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Boundary Analysis of Randomly Selected Three Wetlands Over a Period in Trichirapalli District, Tamil Nadu, India

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Abstract

Wetland conservation is a global issue. In India, wetlands occupy 58.2 Million hectares (directory of Indian wetlands 1990). According to ISRO, Tamil Nadu is one of the wetland rich states as it occupies 6.92% of the total wetlands. But at present inland wetland areas are shrinking due to unchecked real estate exploitation. Monsoon failures is also a contributing factor for disappearance of wetlands. In Tamil Nadu, Trichirapalli district being a Cauvery delta area is affected seriously by this problem. So continous evaluation over a period helps to develop effective precautionary measures to protect the wetlands. For the present study three wetlands were selected randomly and boundary analysis were carried out over a period of time to verify how much the area of the wetlands were changing using GIS tools like ARC GIS(9X).Using 1973 toposheet, 2003 map(based on IRS 1D LISS 4 PAN Merged) and 2010 map(based on IRS P6 LISS 4 FCC) we calculated the boundary changes and the total area in hectares. The result showed conclusively that the selected wetland areas were shrinking.

Keywords: Wetlands, GIS, Remote sensing, boundary analysis, Toposheet, Trichy

Introduction

Wetlands are critical elements in the landscape in terms of habitat and biodiversity, regulation of watershed hydrology, and mediation of biogeochemical cycles (Detenbeck *et al.* 1999, Haag and Kaupenjohann 2001, Bhatti and Preston 2006). Besides

this many of our needs for life such as drinking water, energy, fodder, transportation and recreation are also met by the wetlands over many years. Wetlands perform other essential functions such as flood control, climate stabilization, and improvement of water quality by filtering sediments etc. Acoording to Ramachandra *et al*., 2002 wetlands to some extent remove heavy metals. Hence, they are often described as "kidneys of the landscape".

Very little is known about the extent and condition of global wetland resources. According to Finlayson C. *et al*., 1999, global wetland area was 12.8 million sq.km. In India wetlands are distributed in all the bio-geographic regions occupying 58.2 million hectares, including areas under wet paddy cultivation (directory of Indian wetlands, 1990). But at present large areas of wetlands including agricultural lands have been converted into residential layouts because of unchecked real estate exploitation (Jayaraj. S., 2011). This has led to a shrinking of wetland regions. This is also one of the major reasons for the low and unstable water table during dry seasons. The National Wetland Atlas, prepared by the Ahmedabad (Gujarat) Space Application Centre (SAC), Indian Space Research Organization (ISRO), has classified Puducherry and Tamil Nadu as wetland rich states as they occupy 12.88% and 6.92% of geographic area under wetlands, respectively. Knowing the importance of wetlands, effective assessment tools are needed for continous evaluation of our wetland resources. Therefore, good inventory and boundary analysis using tools like remote sensing and GIS must be taken at regular intervals for effective monitoring of wetland resources.

To investigate the drying up of wetlands due to manmade and environmental factors, boundary analysis of wetlands must be carried out. By analyzing how much the selected wetlands are eroded we can employ certain measures to effectively mitigate the disappearance of wetland regions. The Trichy (Tiruchirapalli) district was selected for the present investigation of boundary analysis of three randomly selected wetlands through geo-spatial technology (GIS and RS).

Study area

Trichy district is one of the important districts in Tamil Nadu and has a population of 8,46,915 (census 2011). In terms of urbanization levels Trichy district ranks 10th place.The study area description given is based on details given in TN Govt.Trichy district official website. Trichy lies between 10° 10' and 11°20' of the northern latitude and 78°10' and 79°0' of eastern latitude in the center part of Tamil Nadu. Trichy is situated at an elevation of 88 meters (289 ft). The general slope of the district is towards east . The Cauvery delta commences 16 km west of the city and is one of the major rivers flowing through Tamil Nadu. The aerial extent of the Ayyar river basin is 1,167 sq.km and covers Musiri and Thuraiyur taluks (Anbalagan *et al*., 2005). In the present study three wetlands namely Thiruthalayur wetland (Thuraiyur taluk), Mullipadi wetland (Musiri taluk) and Nagayanallur wetland(Musiri taluk) receiving water from the Ayyar basin were selected.

Methods

For the present study SOI toposheet (Index no-58J, 58I, 58M) with the scale of 1:250,000 as a medium scale of topographic terrain for tank demarcation with reference of 1:50,000 was used. The toposheet was imported into the ARC GIS (9X) software environment. The data were scanned and saved as a tagged image file format (TIFF). Geometric corrections were made with GCS (Geographic Coordinate System) with respective geographic coordinates of Trichy district. Data management test was used for digital conversion of all tanks within the district.

For the present study of boundary analysis, three tanks of Trichy district were randomly selcted based on the heterogeneous charecteritics and the nearness to the main river, the Cauvery. The tanks are : Thiruthalayur tank comprising a big tank and a small tank with combined size of 285.60 ha, followed by Mullipadi tank of size 52.50 ha and Nagayanallur tank of size 161.80 ha (Figure1)

The first period of data for the three tanks were derived from 1973 toposheet. For the second (2003)and third period (2010) the maps were derived from IRS 1D LISS 4 PAN MERGED and IRS PS LISS 4 FCC. All these satellite images were purchased from NRSA (National Remote Sensing Agency). The digital data were classified and extracted using ARC GIS software. All the raster data were converted to vector data. The vector database contains various attributes such as aerial extent and perimeter of the tank. The changes were deteted by using 1973 as a base data. The changed area were measured and compared with 1973 vs 2003, and 1973 vs 2010.

Tamil Nadu governmental departments such as Public Works Department, Agriculture department and district taluk office were also consulted and relevant data collection were done from the available records.

Results and Discussion

The morphometric details of the tanks given below is based on the available data of the records of PWD, Thuraiyur taluk of Trichy district.

Thiruthalayur big tank

This tank is situated about 0.80 km north of number 67 Thiruthalayur village in Thuraiyur taluk of Trichy district. It lies in SF NO.108 of NO.67. Thiruthalayur village SF NO.66.22 of NO.66 degree T. It receives water supply from its free Ayyar basin of 71.120 sq.km. In addition to this there is a road culvert cum regulator with a vent size 1.40x1.85 meter in the common bund of big tank and small tank. This road culvert cum regulator is practically connecting the water level of both the big and small tank. There are 27 significant upper tanks to this two big and small tank. The capacity of the tank is 5.09 mcm, irrigating 170.6 hectares.

Thiruthalayur small tank

This tank is situated about 1.6 km north of NO.67 Thiruthalayur village in Thuraiyur taluk. It receives its water supply from its free basin of 1.866 sq.km. besides the supply channel from Ayyar river. The capacity of the tank is 1.379 cubic meters irrigating 92.33 hectares. This small tank serves as the immediate upper tank to the big tank.

Nagayanallur tank

This tank is situated in the eastern end of No.24, Nagayanallur village in Musiri taluk of Trichy district. It lies in SF No 382 of No 24 Nagayanallur village. It receives water supply from its free basin besides the surplus of one significant upper tank and six other insignificant upper tanks. In addition the tank receives supply from a supply channel from an anicut across river karaipottanar. This tank has well raised bunds and sluice for the discharge of water for irrigation. Total storage capacity Is 2.618 cubic meters.

Mullipadi tank

This tank is situated on the north west corner of No37 Mullipadi village of Musiri taluk of Trichy district. It lies in SF no 4, 44, 60 and 66, 67,68 of No 37, Mullipadi village and SF No570 of No 19, kulakkudi village. This is a government tank maintained by the PWD(Public Work Department). It receives supply from its free basin besides the surplus of four significant upper tanks namely Sergudi eri, udakulam eri, Surampatti eri and Sittalarai eri. In addition to the surplus of the upper tanks, this tank is also receiving the supply through a supply channel, which offtakes from north bank channel of Cauvery. Full tank water storage capacity is 1.032 M.sq.M.

From the table 1 and 2 it is noted that the area of Thiruthalayur big tank and small tank in 1973 was 173.3 ha and 112.3 ha respectively. But in 2003 (Based on IRS 1D LISS 4 PAN MERGED) the area of big tank and small tank was 156.94 ha and 97.77 ha.The percentage decrease from 1973 to 2003 was 9.49% and 0.46% in big and small tank respectively (Figures 2 and 3). In 2010 (Based on IRS P6 LISS 4FCC) the area of big tank and small tank was 155.98ha and 105.75 ha. From the table 2 it is evident that the percentage decrease of area was 12.6% in big tank and 8.46% in small tank by comparing 1973 data vs 2010 data (Figures 2 and 4)

Like Thiruthalayur tank, Mullipadi and Nagayanaluur wetlands also showed reduction in area over the years. The area of Nagayanallur wetland in 1973 was 161.8ha against 113.21 ha in 2003 (Figures 2 and 3) showing a reduction percentage of 27.56%. In 2010 the Nagayanallur wetland was 157.36ha showing a reduction percentage of 2.72% as against 1973 (Figures 2 and 4).

The area recorded in 1973 for Mullupadu was 52.6 ha as against 49.21ha in 2003 (Figures 2 and 3). The percentage reduction was 6.27%. In 2010 the area of Mullipadi tank was 37.27 ha showing a reduction percentage of 28.99% (Figures 2 and 4).

Table 1 Area of the Wetlands in 1973 (based on 1973 topsheet), 2003 (Based on IRS ID LISS 4 PAN MERGED) and 2010 (Based on IRS P6 LISS 4 FCC)

Name of the wetland	Size (ha) over a period		
	1973	2003	2010
Tiruthalayur			
Big Tank	173.30	156.94	155.98
Small Tank	112.30	97.77	105.75
Nagayanallur	161.80	113.21	157.36
Mullipadi	52.60	49.21	37.27

Table 2 The percentage reduction in area of the wetlands over a period 1973 vs 2003 and 1973 vs 2010

Name of the wetland	1973 vs 2003	1973 vs 2010
Tiruthalayur		
Big Tank	9.49	12.6
Small Tank	0.46	8.46
Nagayanallur	27.56	2.72
Mullipadi	6.27	28.99

Worldwide wetland areas are shrinking. The RAMSAR convention on wetlands is a unique treaty between nations aimed at conserving wetlands. Its main aim is to prevent the loss of wetlands and conserve them.

The first scientific national inventory of wetlands in India carried out at 1:250,000 scale by Space Application Center (ISRO) Ahmedabad at the behest of the Ministry of Environment and Forest(MoEF), government of India using IRS satellite data (1992-93 time frame) put the total wetland extent at about 8.26 million ha. The state wise wetland distribution for Tamil Nadu shows 6.92% (the hindu 2012).

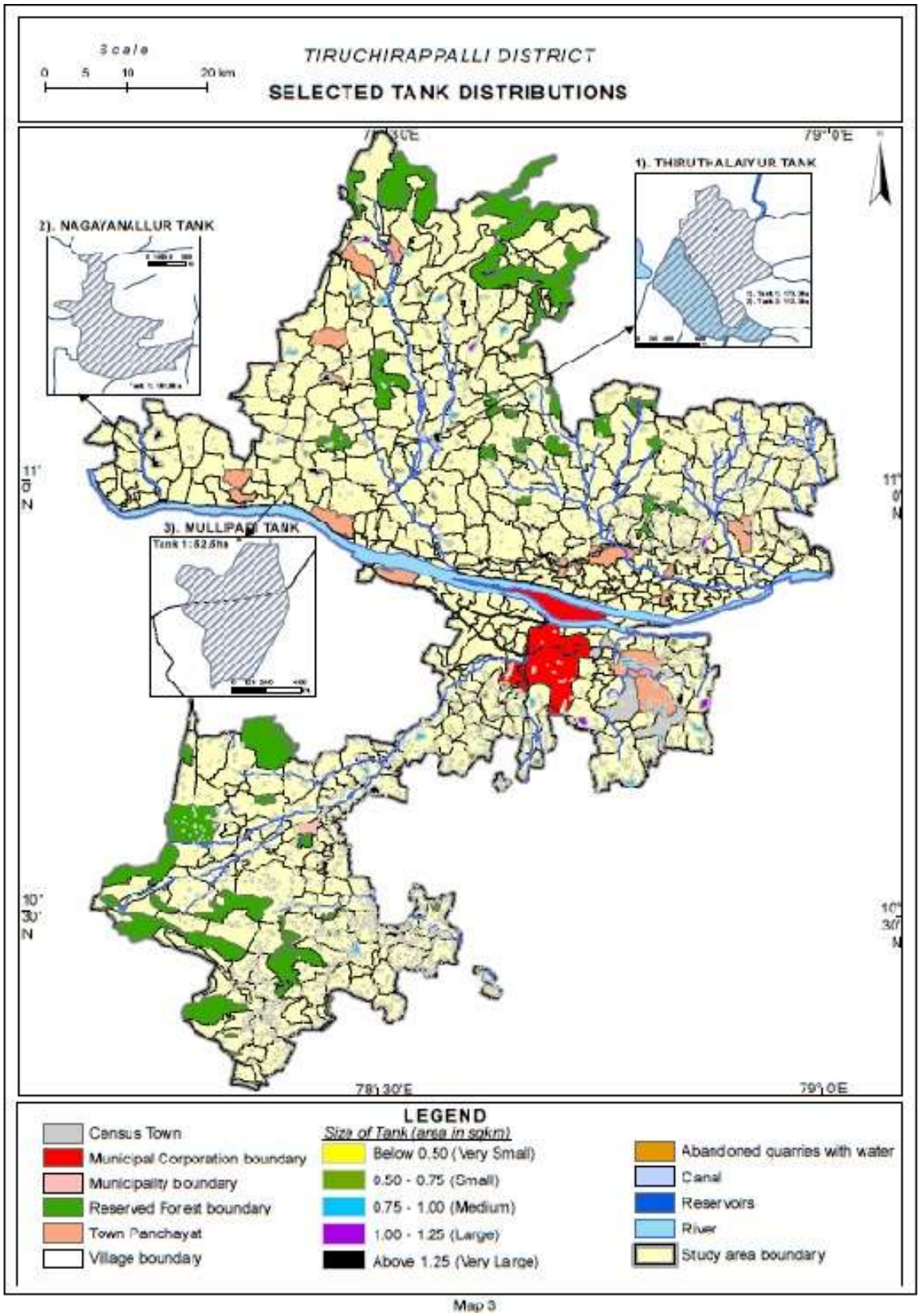

Figure 1 Three randomly selected wetlands in Trichy district

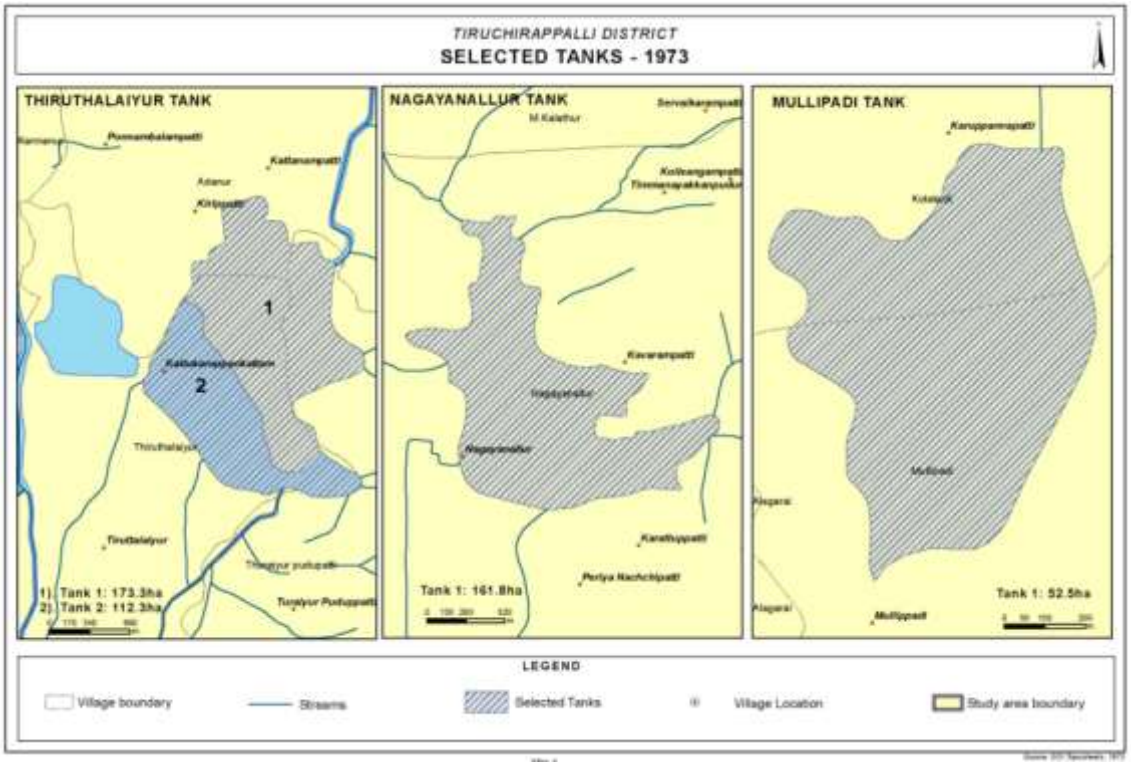

Figure 2 The selected wetlands (1973 toposheet)

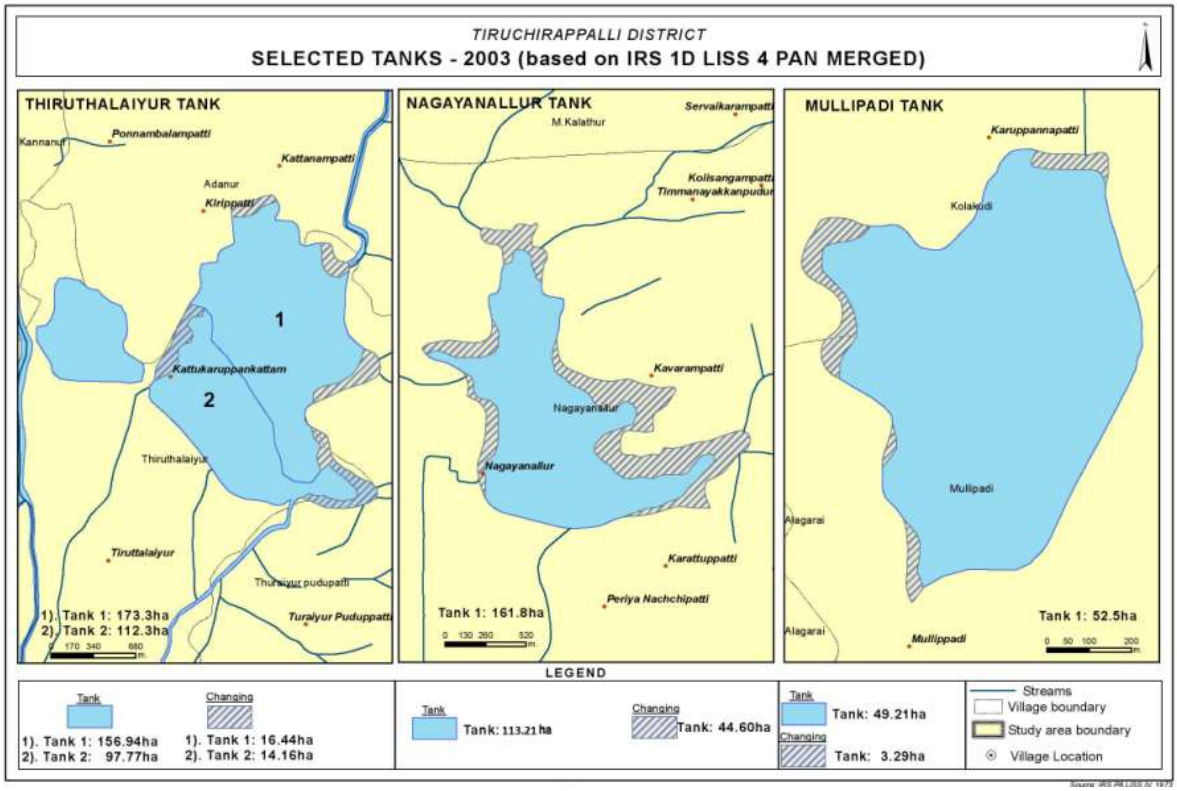

Figure 3 Selected tanks as of 2003

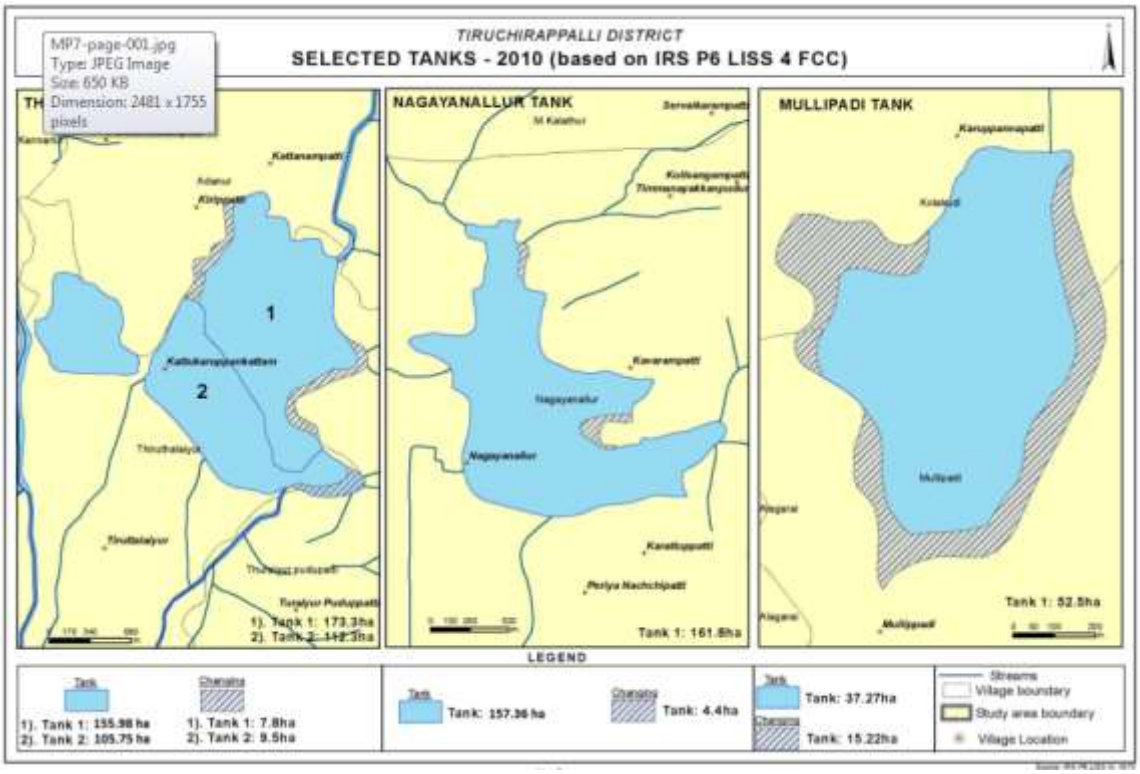

Figure 4 selected tanks as of 2010

Wetlands are ecologically important to protect biodiversity, to retain water during dry periods, diminished flood intensity and meeting many crucial needs of life like drinking water, irrigation etc. Today wetlands are the most threatened habitat in India. Understanding the urgency to protect the wetlands, the government of India is taking all necessary steps in a holistic way. The present study shows all the three wetlands shrinking over the years and thereby changing agriculture pattern and biodiversity and life style of the people.

Conclusion

The main reason for the diminishing area of the three wetlands under study is failure of monsoons and less water supply from the main rivers, the Cauvery and Ayyar. Tamil Nadu government recently sanctioned 57.05 lakh rupees to renovate Thiruthlayur big and small tank (Ganesan S 2013). Renovation includes masontry structures, sluice and weirs, bunds of the tanks and also desilting. During the study period desilting work was being carried out. Similar measures would also help in protecting other wetlands.

Authors Contributions: A.Job Martin Durai is a research scholer preform the experiment and map preparation, wrote the menuscript and correpessponing author of menuscript. and Dr S.Kalavathy is Assosiate professor and Ph.D. supervisor of First author, editded the menuscript.

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