

ASSESSMENT OF LAND USE & LAND COVER CHANGES

Kalyanpura and Thoria Watershed
& Sadhukonda Forest Reserve



2014

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Foundation for Ecological Security



FOUNDATION FOR ECOLOGICAL SECURITY

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1. Introduction

The pressure of growing population, increased demand for food, fodder and fuel wood combined with rapid industrialization and urbanization have caused tremendous pressure on the natural resources. The natural resources (water, soil and forests), that are being over exploited to fulfill the basic need in turn are degrading the quality of our environment. The rapid and consequent impacts of these activities are the causes of deforestation and degradation, which is giving rise to solemn effects on the environment. Some areas (Thoria watershed, Kalyanpura Watershed and Sadhukonda Reserved Forest) facing such problems were sustainably managed and conserved for a number of years and now the changes (positive or negative) in the land use pattern and land cover that has occurred over this time span were studied.

The method that is usually undertaken to identify and highlight these significant differences on the earth's surface with the help of acquired temporal imagery is Change Detection. This procedure has been utilized in this study to identify the temporal changes in the vegetation cover and land use patterns of the study area. However, it can be said that change detection provides the formation of natural resources alteration and the trend of changes. In this study change detection plays a major role as changes in vegetation affect not only the wildlife habitat, aesthetic and historical values but it also influences management and policy decisions. Therefore some specific methods have been developed for monitoring vegetation change as decision making often requires a rapid response to Land use and land cover change.

2. Methodology

Remote sensing technologies are widely applied to understand the physical and biological characteristics of the land surface. The image processing methods employed here were site specific and some of the standard approach has been modified as per the requirement of the study. The satellite data-sets of IRS Resourcesat LISS III for the month of November were used for this study. The previous images of the same area were for the month of November for the years 1993, 2002 and 2006. The land use analysis was done through digital image classification, the process of assigning pixels to classes, where the remotely sensed data are transformed into information. Here, supervised classification was used to extract information. It is the process of

using samples of known identity to classify pixels of unknown identity. When applying supervised training, it is important to have a set of desired classes in mind, and then create the appropriate signatures from the data.

3. Land Use and Land cover Categories: Description

- ♣ **Dry Deciduous Open Forest:** This class includes all those patches, which had a canopy density ranging from 10 to 40 percent. The trees were healthy with a height of 5m to 8m and were evenly spread across the area. Some very small dense patches less than the minimal mapable unit were also observed in some parts. These patches were in a range of dark to light pink with a smooth to rough texture on the satellite images.
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- ♣ **Dry Deciduous Mixed Degraded Forest:** This is a deciduous forest with low thorny trees and xerophytes predominating its composition. The height of the tree is usually less than 10m while the canopy is largely broken or sparse. The vegetation is very sparsely distributed over the area. This appears in the satellite imagery in the range of brownish red to brown. This type of forest can occur within or outside the protected areas.
- ♣ **Agriculture Single Cropped:** These are the agricultural lands where a single crop is harvested during Kharif season. These can be easily identified in the satellite imageries for the months of November and December. Due to the soil moisture content, they appear in the range of greenish blue to blackish green on the satellite data. They follow a very regular shape.
- ♣ **Agriculture Double Cropped:** The agricultural land s where cropping is undertaken during both the kharif as well as Rabi season come in this category. These are easily identified in the satellite imageries for the months of November and December, as visible standing crop. Hence they appear on the satellite area as red to bright red with very regular shapes.

- ♣ **Wasteland:** These are those areas where the land is barren with exposed rocks (shale or slate) and is characterized by the presence of scattered scrubs of *Prosopis juliflora* and *Zizyphus mauritiana*. They had a deep cyan to light bluish signature with pink patches here and there. These lands usually had grasses and therefore they appeared very light pink color in the post monsoon satellite image. These large areas that had grasses were used as pasture lands seasonally but they are kept protected for the first few showers of monsoon. So that the grass grows out properly.
- ♣ **Scrubland:** All land s with poor tree growth comprised mainly of small or stunted trees having canopy less than 10 percent are classified as scrubland (FSI report 1999). These areas are characterized by very scattered vegetation with very small canopy area. They appear in the range of brown to light brown in the satellite imagery. These can occur within or outside the protected areas.
- ♣ **Water bodies:** this class includes all the water bodies present in the Kalyanpura watershed in terms of reservoirs, rivers, rivulets, ponds etc. They appeared as dark blue with specific shapes on the satellite data.

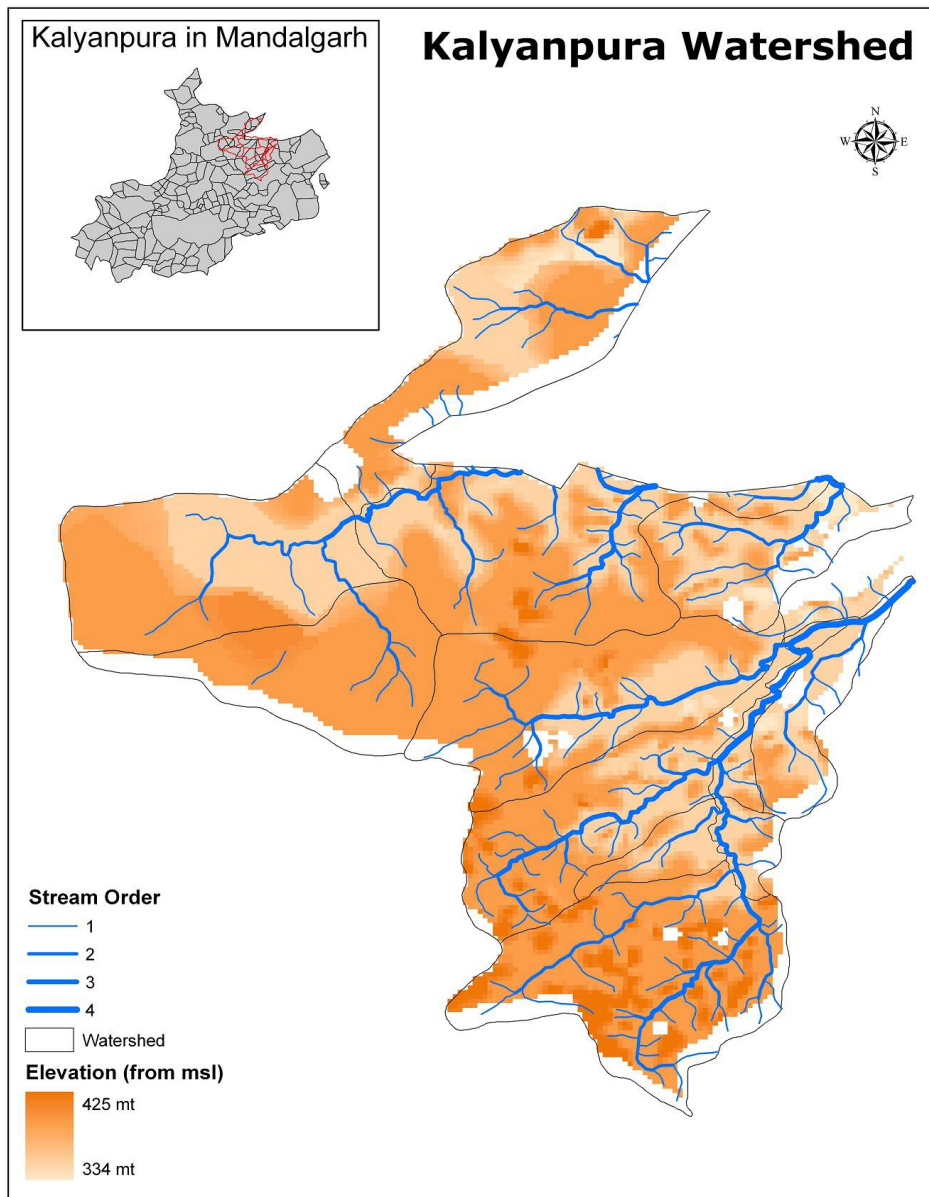
4. Study Area

4.1 Thoria watershed:

The Thoria watershed in the Ajmer district of Rajasthan covers an area of about 4500 ha. The project interventions of FES for the Common Land Development in this region began in 1996 in the village of Thoria under IWDP (Integrated Watershed Development Programme) and were later extended to all other villages in the watershed area through the implementation of various land and water conservation activities. The average annual rainfall of the area is 600mm. the geology of the area with good unconfined aquifer, is favorable for recharge.

4.2 Kalyanpura Watershed:

Kalyanpura watershed located approx. between 25°17' N-25°24'N and 75°09'E-75°15'E, lies in the southern part of Bhilwara in Mandalgarh Tehsil; which forms part of the larger confluence of Aravali, Vindhyan mountain ranges, which exhibit peculiar characteristic of Gorge formation with high banks and occasional waterfalls. The watershed is 70 km from Bhilwara city. The watershed is the part of Mej River which is a tributary of Chambal River and lies on the left bank of river Mej.



4.3 Sadhukonda Reserve Forest:

Sadhukonda Reserve Forest is located approx. between 13°46'N-13°54'N and 78°25'E-75°30'E, spreads over the Paddamandyam and Thamballapalle tahsils of Chittoor district, Andhra Pradesh. It has a hilly terrain.

5. Results and Discussions

5.1 Thoria watershed at Ajmer, Rajasthan

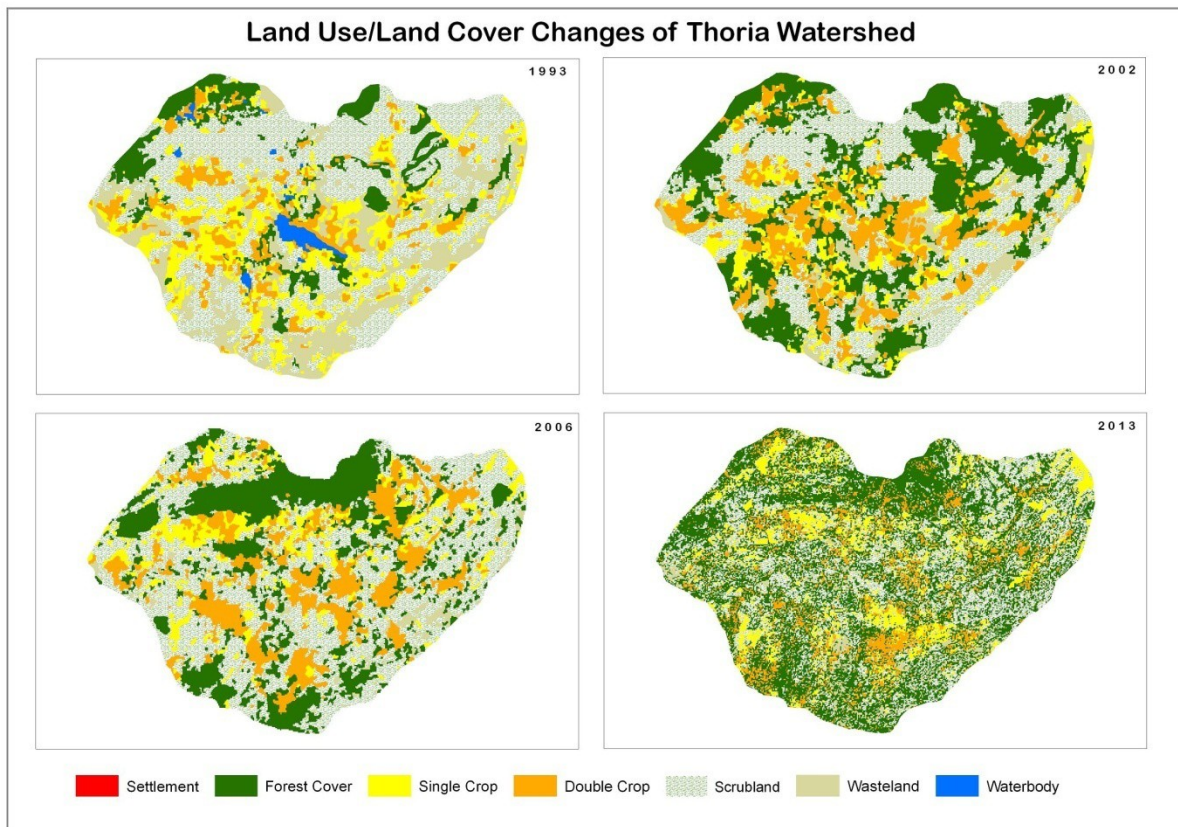
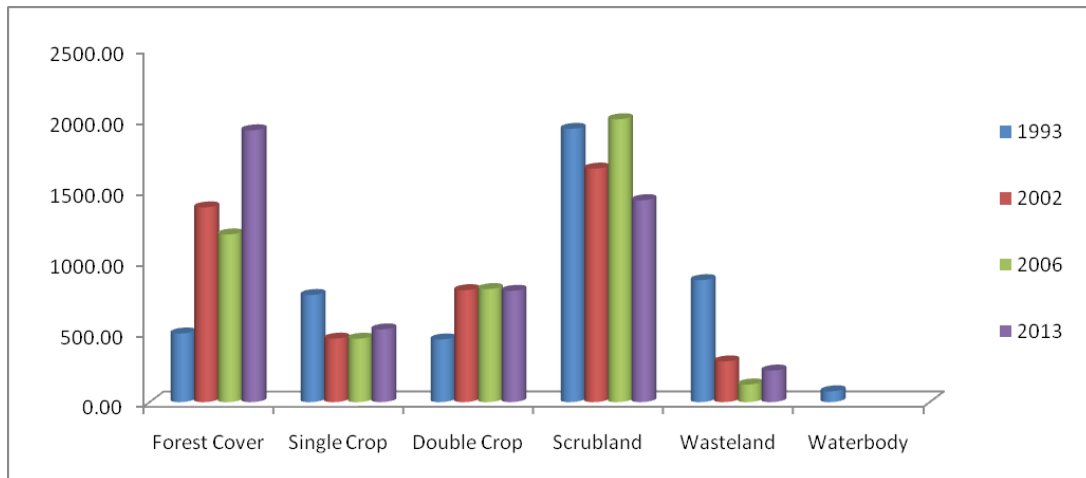
The analysis reveals positive changes in the vegetation class categories along with an increase in the agricultural productivity since the inception of the project. All these positive changes in the study site could be attributed to the protection and sustainable management of the landscape by local communities, through mechanisms of governance and other physical interventions.

There has been a noticeable increase in the forest cover of the area. The Forest cover has increased from a mere 485 hectares to 1922 hectares in the current year- almost an increase of about 300 percent. If the area of 2002 and 2006 is considered then it can be observed that the cover has increased slowly but steadily from a mere 485 ha in 1993 to 1377 ha in 2002 and 1922 in 2013. There has been a bit of decrease of about 191 ha too in the forest cover in 2006 from 2002. However overall there is a positive change in this category.

In terms of agricultural productivity, the double crop has increased by almost 78 percent due to the assured availability of water as compared to the pre-project intervention period. Although as compared to 2006, which had a double crop of about 80 percent, the 2013 shows a minute decrease of about 2 percent. There has been a decrease in the scrub-land and wasteland category since 1993. This is only due to the thorough conservation measures taken up by the local communities. The following table and graph gives a better and clear picture of the changes that has occurred over the years.

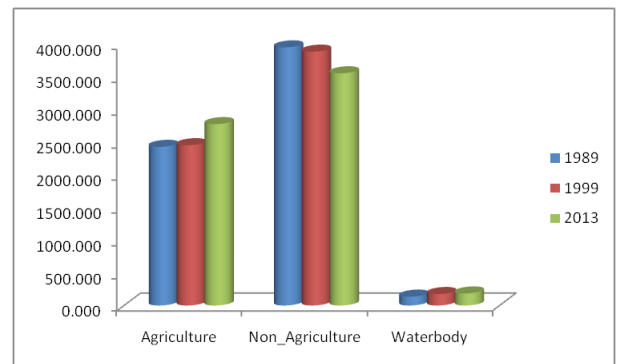
Table- Change in Land-use/ Cover from 1993 to 2013

| Land-use/cover Category | Area in Hectare | | | | Change in Area | | | Percent of Change | | |
|--------------------------------|------------------------|-------------|-------------|-------------|-----------------------|---------------------|---------------------|--------------------------|---------------------|---------------------|
| | 1993 | 2002 | 2006 | 2013 | 1993 to 2002 | 1993 to 2006 | 1993 to 2013 | 1993 to 2002 | 1993 to 2006 | 1993 to 2013 |
| Forest Cover | 485.34 | 1377.20 | 1186.10 | 1922.58 | 891.85 | 700.76 | 1437.24 | 183.76 | 144.38 | 296.13 |
| Single Crop | 757.68 | 449.08 | 448.53 | 514.34 | -308.60 | -309.15 | -243.34 | -40.73 | -40.80 | -32.12 |
| Double Crop | 443.20 | 792.03 | 799.52 | 787.12 | 348.83 | 356.32 | 343.92 | 78.71 | 80.40 | 77.60 |
| Scrubland | 1932.91 | 1651.76 | 2000.84 | 1428.11 | -281.15 | 67.93 | -504.80 | -14.55 | 3.51 | -26.12 |
| Wasteland | 862.48 | 287.80 | 124.65 | 223.00 | -574.67 | -737.83 | -639.48 | -66.63 | -85.55 | -74.14 |
| Waterbody | 76.21 | | | | -76.21 | -76.21 | -76.21 | -100.00 | -100 | -100 |



5.2 Kalyanpura watershed at Bhilwara, Rajasthan

The proper and successful management of the watershed is very much evident from the positive results of the analysis. There has been a lot of improvement in the agricultural productivity in this watershed area compared to its project inception period. This change in the study site could be attributed to the site specific analysis and management of the watershed along with protection and sustainable management of the landscape by local communities, through mechanisms of governance and other physical interventions. Water bodies occupied an area of just 136 ha during the inception period but in 1999, the scenario changed a bit with an increase of 176 ha. And now there has been still an increase in the area occupied by water bodies. Therefore the total increase in area as per water bodies from 1989 to 2013 is 36%.

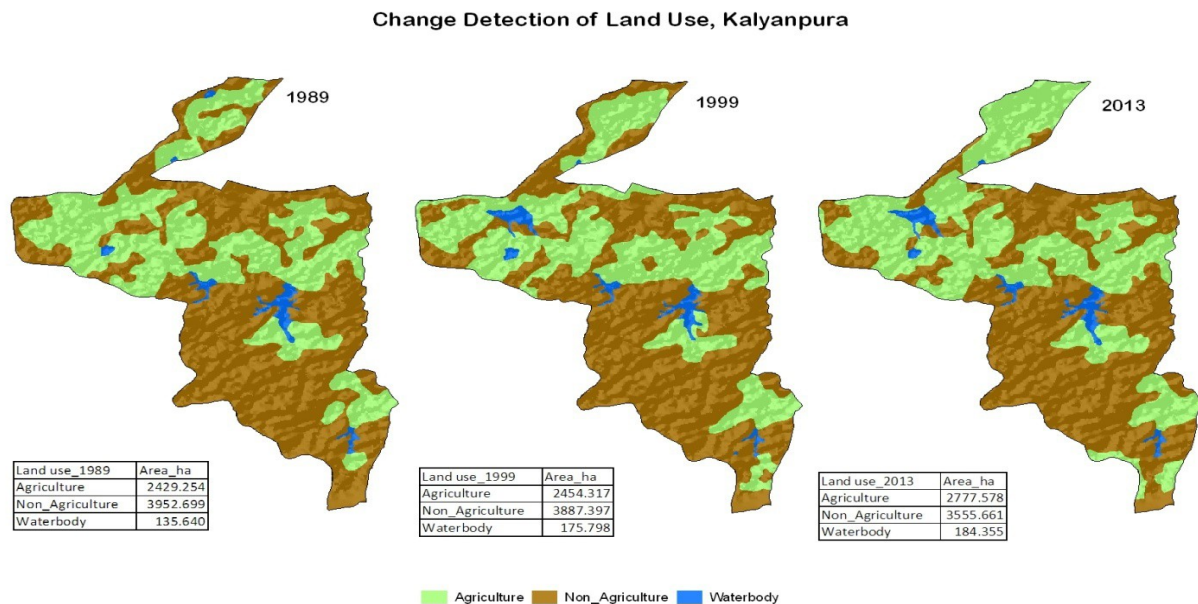


| Landuse/cover Category | Area in Ha | | | Change in Area | | Percent of Change | |
|------------------------|------------|----------|----------|----------------|--------------|-------------------|--------------|
| | 1989 | 1999 | 2013 | 1989 to 1999 | 1989 to 2013 | 1989 to 1999 | 1989 to 2013 |
| Agriculture | 2429.254 | 2454.317 | 2777.578 | 25.063 | 348.323 | 1.032 | 14.339 |
| Non_Agriculture | 3952.699 | 3887.397 | 3555.661 | -65.302 | -397.038 | -1.652 | -10.045 |
| Water-body | 135.640 | 175.798 | 184.355 | 40.159 | 48.715 | 29.607 | 35.915 |

Due to this rise in the water content in the watershed area, there has been an increase in the agricultural productivity. The agricultural area in Kalyanpura has increased by 14 percent as compared to 1989 and 1999. This change is possible only

due to sustainable management of water resources in the area. As a result of which there has been also a decrease of 10% in the non agricultural area. However, it is important to mention that as per the raw satellite data, the non agricultural land includes less amount of wasteland as compared to the previous images (1989, 1999). Most of the wastelands those were barren have

been converted to Gauchars and also the forest area that had scrubby vegetation then can now be considered as an open forest.



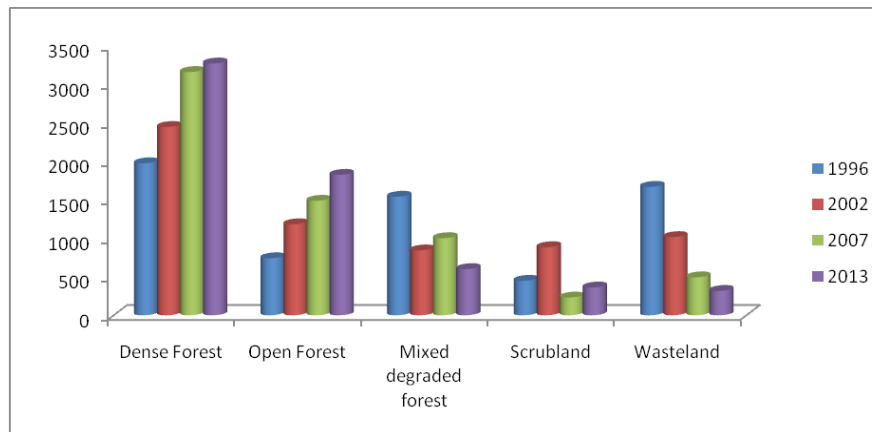
5.3 Sadhukonda Reserve Forest at Chittoor, Andhra Pradesh

The land use and land cover statistics of the Sadhukonda Reserve Forest in the year 1996 shows nominal area under dense and open forest cover category as most of the area had been classified under the degraded Forest and scrub-land category. Also the category of wasteland had a fair amount of Landscape under its name i.e. 1670 ha. The site specific conservation measures and sustainable management of the reserve Forest started showing positive results in its land cover category in 2002. In the later years the situation improved more and the condition in the recent study in 2013 shows good results compared to that of the situation in 1996.

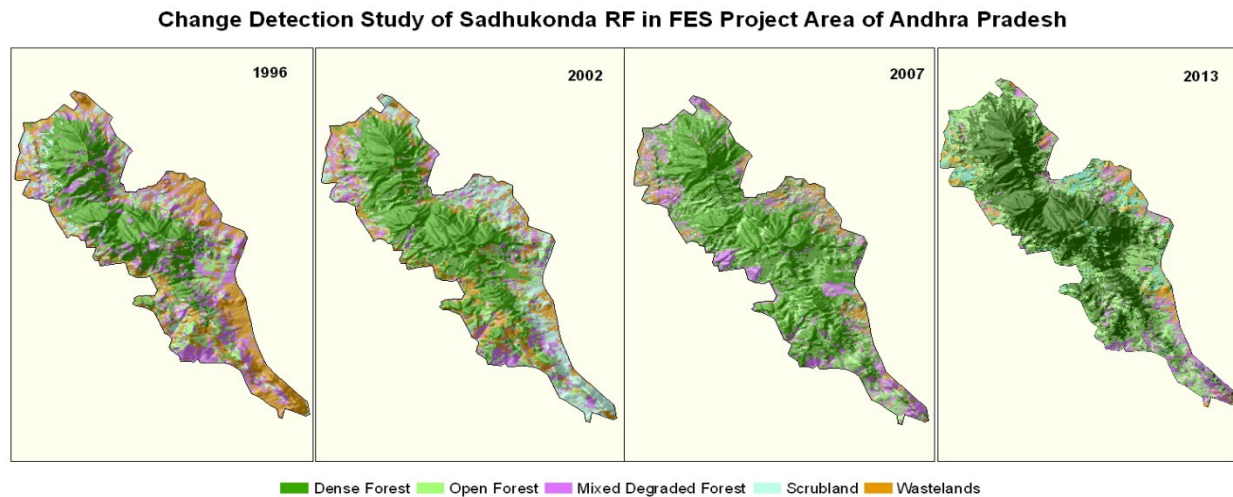
The dense forest category has an increment of 66 percent of area as compared to the year 1996. From the graph and table below, it is evident that the density of the forest increased slowly but steadily over the years after its conservation. The maximum change in the forest categories were observed in the open forest cover. This category showed about 60 percent change in the first 5 years and drastic change has been noticed in the recent analysis i.e. an increase of 146 percent compared to the 1996 scenario.

Table- Change in Land-use/ Cover Category from 1996 to 2013

| Land-use/cover Category | Area in Ha | | | | Change in Area | | | Percentage change | | |
|-------------------------|------------|------|------|------|----------------|--------------|--------------|-------------------|--------------|--------------|
| | 1996 | 2002 | 2007 | 2013 | 1996 to 2002 | 1996 to 2007 | 1996 to 2013 | 1996 to 2002 | 1996 to 2007 | 1996 to 2013 |
| Dense Forest | 1977 | 2449 | 3163 | 3274 | 472 | 1186 | 1297 | 24 | 60 | 66 |
| Open Forest | 742 | 1184 | 1489 | 1826 | 442 | 747 | 1084 | 60 | 101 | 146 |
| Mixed degraded forest | 1542 | 844 | 1003 | 601 | -698 | -539 | -941 | -45 | -35 | -61 |
| Scrub-land | 449 | 886 | 231 | 362 | 437 | -218 | -87 | 97 | -49 | -19 |
| Wasteland | 1670 | 1017 | 494 | 317 | -653 | -1176 | -1353 | -39 | -70 | -81 |



As a result of increase in the land cover of the Reserve Forest under the above two categories, there has been a noticeable decrease in the Mixed degraded Forest, Scrub-land and Wasteland Category over the years as compared to the 1996 analysis.



6. Conclusions

The analysis of the above study depicts positive and vibrant changes in all the study areas. There is rapid improvement in the watersheds of Thoria and Kalyanpura in almost all categories of land use and land cover. The most significant change is in terms of the pasture land that is coming up thereby reducing the barren wastelands. Similarly, in the Sadhukonda Reserve Forest, positive changes can be noticed in terms of forest density; maximum amount of area under the wasteland, scrub-land and Mixed degraded forest have been converted to dense and open Forest. All these positive changes in the study site could be attributed to the protection and sustainable management of the landscape by local communities, through mechanisms of governance and other physical interventions.



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