Change detection of land use land cover - A case study on Kadakola subwatershed

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Change detection of land use land cover- A case study on Kadakola subwatershed

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Abstract:
Land use land cover change is a dynamic process. Various factors influence land use and land cover change and out of which human interventions introduce major changes. Conventional assessment of land use land cover changes are costly and time consuming. Remote sensing technique is promising tool for assessing land dynamics. Many studies have been carried out earlier to examine the potential benefits of satellite imageries in land use change detection and have been proved to be relatively accurate. This study was conducted to evaluate the watershed development program of government of Karnataka by performing land use land cover and change detection analysis on IRS P6-LISS IV high resolution satellite imagery of Kadakola subwatershed in Karnataka. Supervised classification technique was adopted to classify the imageries. The analysis shows considerable increase in the area of double crop and reduction in fallow land.

Keywords: Land Use Land Cover, Subwatershed, Supervised Classification, Double Crop, Single Crop

1. Introduction

Land use land cover change is a dynamic process. Land cover refers to the physical characteristics of Earth's surface, captured in the distribution of vegetation, water, soil and other physical features. Landuse refers to the way in which land has been used by humans and their habitats (such as agriculture, settlements, industry etc.) (Chaudhary et al, 2008). Various factors influence land use and land cover change. Out of which human interventions brings major changes. Conventional assessment of land use land cover changes are costly and time consuming. Remote sensing technique is promising tool for assessing land dynamics. Many studies have been carried out earlier to examine the potential benefits of satellite images on land use land cover change and change detection analysis and these studies indicated relatively good accuracy (Rao & Narendra (2006), Remi et al (2007), Chaudhary et al (2008) and Kim et al (2008)). Various classification techniques such as maximum likelihood classification, artificial neural network, and support vector machine are applied worldwide on different satellite images. This study made use of supervised classification with maximum likelihood classifier. Supervised Maximum Likelihood (ML) classification method based on the Bayes theorem, assumes the statics of each class in each band have normal distribution and probability of given pixels is calculated depends on class of pixel. It makes use of a discriminant function to assign pixel to the class with the highest likelihood (Ahmad & Quegan, 2012). The purpose of this study was to evaluate the development of watershed program by performing land use land cover change (LULC) detection on IRS P6-LISS IV satellite imagery. Watershed development program were implemented across various sub watersheds in Karnataka. This paper represents work carried out in one of these subwatersheds (SWS).

2. Methodology

2.1 Study area

The study area chosen for the study is Kadakola subwatershed of Savanur Taluk, Haveri District, Karnataka. This sub watershed lies between longitude of 75°24'34″ and 75°30'56″ and latitude of 14°59'1″ and 15°3'31″. It comprises of 12 micro watersheds (MWS) and covers an area of 5093.3 Hectares. It experiences an average rainfall of 633mm. Major crops grown in this area are maize, cotton, groundnut, jowar and pulses. Mango and coconut are the horticultural crops grown here. Table 1 shows villages coming under project and control area in ridge, middle and valley. It lies in northern transition zone.

Table 1: Details of Kadakol Subwatershed (Hemanth & Vijay, 2018)

District/ SWS	Project Area MWS/Villages			Control Villages			Agro-Climatic Zones
	Ridge	Middle	Valley	Ridge	Middle	Valley	
Haveri/ Kadakola	Hesaruru	Basavanakoppa	Naikeruru	Sevalalpur	Shirabadagi	Hattimattur	Northern Transition Zone

2.2 Remote sensing datasets

Indian Remote Sensing (IRS- P6) Linear Imaging Self Scanning Sensor (LISS IV) images for November, 2012 and November, 2015 i.e before and after the watershed development program were procured from National Remote Sensing Centre, Hyderabad, India for this study. Satellite data scene has information of three spectral bands which corresponds to Green (G), Red(R) and Near Infrared (NIR). ArcGIS 10.4 software was used for pre-processing and analysis of satellite imageries.

2.3 Land use land cover

Geometrically corrected bands were layer stacked to obtain False Colour Composite (FCC) image. Then images were mosaicked and area of interest was extracted. Basic interpretation was carried out to identify single crop, double crop, fallow land and water body on the image. Further supervised classification was performed on the image. Sirindhorn et al (1990) using supervised classifications of Landsat-TM data found that Landsat-TM data with its high resolution provide very satisfactory results in mapping land use/land cover. Jonathan et al (2007) showed that the Maximum Likelihood Classification Algorithm (ML) would be an appropriate choice, since it is an extremely simple and easily implemented algorithm, but at the same time, is very well known and has already been successfully applied to a broad range of remote sensing problems (Lillesand & Kiefer, 2000). Therefore maximum likelihood algorithm was used as a classifier. Training sites were delineated by creating polygon on the particular classes. Sixty five training sites for each class were considered for the analysis. Finally supervised classification was performed on November 2012 and 2015 LISS IV satellite images.

3 Results and discussion

Land use land cover change was examined for two different years 2012 and 2015. Images were classified into double crop, single crop, fallow land, water body, road network, drainage, and settlements. Figure 1(a) & 1(b) depicts land use land cover for year 2012 and 2015 respectively. Table 2 shows the area under different categories and relative change in the study area. Most extensive land use land cover category is agricultural land followed by fallow land, settlement and water bodies. The results indicated that in the year 2012 double crop covered an area of 70.76 % followed by single crop 22.66%, fallow land 1.35%, water body 0.30, settlement 1.13 %, drainage 0.50 % and road network 0.53% of the total land. The area under double crop which occupied 70.76% in 2012, increased to 75.08 % in 2015 indicating an increase in area of about 4.32%. Single crop decreased from 22.66 % to 21.12%, showing a decline of 1.54%. Also fallow land followed a decreasing trend of 2.77% from 4.12% to 1.35% in 2015. Water body, settlement, drainage and road network maintained the same status. Hence the results indicate that there is a significant increase in double crop of about 4.32 % in 2015 suggesting increase in the groundwater level and soil moisture. Decrease in fallow land of about 2.77% indicates that the land was converted to cultivable land in the span of three years (Hemanth (2018)).

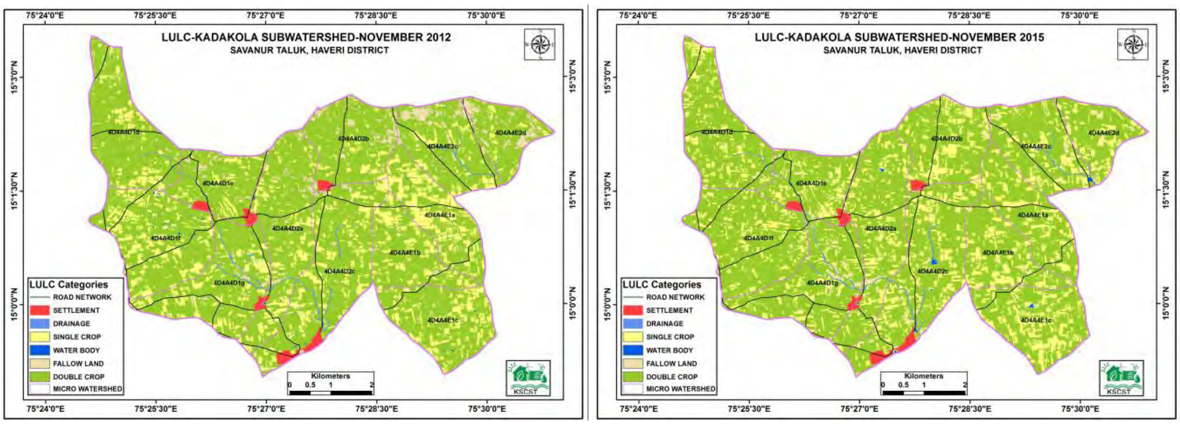

Figure 1(a) & 1(b) Land use land cover classification of Kadakola subwatershed using LISS IV satellite data

Table 2: Land use land cover change detection of LISS IV data

	2015		**2012**		**Relative Change**	
LULC Categories	**ha**	**%**	**ha**	**%**	**ha**	**%**
Double crop	3824.02	75.08	3604.2	70.76	219.83	4.32
Single crop	1075.53	21.12	1154.1	22.66	-78.60	-1.54
Fallow land	68.5625	1.35	209.82	4.12	-141.26	-2.77
Water body	15.2525	0.30	15.253	0.30	0.00	0.00
Settlement	57.4325	1.13	57.408	1.13	0.02	0.00

Drainage	25.57	0.50	25.57	0.50	0.00	0.00
Road network	26.9475	0.53	26.945	0.53	0.00	0.00
Total	5093.31	100	5093.3	100	0	0

4 Conclusions

The study revealed that the study area has undergone notable changes in terms of land use and land cover in the period of 2012 and 2015. Agricultural land (double crop) has increased about 4.32% in 2015. LISS IV satellite images have made it possible to assess the land dynamics and development.

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