"Study of Urban Land Use Development effect on associated Agricultural Land Use in Aurangabad City Maharashtra, India"

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Abstract:

Aurangabad city is one of the most fast growing cities in India, due to the increasing of the population in the city the urban land used increased and the city is surrounding by agricultural land it is predicted that the area of agriculture used will decreased. Agricultural land is one of the essential parts of our ecosystem for producing our crops products. In developing countries, urban expansion is frequently appearing phenomena, which is a type of land use land cover change (LULC). It could be considered as destructive change when the areas of Agricultural lands are lost. This study describes the rate and distribution of urban growth on Aurangabad city from 2008 to 2016 and the resulting effect on the agricultural lands. A LISS III satellite images from 2008 and LISS IV 2016 images collected from NRSC Hyderabad were analyzed with ENVI software to determine the effect of urban expansion on agricultural land use. GIS provide us a significant tool for land use analysis for large scale area along with long period. We compare the datasets to differentiate the changes between the LISS III and LISS IV datasets which indicates a significant increase in urbanization and built-up area at the expense of agricultural area. Our results show that 14km^2 of Agricultural land converted to Built-up land and 27 km^2 became Barren land; the accuracy of 2008 and 2016 was 91.13% 98.5% with kappa 08 and 0.98 respectively. Remote

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sensing and Geographical information systems provide a better means for monitoring and analyzing the changes of land use land cover, GIS is an analytical and organizational tool to assist users in identifying spatial relationships between layers and organize land related data. Before image processing image preprocessing performed for classification of land use analysis, a supervised classification has been done to extract the different categories of the land use. This paper illustrate that the using of remotely sensed data and GIS techniques are helpful to provide effective land use land cover analysis

1. Introduction

Development in urban area is rapidly increasing in the City's. Due to the development in urban area it is directly impact on the environmental, ecological, economically and social activities in urban area or cities [1]. In this research we studied the effect on associate agricultural land use in Aurangabad city due to the development on urban area. Due to the urbanization in the city the agriculture land is continuously decreasing. The importance of this research is that, the agricultural land is a vital part of our ecosystem for producing the food in farms. For classification and detection of used area for development from agricultural land we used Land Used Land Cover (LULC) Technique, Remote Sensing and GIS. Remote sensing (RS) is the technology that can be used for identifying and use as an important tool for monitoring the land surface changes [2]. Satellite remote sensing with combination of Geographical Information System (GIS) is widely useful and as an accepted powerful and effective tool in detecting land use and land cover changes [3]. GIS is useful technique for analyzing the changes in earth surface between two or more time period. Satellite can collect images in multispectral, multi-temporal and multi-spatial data offering a mean for monitoring the land use land cover changes [4].GIS is an effective tool for the data collection, data store and retrieval, data conversion and display spatial data of real world. GIS has the capability to analyze the change detection in the in the particular area by using multiple layer image, classified images, maps, toposheets. Remote Sensing and GIS can be used for soil mapping, telecom and network services, Change detection, Spectral analysis, Image classification etc. . . . In this research we used ENVI software for processing the images acquired from two sources. We have used A LISS III satellite image from 2008 and LISS IV satellite image from 2016. The images were analyzed with ENVI software to determine the effect of urban expansion on agricultural land use. By using ENVI software we used Preprocessing technique, Processing technique, Post Processing technique. In preprocessing technique we made image stacking, mosaicking, sub-setting, image registration and atmospheric correction. Maximum likelihood classifier assumes the normal distribution of training data and it gives better result than minimum distance and spectral angle mapper [5].

2. Study Case Area

Aurangabad is historical city in Maharashtra, India, located geographically between N19 º 53'59'' Latitude and E 75 º 22'46'' Longitude and its elevated 581m above mean see level. Its population is 609206 males and 565910 females as 2011 census [6] figure (1). The total area considered in this work is 260 km^2 to cover Aurangabad city and Waluj area with surrounding agricultural lands (figure 4b, 4d). The study area land cover land use classes are Built-Up land , Agricultural land , Fallow land which is agricultural land left without cultivating for recovering its fertility, barren land and water bodies. So in our classification interpretation we consider fallow land and Agricultural land as one class

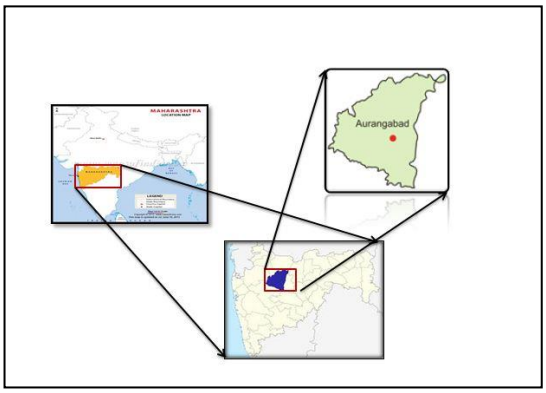


Fig: 1 – Maps of India, Maharashtra, and Aurangabad.

3. Data and Methodology

i. Data Collection

The data used in this work collected from two resources, IRS-c1 LISS III accessed from Bhuvan and IRS-P6 LISS IV purchased from ISRO NRSC, LISS III datasets Acquired in October 2008 after rainy season with resolution of 23.5. Because of the low resolution of LISS III we use Google Earth Pro historical Data from May 2008 facility to chick the training data Region of Interest as ground truth. LISS IV dataset were 5 mater resolution so its fine resolution provide us clear image details to select training data easily , and we used Reference Map link provided by ENVI for Ground truth.

ii. Image processing method

Image classification was performed using Maximum Likelihood Classification, a brief explanation for MLC is provided within the following subsection

Maximum Likelihood Classifier

MLC is on of most used parametric classifiers it's a supervised classifier based on Bayes Theorem , the algorithm based on equation to compute the likelihood D of unknown vector X belong to known class Mc :

D= ln(ac) – [0.5ln(|COVc|)] – [0.5(X-Mc)T(COVc – 1)(X-Mc)] [7]

It assigns each pixel to a class with maximum likelihood or assigned to unclassified if the probability values are all below a threshold determined by the user, MLC assumes normal distribution of training data over classes otherwise the result may be not good enough. ()

In the following subsection a detailed operations step is provided. All the processing steps were done by ENVI 5.5 from ESRI.

iii. Preprocessing of LISS III and LISS IV image

Before preprocessing we were corrected images using dark object sub-tract method for Atmospheric correction for both LISS III and LISS IV images [8] to remove the effect of atmospheric scattering which is common in remote sensing images [9][10]. In preprocessing we made image Mosaicking, image Stacking and image Sub setting. The images divided into the tiles that why we applied image mosaicking operation for joining the tiles and make complete image to cover the whole Area of interest. After loading the images into the ENVI we change the data format to False Color Composite because it's the most format used for information extraction used in LULC [11]. From the complete image we want to cut unwanted area for that we used Region of Interest (ROI) operation for sub setting.

iv. Image Classification

For classification of images we select training data for each cover class from input images with the help of Google Earth Pro. historical data and ENVI reference map links tool for ground truth purpose. We used Maximum Likelihood classification algorithm for classify the images.

v. Post Processing

After Classification Image refinement can be done on classified image. In image refinement we used edit class and majority and minority operations because of some misclassification between different classes. Complete processing steps shown in figure 2.

4. Result

4.1 Urban Expansion Area from 2008 to 2016

Aurangabad city is the major city of Aurangabad district surrounding by hills from all directions and most of the lands around the city are agricultural land, the study area covered in this paper was 260 km^2 for Aurangabad and Waluj area. Classification of Aurangabad area shows that the urban area was 66 km^2 and non-urban Areas was 194 km^2 in 2008. In 2016 urban land area increased to 79 km^2 and non-urban area decreased to 181 km^2 (Table 1), this means that Built-up area increased from 25.38% in 2008 to 30.38% in 2016.On the other hand The agricultural area decreased from 122 km^2 in 2008 to 82 sq.km in 2016, this translate 46.92% in 2008 decreased to 31.54%, 27 km^2 of the lost area was converted to barren land, and 14 km^2 converted to Built-up area. The barren land increased from 63 km^2 in 2008 to 93 km^2 in 2016, which representing increase from 26.5% in 2008 to 37.69% in 2016.Built-up area defined by different kind of infrastructures such as roads, houses, factories etc.., as the most built-up area in Aurangabad, the most common urban feature is housing which can be distributed on urban and rural regions in Aurangabad and Waluj.

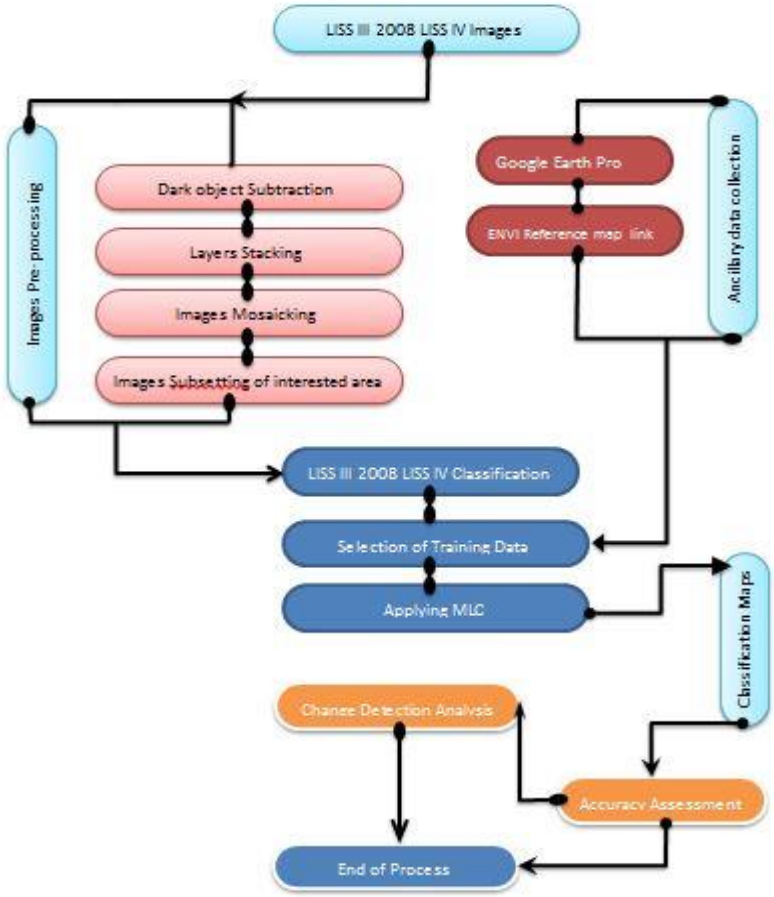


Fig. 2: Flow Chart of Methodology Steps

Table1: Land Use Land Cover Classes Areas in Km^2

Sr. No	Land use Land Cover Classes in 2008 and 2016					
	Land use category	Area In 2008 km^2	%	Area in 2016 km^2	%	Change in km^2
1	Built-up Land	66	25.38	79	30.38	13
2	Agricultural Land /fallow land	122	46.92	82	31.54	-40
3	Barren Land	68	26.15	98	37.69	30
4	Water Bodies	4	1.54	1	0.38	-3
	Total	260	100%	260	100%	0

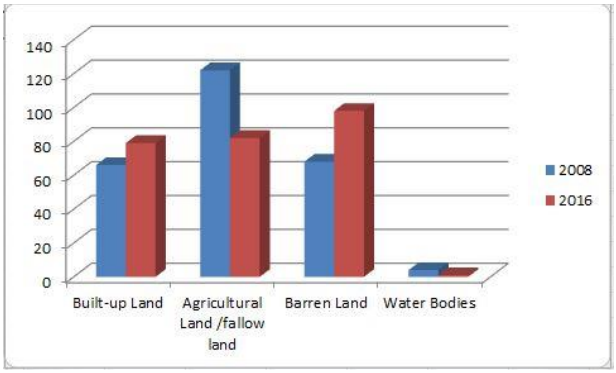
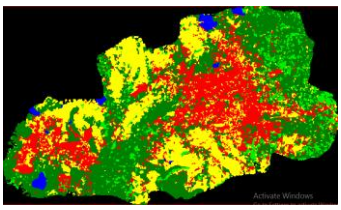


Fig. 3: Chart illustrating the changes in Areas in km^2 for all the cover classes

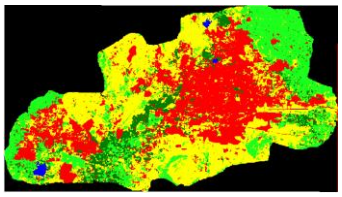
The effect of Urbanization on Agricultural Lands

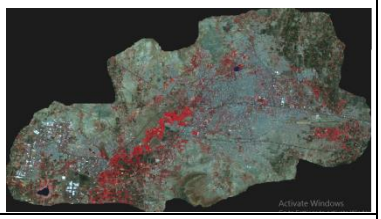
When urbanization happens, Non-Built-up land converted to Built-up land this paper try to determine how much Agricultural Land converted to Built-up Land due to urbanization. figure (2a) shows the classification image of the study area figure (2b) in 2008, then the same agricultural land in 2016 classification image figure (2c) for the same study area in figure (2d), it is clearly that the agricultural loses happens in in sub-urban areas and it seems that will continue while the urban keep expanding in the future. For the illustration of urban area, a map of the classes shows the expansion of urban (Red color) increases in 2016 while Agricultural (green color) decreased



a. Classification image of LISS III image

b. **LISS III image subset for Aurangabad and Waluj area taken 2008 form Bhuvan ISRO**





c. Classification image of LISS IV

d. LISS IV image subset for Aurangabad and Waluj 2016 from ISRO Hyderabad.

Fig. 4: Classification image for 2008, 2016, (a) classification result of LISS III image dataset, (b) Original image subset of LISS III from Bhuvan ISRO, (c) classification result of LISS IV image dataset, (d) Original image subset of LISS IV from ISRO Hyderabad.

Accuracy Assessment

The accuracy assessment in this paper depend on the confusion matrix using ground Truth ROI's, during the selection of training data we used Google earth Pro. For selection the pixels content due to the low resolution of LISS III image, we used Maximum likelihood classifier for the classification process , the accuracy for LISS III image was 91.13% and kappa 0.88 which considered high , and the accuracy of LISS IV was high as 98.5% and kappa of 0.98,

Table2: Accuracy of classification for LISS III image in 2008

Overall Accuracy 91.13% for LISS III Classification							
Kappa Coefficient 0.883							
Ground Truth (Pixels)							
Class	Built-up Area	Agricultural	Water Bodies	Barren Land	Fallow Land	total	User Acc %
Unclassified	0	0	1	8	0	9	
Built-up Area	720	6	5	0	2	733	98.23
Agricultural	7	2094	4	0	159	2264	92.49
Water Bodies	0	0	1017	0	0	1017	100
Barren Land	253	0	0	1143	0	1396	81.88
Fallow Land	50	23	9	0	440	522	84.29
Total	1030	2123	1036	1151	601		
Pro Acc %	96.9	98.63	98.17	99.3	73.21		

Table 3: Accuracy of classification for LISS IV image in 2016

Overall Accuracy 98.5534% for 2016 LISS IV image classification							
Kappa Coefficient 0.9818							
Ground Truth (Pixels)							
Class	Fallow Land	Barren Land	Water Bodies	Agricultural	Built-up Area	Total	User Acc %
Unclassified	0	0	0	0	0		
Fallow Land	7787	78	0	30	14	7909	98.46
Barren Land	0	8848	0	0	53	8901	99.4
Water Bodies	0	0	8459	0	0	8459	100
Agricultural	186	0	14	9941	0	10141	98.3
Built-up Area	7	0	138	76	5570	5791	96.18
Total	7980	8926	8611	10047	5637		
Pro Acc %	97.58	99.13	98.23	98.94	98.81		

Conclusion

Remote sensing data were proved as useful tool for monitoring the changes in Land Use Land Cover over multi-temporal images, the attractive is that the ability to classify large area of land without doing field survey if we have high resolution images for map referencing. This paper shows the impact of urbanization on agricultural land; it shows remarkable increase of Built-up land and also high value of accuracy reach to 98% in high resolution image and 91% in low resolution image. This literature shows that LISS III & LISS IV datasets could be effectively used for analyzing surface cover change.

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