Assessment of NDVI Changes Analysis

Prepared by: GIS Cell, Foundation for Ecological Security

FES

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2017

Contents

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 (Kareda, Kadiri and Anugul Watershed) facing such problems were sustainably managed and conserved for a number of years and now the changes (positive or negative) in the NDVI (The normalized difference vegetation index) 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 NDVI data from 2004 to 2013. This procedure has been utilized in this study to identify the NDVI changes in the vegetation cover of the study area. In particular, there are several sectors that use NDVI. For example, in agriculture, farmers use NDVI for precision farming and to measure biomass. Whereas, in forestry, foresters use NDVI to quantify forest supply and leaf area index. Many sensors carried aboard satellites measure red and near-infrared light waves reflected by land surfaces. Using mathematical formulas (algorithms), scientists transform raw satellite data about these light waves into vegetation indices. A vegetation index is an indicator that describes the greenness — the relative density and health of vegetation — for each picture element, or pixel, in a satellite image. NDVI values range from +1.0 to -1.0. Areas of barren rock, sand, or snow usually show very low NDVI values (for example, 0.1 or less). Sparse vegetation such as shrubs and grasslands or senescing crops may result in moderate NDVI values (approximately 0.2 to 0.5). High NDVI values (approximately 0.6 to 0.9) correspond to dense vegetation such as that found in temperate and tropical forests or crops at their peak growth stage.

2. 2. Methodology

The NDVI change analysis methods employed here were site specific and some of the standard approach has been modified as per the requirement of the study. The satellite datasets of MOD13Q1_NDVI 16 days interval data for Pre-monsoon the month of May and Post-monsoon the month of September for Northern India and November for Southern India were used for this study. For Agriculture NDVI change analysis, single and double crop data from landuse and for Non-agriculture Gully/ravines, wasteland, forest, scrubland, built-up, plantation-orchard, snow-covered.

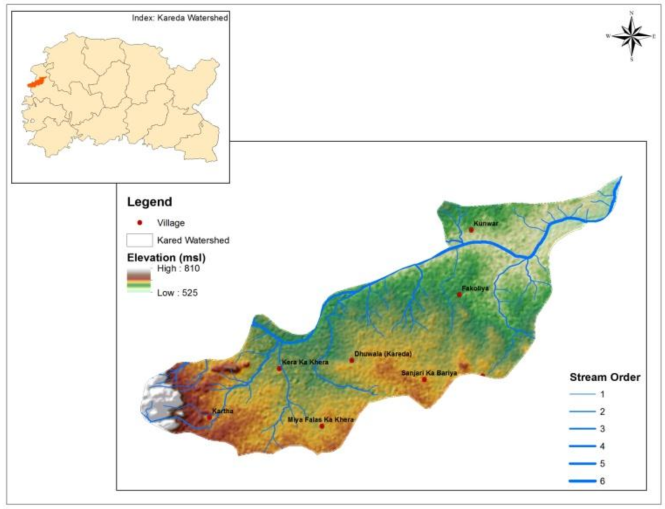
3. Characteristic NDVI Signatures:

Theoretically, NDVI values are represented as a ratio ranging in value from -1 to 1 but in practice extreme negative values represent water, values around zero represent bare soil and values over 6 represent dense green vegetation.

- **-1 (negative value):** Extreme negative values represent water in the particular area.
- **0 - 0.1:** Areas of barren rock, sand, or snow usually show very low NDVI values.
- **0.2 - 0.5 (Sparse Vegetation):** Sparse vegetation such as shrubs and grasslands or senescing crops may result in moderate NDVI values.
- **0.6 - 0.9:** High NDVI values (approximately 0.6 to 0.9) correspond to dense vegetation such as that found in temperate and tropical forests or crops at their peak growth stage.

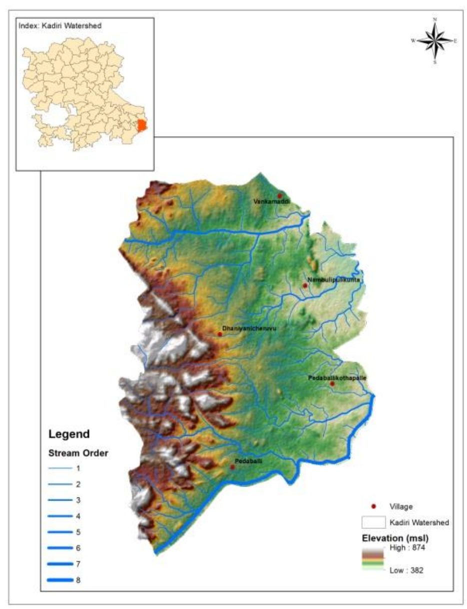
4. Study Area

4.1 Kareda watershed:



The Kareda watershed in the Bhilwara district of Rajasthan covers an area of about 5116 ha. The watershed located approx. between 25°38'25.166"N - 25°33'27.274"N and 74°3'18.58"E - 74°11'49.398"E, lies in the Estern part of Bhilwara in Mandal Tahsil. The average annual rainfall of the area is 400-600mm. The project interventions of FES for the Common Land Development in this region of Kareda under NABARD (National Bank for Agriculture and Rural Development) and were later extended to all other villages in the watershed area through the implementation of various land and water conservation activities. The geology of the area with good unconfined aquifer, is favorable for recharge. The watershed is the part of Khari River which is a tributary of Banas River and lies on the bank of river Khari.

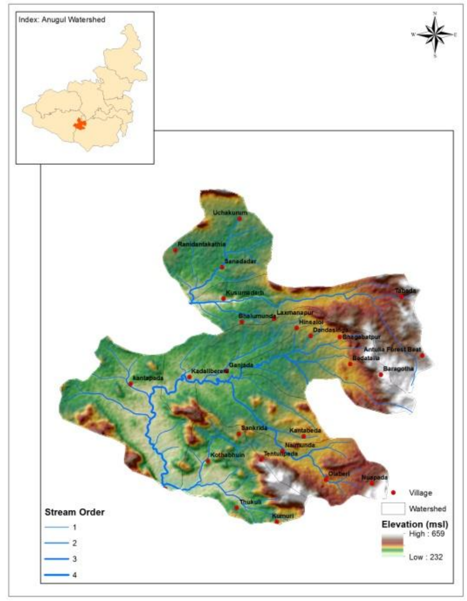
4.2 Kadiri Watershed:



The Kadiri watershed in the Anantapuram district of Andhra Pradesh covers an area of about 18574 ha. The watershed located approx. between 14°7'4.213"N - 13°56'1.597"N and 78°19'51.301"E - 78°27'15.084"E, lies in the Southern part of Anantapuram in Nambulipulikunta Mandal. The average annual rainfall of the area is 600-800mm. The geology of the area with crystalline rocks aquifer, is favorable for recharge. The watershed is the part of Redda River which is a tributary of Penner River and lies on the left bank of river Redda.

4.3 Anugul Watershed:

The Anugul watershed in the Anugul district of Odisha covers an area of about 7922 ha. Anugul watershed is located approx. between 20°49'54.653"N - 20°43'20.658"N and 84°43'26.918"E - 84°50'46.536"E, spreads over the Athmallik and Anugul blocks of Anugul district, Odisha. The average annual rainfall of the area is 1200-1400mm. The geology of the area with crystalline rocks aquifer, is favorable for recharge. The watershed is the part of Chanagorhi River which is a tributary of Mahanadi River and lies on the bank of river Chanagorhi.

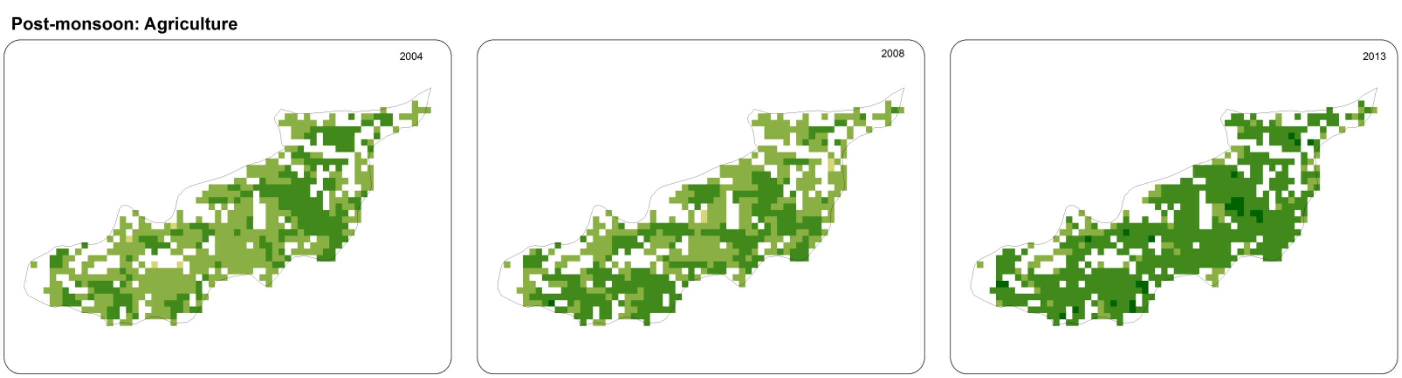


5. Results and Discussions

5.1 Kareda watershed at Bhilwara, Rajasthan

The analysis reveals positive changes in the vegetation along with an increase in the agricultural and non-agriculture productivity since 2004 to 2013. 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 post monsoon in the agriculture as well as forest cover of the area since 2004 to 2013. The average agriculture vegetation has increased from a mere 0.43 in 2004 to 0.51 in 2013 in post monsoon. The average non-agriculture vegetation has increased from a mere 0.41 in 2004 to 0.49 in 2013 in post monsoon.



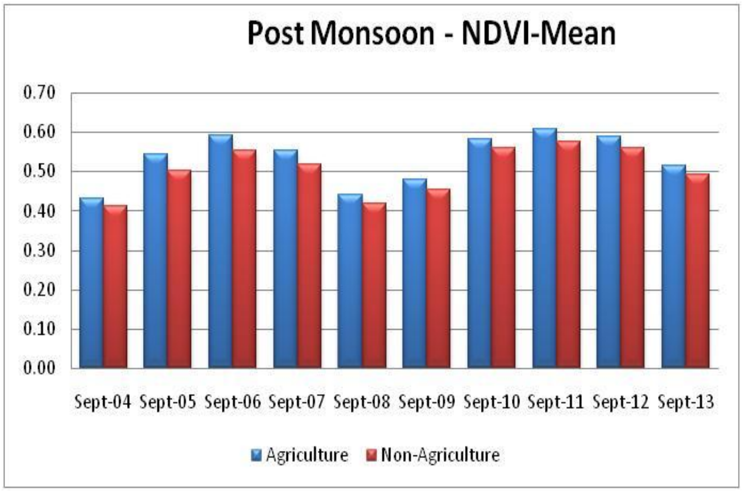
Post-monsoon: Non-Agriculture

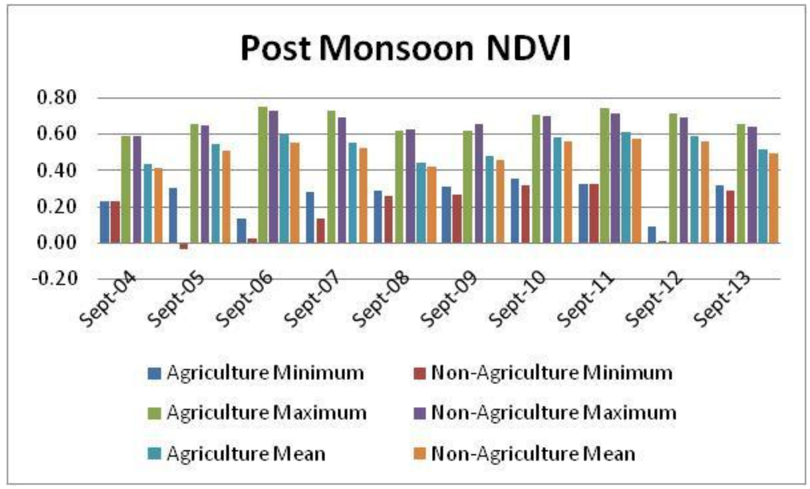
Agriculture (Post-Monsoon)			
Month-Year	**Minimum**	**Maximum**	**Mean**
Sept-04	0.23	0.58	0.43
Sept-05	0.30	0.65	0.54
Sept-06	0.13	0.75	0.59
Sept-07	0.28	0.73	0.55
Sept-08	0.28	0.61	0.44
Sept-09	0.31	0.62	0.48
Sept-10	0.35	0.70	0.58
Sept-11	0.32	0.74	0.61
Sept-12	0.09	0.71	0.59
Sept-13	0.31	0.65	0.51

Non-Agriculture (Post-Monsoon)			
Month-Year	**Minimum**	**Maximum**	**Mean**
Sept-04	0.23	0.58	0.41
Sept-05	-0.04	0.65	0.50
Sept-06	0.02	0.72	0.55
Sept-07	0.13	0.69	0.52
Sept-08	0.25	0.62	0.42
Sept-09	0.26	0.65	0.45
Sept-10	0.31	0.69	0.56
Sept-11	0.32	0.71	0.58
Sept-12	0.00	0.69	0.56
Sept-13	0.29	0.64	0.49

Average from 2004 to 2013

Month-Year	Agriculture	Non-Agriculture
Sept-04	0.43	0.41
Sept-05	0.54	0.50
Sept-06	0.59	0.55
Sept-07	0.55	0.52
Sept-08	0.44	0.42
Sept-09	0.48	0.45
Sept-10	0.58	0.56
Sept-11	0.61	0.58
Sept-12	0.59	0.56
Sept-13	0.51	0.49



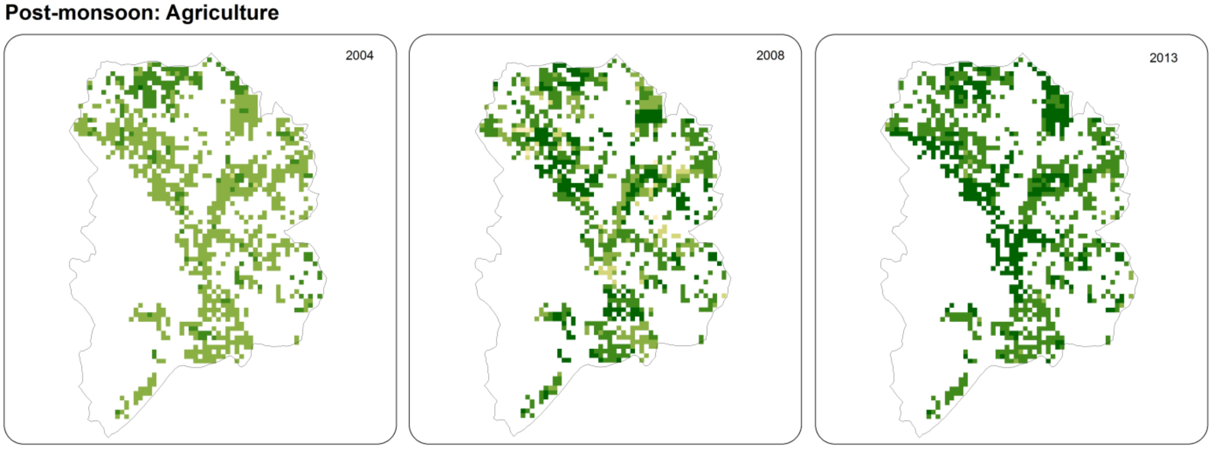


5.2 Kadiri watershed at Anantapur, Andhra Pradesh

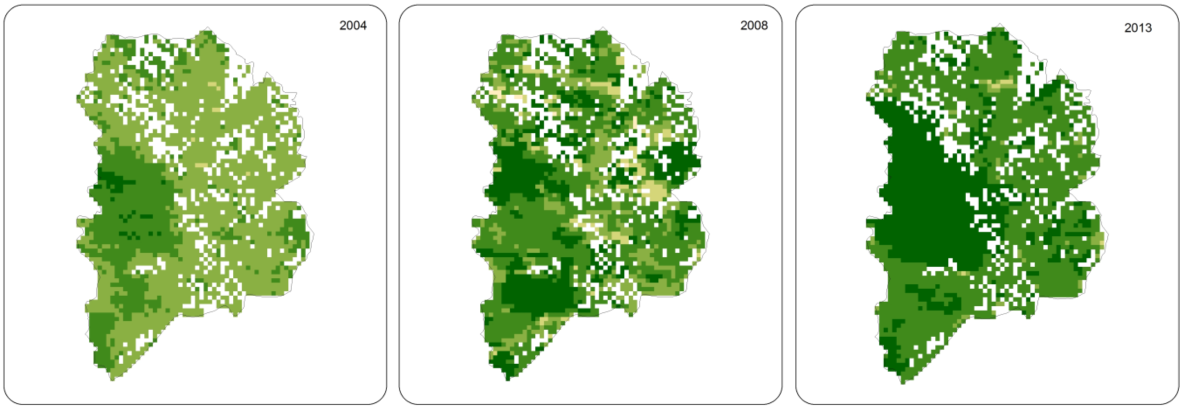
The analysis reveals positive changes in the vegetation along with an increase in the agricultural and non-agriculture productivity since 2004 to 2013. All these positive changes in the vegetation of the study site occurred in last ten years. More growth in the development in dense vegetation is shown in non-agriculture area.

There has been a noticeable increase in post monsoon in the agriculture as well as non-agriculture area since 2004 to 2013. The average agriculture vegetation has increased from a mere 0.41 in 2004 to 0.58 in 2013 in post monsoon. The average non-agriculture vegetation has increased from a mere 0.43 in 2004 to 0.63 in 2013 in post monsoon.

Post-monsoon: Agriculture



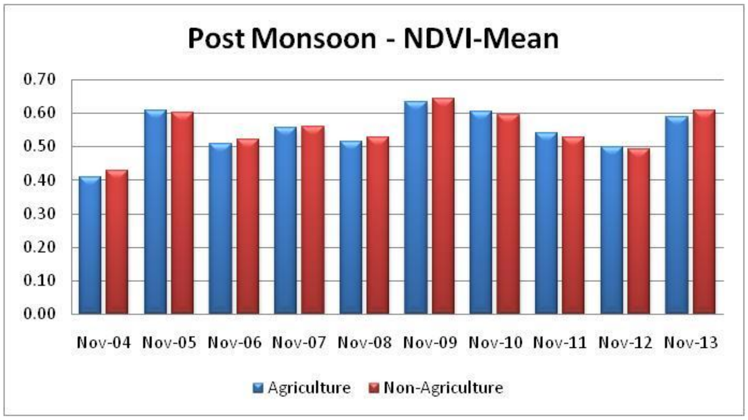
Post-monsoon: Non-Agriculture

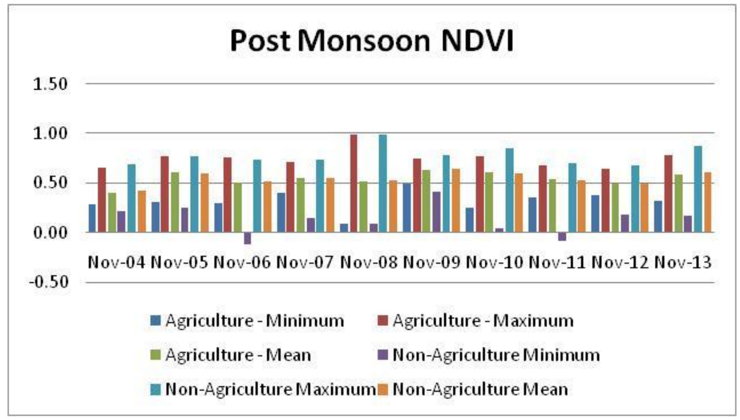


Agriculture (Post-Monsoon)			
Month-Year	Minimum	Maximum	Mean
Nov-04	0.29	0.66	0.41
Nov-05	0.309	0.770	0.607
Nov-06	0.296	0.765	0.507
Nov-07	0.401	0.716	0.557
Nov-08	0.085	0.990	0.515
Nov-09	0.496	0.752	0.633
Nov-10	0.256	0.767	0.605
Nov-11	0.356	0.674	0.540
Nov-12	0.382	0.648	0.498
Nov-13	0.326	0.785	0.589

Non-Agriculture (Post-Monsoon)			
Month-Year	Minimum	Maximum	Mean
Nov-04	0.21	0.69	0.43
Nov-05	0.25	0.77	0.60
Nov-06	-0.11	0.73	0.52
Nov-07	0.15	0.74	0.56
Nov-08	0.08	0.99	0.53
Nov-09	0.41	0.79	0.64
Nov-10	0.05	0.85	0.59
Nov-11	-0.08	0.71	0.53
Nov-12	0.18	0.68	0.49
Nov-13	0.17	0.88	0.61

Month-Year	Agriculture	Non-Agriculture
Nov-04	0.41	0.43
Nov-05	0.61	0.60
Nov-06	0.51	0.52
Nov-07	0.56	0.56
Nov-08	0.52	0.53
Nov-09	0.63	0.64
Nov-10	0.60	0.59
Nov-11	0.54	0.53
Nov-12	0.50	0.49
Nov-13	0.59	0.61

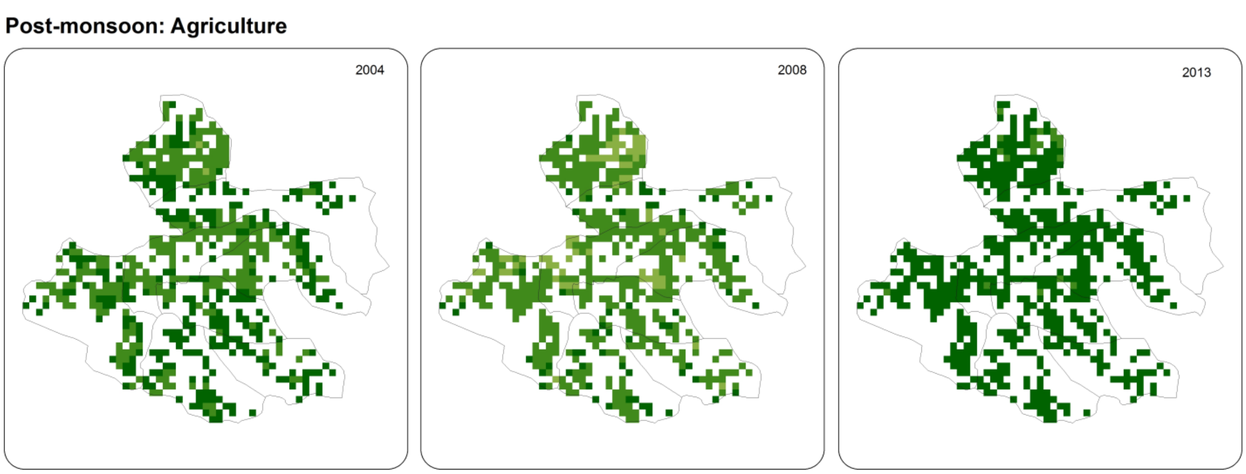




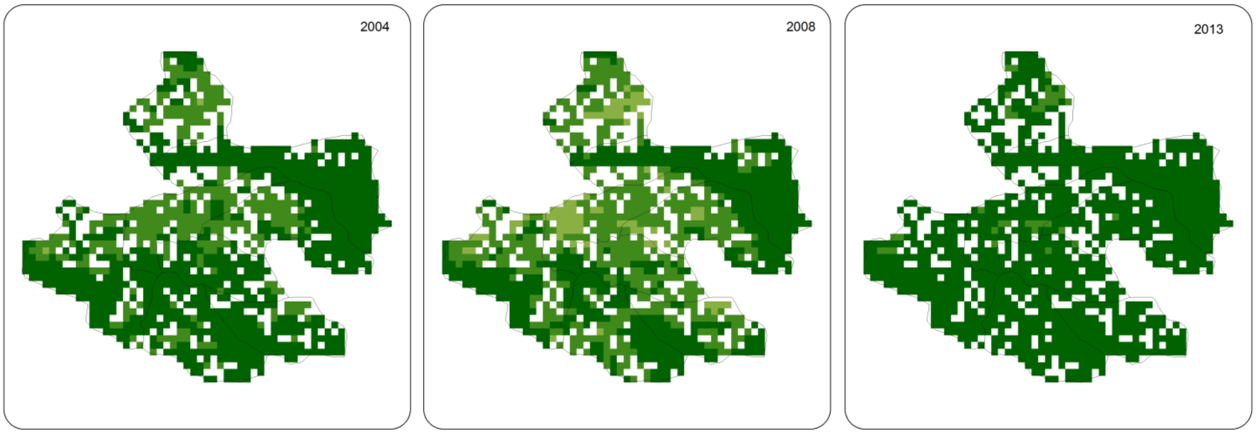
5.3 Anugul watershed at Anugul, Odisha

The final output and analysis reveals positive changes in the vegetation along with an increase in the agricultural and non-agriculture productivity since 2004 to 2013 both in pre and post monsoon. All these positive changes in the vegetation of the study site occurred in last ten years. More growth in the development in dense vegetation is shown in agriculture and non-agriculture area.

There has been a noticeable increase in pre and post monsoon in the agriculture as well as non-agriculture area since 2004 to 2013. The average agriculture vegetation has increased from a mere 0.61 in 2004 to 0.69 in 2013 in post monsoon. The average non-agriculture vegetation has increased from a mere 0.69 in 2004 to 0.73 in 2013 in post monsoon.



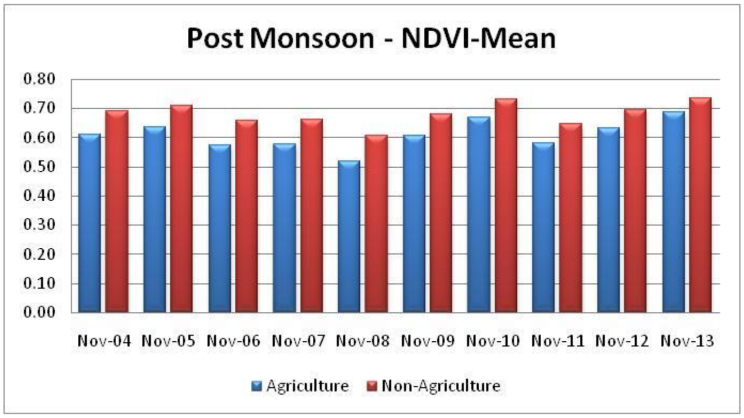
Post-monsoon: Non-Agriculture

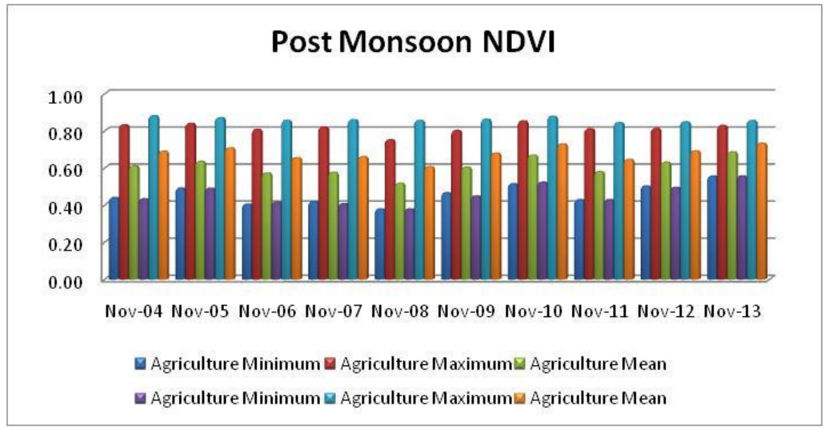


Agriculture (Post-Monsoon)			
Month-Year	Minimum	Maximum	Mean
Nov-04	0.44	0.83	0.61
Nov-05	0.49	0.84	0.64
Nov-06	0.41	0.81	0.57
Nov-07	0.42	0.82	0.58
Nov-08	0.38	0.75	0.52
Nov-09	0.47	0.80	0.60
Nov-10	0.52	0.85	0.67
Nov-11	0.43	0.81	0.58
Nov-12	0.50	0.81	0.63
Nov-13	0.56	0.83	0.69

Non-Agriculture (Post-Monsoon)			
Month-Year	Minimum	Maximum	Mean
Nov-04	0.43	0.88	0.69
Nov-05	0.49	0.87	0.71
Nov-06	0.42	0.86	0.66
Nov-07	0.41	0.86	0.66
Nov-08	0.38	0.86	0.61
Nov-09	0.45	0.86	0.68
Nov-10	0.52	0.88	0.73
Nov-11	0.43	0.84	0.65
Nov-12	0.50	0.85	0.69
Nov-13	0.56	0.86	0.73

Month-Year	Agriculture	Non-Agriculture
Nov-04	0.61	0.69
Nov-05	0.64	0.71
Nov-06	0.57	0.66
Nov-07	0.58	0.66
Nov-08	0.52	0.61
Nov-09	0.60	0.68
Nov-10	0.67	0.73
Nov-11	0.58	0.65
Nov-12	0.63	0.69
Nov-13	0.69	0.73





6. Conclusions

The analysis of the above study depicts positive and vibrant changes in all the study areas. There is rapid vegetation improvement in the watersheds of Kareda, Kadiri and Anugul in agriculture and non-agriculture area. 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.