandrika Village**

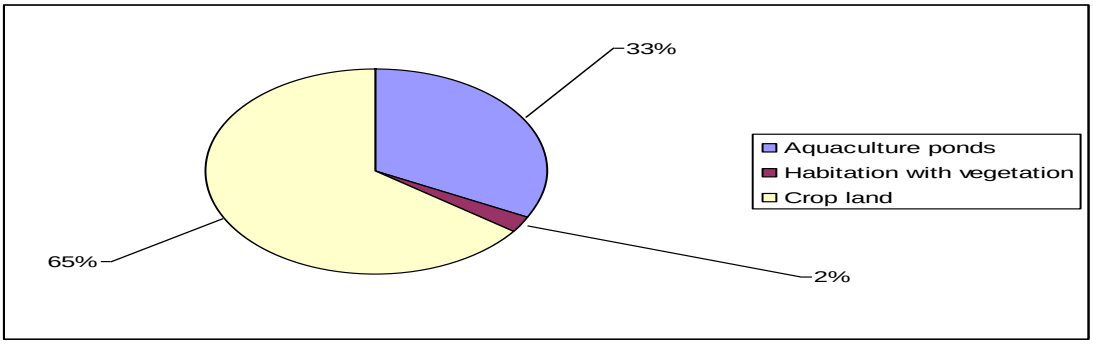

Figure14:Pie Chart Showing Land Use / Land Cover Distribution in the Pogadarevu Khandrika Village

4.2.7 Somaraju Palle Village:

The land use/land cover categories such as Aquaculture ponds, Habitation with vegetation, Crop land, Tanks in this categories major part of the study area has been occupied Aquaculture ponds (85%). Crop land (8%) is the second major class in this village.The remaining classes are Mainer portion has been occupied in the **Somaraju Palle Village.**

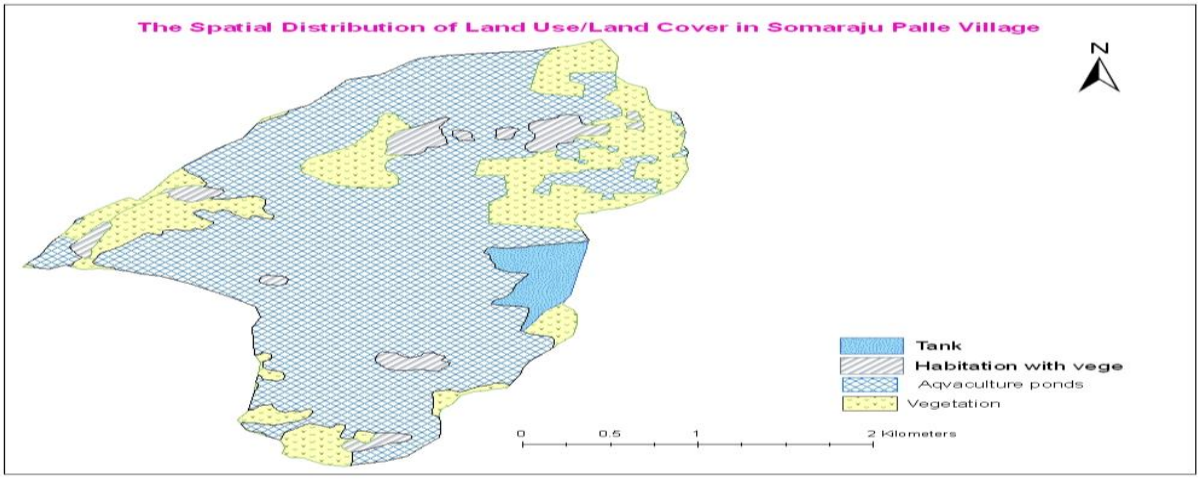

Figure 15: Land use/Land cover map of Somaraju Palle Village

The Land Use\Land Cover Spread of Somaraju Palle Village		
S.No	**Feature Name**	**Area in sq.mrs**
	Aquaculture ponds	290
	Habitation with vegetation	13
	Crop land	28
	Tanks	11
Total		**342**

Table – VI: Shows the Land Use\Land Cover Spread of **Somaraju Palle Village**

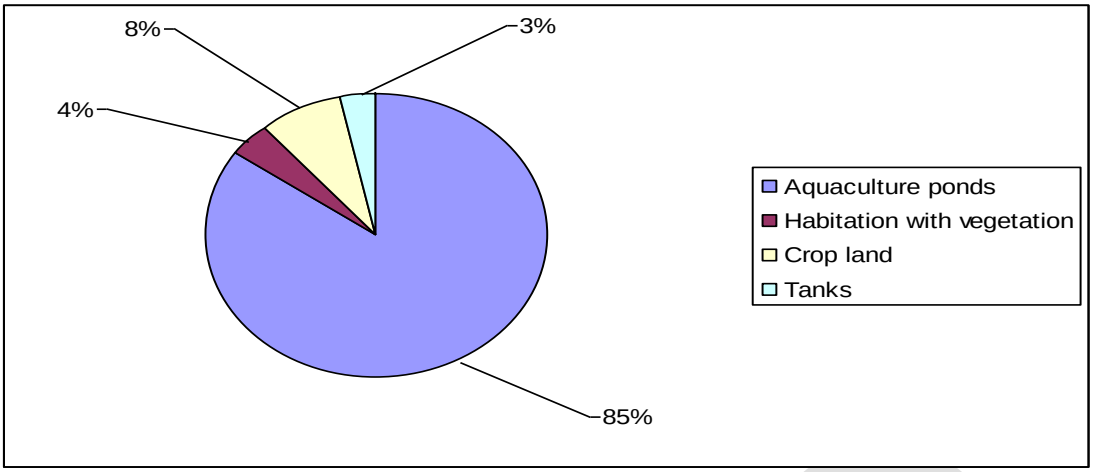

Figure 16: Pie Chart Showing Land Use / Land Cover Distribution in the Somaraju Palle Village

4.3 SPATIAL DISTRIBUTION OF AQUACULTURE VILLAGE WISE

Based on the above study Somarajupalle(36%), Gangapatnam(32%), Kudithipalem(21%) Aquaculture ponds are occupied major part of the study area Koruturu(8%), Pogadadoruvu Khandrika(2%) Aquaculture ponds are occupied medium and Maipadu(1%) Aquaculture ponds are occupied minor part of the study area.

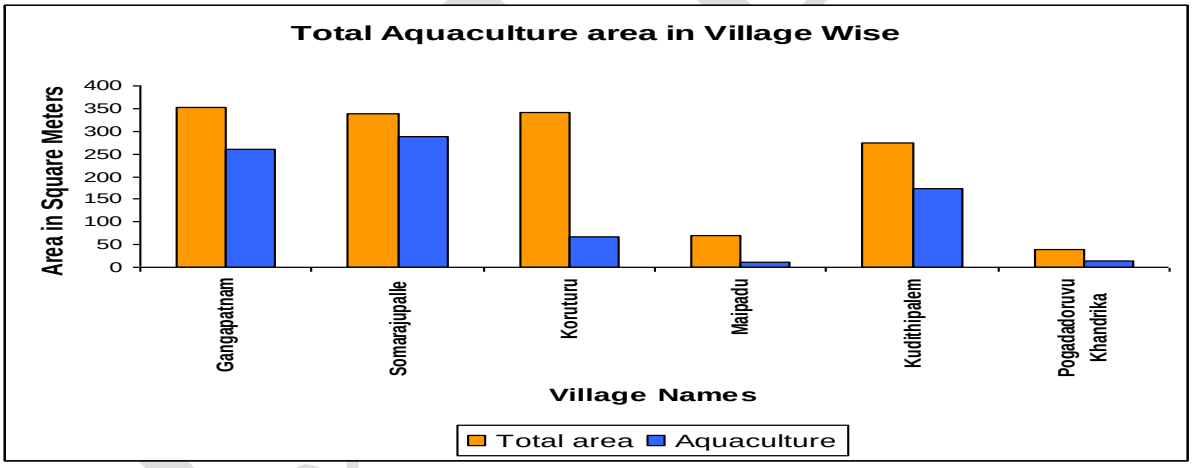

Figure 17: Village wise Total Aquaculture area in study area

S.no	Village name	Area in sq.mtrs	Aqua area in sq.mts
1	Kudithipalem	281	175
2	Gangapatnam	357	260
3	Maipadu	71	12
4	Koruturu	346	69
5	Pogadadoruvu Khandrika	43	14
6	Somarajupalle	342	290
Total		**1440**	**820**

Table-VII : Shows the Village wise Total area and Aquaculture area in study area

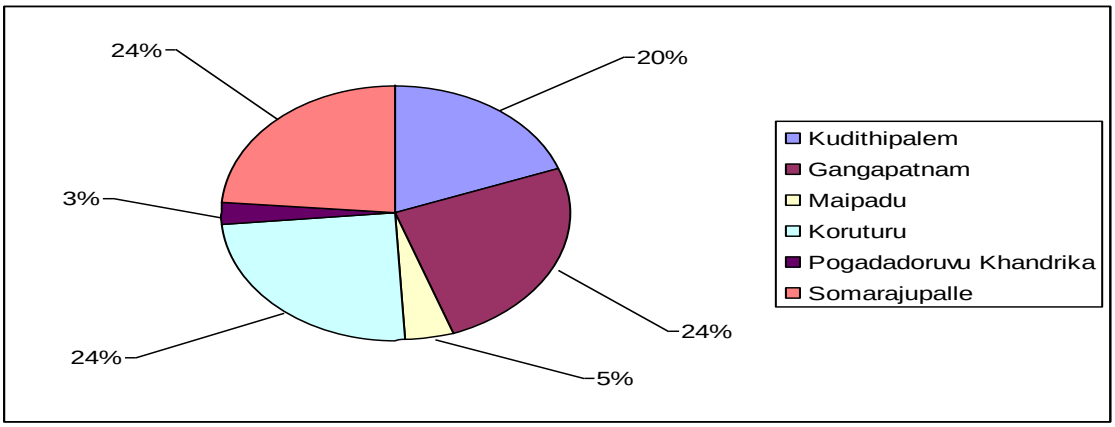

Figure 18: Pie Chart Showing village wise Distribution in the study area

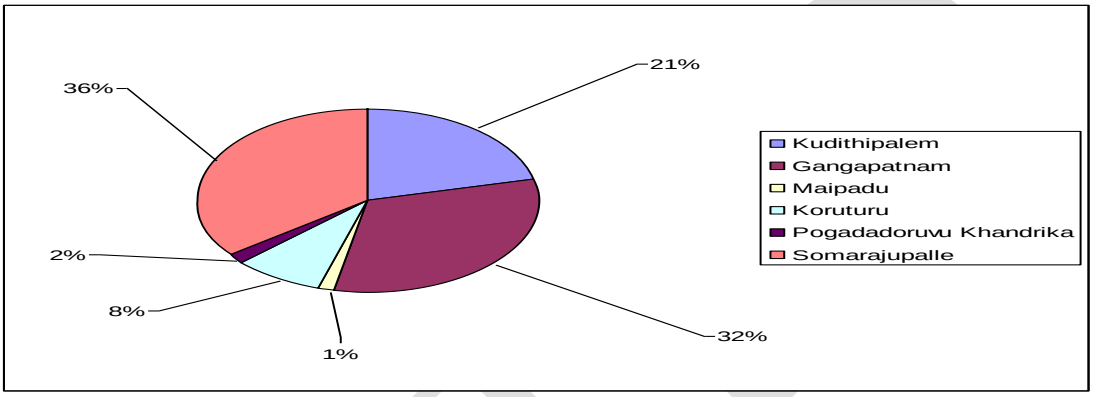

Figure 19: Pie Chart Showing Aquaculture Distribution in the study area

5 Conclusion:

In this study area six villages are in Indukurupeta Mandal, Nellore District. These six villages covered 1440sq.mrs. Aquaculture forms are occupied as 820 sq.mrs. according to the above study 57% of the study area is covered by Aquaculture.These Aquaculture forms causes contamination of ground water, surface water and soils chemicals release from ponds. Most fish pathogens are not hazardous to humans, but some fish pathogens such as Streptococcus bacteria can infect humans and animals facing the problems Many studies have implicated overfeeding in fish farms as the cause of changes in benthic community structure because a high food supply may favour some organisms over others moreover, sedentary animals may die in water depleted of oxygen resulting from microbial decomposition, while the mobile population may migrate to other areas. Antibiotics and other Therapeutic chemicals added to feed can affect organisms for which they were not intended when the drugs used are released as the uneaten pellets decompose. Nonetheless, many drugs used in fish farms have been found to have minimal deleterious effects on the aquatic environment, Once we use land for aquaculture cultivation, we cannot use for other cultivation like paddy, horticulture.These are the highly effects on the environment, so we reduce the aquaculture forms and

effluents, proper treatment for the aquaculture pond water, primary and secondary treatments after that release in coastal water.

References:

1.Dipanjali B D., 2000. "Simulation of Seawater Intrusion for Cochin Coast (Ernakulam District)", M.Tech. Dissertation, Centre for Environmental Studies, Department of Civil Engineering, K.L.E. Society's College of Engineering and Technology, Belgaum – 590008 (Karnataka), India.

2.Fitzpatrick, D.J., 1985, "Occurrence of saltwater in the alluvial aquifer in the Beouf—Tensas basin, Arkansas" U.S. Geological Survey Water Resources Investigation Report 85-4029.

3. Watershed atlas of India, Published by All India Soil and Landuse Survey, 1990

Estes, J., What GIS is, Where it came from and what it does, Proc. Cambridge conference for national mapping organizations, Workshop paper 2, 1/18, 1995.

4.Burrough P. A and Rachael Mc Donnell, Principles of Geographical Information Systems, Oxford University Press, New York, 1998.

5.Thomas M. Lillesand and Ralph W. Keifer, Remote sensing and Image interpretation, Fourth Edition, John Wiley and Sons, Inc, New York, 2000.

6.National Remote Sensing Agency (1995), Integrated Mission for Sustainable Development, Technical Guidelines pp: 1-100.

7.Irrigation and C.A.D Department, Government of Andhrapradesh, 2000, Profile of Irrigation Projects in Nellore District, pp 1- 10.

8.Manual of Land use / land cover mapping using satellite imagery, Part I and II, National Remote Sensing Agency, Department of Space, Govt. of India, 1989

9.Davis S.N and Deweist R.S.M, 1975., "Hydrology" John Willey, Publ., New York

Doneen L.D., 1962, The influence of crop and soil on percolation waters. Proc 1961, Biennial conference on groundwater recharge

10. Gangadhatra Rao. Subba Rao C, Prasad N, Eswara Rao K and Murthy D, Groundwater salinity in the water logged areas of lower Godavari delta., Indian j. Environmental Protection Vol.21, No 11, Nov 2001

11. Ma, T.S, M. Sophocleous, Y. Yu, R.W. Buddemeier, 1998, "Modeling saltwater upconing in a freshwater aquifer in south-central Kansas" Journal of Hydrology, 201, 120-137.

12.John R Jensen, Remotesensing of the Environment, A earth resource perspective, low price edition, Keith c.clarke, series editor, Pearson education.

13. Mishra H.C "GIS hand book", GIS India 1998.

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