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Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

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ORIGINAL ARTICLE

ASSESSMENT OF POMEGRANATE ORCHARD USING REMOTE SENSING AND GIS TECHNIQUES FOR THE SOLAPUR, MAHARASHTRA

ANIL S.YEDAGE , R.S.GAVALI AND ASHAVINI SURVANSHI

School of Earth Sciences, Solapur University, Solapur.

Abstract:

Horticultural crops play an important role in economic development of semi-arid regions. Among horticulture crops which are xeromesophytes such as pomegranate, not only require less water but also grows well on barren land. In India, 70% of pomegranate production comes from the orchard in Maharashtra state. In Maharashtra state, Solapur is one of leading producer in pomegranate. Remote sensing and GIS has become the most important technique for crop monitoring, inventory and production assessment. Present study deals with the identification and assessment of pomegranate cultivation area of using IRS P6 and LANDSAT-7 data. Various digital classification algorithms were used like supervised MXL, Unsupervised ISODATA, sub pixel based. Supervised classification was found to be the best, because of accuracy (82.44 %) as compared to other classification techniques. On the basis of spectral response it was clearly distinguished from the other crops. To generate the normalized difference vegetation index (NDVI), 0.3 NDVI value was found to indicate the pomegranate orchards and also the Bhatia crop concentration index showed that the western part of the district has the maximum concentration.

KEYWORDS:

Pomegranate, Semi-arid, MXL, Orchards, Remote Sensing GIS.

INTRODUCTION:

Agricultural, being the most primitive occupation of the civilized man draws much on its development starting from shifting agricultural to advanced precision farming. Agriculture contributes a high share of net domestic product by sectors in India. Farmers are growing numerous of crops in the field rather than single crop. The distributional pattern of crops in any region is an outcome of predominance of certain crop or combination of crops. This is a term of emergence of typical crop concentration. Cropping pattern in study region has undergone an evolutionary process. The soil and other natural environmental factors, along with the socioeconomic factors, affect the cropping pattern in study region. The statistical techniques provide accurate techniques. For the study of agriculture land use and cropping pattern various methods have used by scholars, scientists and geographers. Among them Bhatia's method is selected in present investigation. Satellite based space technology is used for crop production estimation worldwide. Indian (IRS) LISS-III sensor Estimate production of fruits and vegetable crops grow and identify like date of harvesting vegetable crops (Rao, P. et al 2004)

1.1 BACKGROUND of POMEGRANATE

Pomegranates have originated from Iran. It is cultivated in Spain, Egypt, Afghanistan, Pakistan,

China, Japan, Russia, America, and India. Maharashtra State is the leading producer of Pomegranates in India (NRCP Annual Report 2009). In India more than 0.1 million hectares of area is under pomegranate cultivation presently. In Maharashtra pomegranate is cultivated in the districts of Solapur, Nasik, Ahamadnagar, Pune, Sangli, Dhule, Latur, Usmanabad, Jalna, Parbhani, Aurangabad, Beed and Satara. Main Varieties are Ganesh, Phule Arakta, Mridula, & Bhagwa. The fruits are available for an export mainly from July to September (NRCP Annual Report 2010).Pomegranate is an important fruit crop of Maharashtra. Within Maharashtra, production of Pomegranate is mainly concentrated in the Western Maharashtra region and the Marathwada region. The variety Ganesh, Bhagwa (Red Ruby) cultivated in Maharashtra is suitable for export purposes. At present fair amounts of exports of Pomegranate takes place from the state in Reefer containers by sea. Maharashtra state is considered Basket in India contributing more than 70% of the total area under the pomegranate besides, part of Karnataka, Andhra Pradesh, Tamilnadu, Gujarat, and Rajasthan are also suitable for quality production pomegranate in India. It is very popular fruit of tropical and subtropical regions and has versatile adoptability to wide range of climatic condition

1.2 STUDAY AREA

Solapur district is south-west part Maharashtra state was selected study Area. It is lie between 170 05'to 18032' degrees to the north latitude while it is about 74042' to 76015' degrees to the east longitude. Solapur does not have any important hill land there are only a few spurs of Balaghat range in the north of Barshi Taluka that pass through the south of Solapur for a few kilometers. You also find a scattering of hills in Malshiras, Sangola, Karmala and Talukas. The terrain of Solapur is basically flat and undulating where the low table land and small hills of Karmala and Madha Talukas act as a watershed between Sina and Bhima rivers.. The soil here is of moderate uniformity while rainfall is uncertain and less than 100 cm. The crops grown here are kharip and rabbi.

2 DATA USED

2.1 Satellite data: LISS-III, ETM +

Indian Remote Sensing satellite LISS-III sensor data during period January and February2008. LANDSAT -7 satellite ETM+ sensor 30 m resolution data January 2002 taken from USGS website Toposheet survey of India 1:50000 scales used for boundary and area marking.GPS survey was carried out in field for field and identification ground truth Checked.

2.2 Ancillary data:-

Horticultural Cultivation and production data Talukawised (1991 to 2010) collected from District Agriculture Office

3 Methods
3.1Crop Concentration

Bhatia (1965) developed a formula based on the gross cropped area. crop concentration like that crop diversification, have great relevance in the agricultural land use studies, Crop concentration is an important component of the crop geography of a region. It refers to crop variety. Larger the number of crops grown in an area during a year with each occupying equal proportion of cropland, the higher is crop concentration. Crop concentration means areal density of individual crop or crop concentration reveals the variation in the density of any crop in a given region at a point of time (Chauhan, YS 1987). Cropping pattern is the proportion of area under various crops at a point of as it changes over space and time (Kashid, D.L and Kashid, N.D. 2010)

3.2 Digital Image classification

Digital image processing Techniques classify images based on digital number. Classification is a specific part of the feature space corresponding to a specific class. Classes have to be distinguished in an image and classification needs to have different spectral characteristics. This can be analyzed by comparing spectral reflectance curves. Image classification gives results to certain level of reliability. The principle of image classification is that a pixel is assigned to a class based on its feature vector by comparing it to

predefined clusters in the feature space there are two approaches for classification. One is the pixel based image analysis approach and the other object oriented image analysis approach. For this study Pixel Based Image analysis approach was used.

3.2.1 Supervised Classification MXL (Maximum likelihood)

Here the image analyst supervises the pixel categorization process by specifying, to the computer algorithm, numerical descriptors of various land cover types present in the image. Training samples that describes the typical spectral pattern of land cover classes are defined. Pixels in the image are compared numerically to the training samples and are labeled to land cover classes that have similar characteristics. Where use of global positioning system (GPS), and Toposheet of LANDSAT (January 2002), LISS III (January 2008) the topographic maps could be used as the area comes under the purview of the restricted area. Ground truth information corresponding to various land use/land cover classes were collected after critically examining the spectral variations in the Geocoded FCC. For crop identification, supervised classification was performed for all the images. Maximum Likelihood Classification (MLC) techniques have been applied for the images classification it is good result of other two techniques.

3.2.1 Unsupervised Classification ISODATA

The unsupervised classification was carried out for two images. ISODATA algorithm(ERDAS 2006) has some further refinements by splitting and merging of clusters are merged if either the number of members (pixel) in a cluster is less than a certain threshold or if the centers of two clusters are closer than a certain threshold. Clusters are split into two different clusters if the cluster standard deviation exceeds a predefined value and the number of pixels is twice the threshold for the minimum number of pixels. Unsupervised technique its very really used .the meanly two techniques is available K-mans and ISODATA (Interactive self Organizing data analysis techniques) for the classification mostly used ISODATA technique used. Automatically training sites are generating.

Sub-pixel based classification in remote sensing imagery the measured spectral radiance of a pixel is the integration of the radiance reflected from all the objects within the ground instantaneous field of view, resulting in the mixed spectral response to the sensor for that particular pixel. Mixed pixels are generated if size of the pixel is larger than size of the object being sensed. Consequently the resulting pixel includes more than one type of terrain objects. Obviously, spectral mixing is inherent in any finite resolution digital imagery of a heterogeneous surface. Several methods based on combination of multi-temporal, multi-sensor or multi-scale remote sensing imagery, as well as the incorporation of ancillary data prior and after classification procedures, have been applied in the past to overcome the above mentioned problems.(Matinfar et al 2007) Pixel based image Analysis means that the classic image classification method that classifies remote sensing images according to the spectral information in the image and the classification manner is pixel by pixel and one pixel only belongs to one class so for this study use the multispectral data, LISS-III and LANDSAT 7ETM+ images. Easily indicate the healthy pomegranate orchards. Spectral response is more good, and help for indicate the tress crop.

3.3 Normalized Difference Vegetation Index (NDVI)

The Normalized Difference Vegetation Index is a simple graphical indicator that can be used to analyze remote sensing data measurements, typically but not necessarily from a space platform and assess whether the target being observed contains live green vegetation or not Vegetation indexes are algorithms aimed at simplifying data from multiple reflectance bands to a single value correlating to physical vegetation parameters (such as biomass, productivity, leaf area index, or percent vegetation ground cover) (Tucker C.J. et al 197).The Normalized Difference Vegetation Index (NDVI) is a simple graphical indicator that can be used to analyze remote sensing measurements, typically but not necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not. Thus, NDVI was one of the most successful of many attempts to simply and quickly identify vegetated areas and their "condition," and it remains the most well-known and used index to detect live green plant canopies in multispectral remote sensing data.

4 RESULTS AND DISCUSSION

4.1 Crop Concentration Index

We are taken the last 20 year (1991 – 2010) data of all horticultural crop production taluka-wise in Solapur

district. Here analyzed the whole data with the help of Bhatia crop concentration methods

In that analysis we meanly used location quotient technique for the delineation of crop concentration lies in the fact that it enables to understand the area of specialization different crop grown in a region at a given point of time. So on that study we observed most of pomegranate area concentrated in western part of Solapur district. Sangola, Malshiras, Mangalwedha, and Pandharpur this taluka are highly concentrated.

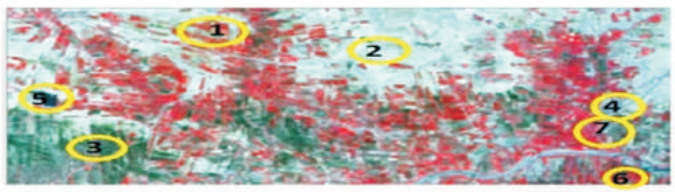


Figure 1.1 Shows Visual Interpretation of the Images

1Pomegranate, 2 Barren Land, 3Fellow Land, 4 Settlement, 5Water body, 6 Sugarcane Crop, 7 Rabbi Crop

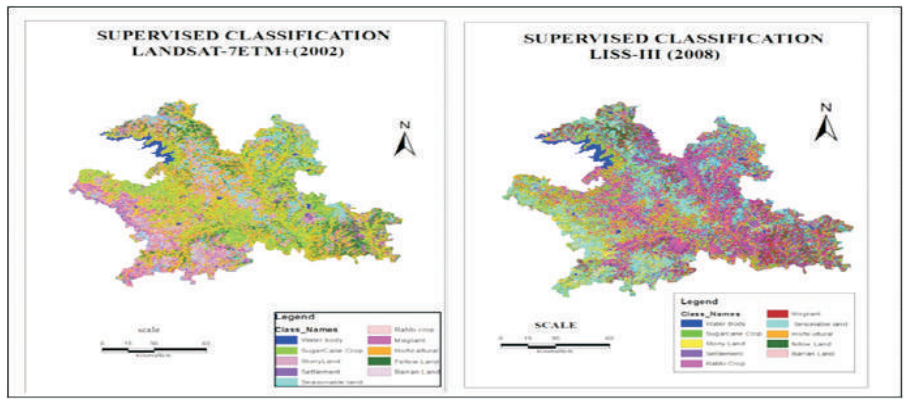
4.2 Supervised Classification of LISS III Image

The LISS III image was classified into same ten classes as mentioned above (horticultural, water body, Fellow land, barren land, Stony land mix plant, Rabbi Crops, Sugarcane and settlements) as shown in Figure 2. Of the three classification techniques MLC showed the lowest degree of mixing. The classified image was validated with the ground truth data. The best result was obtained from maximum likelihood classifier (MLC). The overall accuracy for the LISS III classified image was found to be 82.44%. Supervised Classification of LANDSAT-7 ETM+Image The LANDSAT 7ETM+ Image was classified into same ten classes as mentioned above (horticultural, water body, Fellow land, barren land, Stony land mix plant, Rabbi Crop, Sugarcane and settlements) as shown in Figure 2. Of the three classification techniques MLC showed the lowest degree of mixing. The classified image was validated with the ground truth data. The best result was obtained from maximum likelihood classifier (MLC). The overall accuracy for the LISS III classified image was found to be 78 %.

4.3 Accuracy Assessment:-

In accuracy assessment the main assumption is that the reference data or field data are correct. Classification accuracy will be determined by using three complementary measures which are based on error matrices or confusion matrix derived from independent field data. The two methods used for accuracy assessment are: over all accuracy and producer accuracy

Figures.2 supervised classification



Figures.2 supervised classification

Accuracy assessment Supervised classification: Overall Classification Accuracy LISS III = 82.40%, LANDSAT ETM + = 78.00%
KAPPA (K^) STATISTICS Overall Kappa Statistics LISS-III = 0.8044, LANDSAT ETM+ 0.7321

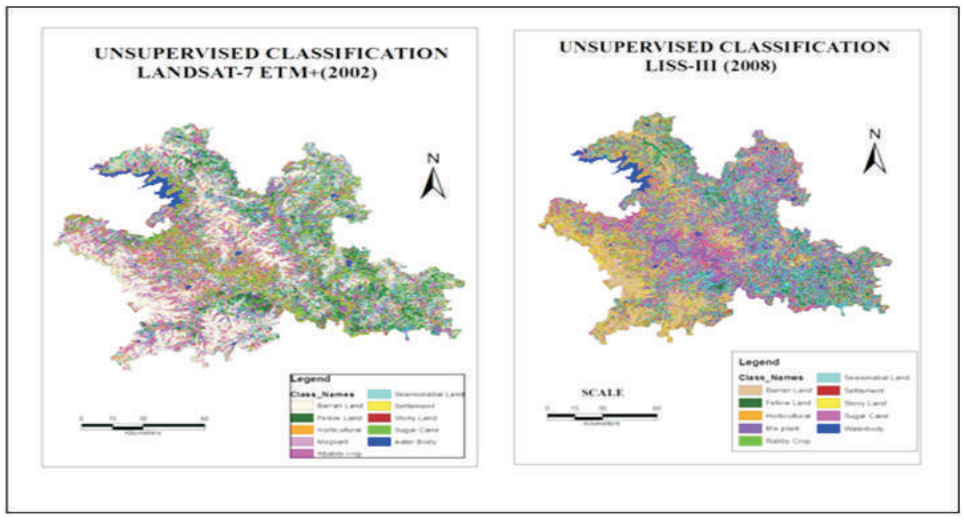
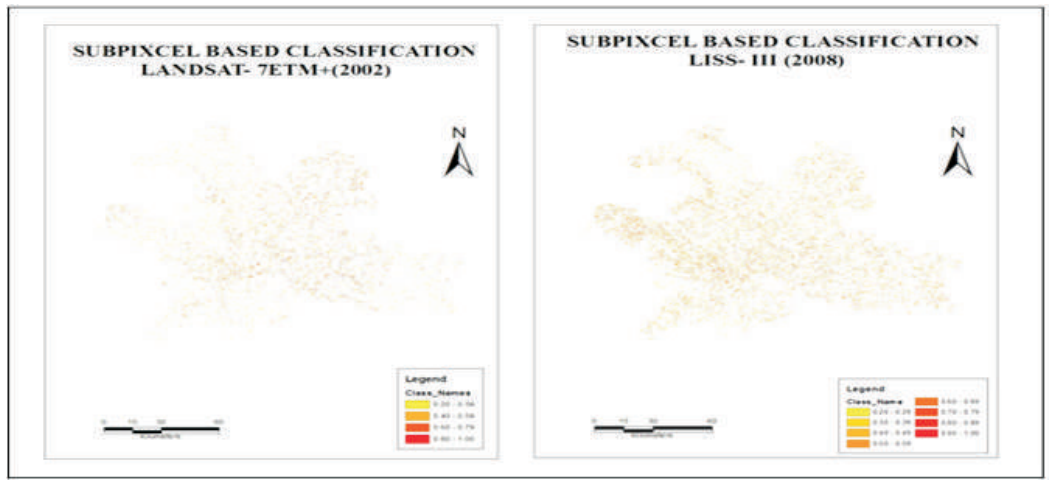


Figure.3 unsupervised classification

Accuracy assessment Unsupervised classification
Overall Classification Accuracy LISS II I= 80.00%, LANDSAT-7 ETM+ = 82.00%
KAPPA (K^) STATISTICS Overall Kappa Statistics LISSIII = 0.770, LANDSAT ETM+ = 0.7892



Figures.4 Sub pixel based classification

So fo r this study use the multispectral data, LISS-III and LANDSAT 7ETM+ images. Easily indicate the healthy pomegranate orchards. Spectral response is more good, and help for indicate the tress crop. Accuracy assessment sub-pixel based classification Overall Classification Accuracy LISS-III = 62.00% Landsat -7 ETM+ = 64.00%

KAPPA (K^) STATISTICS

Overall Kappa Statistics LISS III = 0.5357 Landsat-7 ETM+ = 0.432

CONCLUSIONS

Medium high Resolution image like LISS III and ETM + could be easily identified more than two hector pomegranate field. As compared to the LISS and ETM+ image LISS- III image gave much better results. In this classification techniques supervised classification approached (maximum likelihood) is the best as compared unsupervised and sub pixel based classification. Concentration index easily find out the regional pattern of particular crop. Finally find out western part of district geographical and socio-economic maximum concentration field and progressive farmers in pomegranate cultivation. Normalized difference vegetation index (NDVI) has been used to categorized various crop where high NDVI value 0.4 indicate the sugar crop, 0.3 value is shows the pomegranate and the lowest value of 0.1 it show the rabbi crop.

REFERENCES

Amith Kumar, K.N., Singh, B. L., and Singh, R.D., (2008) Mapping of Apple orchard Using Remote Sensing Techniques in Cold Desert Of Himachal Pradesh, India. J. Indian Sco. Remote Sensing, 36:3, pp.87- 392.

Anji, R., (2010) Textbook of Geographical Information Systems, BS Publication, third edition, Hyderabad.

Anonymous (2000) Technology Mission on integrated development of horticulture in northern-eastern states including Sikkim. Department of agricultural and cooperation, ministry of Agriculture, govt. of India.

Abdel, E.M., Rahma, Ahmed, F. B. (2008) The application of remote sensing techniques to sugarcane (Saccharum spp. hybrid) production: a review of the literature. International Journal of Remote Sensing, .29(13), pp.3753–3767.

Alka S. S. Panigraphy. Apple orchard characterization using remote sensing & GIS in Shimla District of Himachal Pradesh.

Amith Kumar, K.N. Singh. Brig Lal. R.D. Singh. (2008) Mapping of Apple orchard Using Remote Sensing Techniques in Cold Desert Of Himachal Pradesh, India. J. Indian Sco. Rmote Sensing 36, pp.387- 392.

Bandyopadhyay, S., Jaiswal, R K., Hegde, V S, and Jayaraman, V., (2003) Assessment of land suitability potentials for agriculture using a remote sensing and GIS based approach, International journal of Remote sensing, 30(4) pp.879-895.

Bannari, A., Morin, D., and Bonn, F. (1995) A review of vegetation indices .remote sensing review, 13, pp. 95-120.

Blakemore, M., Ed. (1984) Principles of Geographical Information Systems for Land Resources Assessment, Oxford Science Publication, Clarendon Press, Oxford.

Bowker, D.E., Davis, R.E., Myrick, D.L., and Jones W.T. (1986) Spectral Reflectance of Natural Targets for Use in Remote Sensing Studies; NASA Reference Publication 1139-N85-30450; NASA: Hampton, VA, USA, pp. 188.

Chauhan, Y.S.(1987)Screening for tolerance to salinity and water logging: Case studies with pigeonpea and chickpea. Proceedings of consultants. ICRISAT, Patancheru, India. pp. 19-21.

Dadhaval, V.K, Singh P, Dutta S., Parihar, J.S. (2002) Remote sensing based crop inventory: A review of Indian experience. Tropical Ecology, 43(1) pp.107-122, 2002.

ERDAS. ERDAS Imagine 9.1(2006) User manual; applied Analysis Inc., USA.

Kalpana, R., Natarajan, S., Mythili, S., Shekinah, D.E., and Krishnarajan, J.,(2003) Remote Sensing for Crop Monitoring - A Review, Agric.Rev, 24(1), pp.31-39.

Kashid,D.L. and Kashid,N.D.(2010) Crop concentration in Sindhudurg district. A Geographic Analysis. Geosciences Research, 1(2), pp.28-33

Palanisami, K. C.R.Ranganathan, Senthilnathn and ChiekoUmetsu. Diversification of Agriculture in Coastal Districts of Tamil Nadu– a Spatio- Temporal.

Lillesand, T.M. and Kiefer, R.W. (2001) Remote Sensing and Image Interpretation, 4th edition, John Wiley and Sons, inc. USA.

Matinfar H.R., Sarmadian, F. S.,Alavi, Panah, Heck, R.J. (2007) Comparisons of Object-Oriented and Pixel-Based Classification of Land Use/Land Cover. American-Eurasian J. Agric. & Environ. Sci.,2 (4),pp. 448-456

Rao, P., H.M. Ravishankar., Uday Raj., K.Nagajoyti. (2004) Production Estimation Horticulture crops using IRS 1DLISS –III data J.India Society Remote sensing, 32(4)

Gong.P. P.J. Howarth. Land used classification of SPOT HRV data using cover frequency method.

Todkari G.U.(2010) Agriculture Land use Pattern in Solapur District of Maharashtra.International Journal of Agriculture Sciences; 2(2) pp.1-8.

Tucker, C.J. (1979) Red and photographic infrared linear combinations for monitoring vegetation. Remote Sensing of the Environment, 8, pp.127-150
Maharashtra pomegranate grower and research association Pune, India http://www.pomegranateindia.org/