

ASSESSMENT OF IMPACT OF URBANIZATION ON WATER BODIES IN CUDDALORE DISTRICT USING REMOTE SENSING AND GIS

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Abstract- Water bodies are the important natural resources, which is necessary for different objectives such as Agriculture, Forestry, provides habitat for aquatic organisms and day to day demands as required for human needs. The problem of water quality in and around the urban areas is drawing interest for several years. But in recent days due to urbanization the water bodies are being vanished. Hence there is a need for analysis for water quantity. The aim of the study is to find out the location and Land use and Land Cover changes in Cuddalore District covering an area about 3564 km² during the year 1980, 2000 and 2020 satellite imageries from the P6 LISS - iii Resource satellite - IRS and Survey of India toposheet number 58M/3, 1970 used for the preparation of drainage map which is basically needed to compared with the geo- reference maps. For few decades, the study area has faced the variations in water bodies due to large number of anthropogenic activities. The impact on these activities on shrinkage of water bodies is attempted and evaluated by Remote Sensing and GIS technique. Change detection method is used to assess the water bodies which are shrunk to a larger extent of the study area. After completing the analysis of GIS environment, it is inferred that the pond areas started vanishing significantly during 1980 to 2000. This is due to poor rainfall, increase in population and industrialization in large scale and led to encroachment. The field visit is completed for three sites namely Nathapattu, Thazhangudai and Vazhapattu for observing and assessing the present status of the pond and gathering the information about the pond from the local people. Adiyam pond is located in Vazhapattu village is severely affected and completely encroached. After the completion of digitization process questionary survey is conducted for the selected pond area the suggestions are provided to conserve the present water bodies.

KEY WORDS: Remote Sensing, GIS, Urbanization, Shrinkage of Water Bodies, Anthropogenic activities.

1. INTRODUCTION

The terms land use and land cover is often used interchangeably but each term has its own unique meaning. Land cover refers to the surface cover on ground like vegetation, urban infrastructure, bare soil etc. Identification of land cover establishes the baseline information for activities like thematic mapping and change detection analyzing. Land use refers to the purpose the land serves, for

example, recreation, wildlife habitat or agriculture. When used together with the phrase Land Use/Land Cover (LULC) generally refers to the categorization or classification of human activities and natural elements on the landscape within a specific time frame based on established scientific and statistical method of analysis of appropriate source materials. Land cover is the physical material at the surface of the earth. Land use is the description of how people utilize the land for the socio-economic activities.

Water is a primary natural resource which is necessary for different objectives such as Forestry, Agriculture, Urbanization and other day to day demands as required for human needs. The problem of water quality in and around urban areas is drawing interest for several years. The unscientific and unplanned urbanization and industrialization practices are getting a numerous problem which include the portable water quality. Hence there is a need for the analysis of water quality problem in urban areas. Since the changes in climatic conditions the annual rainfall is continuously result in the reduction of water bodies adulterating the quality of ground water, contamination of portable water and different health hazards.

Adequate supply of pure water is a basic need for all humans yet it has been observed that millions of people worldwide are deprived of this. The consequence of urbanization and industrialization has caused the deterioration of water quality. Contamination of drinking water may occur by percolation of toxics through the soil into groundwater that is used as a source of drinking water. Groundwater quality is being threatened by disposal of urban and industrial waste and agricultural chemicals. The rate of depletion of groundwater and deterioration of groundwater quality are of immediately concern in major cities and towns of the country. Geographic Information System (GIS) and Remote Sensing are effective tools for water quality mapping and land cover mapping essential for monitoring, modelling and environmental changes detection. GIS can be a powerful tool for developing solutions for problem related to water

resource for assessing water quality and managing water resource on a local or regional scale.

SCOPE & OBJECTIVE

This study has attempted the following objectives to assess the current situation of water bodies in Cuddalore district due to rapid urbanization.

- To study the land use and land cover changes.
- To analyze the change detection using Geographical Information System (GIS) and Remote Sensing.
- To study about the Shrinkage of water bodies.

2. LITERATURE REVIEW

Impact of Urban Growth on Water Bodies – A Case on Hyderabad. Et.al / 2014. This study makes an attempt to analyze the transformation of common property resources into private property. It argues that in this process of loss of water bodies in Hyderabad the state as much as responsible as private agencies in term of the policies that it has formulated and the lack of ensuring legislation and implementation.

Impact of Land use and Land Cover Changes on LST; A Case Study from Salem Area, Tamil Nadu using Remote Sensing and GIS. A. Muthamilselvan et.al / 2016. In this study, multi – temporal data sets have been used to prepare thematic maps like land use and lands cover, Normalized Difference Vegetation Index and Land Surface Temperature maps for the year 2001 and 2013. The study is done and result is obtained as light significant variation in the land use land cover pattern and its related impact on Land Surface Temperature variation within a short period of time.

Eploring the Impact of urban growth on surface waterbody area loss in Khulna city using GIS Technique. Md Marufuzzaman et.al / 2019. This study deals about the amount of filled up surface water body area in Khunla City Corporation (KCC) during the past twenty years (1998 – 2018). In the result there is a significant land cover changed happen in the last twenty years in Khunla City area and a considerable amount of surface water body area has been replaced by built- up urban space.

LITERATURE SUMMARY

From the above journals, conference papers and also from various articles it is to justify that the Surface water body area encroachment. Several similar kinds pond filling,

location identification using GIS and Remote Sensing technology, the association of surface water body area change with rapid urbanization has been studied to understand the procedure of identifying the location of filled up surface water body area. Finally a specific objective which is identifying the location and amount filled up urban surface water body area using GIS and Remote Sensing technology has been formulated from the literature survey.

2.1 STUDY AREA

The district of Cuddalore is one of the important districts of the state of Tamil Nadu. The district is located along the Eastern Coastal region of the state. The district of Cuddalore is bordered by the district at Villupuram, Nagapattinam and Perambalur. The district is also bordered by Bay of Bengal on the Eastern side. It lies in the Agro climatic Zone II (East coast plains and Hills) and the geographic Coordinates of the district are: Latitude is 15°5' / 11°11' and 12°35'N, Longitude is 78°38' to 80°00' and altitude 4.6 MSL.

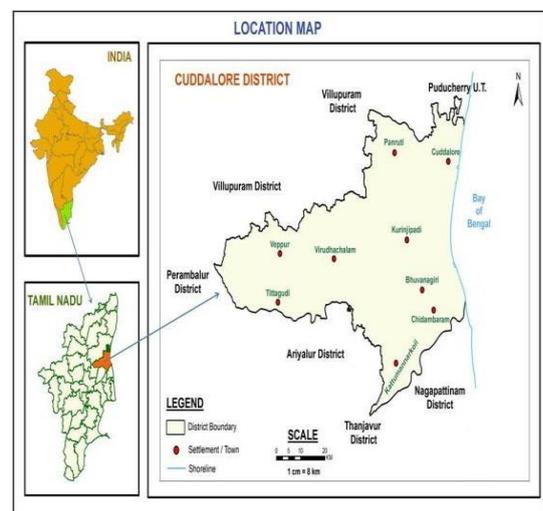


Fig 1: Location Map of Cuddalore District

3. METHODOLOGY

The methodology is a flow chart of the work to be done to complete the project. It comprises the theoretical analysis of the frame of methods and principles associated with the project.

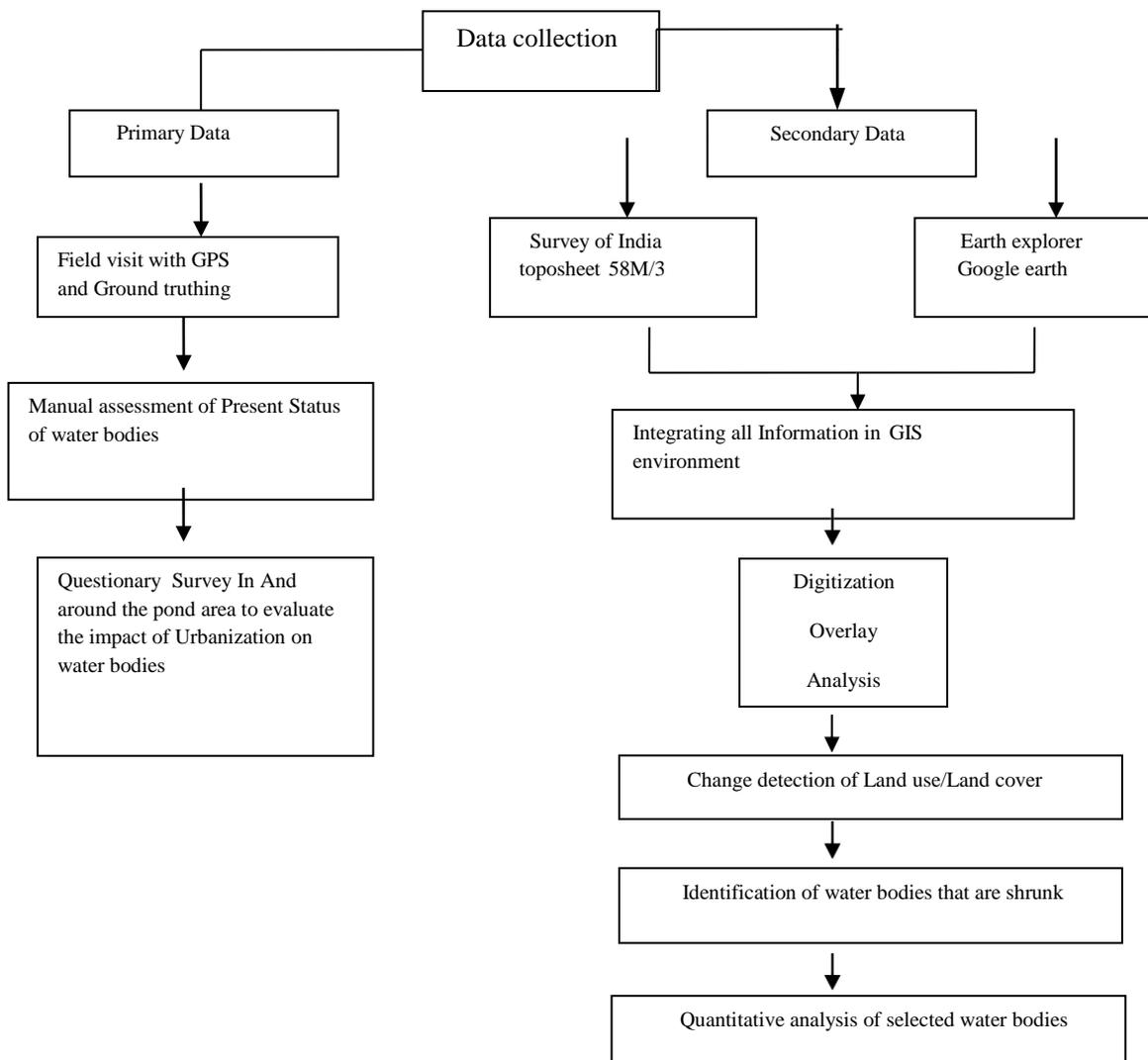


Fig 3.1 Flowchart showing the propose Methodology

4. RESULT AND DISCUSSION

The images clearly indicates that the current encroachment in the pond areas of the four villages. The trace of the pond was observed by digitizing the survey of India toposheet 58M/3 by using the software arc GIS 10.2. With the help of the Google earth explorer the historical images of the study area has been recovered. It is helpful for comparing the satellite image with the geo-browser image. The ponds in the four villages namely Nathapattu, Vazhapattu, Thazhankudai, Senjikumarapuram were clearly analyzed by using Google earth explorer and the field study has been conducted to know the present status of the pond area and the present condition was mentioned. The field visit images are the evident that the water body is vanishing and shrinking because of the dumping of residential sewage and industrial waste. This has resulted in the alarming increase of acidic content in the water body which has subsequently led to the rapid growth of a defense layer of algae and weeds. The sewage water from the residential region has been noticed. This is the main reason behind the death of aquatic life in the water body. The saline, tepid, greenish water, which is home to several weeds and harmful microorganisms is totally unfit for drinking and domestic purposes. Sewage chiefly contains organic matter which promotes the growth of various micro-organisms especially bacteria. Various pathogenic bacteria are known to occur in the water at the points of sewage disposal (Tiwaari and en, 1991). The effluent from small plywood industry discharged into the aquatic system change the physio- chemical properties of water were affected. Thereby effecting the aquatic flora and fauna in general and the fish population in the particular area. The industrial effluents generally contains heavy metal which have more disastrous and long lasting adverse effects on the human health

STATUS OF WATER BODIES

Cuddalore district is divided into 6 taluks. The taluks where further divided into 13 blocks which is further divided into 898 villages. The study area contains 11263 dugwells, 30687 tube wells, 594 tanks, 270 canals, 21 others

S.No	Taluk	Area in Hectars	No. of villages	Block	No. of villages
1	Cuddalore	56645	148	1.Cuddalore	77
				2.Kurinjipadi	72

2	Panruti	56097	99	3.Annagramam	55
				4.Panuruti	44
3	Chidambaram	64582	189	5.bhuvanagiri	55
				6.parangipettai	57
				7.keerapalayam	77
4	Kattumannarkoil	48523	165	8.kattumanarkoil	76
				9.kumaratchi	89
5	Virdhachalam	82247	135	10.virddhachalam	69
				11.kammapuram	66
6	Tittagudi	59687	162	12.nallur	77
				13.mangalur	85
	Total	367781	898		898

(Source: Dept. of statistics, Cuddalore)

Table 4.1: The block and villages detail of the study area

The status of ponds in the area under study varied greatly

Four ponds (covering four survey numbers and three sites) are completely lost as they have been converted to other forms of land use. These ponds are located within Block-I of municipality boundary that has been considerably urbanized in the recent decades. In the site where these ponds once stood, we found congested residential layouts interspersed with the roads, shops and religious institutions. One of them has been converted over a decade to make way for facilities such as Grama panchayat kudam in addition to houses; the

other is enclosed within the property belonging to the defense authorities

Eight ponds were in a degraded state there were signs of extreme pollution, large heaps of garbage and construction debris were found dumped in the pond and the surroundings (www.cdlpwd.com) Sewage was also found flowing into a couple of these degrade ponds. Invasive water hyacinth covered the water's surface in several of the ponds, while weeds clogged the water's edge. In most of the areas, the drier parts of the bed and surroundings were being used for open defecation by migrant workers and urban poor who had set up settlements in the lands next to these water bodies (source: Dept. of statistics, Cuddalore). Many of these were construction laborers', who had not been provided any facilities for sanitation or water by the contractors. In one of the site, we noted considerably encroachment, as people had built hutments on the drier part.

We recorded 3 ponds in relatively good condition. While there was not much water even after the rains in the site, our observations indicated that the surrounding were not used as sites for dumping garbage as extensively as in the case of degraded site, nor were there any signs of encroachment. The ponds were sites for grazing livestock and collecting fodder, and the pools of water were accessed for washing and watering the animals. In one of the pond, we observed women collecting a variety of leaf vegetable locally termed onagane soppu (*Alternanthera sesilis*) a high nutritional value produce and part of the local diet. Washing clothes and bathing were also observed in some of the pond areas, though to a very limited extent.

Two ponds were in good condition. We found that they held considerable water after the rains, and had fewer signs of pollution when compared to the other ponds. We observed garbage and construction debris dumped in the site and surroundings, but this was much less compared to any of the

extent observed in the degrade pond. We observed five relatively ponds tendered for fishing had been given. Traditionally fishing in these ponds was done by locals who revealed that the fish was a source of protein in their diet. Under the current system, ponds are leased for fishing for a specified period of time to the highest bidder. These fishers introduced fingerlings of specific species, which have replaced indigenous varieties. The fish is then sold in the market and to eateries across the villages. In one of these ponds we also witnessed local youth catching fish using lines even though the pond was leased out. Three of these ponds has been developed - with fencing and neatly paved footpaths that were accessed by the local residents for walking. With the exception of the privatized pond and the pond enclosed with fencing, we observed grazing, fodder collection, collection of leafy vegetables, or washing of clothes and vehicles. Fuel wood collection was also seen along the bund and around the area. At present, the lake boundary exists, and we observed small pools of water within the boundary. One of the visits we noticed women collecting grass with which to make brooms from the land around the pond. Locals said that initially it had been encroached, but speculated that the land would be allocated for slums. All the ponds in the study area fall within the spectrum of varying urban to rural features. In more rural parts, some very typical features are visible. The land use around pond includes a mix of rural and urban processes. Thus in some sites cultivation of flowers, fodder grass, and vegetables were found to exist in close proximity with small business enterprises such as block making, small plywood factories and brick making units. Residential layouts have been marked for development around the lakes and ponds slum people's houses were constructed

No. of Ponds	No. of sites	Status of Pond	Type of Use	Dependence of Pond
4	4	Converted	<ul style="list-style-type: none"> ➤ To houses for disadvantaged groups ➤ Grama panchayat Kudam ➤ Enclosed for defence established ➤ Small traders 	<ul style="list-style-type: none"> ➤ NA
4	4	Degraded	<ul style="list-style-type: none"> ➤ Extreme pollution caused Dumping of garbage and construction debris ➤ Sewage inflow ➤ Invasive water hyacinth growth ➤ Open defecation encroachment 	<ul style="list-style-type: none"> ➤ Some cultivation in wetland ➤ Grazing to some extent
5	5	Relatively good	<ul style="list-style-type: none"> ➤ Not much water in pond ➤ Some dumping of garbage 	<ul style="list-style-type: none"> ➤ Grazing and fodder collection around pond areas ➤ Water from some existing pools used for washing clothes and watering livestock's ➤ Foraging for food ➤ Water for household use ➤ Fuel wood collection
5	5	Good	<ul style="list-style-type: none"> ➤ Lesser signs of pollution ➤ Less garbage and construction debris dumping ➤ Less water hyacinth growth 	<ul style="list-style-type: none"> Fishing via tenders Recreational use Grazing and fodder collection Washing of clothes and vehicles Collection of leafy vegetables Fuel wood collection

Table 4.1.1: Ponds in study sites and dependence

4. 2 IDENTIFICATION OF WATER BODIES THAT ARE SHRUNK TO LARGE EXTENT

Finally we discussed to go for an field visit for four places that are completely converted into other form land use and the places are tabulated in the following table

Google earth explorer has been used for recovering the historical images for the respective places which is undergone for field visit

Sl.No	Name of the pond	Name of the village
1	Pattur pond	Nathapattu
2	Thai pond	Thazhangudai
3	Adiyankulam	Vazhapattu

Table 4.2: Water Bodies that are shrunk to larger extent

4.3. HISTORICAL IMAGES OF THE ENCROACHED AREAS :

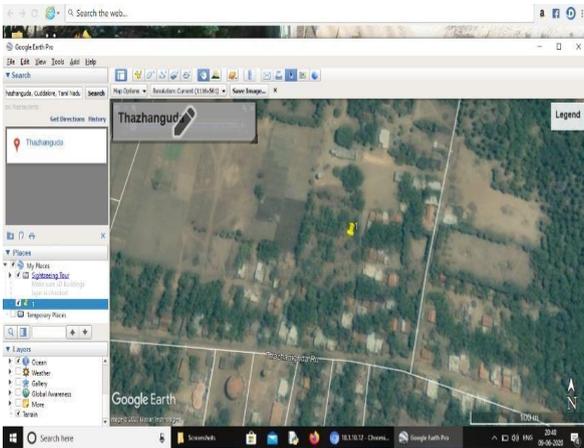


Fig 4.3a Google image of Thazhankudai of the year 1980



Fig 4.3 d Field Photograph of Thazhankudai

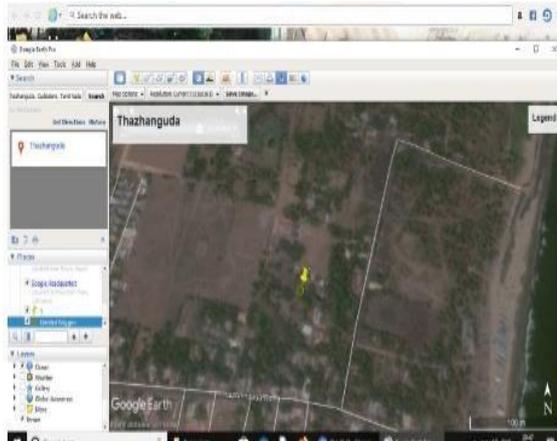


Fig 4.3b Google image of Thazhankudai of the year 2000

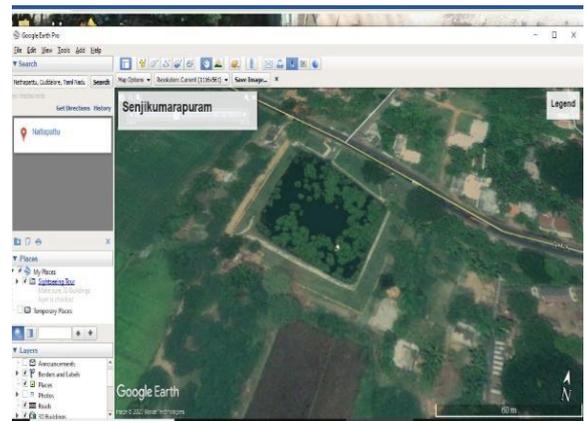


Fig 4.3e Google image of Senjikumarapuram of the year 1980

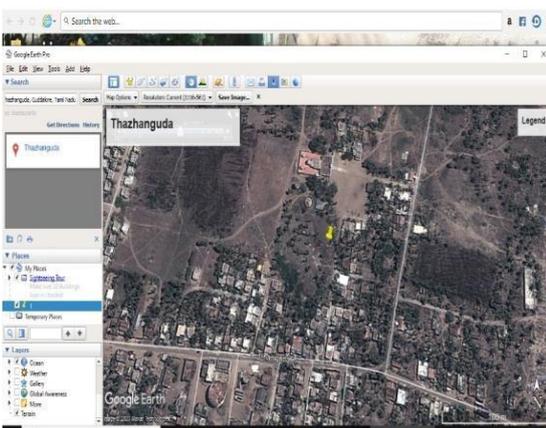


Fig 4.3c Google image of Thazhankudai of the year 2020

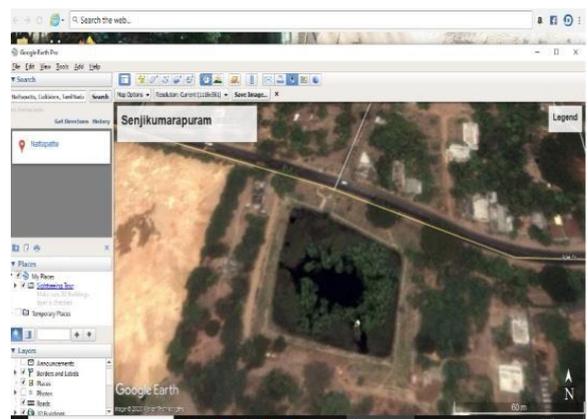


Fig 4.3f Google image of Senjikumarapuram of the year 2000

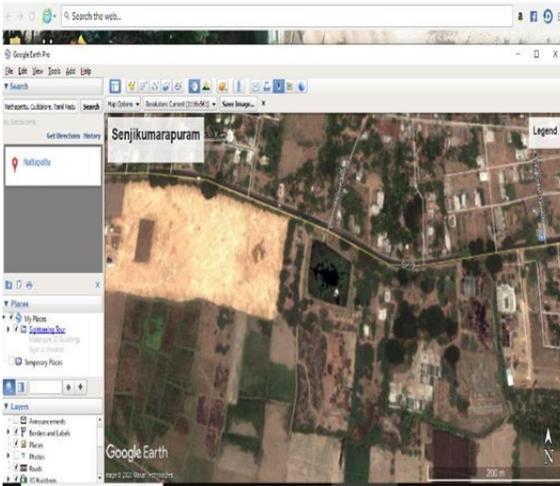


Fig 4.3g Google image of Senjikumarapuram of the year 2020

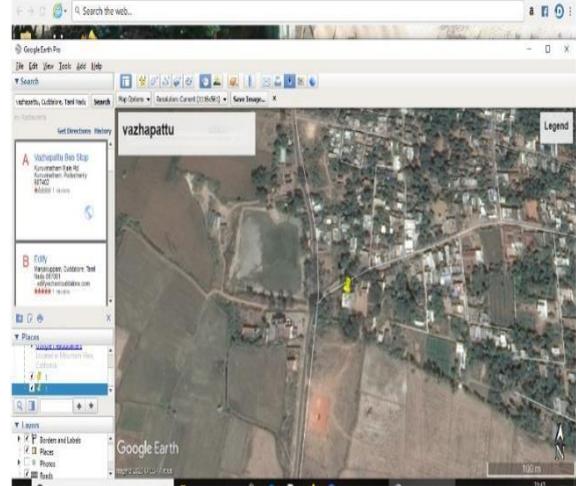


Fig 4.3j Google image of Vazhapattu of the year 2000



Fig 4.3h Field Photograph of Senjikumarapuram

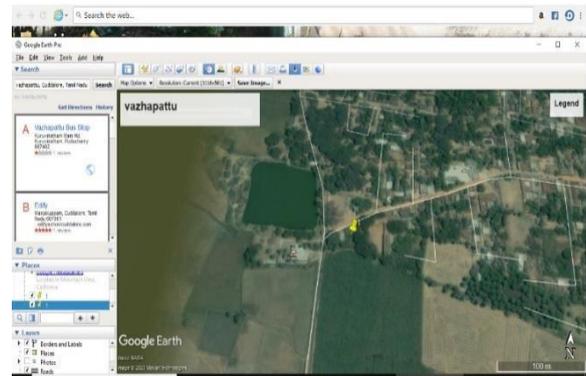


Fig 4.3k Google image of Vazhapattu of the year 2020

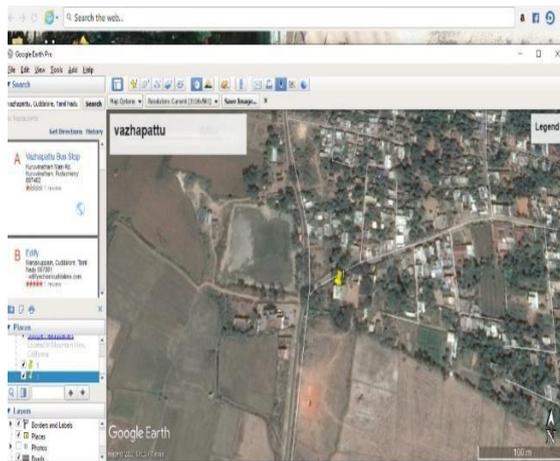


Fig 4.3i Google image of Vazhapattu of the year 1980



Fig 4.3l Field Photograph of Vazhapattu

Sl. No	Name of the village	Name of the pond	Current status of the pond	Type of Use	Description
1	Thazhankudai	Thai pond	Converted	To houses for disadvantaged groups	NA
2	Nathapattu	Pattur pond	Encroachment around the pond area	Grama panchayat Kudam Slum people houses	<ol style="list-style-type: none"> 1. Grazing and fodder collection 2. Washing of clothes and vehicles 3. Collection of leafy vegetables 4. Fuelwood collection
3	Vazhapattu	Adiyan pond	Converted	Enclosed for defense established	NA

Table 4.3: Summary table of field visit

SUGGESTION

- At the beginning of the year 2000 and at the ends of the year's 1998,1999 The pond areas started vanishing to poor rainfall due to the climatic change happened in the world, next the increase in population and large scale industrialization made those areas to get encroached so rapidly three pond areas were converted into build up area. Remaining are used for sewage dumping
- Proper drainage facility should be planned for the residents and sewage treatment plant for industries must be checked regularly.
- Proper law must be implement for the protection of the areas of the water bodies, and under construction building on pond area must be demolished. Awareness program regarding lake conservation among residents should be encouraged.

- Demolishment of slum houses should be taken for Repair, Renovation and Restoration of the pond area
- Government should ordered the slum peoples to vacate their houses around the pond areas
- Awareness program to the youngsters about the environmental benefits through the water bodies
- It is also required to replace the fast development programmes, with well analyzed and environmentally sustainable programmes based on a holistic understanding of urban environments and its needs.
- It is also suggested here that the ecosystem service provided by a water body must be valued in terms of quantification of its benefits

5. CONCLUSION

The result of this study clearly shows the urban sprawl is the major reason for the changes in and around the pond areas in Cuddalore district. The satellite data collected from P6LISS-III Indian resources satellite along with the field verification data and Google earth explorer geobrowser data were used to analyze the current status of the pond area and the type of usage of the pond in the study area during 2004- 2019 using Remote Sensing (RS) and Geographic Information System (GIS) tools showed that the built up area expansion and reduction of water bodies during this period. Most of the expansion was observed which caused the considerable loss of water bodies in the study area. A holistic understanding and acknowledgement of urban water system should be important part of urban water management plan. Without a healthy catchment water body is no more than a tank and has no abilities to maintain its water balance by its own. There is also a need to emphasis on developing a systematic strategy involving all the components that have an impact on the water body and the involved stakeholders along with a better coordinating among the government agencies, as part of pond/lake and wetland restoration and protection programmes. Citizens should be aware of the importance and benefits of ponds in their lives, it is extremely difficult to implement law effectively. Hence it is strongly recommended that stakeholder participation and capacity building must be used as an important instrument for better management of urban water bodies. For the protection of basic needs of various human activities, depend on the natural environment factors they are one time origin, they may not be recycled. Hence when disturb the natural environmental factors like air, water and land beyond their limitations of self sustainable capacity it will difficulty to various human activities. Each and every human activities support directly/indirectly by natural environmental factors. Due to degradation of water body (ponds), it will directly/indirectly disturb the quality and quantity of natural environmental factors Hence protection of natural environmental factors, much essential. This analysis result can be useful in policy preparation in

urban development and watershed management. Understanding the rate of land use changes in time and space is useful in planning for suitable management of land and water resources

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