Nonavinakere Waterbody Analysis
Tiptur Taluk,
Tumkur District

Preliminary Report

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1. Background - District details

Nonavinakere waterbody is situated under Tiptur Taluk, Tumkur district. Hence it is important to note the district and physiographical setup while analysing the waterbody, as part of the study. Census data (2011) and the District handbook does give a good amount of information about the district, which is referred to here to under broad details about the district. It is located on the eastern belt in the southern region of the State. Tumkur district comprises of an area of 10,597 sq.km. It is the third largest district in terms of area in the State. The district's north to south extension runs to 174 km. and east to west extension is measured as 125 km. Tumkur is a part of the southern Karnataka plateau and located in the eastern belt in the southern half of the State. Tumkur is a land locked district. It has no natural features like rivers or mountains dividing it from the other districts of the State. The landscape consists mainly of undulating plains interspersed with a sprinkling of hills. To the east of Tumkur and north by Devarayanadurga, there is a short stretch of hilly country intersected by cultivated villages.

1,1 Physiography

There are several hill ranges and isolated hills as well. While the western parts are occupied by long ranges of hills running in a south by south-easterly direction, the eastern parts are occupied by a narrow range of granitic hills running north and south. There are two parallel ranges running north to south and the first one of these in the eastern portion passes through Pavagada, Madhugiri, Koratagere and northern part of Tumkur taluk. The second range, mainly composed of schistose rocks, passes through the western parts of the district in the taluks of Chiknayakanahalli, Sira and Gubbi. There is another cluster of hills covering the middle and the southern parts of Kunigal taluk. In this zone the tree-growth is comparatively dense and trees tend to grow taller and stouter.

1.2 Climate

The year may be divided into four seasons. The district experiences continuous rise in temperature during the months of March to May and April is usually considered as hottest month. Maximum temperature may reach 40^0 or 41^0 C during the hot season. Southwest monsoon sets in during the period of June to September. In this season, the temperature drops appreciably and the weather is pleasant throughout the season. October and November may be termed as post- monsoon season and during the period temperature decreases

steadily and remains cool till February. Winter sets in December and prolongs up to February. December is generally the coolest month of the year and the daily minimum temperature in this season sometimes reaches 9^0 to 10^0 C.

Rainfall in Tiptur & Turuvekere Taluks (Source: KSNDMC)

Tiptur taluk	Average Rainfall(Mm)	166	319	228	713
	Minimum Rainfall (Mm)	12	69	42	294
	Maximum Rainfall (Mm)	393	650	486	1062
	Standard Deviation (Mm)	84	132	115	181
	C.V(%)	50	41	50	25
Turuvekere taluk	Average Rainfall(Mm)	168	381	234	782
	Minimum Rainfall (Mm)	24	152	47	393
	Maximum Rainfall (Mm)	347	651	521	1258
	Standard Deviation (Mm)	82	134	106	200
	C.V(%)	49	35	45	26

1.3 Forest

The total forest area constitutes 4.3 per cent of the total geographical area. These forest areas lie in the dry belt zone. The vegetation in this dry belt is inferior to those found in evergreen forests. Forest region in the district is found to a larger extent on the lower slopes of hill ranges.

1.4 Geology & Soils

Geologically, Tumkur district is situated right on the archaeon complex. The rock formations are represented by the crystalline schists, the granitic gneisses and the newer granites. The crystalline schists of this district, which form the southern extention of the well-defined Chitradurga

1.5 Soil

The soil in the district is generally hard and less fertile. More commonly seen in the district are red soil, black soil and sandy soil. The red soil also known as ragi soil is seen in southern and western taluks, while the black soils in northern taluks and sandy soils in eastern tract are spotted in the district. As per the definition of National Soil survey Organization & Land Use Planning, the soils in the district can be classified as Ustalfs and Ustalfs-Tropepts. Red, gravelly, sandy, clay loam, blade soil, sandy clay, clay and alkaline soils confined to Koratagere taluk alone are the other types of soils found in the district. The red soil is found in the taluks of Tumkur, Madhugiri, Pavagada, Tiptur, Turuvekere, Kunigal and Gubbi. Especially in Tumkur, Kunigal and Sira, the soils are red loams and are 2 to 5 feet fairly deep. They are under laid with murram and are well drained but poor in lime and bases. The red and red loamy soils are suitable for graining a wide variety of crops with manuring and proper irrigation. These soils occur in regions of medium rainfall ranging from 25 inches to 60 inches. Except plantation crops like coffee and cardamom, almost all crops are grown in the district. The black soil are more suitable for cultivation of cotton crops is found in large extent in Madhugiri taluk. This type of soil is also found in Sira, Chiknayakanahalli, Gubbi, Tiptur, Turuvekere and Pavagada taluks. These soils are rich in bases and have a high water holding capacity. The rainfall in these tracts is generally lower than in other parts and farming is of the dry type. Black soils are particularly suited for rain-fed crops like short staple cotton, groundnut, jowar and toor.

1.6 Cropping

The economy of Tumkur is mainly dependent on agricultural land. The district inspite of being not blessed, with major rivers and also with few irrigation projects, the agricultural activity and its contribution to the district economy is worth mentioning. Another feature of the agricultural economy of the district is that, a considerable portion of its land lies in the coconut belt. According to 2011 Census, cultivators form 37.35 percent and agricultural labourers form 26.01 percent, which highlights that agricultural activity is still predominant in the district.

AREA, PRODUCTION AND AVERAGE YIELD OF PRINCIPAL CROPS FOR 2009-10 UNDER ALL SEASONS

Principal Crops	Irrigated			Un-irrigated			Total		
	Area in hectare	Production in tonnes	Yield in Kgs per hectare	Area in hectare	Production in tonnes	Yield in Kgs per hectare	Area in hectare	Production in tonnes	Yield in Kgs per hectare
1	2	3	4	5	6	7	8	9	10
Paddy	35871	138415	4062	464	950	2155	36335	139365	4037
Rice	35871	92325	2709	464	634	1438	36335	92959	2693

LAND HOLDINGS IN HECTARES 2005-06

Sl. No.	Name of Taluk	Marginal (Below 1)		Small (1-2)		Semi-Medium (2-4)		Medium (4-10)		Large (10 and above)		Total Holdings	
		Holder	Area	Holder	Area	Holder	Area	Holder	Area	Holder	Area	Holder	Area
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Chiknayakanhalli	18934	9209	10728	15350	7323	20176	3214	18175	243	3178	40442	66088
2	Sira	15133	7994	13341	19370	10470	28811	5827	33953	988	14713	45759	104841
3	Pavagada	14096	7481	9409	13356	7850	21404	5470	32813	1599	25152	38424	100206
4	Madhugiri	21342	10402	11578	16609	7338	19932	2912	16838	382	5395	43552	69176
5	Koratagere	14173	6871	7659	10922	4602	12658	1905	10696	152	2322	28491	43469
6	Tumkur	30520	13963	12542	17813	7204	19654	2723	16590	236	3355	53275	71375
7	Gubbi	28514	13302	13270	18830	8214	22394	2825	15987	219	2970	53042	73483
8	Tiptur	24113	10946	10504	14867	5825	15994	2156	12174	179	2570	42777	56551
9	Turuvekere	18005	8850	8772	12609	5563	15249	2234	12415	215	2957	34789	52080
10	Kunigal	22109	9997	10121	14317	6946	19103	2663	15029	213	2925	42052	61371
	Total	**206939**	**99015**	**107924**	**154043**	**71335**	**195375**	**31929**	**184670**	**4426**	**65537**	**422603**	**698640**

Source: Tumkur District at a glance 2009-10, District Statistical Office, Tumkur.

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1	2	3	4	5	6	7	8	9	10
Jowar	277	450	1710	7090	5490	815	7367	5940	849
Bajra	0	0	0	136	42	327	136	42	327
Maize	8587	17126	2099	11719	22222	1996	20306	39348	2040
Ragi	8186	16269	2092	171981	236219	1446	180167	252488	1475
Wheat	0	0	0	0	0	0	0	0	0
Total small Millets	-	-	-	-	-	-	2880	2026	740
Total cereals and Millets	**-**	**-**	**-**	**-**	**-**	**-**	**247191**	**392803**	**1673**
Total Pulses	**-**	**-**	**-**	**-**	**-**	**-**	**65040**	**36136**	**585**

The size of the agricultural land holdings is one of the important factors that determine the productivity of the land. The landholdings for the year 2005-06 of different size are given in the below table. From the table given below it is observed that the number of marginal holdings below one hectare and small holdings of size one to two hectares constitute 74.50% of the total holdings. Only 1.05% holders own land more than ten hectares.

Ragi is most extensively cultivated food crop of the district. It is grown both under irrigated and un-irrigated conditions. The total area put under cultivation of ragi roughly constitutes one-third of the total cropped area. Paddy, maize and jowar are the other important crops that is being raised in the district. The major oil seeds grown in the district are sunflower, castor, groundnut, nigerseeds besides rape and mustard, sesamum and soyabean. Cotton, sugarcane and tobacco are the commercial crops raised in the district. Coconut, mango, grapes, brinjal, potato, banana, tomato, papaya and cabbage are some of the plantation and horticultural crops cultivated in the district. Among condiments and spices, the district is known for dry chillies, dry ginger, coriander, black pepper and garlic.

2. Nonavinakere, Tiptur Taluk

2.1 Village Details (as per Census 2011)

Nonavinakere is a Village in Tiptur Taluka, Tumkur district and Karnataka State. Nonavinakere Village Total population is 4631 and number of houses are 1153. Female Population is 49.2%. Village literacy rate is 77.6% and the Female Literacy rate is 36.5% as per 2011 population census data.

In Nonavinakere village, population of children with age 0-6 is 450 which makes up 9.72 % of total population of village. Average Sex Ratio of Nonavinakere village is 969 which is lower than Karnataka state average of 973. Child Sex Ratio for the Nonavinakere as per census is 923, lower than Karnataka average of 948.

Particulars	Total	Male	Female
Total No. of Houses	**1,153**	-	-
Population	**4,631**	2,352	2,279
Child (0-6)	**450**	234	216
Schedule Caste	**365**	157	208
Schedule Tribe	**313**	155	158
Literacy	**3594** 77.6%	1905 41.1%	1689 36.5%
Total Workers	**2,033**	1,478	555
Main Worker	**1,759**	-	-
Marginal Worker	**274**	181	93

2.2 Location and Administration

Nonavinakere Village Gram Panchayath name is **Nonavinakere**. Nonavinakere is 14 km distance from Sub District HeadQuarter Tiptur and it is 86 km distance from District HeadQuarter Tumkur. Nearest Statutory Town is **Tiptur** in 14 km Distance . Nonavinakere Total area is 424.62 hectares, Non-Agricultural area is 354.73 hectares andTotal irrigated area is 243.65 hectares

2.3 Education

Private Pre Primary, Govt Primary, Govt Middle and Govt Secondary Schools are available in this Village. Govt Arts and Science Degree is available in this village. Nearest Private Engineering College and Govt Polytechnic College are in **Tiptur**. Nearest Govt Disabled School and Private Medical College are in **Tumkur**.

2.4 Health

1 Primary Health care centre , 1 Primary Health Sub-Centre , 1 Maternity And Child Welfare centre , 1 TB Clinic , 1 Veterinary Hospital , 1 Family Welfare centre , 1 MBBS Doctor Practice , 1 RMP doctor , 5 Medical Shops are available in this village.

2.5 Agriculture

Coconuts, Paddy and Ragi are agriculture commodities grow in this village. Total irrigated area in this village is 243.65 hectares from Boreholes/Tube wells 243.65 hectares is the Source of irrigation.

2.6 Drinking-Water and Sanitation

Treated Tap Water Supply all round the year and in summer also available. UnCovered Well, Hand Pump and Tube Wells/Boreholes are other Drinking Water sources.
Open Drainage System Available in this Village. There is no system to Collect garbage on street. Drain water is discharged directly into water bodies.

3.0 Nonavinakere Tank

Nonavinakere is one of the huge water bodies that can be seen in Tiptur taluk with the adjoining, yet another massive water body, " Mallaghattakere". Both these water bodies exist in a series and support large areas of agricultural and irrigation activities. Data from field offices show that Nonavinakere water body was constructed around 1890 with a catchment area of 69.98 sq km. It supported a water spread area of 499.30 Ha with a total capacity of 354.91 million cubic feet and live capacity of 296.00 million cubic feet and the length of the bund is reported to be 2 km.

The discharge capacity was planned to be 11656 cu.secs, proposed utilisation was put at 191.75 mill cubic feet and registered atchkat was 540.92 Ha. The tank was supported with 2 canals, left bank with 6.5 km and right bank with 4.5 km with 3 waste weirs.

3.1 Broad Objectives:

Considering that Nonavinakere is a large waterbody with great potential to support large areas of cropping and horticulture activities, it is decided to holistically analyse the water body and the areas around the water body, including the areas that it can support for agricultural activities. Accordingly, following broad objectives are considered.

1. Surface water body (Nonavinakere lake) area estimation using time series remote sensing data

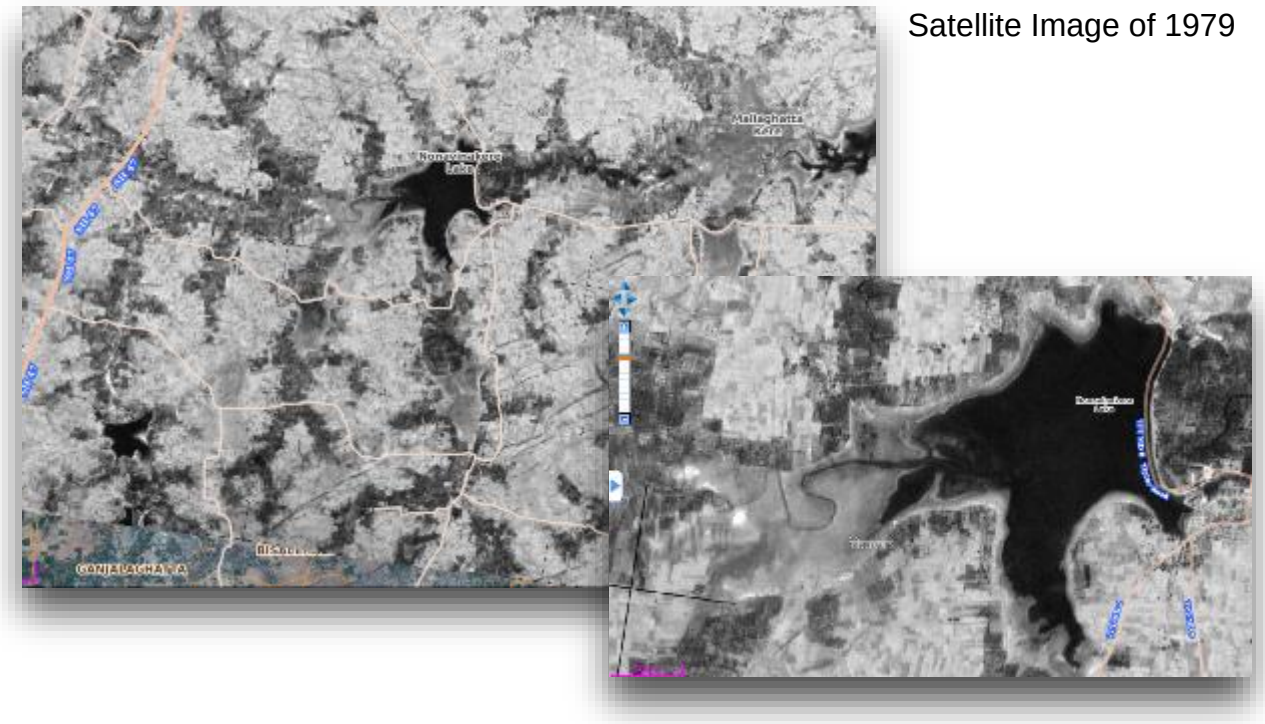
2. Season-wise cropping in and around selected villages of the command area
3. Estimated irrigated and non-irrigated areas in selected season
4. Estimated cultivated areas in selected seasons
5. Other land use and land cover around nonavinakere area

3.2 Data and Analysis Strategy:

Nonavinakere water body and surrounding area is considered for the study. This is taken up by obtaining satellite data from various sources and being stacked for analysis. Following data needs and other important input data are being organised for analysis,

1. Multi-time satellite data
2. Basemap layers
3. Drainage map
4. Watershed and Catchment area boundary
5. Village Boundaries
6. Digital Surface Model
7. Other available thematic maps

Some of the examples of the satellite images that are created and georeferenced to facilitate a geospatial analysis of multiple layers of data are shown as below.



Satellite Image of 1979

Status of Nonavinakere can be assessed by interpretation and analysis of the satellite images of different time periods. Above is one of the oldest satellite image available that clearly shows the status of the land and water features, that can be analysed with respect to the resources. The satellite images shows broad drainage structures and also the surface waterbody of Nonavinakere waterbody at that point of time. Various water channels and also agriculture and plantations can be assessed from the above image.

A series of satellite images, taken for about 10 to 15 years could give a reasonably good information on the waterbody in focus and also the agricultural activities at different point of time. In the present study, we plan to carry out such an analysis of time series data. Satellite data acquisition of late 1990s to recent times are in process for the analysis. Some of the data sets are already presented in this interim report.

Premonsoon image of 2013

Postmonsoon image Of 2013

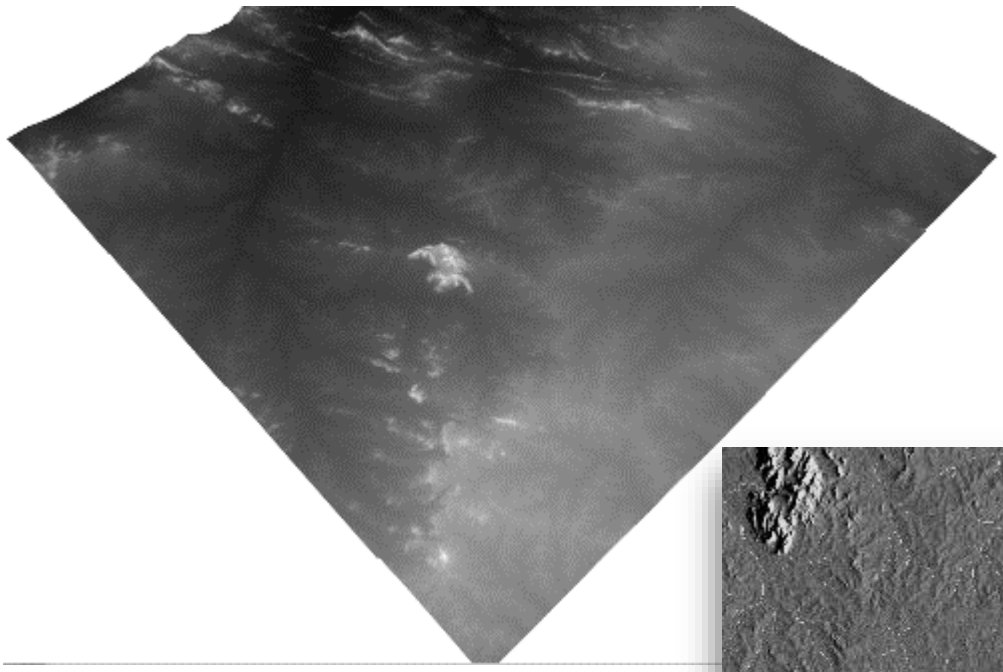
It is clear from the above images that the post monsoon image clearly shows increased amount of water in the nonavinakere and other water bodies.

3.3 Village and Watershed Boundaries

Village boundaries with village names as attributes and watershed boundaries are super imposed on one of the recent satellite data, which shows very little water in nonavinakere and almost no water in the Mallaghattakere. The watershed boundaries are very important to analyse the dynamics of soil and water conservation. Basemap information on road infrastructure are also superimposed on the data for necessary geo-referencing and analysis. The illustration below, with overlay of base layer, watersheds and village boundaries demonstrates the above mentioned facts. The dynamics of water status in waterbodies can be effectively analysed using seasonal satellite remote sensing data that gives clear information on the surface waterbodies in the area of interest. It also brings out the fact that

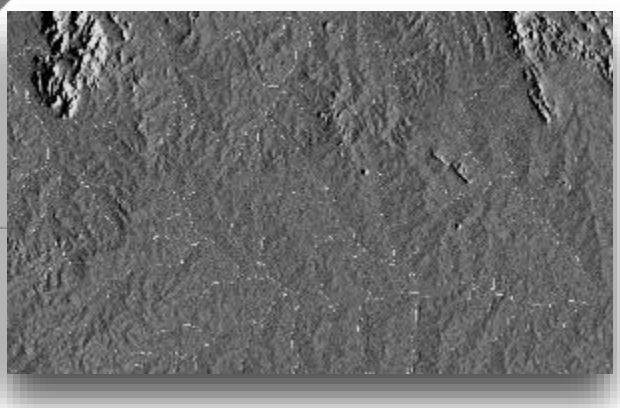
these waterbodies depend on the rainwater from the catchment areas and hence the relevance of watersheds and catchments for analysis.

3.4 Digital Surface Model & derived product:



Digital Surface Model derived From CARTOSAT-1 Stereo images

Relief Shaded Image & drainage of study area

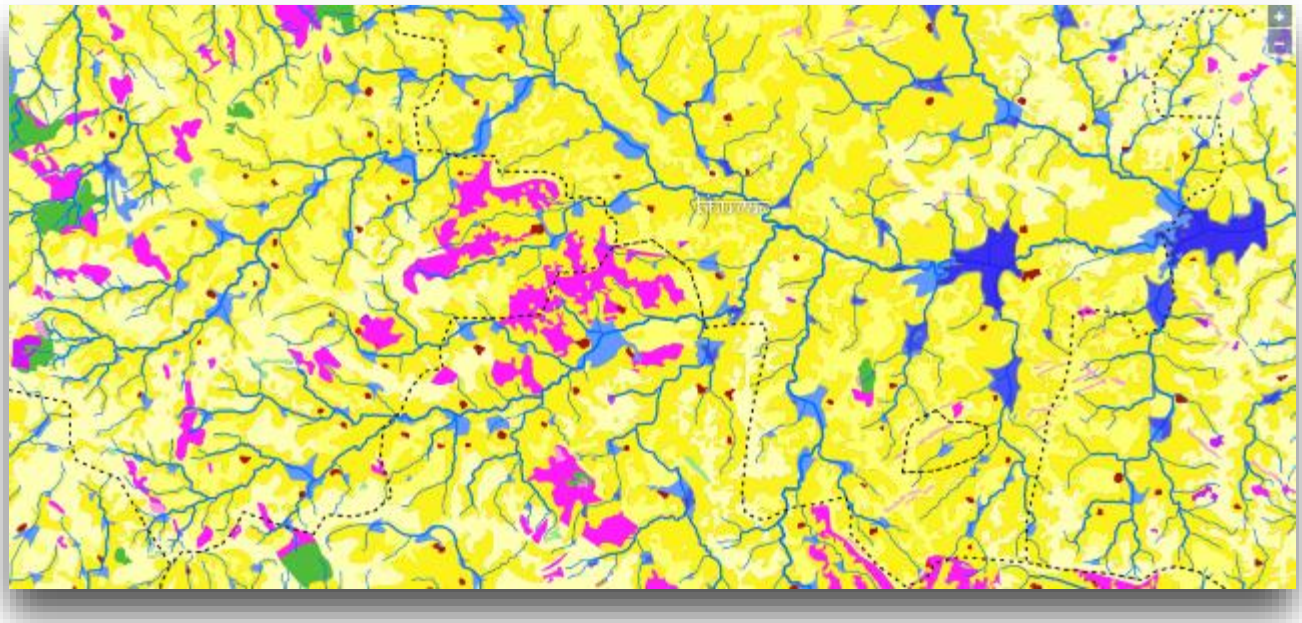


For a study of waterbody and its dynamics, it is essential to generate Digital Surface model (DSM) and use the same with respect to the analysis related to slopes and gradients in the area of interest. A derived product, shaded relief image, is prepared from the DSM that allows better visualisation of the terrain. The drainage network, derived from DSM, is also superimposed to visualise the drainage network on this undulating terrain.

3.5 Land use / Land cover Classification

Satellite images of the study area are further used for image classification with a focus on the agricultural activities. This helps in understanding the areas that are predominantly into agriculture plantations including coconut and the seasonal cropping in the given area.

To better understand the dynamics of the nonavinakere water tank and surroundings, it is essential to analyse multi-time satellite data for both surface water body and agriculture or cropping situation. While analysing the crop map, it is also essential to have the drainage network to understand the gradient and crop-water dynamics.



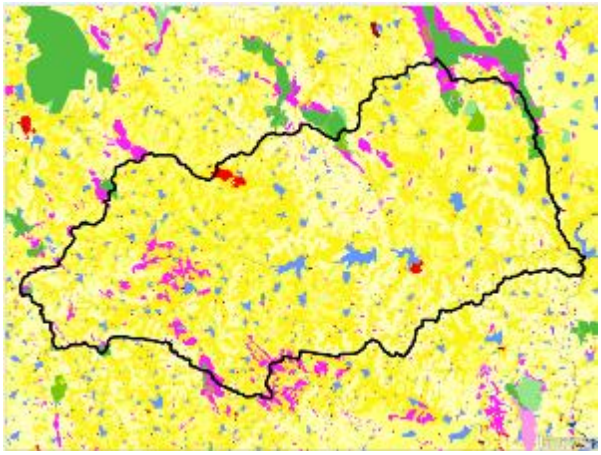
The crop map depicted above, with the overlay of drainage network, clearly shows that all the waterbodies are very well connected through the different orders of streams and rivers that allows rainwater flow and also has enabled creation of water ponds of different sizes, depending on slopes and natural conditions for water holding capacity. The figure shows that, Nonavinakere and Mallaghattakere are the biggest waterbodies in the given area of interest with large capacity to support agriculture and horticulture activities.

3.6 Time Series Analysis:

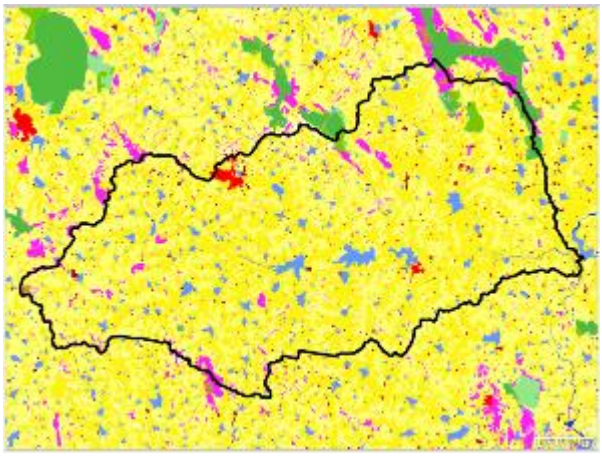
Considering the large sized waterbodies like Nonavinakere, it is appropriate to carry out analysis with regard to water spread in the pond and related to agricultural activities by looking into a well organised time series data. Hence, best available satellite data for more than 20 years is considered for the analysis. A quick assessment of water spread area from 1995 to 2020 shows that there is reduction in the waterspread. Water spread was about 350 hectares in 1995 - 96 and it is about 300 Hectares in 2019 - 20. There has been a gradual decrease in this number ever since 1995, except that in 2011 the value was about 311 Ha. More detailed analysis need to be done to get clear reasoning and related details of such a reduction, which could also be due to silt accumulation and hence reduction in the storage capacity of the water body.

3.7 Watershed-wise Analysis

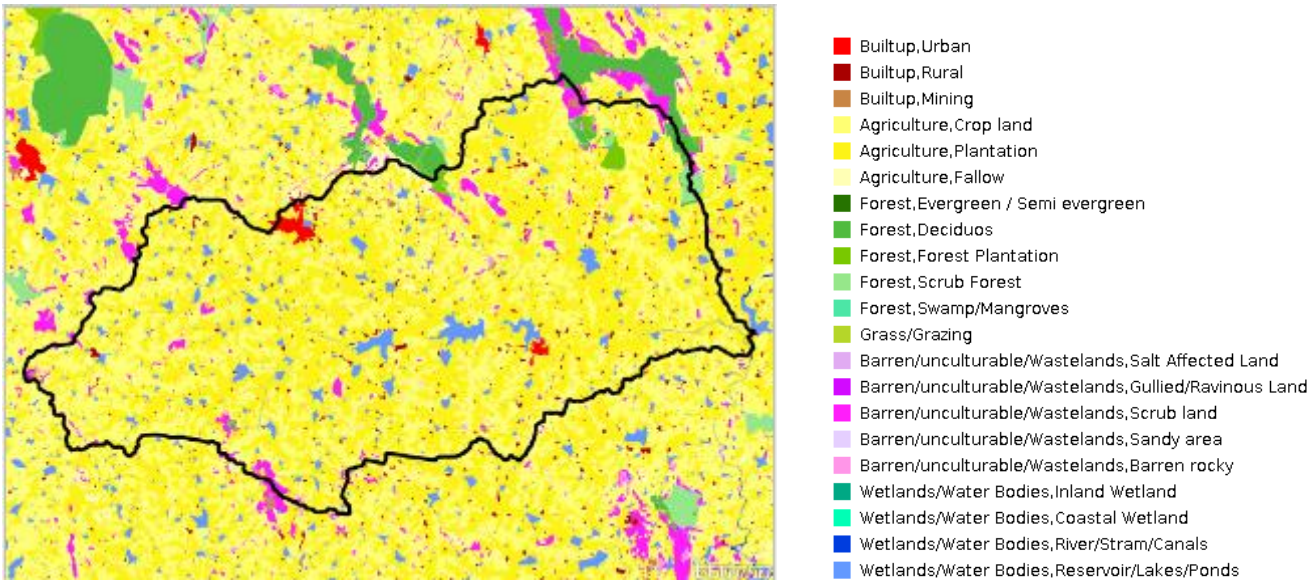
As it has been addressed above, carrying out analysis with well defined natural boundaries helps in making better assessment of the agricultural activities and the related waterbodies, acting as major water storage and also providing support for agriculture and horticultural activities, like a command area. Hence, a group of watersheds around Nonavinakere water-body have been considered and they have been dissolved using GIS tools to make a uniform catchment/command boundary. Satellite data analysis has been done using the catchment boundary as a mask to arrive at a definitive findings with regard to water storage in nonovina-kere and the agricultural activities in the area. Following set of images show the landuse data with regard to nonavinakere catchment area.



Agricultural Land use/ Land Cover **(2005-06)**



Agricultural Land use/ Land Cover **(2011-12)**



Agricultural Land use/ Land Cover **(2015-16)**

As it can be seen from the above, majority of the land use/ cover in the area happens to be Agriculture crop land / Agriculture plantation / Agriculture fallow classes in the vicinity of nonavinakere. The above three classification images, done from 2005-06 to 2015-16, also shows the dissolved watershed boundaries that has been considered as the area of interest which clearly defines nonavinakere waterbody and its catchment for further analysis.

Way-ahead

Detailed analysis of multiple data set from remote sensing on agricultural activities and that of Nonavinakere waterbody is further being carried out to obtain more detailed insights into the dynamics of agricultural activities and the water tank itself.