ACCURACY ASSESSMENT OF LAND USE/LAND COVER CLASSIFICATION USING REMOTE SENSING AND GIS FOR MIDDLE GUJARAT

NIRAV PAMPANIYA[1], JAYDIP MAKWANA[2], *KHYATI VYAS[3] AND M. K. TIWARI[4]

SOIL AND WATER ENGINEERING DEPARTMENT
COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
ANAND AGRICULTURAL UNIVERSITY, GODHRA, GUJARAT, INDIA

E.mail: khyativyas46@gmail.com

1 Senior Research Fellow, Soil and Water Engineering Department, College of Agricultural, Engineering and Technology, Anand Agricultural University, Godhra, Gujarat, India, Email-pampaniyanirav@gmail.com
2 Research Associate, Research Testing and Training Centre, Junagadh Agricultural University, Junagadh, Gujarat, India, Email-makwanajaydip@gmail.com
3 Senior Research Assistant, Soil and Water Engineering Department, College of Agricultural Engineering and Technology, Anand Agricultural University, Godhra, Gujarat, India, Email-khyativyas46@gmail.com
4 Assistant Professor, Soil and Water Engineering Department, College of Agricultural Engineering and Technology, Anand Agricultural University, Godhra, Gujarat, India, Email-mukesh.tiwari@aau.in

ABSTRACT

Land cover/land use (LCLU) maps are essential inputs for environmental analysis. Remote sensing provides an opportunity to construct LCLU maps of large geographic area in a timely fashion. Remote sensing is one of the tool which is very important for the production of land use and land cover maps through a process called image classification. For the image classification process to be successfully, several factors should be considered including availability of quality of imagery and secondary data, a precise classification process and user's experiences and expertise of the procedures. The objective of this research is to classify the landuse/land cover map and its accuracy assessment. In this study the LISS III imagery is used and classified into five categories like forest, agriculture land, waste land, built up and water bodies. In this study it is found that the overall accuracy derived from the stratified random sampling method is 76.00 % with an overall kappa coefficient of 0.67.The kappa coefficient is rated as substantial and hence the classified image found to be fit for further research. This study is essential source of information whereby planners and decision makers can use to sustainably plan the environment.

KEY WORDS: Land cover/land use, Classification, Accuracy assessment, remote sensing and GIS

INTRODUCTION

Land use/Land cover data gives highly valuable information to monitor the extension and status of land resources and give an important contribution to understanding the balance between global land cover pattern, climate and biochemistry of the earth system (Brovelli et al. 2015). Thematic maps generated from remotely sensed data are used in many areas of water resource applications, including as input parameters to models, as source of regionally extensive environmental data, or as basis of policy analysis. Meaningful and consistent measures of thematic map reliability are necessary for the map user to assess the appropriateness of the map data for a particular application; additionally, the accuracy of the thematic map may significantly affect the outcome of an application (Powell et al. 2004).

The accuracy of Remote sensing spatial data has been defined by the United

States Geological Survey USGS, 1990 as: Accuracy assessment or validation is an important step in the processing of remote sensing data (Adam et al. 2013). It measures of the information value of the resulting data to a last user. Productive utilization of geo-data is only possible if the quality of the data is known. Furthermore, integrated processing of different types of geo-data cannot be effective if the data quality is not known. The increased usage of remote sensing data and techniques has made geospatial analysis faster and more powerful, but the increased complexity also creates increased possibilities for error. In the past, accuracy assessment was not a priority in image classification studies. Because of the increased chances for error presented by digital imagery, however, accuracy assessment has become more important than ever. In a view to importance of accuracy assessment of land use classification numerous studies have been published (Congalton, 1991**;** Foody, 2002; Liu et al. 2007; Manandhar et al. 2009; Stehman, 2009). In this research agriculture predominant Limkheda watershed situated in middle region of Gujarat, India was selected. For classification LISS III image of the year 2012 was used. The objective of this research was to assess the accuracy of classification.

METHODOLOGY

Study area

A Limkheda agricultural watershed located in the semi-arid middle region of Gujarat, India is selected in this study for accuracy assessment. The total area of the Limkheda watershed is 220.86 km^2. The outlet of the watershed is located at latitude 22° 49' 55" and longitude 73° 59' 15"at an elevation of 207 m. Geographical location of the study area is shown in Fig. 1.

A LISS III image acquired on 21th November 2012 were used to analyze accuracy assessment over the study area. The image was obtained from NRSC Hyderabad. It was assume that LISS III image was captured under the clear atmospheric condition so no atmospheric condition were applied. The image is geo referenced to datum WGS 1984 and Universal Transverse Mercator (UTM) zone 43N coordinate system, then the stacking of the image has been done to get the false color composite image, bands 4, 3 and 2 are used. The ERDAS IMAGINE tool has been used for the generation of land use map by performing the supervised classification. The ArcGIS tool was used for the generation of the maps. Area generation of the land use/land cover shows the land occupied by the various classes which further helps in the sustainable development of the natural resources. Stratified random sampling design was adopted for the accuracy assessment. Only five categories, Agriculture, Forest, Water bodies, Waste land and Built up were considered for accuracy assessment with 148 samples considered.

RESULTS AND DISCUSSION

Classification of Image

To evaluate accuracy assessment remote sensing image LISS III of the year 2012 used. This LISS-III image is obtained from NRSC Hyderabad for year 2012. The image is then classified using supervised classification. ERDAS IMAGINE 11 is used to classify these remote sensing images. For image classification Limkheda watershed is classified into five main land use land cover class i.e. Agriculture, Forest, Water bodies, Built up, and Waste land. A Land use category of the classified image is presented in Fig.2. Table 1 shows the area under different land use categories of the classified image. The Image class i.e. Agriculture, Forest, Water bodies, Built up, and Waste land have occupied 97.47,91.54, 2.37, 13.11 and 16.37 sq. km area respectively.

Accuracy Assessment

Stratified random sampling design was adopted for the accuracy assessment. Only five categories, Agriculture, Forest, Water

bodies, Waste land and Built up were considered for accuracy assessment with 148 samples considered. A common tool to assess accuracy is the error matrix. Error matrices compare pixels or polygons in a classified image against ground reference data (Jensen 2005). These matrices can measure accuracy in several ways. The overall accuracy of the classified image compares how each of the pixels is classified versus the actual land cover conditions obtained from their corresponding ground truth data. Producer's accuracy measures errors of omission, which is a measure of how well real-world land cover types can be classified. User's accuracy measures errors of commission, which represents the likelihood of a classified pixel matching the land cover type of its corresponding real-world location (Campbell 2007, Congalton 1991, Jensen 2005). Error matrices have been used in many land use classification studies and they were an essential component of this research. Error metric and Accuracy of this study has been shown in Table. 2 and Table 3, respectively.

CONCLUSION

To assess the accuracy of the classification system, 150 reference test pixels are identified. The assessment showed an overall accuracy derived from the stratified random sampling method for the 2012 classified images is 76.00 % with an overall kappa coefficient of 0.67.Considering the categories accuracy, the stratified random method provided very high accuracy assessment in water bodies with an accuracy of 100%, followed by Waste land, agriculture, built up, and forest, it provided accuracy 94.44, 78.69, 68.18 and 58.33 respectively. This reduction in accuracy is due to the similarity between range agriculture land and the forest land. Moreover, the open forest vegetation is similar to range agriculture, thus conversion occurred between these (LU) and (LC) categories. The use of accuracy assessment in thematic maps can improve lands use, land cover characterization by allowing clear acknowledgement of heterogeneity within map units and scale. Based on this it is proved that remote sensing is very useful for periodical survey and water resources management aspect and other essential information of land use/land cover change and its distortion.

ACKNOWLEDMENT

We are acknowledged to our sponsor agency ITRA- Media Lab Asia.

REFERENCES

Brovelli M. A., Molinari M. E., Hussein E., Chen J. and Li R. 2015, The First Comprehensive Accuracy Assessment of Globe Land 30 at a National Level: Methodology and Results. Remote Sensing, 7, 4191-4212; doi:10.3390/rs70404191

Powella R. L., Matzkea N. ,Jr C. d. S, Clarka M. ,NumataaI., HesscL. L. and Roberts D.A. 2004 Sources of error in accuracy assessment of thematic land-cover maps in the Brazilian Amazon Remote Sensing of Environment 90: 221 – 234

Adam A.H.M,; Elhag A.M.H.; Salih and Abdelrahim M. (2013) Accuracy assessment of land use & land cover classification (LU/LC) "Case study of Shomadi area Renk County-Upper Nile State, South Sudan". International journal of scientific and research publications, 3(5):1-6.

Foody G.M. (2002) Status of land cover classification accuracy assessment. Remote sensing of environment, 80:185–201.

Manandhar R., OdehI.O. A. and AncevT. 2009 Improving the Accuracy of Land Use and Land Cover Classification of Landsat Data Using Post-Classification Enhancement. *Remote Sens.* **2009**, *1*, 330-344; doi:10.3390/rs1030330

Stehman, S.V. 2009 Sampling design for accuracy assessment of land cover.International Journal of Remote Sensing, *30*, 5243–5272.

Congalton, R.G. 1991A review of assessing the accuracy of classification of remotely sensed data. Remote Sensing of Environment,*37*, 35–46.

Liu, C.; Frazier P. and Kumar, L. 2007 Comparative fassessment of the measures of thematic classification accuracy. Remote Sensing of Environment, 107, 606–616.

Jensen, J.R., 2005. Introductory Digital Image Processing: A Remote Sensing Perspective. 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Congalton, R.G., 1991. A review of assessing the accuracy of classifications of remotelysensed data. Remote Sensing of the Environment, 37 (1), 35-46.

Campbell, J.B., 2007. Introduction to Remote Sensing. 4th ed. New York: The Guilford Press

Table 1: Area occupy by each class

Land use Class	Year 2012(LISS-III)	
	Area (km^2)	Area (%)
Agricultural land	97.47	44.13
Forest	91.54	41.45
Waste land	16.37	7.41
Built up	13.11	5.94
Water bodies	2.37	1.07
Total	**220.86**	**100**

Table 2: Error Matric

	Agriculture	Forest	Built up	Waste land	Water Bodies	Total
Agriculture	48	8	1	4	0	61
Forest	12	21	1	2	0	36
Built up	2	2	15	3	0	22
Waste land	1	0	0	17	0	18
Water Bodies	0	0	0	0	13	13
Total	**63**	**31**	**17**	**26**	**13**	**150**

Table 3: Accuracy

	Producers Accuracy	Omission Error	Users Accuracy	Commission Error
Agriculture	76.19	0.31	78.69	0.21
Forest	67.74	0.48	58.33	0.42
Built up	88.24	0.13	68.18	0.32
Waste land	65.38	0.53	94.44	0.06
Water Bodies	100	0	100	0
Overall Accuracy	**76.00 %**			
Kappa Coeffeicient	**0.67**			

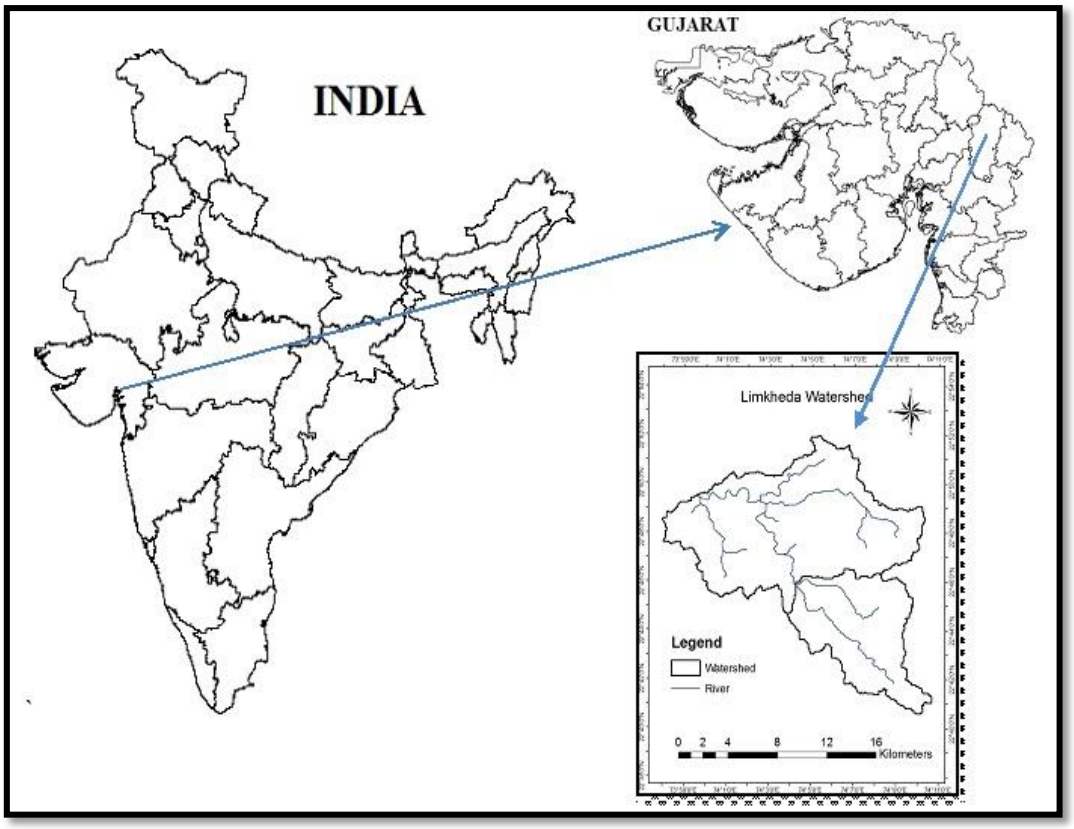

Fig. 1: Geographical location of study area

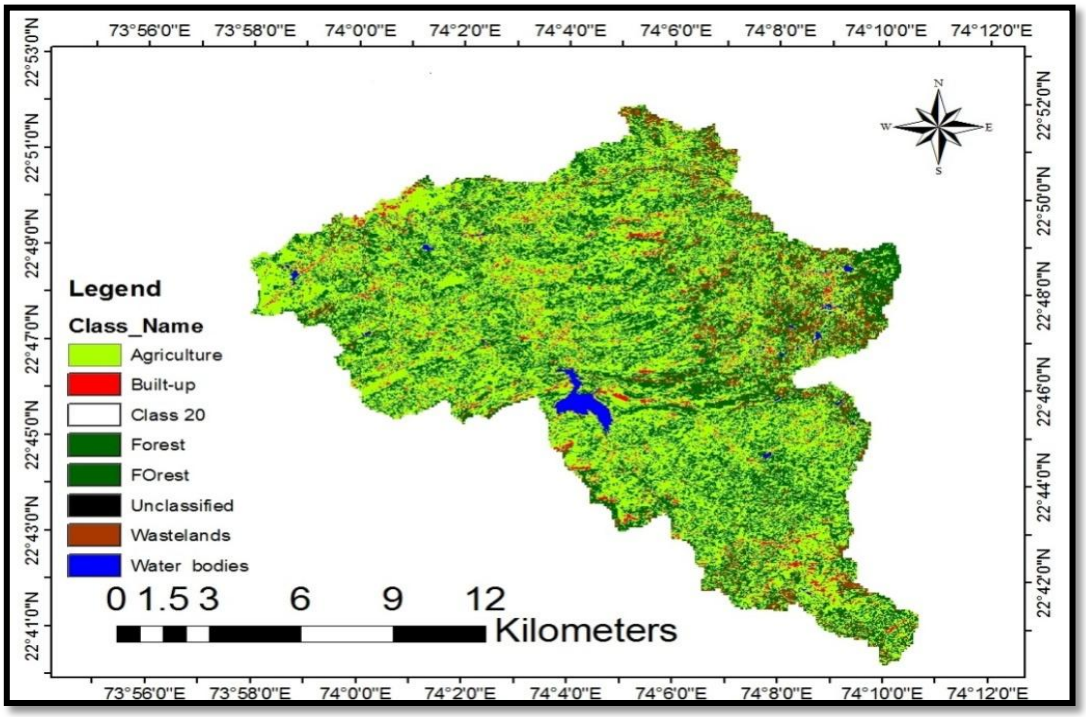

Fig.2: Classified LISS III Image

[MS received : June 26, 2017] *[MS accepted : June 28, 2017]*