Land Use Change Detection using Remote Sensing and GIS- A Case Study of Dindigul Panchayat Union, Dindigul District, Tamil Nadu

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ABSTRACT *Land is a basic and non-renewable natural resource on which man depends for his food, fiber and fuel requirements. Per capita land is declining and consequently the pressure on land resources are increasing, that leads to over exploitation of resources. To maintain sustainability of land resources, analysis of land use pattern on real time basis is essential. Hence, an attempt is made in the present study to analyse the land use pattern in Dindigul Panchayat Union for the periods 1973, 1997 and 2017. The methodology includes visual interpretation and classification of land use classes of multi date satellite data of the study area. The interpreted maps are digitized and the areal statistics for each land use classification is presented. Using ARC/INFO GIS techniques, the maps are overlayered to analyze the change detection. This study would assist for future land resource evaluation, management and environmental assessment.*

Keywords: *Land Use, Overlay, Change Detection.*

Introduction

Land is a basic and non-renewable natural resource on which man depends for his food, fiber and fuel requirements. Per capita land is declining due to growing population and consequently the pressure on land resources are increasing, that leads to over exploitation of resources. The term land use generally refers to the functional traits of an area with respect to the occupation of man and his culture. To maintain sustainability of land resources, analysis of land use pattern on real time basis is essential.Hence in the present study, an attempt is made to analyse the land use pattern in Dindigul Panchayat Union for the periods 1973, 1997 and 2017. The results will help in future land resource evaluation, management and environmental assessment.

Study Area

Dindigul Panchayat Union is located in Dindigul district, Tamil Nadu (Fig 1). The study area lies between 10°14'45" and 10°31'00" North latitudes and 77°45' and 78°4'30" East longitudes covering the Survey of India (SOI) topographic maps 58 F/14, F/15, F/16 and 58 J/3 extending over an area of 378.71Sq.Kms. The area consists of 18 administrative units i.e., village panchayats namely Adiyanuthu, Agaram, Alakkuvarpatti, Ammakulathupatti, Anaipatti, Balakrishnapuram, Chettinaickanpatti, Kovilur, Kurumbapatti, Mullipadi, Pallapatti, Periyakottai, Silapadi, Sirumalai, Thadikombu, Thamaraipadi, Thottanuthu and Vellodu. Among these, Sirumalai village panchayat is a hilly area located in the southern part of the study area. Dindigul Corporation (C) is the headquarters of the study area (Fig 2).

Fig 1 STUDY AREA - LOCATION MAP

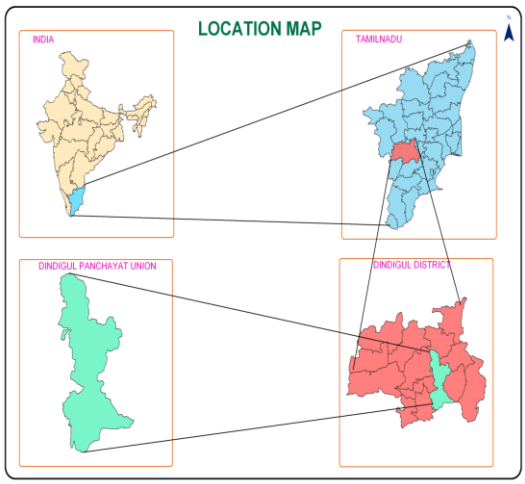
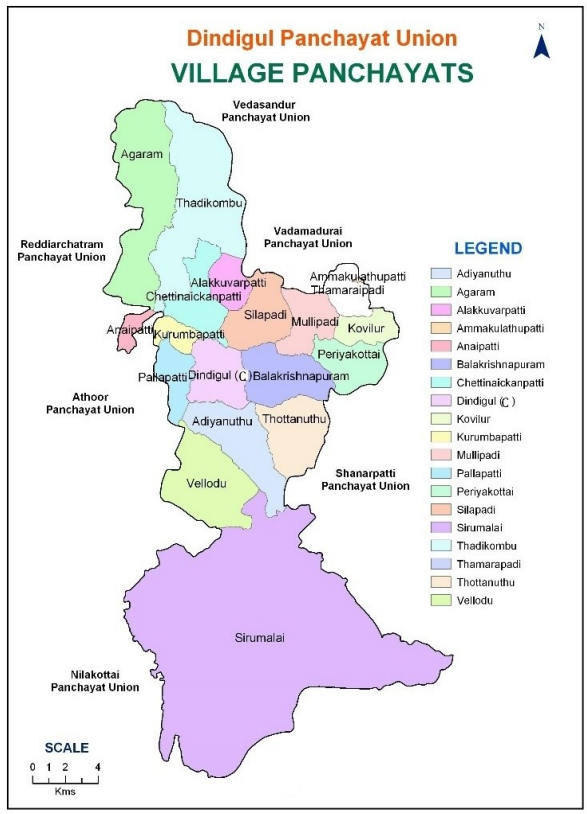


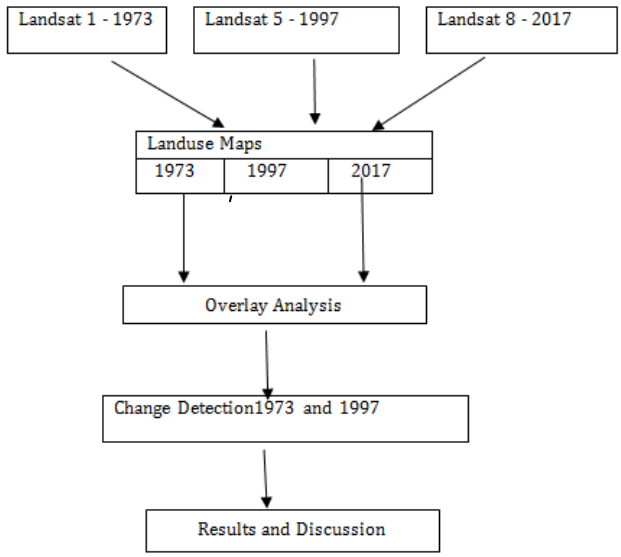
Fig 2 DINDIGUL PANCHAYAT UNION – VILLAGE PANCHAYATS



Data Base and Methodology

The methodology to analyze the land use change detection in Dindigul panchayat union is shown in Flow Chart 1.The methodology adopted for analyzing the change detection includes visual interpretation and classification of land use classes of multi date satellite data of the study area. The interpreted maps are digitized and the areal statistics for each land use classification is presented. Using ARC GIS techniques, the land use maps are overlayered to analyze the change detection.

Flow Chart 1 METHODOLOGY FOR ASSESSING LANDUSE CHANGE DETECTION



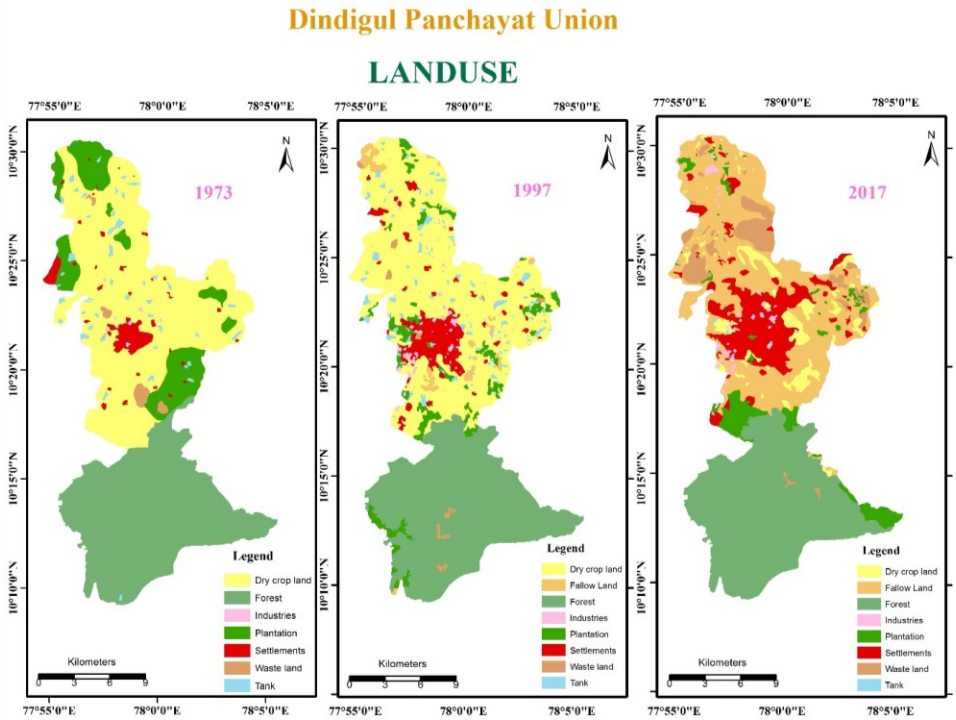
Objectives

1. To identify the area under each land use category in the study area for the periods 1973, 1997 and 2017.
2. To attempt change detection of land use between1973 and 2017.

Results and Discussion

The land use maps for the years 1973, 1997 and 2017 are shown in Figure 3.

Fig 3 Landuse 1973, 1997, 2017



The land use classes and the area covered by each class for thesethree periods in the study area are given in Table 1.

Table 1 Area under Landuse classes

Sl.No	Land useClasses	Area (Sq.Kms)		
		1973	1997	2017
1	Crop Land	170.75	169.49	19.94
2	Fallow Land	0	14.23	133.28
3	Forest	141.06	138.05	137.81
4	Industries	0.53	0.70	0.86
5	Plantation	41.10	20.56	20.37
6	Settlements	10.45	21.26	44.85
7	Tanks	12.20	11.45	0.39
8	Waste land	2.62	2.97	21.21

Land use – 1973

The area under various land use categories during 1973 is shown in Figure 3. From the figure, it could be observed that the crop land is seen almost in all the village panchayats, totally covering 170.75Sq.Kms (45.09 percent). The area under fallow land is completely absent in this period. Forest covers the whole Sirumalai village panchayats for about 141.06Sq.Kms (37.25 percent).The area under industries which cover 0.53Sq.Kms (0.14 percent) is found scattered in Dindigul (C), Pallapatti, Balakrishnapuram and Silapadi village panchayats.The plantation area extending to about 41.10Sq.Kms (10.85 percent) is noticed as patches in Thadikombu, Agaram,Thamaraipadi,Thottanuthu, and Sirumalai village panchayats. The area under settlements accounting for 10.45Sq.Kms (2.76 percent) occupies the major area of Dindigul (C) and is also found scattered throughout the study area. The tanks cover an area of about 12.20Sq.Kms (3.22

percent) is found spread throughout the study area.Wasteland covers about 2.62Sq.Kms (0.69 percent), which is seen in small patches in Adiyanuthu, Thottanuthu, Pallapatti and Thadikombu village panchayats.

Land use - 1997

The area under various land use categories during 1997 is shown in Figure 3. From the figure, it could be observed that crop land area is seen scattered throughout the study area except the southern part, totally covering 169.49 Sq.Kms (44.76 percent). The fallow land has newly developed from this year, covering an area of 14.23Sq.Kms (3.76 percent) is seen inAgaram, Adiyanuthu, Balakrishnapuram and Periyakottai village panchayats. Forest covers the whole Sirumalai village panchayat covering about 138.05Sq.Kms (36.45 percent).The area under industries, which cover 0.70Sq.Kms (0.18 percent), is found aroundDindigul(C), Pallapatti, Balakrishnapuram, Vellodu and Agaram village panchayats.The area under plantation covering 20.56Sq.Kms (5.43 percent) is noticed as small patches in Sirumalai village panchayat and also found distributed throughout the study area. The area under settlements accounts for 21.26Sq.Kms (5.61 percent) and is found scattered throughout the study area. The tanks cover an area of about 11.45Sq.Kms (3.02 percent) is found scattered throughout the study area.Wasteland covers about 2.97Sq.Kms (0.79 percent), scattered in small patches in Sirumalai, Agaram, Thadikombu, Kovilur and Pallapatti village panchayats.

Land use – 2017

The area under various land use categories during 2017 is shown in Figure 3. From the figure, it could be observed that crop land area has decreased to a greater extent and is found in small patches scattered throughout the study area, totally covering 19.94Sq.Kms (5.27 percent). The fallow land covers an area of 133.28Sq.Kms (35.19 percent) is seen in the major areas of the study area, except the southern part. Forest covers the whole Sirumalai covering about 137.81Sq.Kms (36.39 percent). The area under industries, which cover 0.86Sq.Kms (0.23 percent), is found scattered in Dindigul(C), Pallapatti, Balakrishnapuram, Vellodu and Agaram village panchayats. The area under plantation covering 20.37Sq.Kms (5.38 percent) is noticed in Sirumalai village panchayat and also found distributed throughout the study area. The area under settlements accounts for 44.85 Sq.Kms (11.84 percent) and is found scattered and the major settlement is Dindigul (C)in the study area. The tanks covering an area of about 0.39Sq.Kms (0.10 percent) is found in lesser areasin the study area. Wasteland covers about 21.21Sq.Kms (5.60 percent), found in Thadikombu, Agaram, Kovilur, Perriyakottai and Sirumalai village panchayats.

Land use Changes detection between 1973 and 2017

Crop land

Between the periods 1973 and 2017, area under the crop land has been converted into settlements mostly around Dindigul Corporation. This conversion will lead to a decline in cultivable land and end up in scarcity of food production. Secondly, the crop land has also been converted into fallow and waste land between these periods. This may be due to fluctuating and unreliable monsoon rainfall, lack of irrigation facilities and decreasing ground water level in the study area.

Forest

The area under forest that has been converted to waste land in Sirumalai village panchayat. The decrease in area under forest may be due to lack of awareness among the people, negligence among people in following the facilities provided by the government and in adopting immediate steps needed to protect the land under forest.

Industries

Between these year periods, industries are newly formed in the western and central parts of the study area covering village panchayats like Pallapatti, Adiyanuthu, Vellodu, and Dindigul Corporation. It could be noted that the newly formed industries are developed in the locations that are much closer to the older ones. Most of the them are leather tanning industries. The other industries include textile industry and tobacco-processing industry. The newly developing district might have attracted the introduction of new industries.The landuse maps of these periods reveal that most of the new industries have developed in the area under crop land. This is not a good symptom for agricultural development. There are 38 leather tannery units that are distributed in Pallapatti (19), Adiyanuthu (12) village panchayat, Dindigul Corporation (4), and Vellodu (3) village panchayat. These industries that are concentrated in the central western part of the study area. discharge about 6,88,000 litres to 15,48,000 litres per day of waste water

which is mixed with toxic effluents like, Chloride, Chromium, Nitrate, Sodium, Calcium, Magnesium, Copper, Iron etc. The toxic effluents might have also affected the crop land areas around the units which in turn might have become less fertile.

Plantation Area

The area under plantation has decreased between 1973 and 2017, as they are converted into fallow and waste land. At the same time, new areas under plantation has been developed in Sirumalai and Vellodu village panchayats. This may be due to the awareness created among the people to safeguard and protect the area under plantation.

Settlements

The major settlement in the study area was Dindigul, the headquarters of the study area. New settlements have developed between 1973 and 2017. The major development in the settlements is noticed around Dindigul and minor settlements have also developed throughout the study area. A look at the land use maps of these periods prove that, the area under crop land have been converted into settlement area. The increase in the area under settlements might be due to the increase in population in the study area.Dindigul developed as a new district in 1985, once it was bifurcated from the former Madurai district. In 2014, Dindigul was upgraded as a corporation.

Waste land

The area under wasteland has increased between 1973 and 2017. Most of the crop land has been converted into waste land. The area under waste land has newly formed in Thadicombu and Agaram village panchayats. The waste lands have developed in small patches in Ammakulathupatti, Kovilur, Periyakottai and Sirumalai village panchayats.

Tanks

The area under tanks has also decreased between 1973 and 2017 in the study area. This may be due to the uncertainty of rainfall.

Recommendations

The following recommendations are suggested for improving theavailable crop land, and to bring the fallow land and waste land under appropriate utilization, in the study area.

-Proper land improvement and reclamation methods would bring the fallow and waste lands in usage.

-As the land holding size plays a vital role, fragmentation of land should be avoidedwhich would pave way for increasing the maximum utilization of available crop land.

-Small and marginal landholders should use bio fertilizers, like coconut coir and piths, neem seed kernel, neem seed oil cake and groundnut oil cake that could increase the available land potential considerably.

-As the fertilizer consumption determines the growth of a crop, the increased use of green manure will enhance the productivity in the fallow land.

-Bio fertilizer and compost may stabilize the fertility of the currently available crop land.

-Natural farming using herbal pesticides will protect the microorganisms in the crop land.

-Pest attack recommendations suggested by the agricultural department should be followed, for minimizing the further degradation of the crop land.

-Periodical soil and water testing has to be done and based on this, the crops suitable for cultivation can be selected.

-Latest farm practices like ridge and burrow method, sprinkler and drip irrigation methods can be followed.

-Machineries like tractors, tube wells and modern agricultural implements are recommended for the better utilization offallow land.

-Proper soil management is the dire need for decreasing the area under waste land.

-Replacing low water requirement crops can help in increasing the usage of fallow and waste lands effectively.

-Improved farming practices and best-suited technologies like, agro-horticulture, silvi-pasture and agro-forestry can be followed to bring the waste land and fallow land under use.

-Dry farming technologies are also suggested, to bring the fallow land back for usage.

-Rain water harvesting method and moisture retention activities can be done for bringing back the fallow land or waste land in practice.

-Policies should be framed in adopting suitable restriction on the use of vulnerable lands. This can be better achieved through national spirit and co-operation with technical experts, planners, administrators and active participation of farmers.

-Cultural practices like removal of weeds in the crop land, should be done periodically.
-Inter cropping method and Crop rotation method can be followed, to enrich the soil fertility of the available crop land.
-Boundary plantation can also be practicedin the waste lands which would reduce the wind velocity, give shelter, can also be used as a green manure and it gives additional income too.
-Native trees, which need less water, may also be planted in fallow and waste lands. Neem is the best native tree that can be grown in any type of soil.
-Farmers can cultivate medical plants like Indigoferatinctoria, Adhatodavasica, Recinuscommunis, Aloe vera, Catheranthusroseos, Ocimum sanctum and Phyllanthus emblica, in the waste or fallow lands, as they need minimum supply of water.
-Jatropha plant is recommended in waste lands of the study area. The oil obtained by crushing its seeds is so ideal for conversion into biodiesel. With global warming becoming a cause for concern and with petroleum reserves dwindling, our government is stepping up research in biodiesel. Apart from this, it gives additional income to the farmers.
-Since the area under tanks have decreased in the study area, the available ground water resources should be maintained by adopting the measures suggested below.

-Regulation in the utilization of groundwater by enacting legislation.
-Artificial recharge to augment ground water resources.
-Arresting further deterioration of ground water in the study area.
-Popularizing micro-irrigation scheme.
-Implementation of widespread rainwater harvesting methods.

By adopting these measures in the right time, the available crop land can be utilized properly and the increase of area under waste and fallow land can be minimized in Dindigul panchayat union.

Conclusion

The study on land use changes in Dindigul panchayat union reveals that the area under fallow land, settlements, waste land and industries has increased between 1973 and 2017. The increase in area under settlements may be due to the tremendous increase in population in the study area. But the increase in fallow land and waste land is an alarming truth and needs an immediate renovation.

At the same time, the area under crop land, plantation, tanks and forest has decreased between 1973 and 2017. The decrease in the area under crop land may be due to the lack of rainfall, irrigation facilities and the conversion of cropland into area under settlements. The decrease in area under plantation, tanks and forest may be related also to climate changes.

The above study on land use pattern of Dindigul panchayat union has proved that it has undergone changes between the years 1973 and 2017.

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