

Remote Sensing Satellite Data Analysis applied to precision Agriculture Modeling

Hari Kumar Singh¹, Sanjeev Sharma², Pooja Singh³, Shiv Kumar Tomar⁴

² R.D. Engineering College, Ghaziabad, Uttar Pradesh,

^{1,4}Department of ECE, FET, MJP Rohilkhand University, Bareilly, harsdik@gmail.com

³Research Scholar, Delhi Technological University, Delhi

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Abstract:

This research paper focuses on analysis of Image of Data from Remote Sensing which integrate Spatial, Temporal and Spectral Features of the objects in the field of Satellite image processing. We used remote sensed data in multi spectral form to detect spectral signature related to several objects in several regions used in land cover classification, change in land use with respect to time and using temporal analysis for analysis the effect of climate upon the surface. Few band combinations of data from remote sensing are very useful in classification for land cover. Land cover types having spatial distributions like; agriculture land, urban area and water resource are easy to interpret. Method used to derive agriculture variables from different data through remote sensing to extract quantitative parameters using several multispectral sensors in remote sensing, issues related to inter-calibration in different methods are to be considered for the assurance of comparability. Some features affects vegetation indices like; atmospheric conditions, sensor geometry, radiometric or spatial resolution and topography. Factors involved in this research are spectral characteristics related to different sensors viz- bandwidth, centre wavelengths, and band position, and may be described by relative spectral response functions. Vegetation Index (VI) and Weighted Difference Vegetation Index (WDVI) in between several sensor pairs using regression are based on multispectral sensors in simulated form. The method which combines the information in multi-spectral form with calculation was not able to provide good results and was beaten by use of single sensor, in the case of multispectral information. The results of remote sensing and statistical data are used for estimation of input parameters for application in agriculture. Input parameter for agriculture extracted from the data of remote sensing is main advantage in this technique as a large area of spatial overview is taken. Next challenge was for integration of the agriculture variables extracted from data in multispectral form into model for agriculture growth for increase the accuracy of estimation for final yield. At present the linking for our benefit between these two techniques is limited for classification of land use using remote sensing to adopt the appropriate model and agriculture growth quantification as well as development curves with the use of biophysical parameters extracted from images from remote sensing for calibration of models. Hence variables of remote sensing are integrated with agriculture growth are modeled for improving the accuracy of estimation of final yield as compared to parameter setting as automatic input for obtaining optimized yield. Hence data of remote sensing integration with model of agriculture growth facilitates the spatial application in prediction at best scale for agriculture production. Above approach is best one with any other evaluated method of yield estimation using direct multi sensors. This research has proved the retrieval of biophysical parameters from the data of remote sensing and used to prepare model for agriculture growth, for improved estimation of final yield for sustainable agricultural production for developed as well as developing countries.

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I INTRODUCTION

At present, asset's auspicious data is assumed as critical part in the world. Reasonable arrangement and dealing related to assets has a high scope. The effect of fast urbanization and urban collapse is significant upon provinces of urban biological system. Changes and spreading in the areas of utilizing are moderately associated with several features for wellbeing of mankind and their welfare which includes sustenance creation, biodiversity and sickness related issues. One of the big threats for sustainability in developing countries like India is fast development of concrete jungles in haphazard manners. So exact and renovated for the organization of urban area requires the creation of methods, effective arrangements and administration for the district's assets developments for increasing the employments in urban areas. Regarding this, satellites prove a key for providing the cost effective and convenient data related to the assets of an area. Due to enhanced nature and simple accessibility of multi-transient and multi-spatial remote sensed data with the use of new techniques, it is now advised for screening of urban area, land use change and urban expansion in appropriate and cost effective manner.

An important part in this research is the deep examination using Integrating Temporal, Spatial and Spectral Features of Objects from the Remote Sensed Data received from National Remote Sensing Agency, Space Department, Government of India. Multi-spectral remote sensed information is used for locating marks related to several objects of districts in an area, time change the utilization of the area, and performing global investigation for removing the atmospheric effects upon the surface.

For efficient management of agriculture work, the associated information in efficient way will be required, hence satellites proves to be the trusted and best assets for providing information in convenient manner. Information from multispectral satellite enables us for investigation different parameters like- concrete structures, vegetation etc, which

cannot extracted in visible band. Information from Satellites has great perspective related to the surface which is otherwise impossible. These results from satellite may be applied for justified arrangement and administration. Information from Satellite is specially practical. In the case if ground observations are to be carried out then cost of observation becomes very huge.

Prime object in this research work is for upgrading the patterns of land use in reasonable manner as well as monetarily for urban improvement. Above analysis may be used in following applications:

1. Unauthorized development monitoring of the colonies.
2. Deforestation.
3. Agricultural management and planning.
4. Planning of water resource.
5. Infrastructure planning.

In our country, multi-spectral and satellites having very high resolution is not the story of very far future, which will provide us extremely valuable information in a convenient way. Then it is our task to extract the valuable data from this received information.

II METHODOLOGY

In the proposed researched attempt is made to overcome the above deficiencies by evolving a systematic methodology explained.

1. Select an area of interest and gather the satellite image for this region. The area based items will be recognized utilizing picture handling strategy. Image cluster of comparative pixels qualities can be framed by C-mean calculation in the accompanying steps.
2. Having framed the image clusters in above steps, the region of the rural area will be evaluated. The dirt sort can be recognized which will help in assessing the farming yield of the locale of interest. This progression will require utilization of fluffy neural system connected to image

processing. This strategy can likewise be utilized for distinguishing the ailment contaminating the yield.

- A agriculture model of exactness farming will be produced with inputs like area range, watering system, barometrical conditions, and soil conditions. The model would gauge the product yield and contrasts it and target and criticism the error to the model information. This works in an iterative way till a met arrangement is acquired.

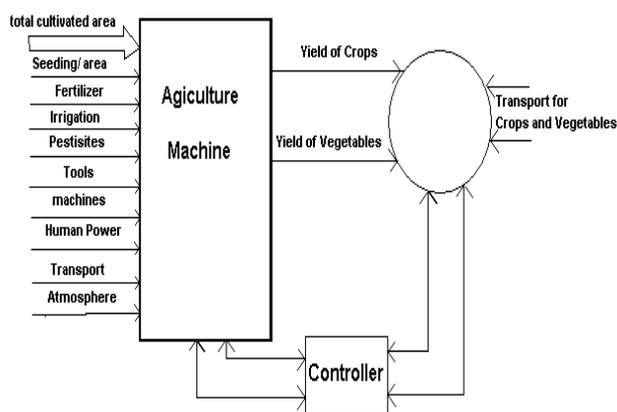


Figure 1 Agriculture model

III DISCUSSION

Analysis of the Multi Spectral Image Using ANN:

Step 1 Assembling the Training Data: We have gotten the image of the Bareilly Ramganga area as appeared in the figure 4.8 and by utilizing the Data Cursor apparatus as a part of the MATLAB we have acquired the R-G-B segments of the pixels which best speak to the distinctive components of the image like the River and Water Bodies, the Concrete Structures, the Roads and the Vegetation shown in figure below

Features	R	G	B
River and Water Bodi	120	059	056
	128	049	052
	131	051	060
	136	081	076
	142	052	058
Concrete Structures	151	104	096
	172	093	088
	181	059	074
	186	074	088
	197	098	104
	154	049	064
	163	052	068

Roads	169	096	087
	172	074	089
	178	062	073
Vegetation	224	086	101
	229	119	130
	230	096	105
	234	082	095
	240	104	114

Figure 2 Few of Pixels representing different Features



Figure 3 Original image of Bareilly [National remote sensing Agency]

Accordingly we got R-G-B estimations of right around 100 pixels and these qualities might be shaped to frame a 3X100 framework as in figure 3

R: 120 128 131 136 142 151 172 181 186 197 154 163 169 172....
G: 059 049 051 081 052 104 093 059 074 098 049 052 096 074....
B: 056 052 060 076 058 096 088 074 088 104 064 068 087 089....

Figure 4 The Matrix of Input Pixels

Step 2 Create the Network Object:

Presently we characterize the system and indicate its elements like no. of neurons, range of the estimations of the info neurons, no. of layers and so on and indicate the info and target grids. In target grid, there is a specific shading for the specific component to create the FCC.

R: 0.0 0.0 0.0 0.0 0.6 0.6 0.6 0.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0....
G: 0.7 0.7 0.7 0.7 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0....
B: 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.8 0.8 0.8 0.8 0.0 0.0 0.0 0.0....

Figure 5 The Matrix of Target FCC

Presently begins the preparation of the system and the weights are doled out consequently. Since, the info and yield are as of now characterized; the weights for every

information yield pair can be produced. In this way, the progression 2 makes it to meet the necessity of the mapping relationship between the info and the objective.

Step 3 Simulate the Network Response for Whole the Image:

Presently, as we have gotten the capacity speaking to the connection between the information and the objective, we are prepared to create a subsequent framework relating to the last FCC of the given image.

However, before we mimic the image with the assistance of given system of neurons, we are to change over the 3-dimensional grid of measurements '512 X 512 X 3' relating to the multi ghostly image into a 3-dimensional framework of measurements '3 X 512 X 512' i.e. '3 X 262144'.

Presently this changed over type of the multi otherworldly image connected to neural system for the recreation. After the reproduction, what we get as the outcome is again a 2-dimensional grid of the same measurements '3 X 262144', which is again to be changed over into the 3-dimensional framework of measurements which speaks to the FCC relating to the given multi otherworldly image.

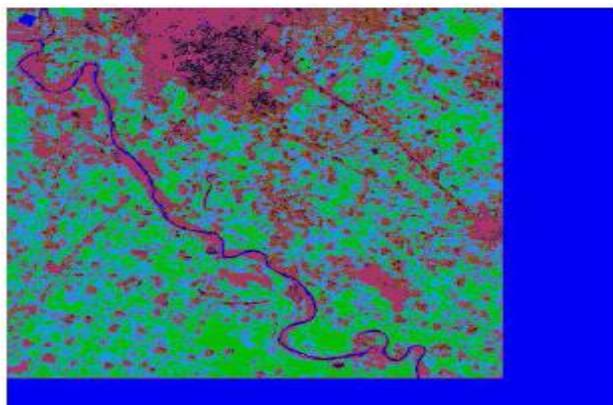


Figure 6 FCC Image of the Multi Spectral image

Analysis of the Multi Spectral Image Using DWT

Step 1:- In the initial step we get the multispectral image and change over it into the grayscale image as in figure 7a to apply the DWT algorithm on the image.

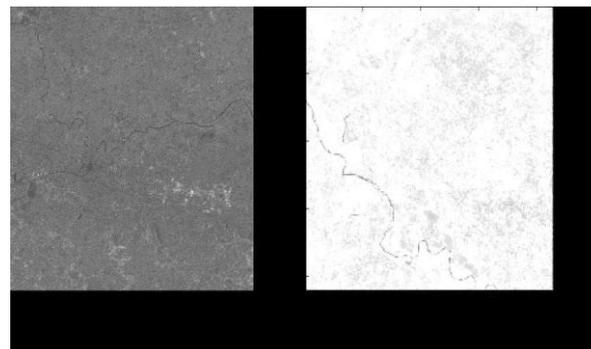


Figure 7 (a) Grayscale Image (b) Averaged Component

Step 2:- After we have the grayscale image, we apply the averaging and differencing calculation of the discrete wavelet change on the multi phantom image and dissect the arrived at the midpoint of segment of this multispectral image, as appeared in the figure 7b.

This Averaged component of the image is considered as the original image and the DWT algorithm is again applied on this averaged component. Among the resulting components the averaged component is again analyzed. This process of calculating DWT is repeated four to five times and each averaged component is analyzed for the presence of the pixels representing the corresponding features.

Step 3:- Now as we have obtained the fifth averaged component of the multi spectral image, the inverse process is to be undergone. In this process of calculating inverse DWT, the four resulting components of the input image are considered to be the input of the inverse filter.

After we apply the four components averaged, vertical, horizontal and diagonal, we get the earlier averaged component of the image. And after repeating this inverse filtering process what we get as the result is the original multi spectral image.

Step 4:- Now, we finalize our study by analyzing all the averaged components and try to check out the features of the multispectral image. What turned out to be our result of the DWT analysis is that shown in the figure.

Analysis Of The Multi Spectral Image Using (DCT)

Step 1:- In the initial step we get the multispectral image and change over it into the grayscale image.

Step 2:- After achieving gray scale image, we apply the DCT algorithm on this grayscale image and get the DCT coefficients of the multi spectral image, shown in the figure 8.

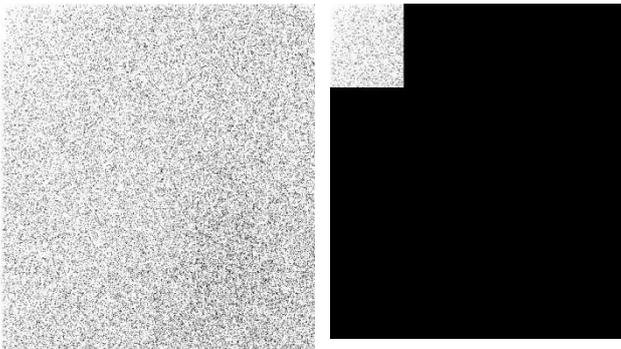


Figure 8 DCT Coefficients Image and Compressed matrix of the DCT Coefficients

Step 3:- Now, that we have obtained the DCT coefficient matrix, we can go for scaling these coefficients, and can get a smaller matrix as shown hereunder.

Step 4:- If we desire to get the original image back from the coefficients, the inverse DCT algorithm will be employed. Here if the image containing all the coefficients is used then what we get as result is the uncompressed all the same original grayscale image. But if we use the smaller coefficients matrix then we get a compressed grayscale image of the original image which is given herein figure.

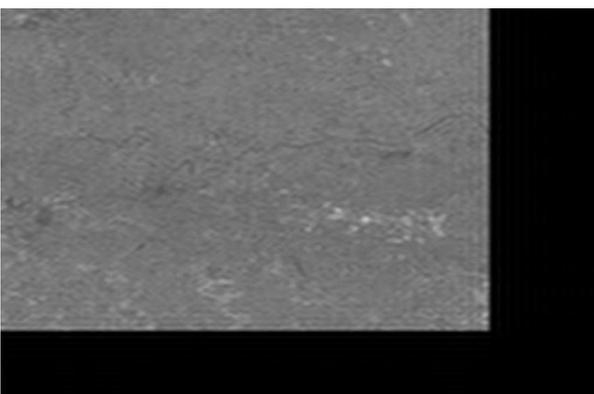


Figure 9 Compressed Images Obtained from the Smaller Coefficient Matrix

The analysis of this compressed image shows that the pixels representing the vegetations in the multi spectral image are not as clear, but the pixels representing the water bodies and the concrete structure are quite revealing.

Analysis of The Multi Spectral Image Using NDVI

Step 1:- Colour image received by us has the components known as RGB where R stands for near Infrared band, G stands for Red band and B stands for Green band.

Step 2:-In the wake of getting the images of the distinctive groups now our point is to discover the NDVI estimations of the given image $NDVI = (NIR - RED)/(NIR + RED)$ By utilizing the MATLAB we got the NDVI estimations of every pixel lastly we got image as appeared in the figure 4.36

The estimations of NDVI are in the scope of - 1 to +1. For making the image we have changed over this reach to 0 to 200; as $NDVI \text{ image value} = (NDVI \text{ value} + 1) * 100$;

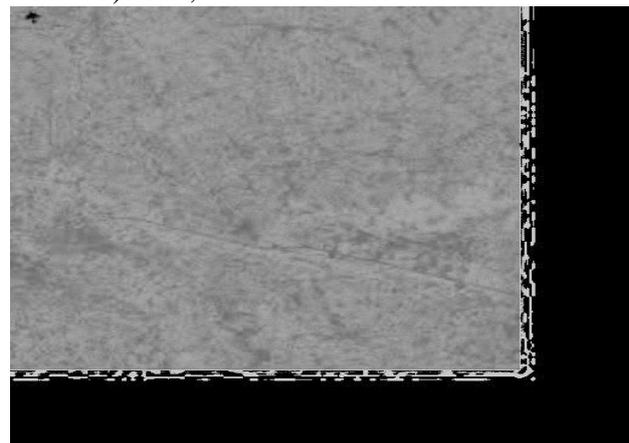


Figure 10 NDVI image

Step 3;-Construction of the false color composite:

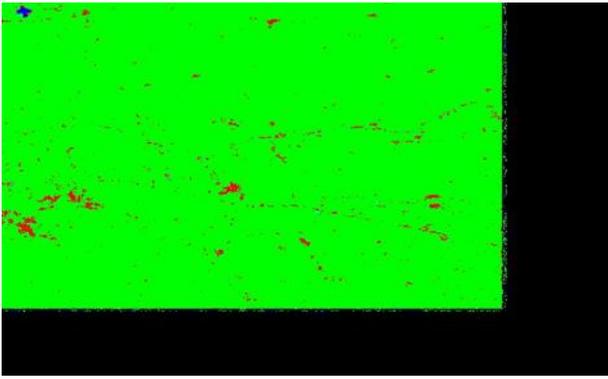


Figure 11 False Color Composite of Multi Spectral Image

found the particular scope of the FCM for every article.

1. For the vegetation, I found the FCM vales are in the middle of 0 and 1, the grouping of the vegetation is in the scope of the 0.01 to 0.1:
($fcm(m,n) < 0.1$) and ($fcm(m,n) \geq 0.01$)
2. For the thick structures, I found the FCM vales are in the scope of between 0.1 to 0.2:
($fcm(m,n) \leq 0.2$) and ($fcm(m,n) \geq 0.1$)
3. For the streets, I found the FCM vales are in the scope of somewhere around 1 and 0:
($fcm(m,n) < 1.0$) and
($fcm(m,n) \geq 0.5$) | ($nir(m,n) < 0.79$) and
($nir(m,n) > 0.7$)
4. For the water, I found the FCM vales are in the scope of somewhere around 1 and 0:
($fcm(m,n) < 0.225$) and ($fcm(m,n) > 0.2$)
5. For the powerless structure, I found the FCM vales are in the scope of somewhere around 1 and 0:
($fcm(m,n) < 0.5$) and ($fcm(m,n) \geq 0.225$)
6. For the area, I found the FCM vales are in the scope of somewhere around 1 and 0:
($fcm(m,n) < 0.01$)

Results for Images after Applying Different Algorithms:

1 Images for Bareilly:

Analysis of the Multi Spectral Image Using FCM:

Step 1: In the initial step we get the multispectral image and change over it into the twofold image to apply the FCM calculation on the image.

Step 2: After we have the twofold image, we apply the nir, red and green band images calculation of the FCM on the multi phantom image and break down the arrived at the midpoint of segment of this multispectral image

Step 3: Now as we have gotten the orchestrate information in a network part of the multi otherworldly image, utilizing "reshape" capacity.

Step 4: After getting the images of the diverse groups and reshape the image now our point is to discover the bunch estimations of FCM of the given image [CTR,CLASS]=FCM(DATA,4);

By utilizing the MATLAB we got the bunch estimations of every pixel lastly we got the image. The estimations of group of FCM are in the scope of 0 to +1.

Step 5: Now we ascertain the reshape of class information utilizing reshape capacity.

Step 6: Next point in the wake of getting the FCM image was to get the grouped images of the area, keeping in mind the end goal to get the these images we played out the ground review at different spots of the city and taken the best possible longitude and scope estimations of the overview district from Google earth, and with the assistance of that we recognized the study areas into the multi phantom images. By the assistance of the ground review I

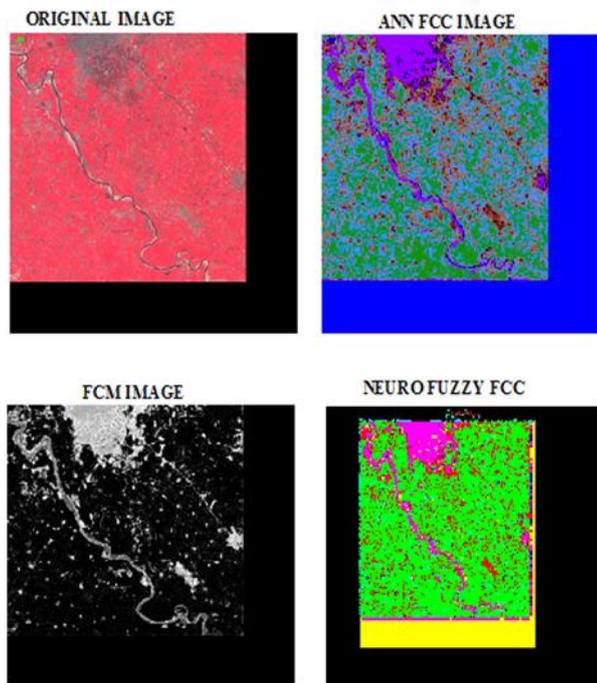


Figure 12 Images of Bareilly using different algorithms

2 Images for Bhopal :

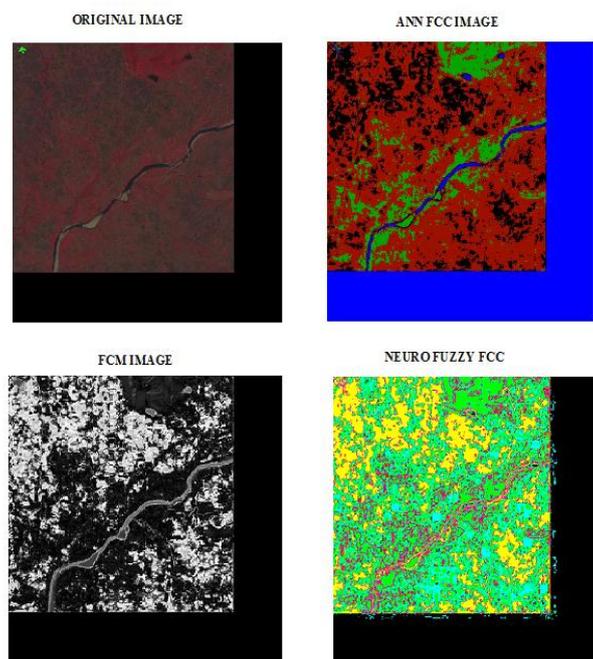


Figure 13 Images of Bhopal using different algorithms

3 Images for Hyderabad:

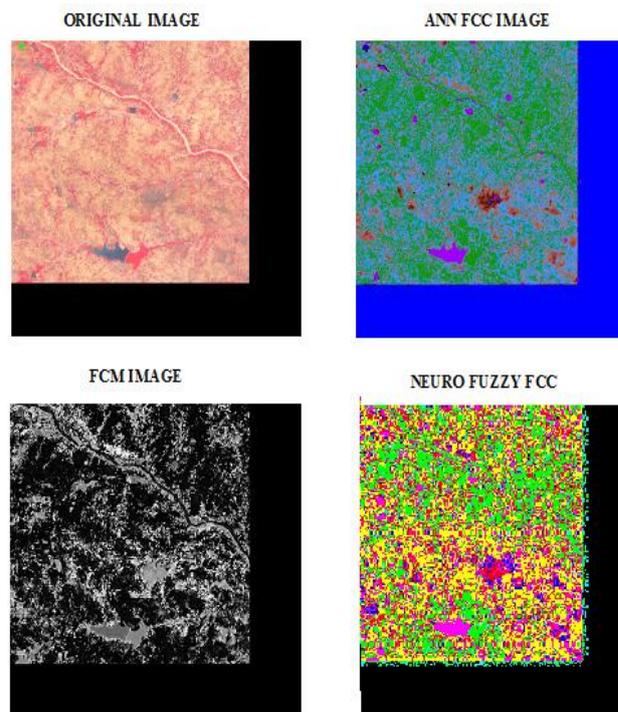


Figure 14 Images of Hyderabad using different algorithms

4 Images for Haridwar:

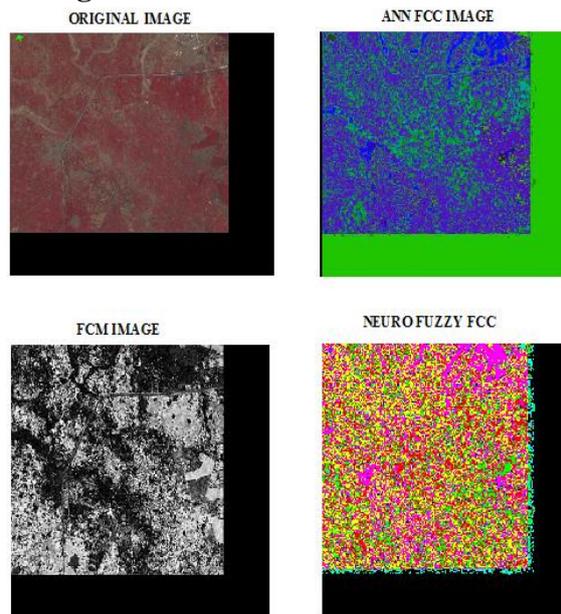


Figure 15 Images of Haridwar using different algorithms

5 Images For Imphal:

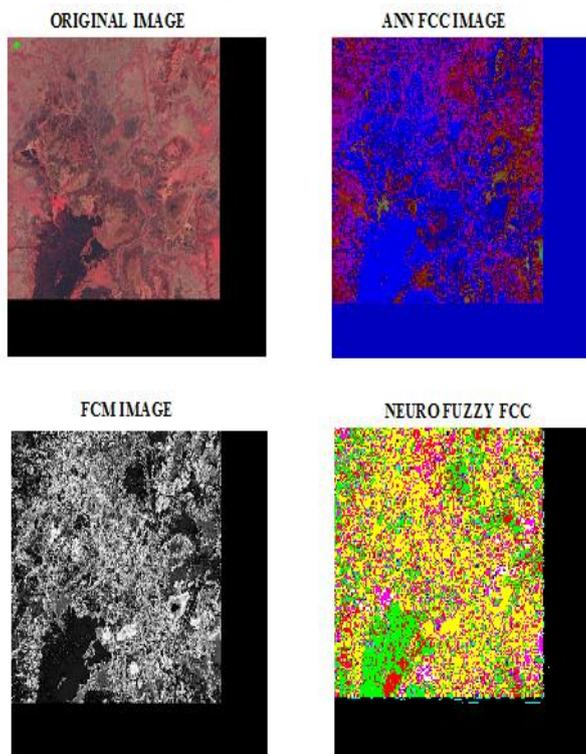


Figure 16 Images of Imphal using different algorithms

7 Images for Shimla:

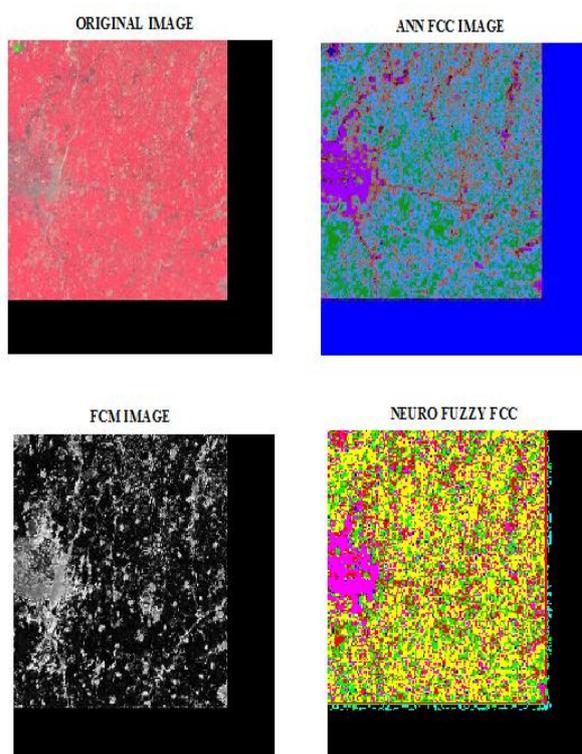


Figure 18 Images of Shimla using different algorithms

6 Images for Jamnagar:

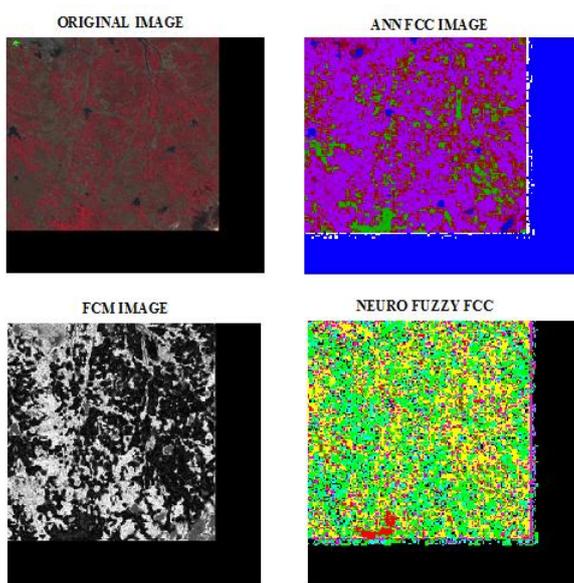


Figure 17 Images of Jamnagar using different algorithms

CALCULATION OF ONE PIXEL IN KILOMETERS LISS-IV SENSOR

- One camera every channel and there are three channels VIS/NIR radiometer
- There are 4096 pixel/line per camera; swath 23.9 km if the three cameras are utilized for every channel (accordingly multi-unearthly), or 70 km in the event that all cameras are utilized for survey parallel strips as a part of the same channel (in this way panchromatic).
- Cross-track guiding ability $\pm 26^\circ$ for stereoscopy in the middle of circles and worldwide scope in 24 days, in sunshine. 5 days for an objective zone by utilizing cross-track indicating.
- Then for one channel=23.9km
- Value of one pixel by estimation gets to be $= (23.9*23.9)/(512*512) \text{ km}^2 = 0.0022 \text{ km}^2$

Agriculture is science and art for practicing farming which including harvesting crops, soil cultivation, livestock rising, plants, animals and other useful products production, useful for survival of human

being. Agriculture area contains the region having homogeneity related to help, climate conditions, cultivating practices, crop yield etc. (Caswell, J.A. 2013)

Agriculture proved as back bone related to Indian economy from the centuries and at present around 70% of population depends upon agriculture directly or indirectly. Agriculture fulfills the basic needs related to the humans as well as different living organisms. Agriculture raw material is supplied to many industries. Agriculture takes place in plain areas, ripeness in soil, long season and huge change in climate condition etc. The conditions of Indian continent are most suitable for agriculture as it provides several favorable conditions. Despite the topographical conditions in extreme, India is involved constantly in inventive works with exploration, innovation and science in the field of more yield creation.

IV PRECISION AGRICULTURE

The ability of precision agriculture from biological and financial point of view planned with declined water use, chemicals, pesticides and herbicides other than farmhouse devices. Precision developing methodology is opposite to regulating the field basis upon the typical theoretical condition, as it observes complexities related to specific site in fields and controls practices of organization if necessary. Precision agriculture streamlines and performs the collection as well as examination of the information. It suggests administration in decision making in shorter time frame for larger fields. (Rahul Tripathi, 2012)

Technologies used in Precision Agriculture

From the point of view to end result for gathering and utilizing data precisely, it is necessary having past consideration of Precision Agriculture combined with current accessible innovative hardware. The instruments combined equipment, programming and best management exercise. These are shown in the below table 5.6 (Zhangyin Li and Zhangrui Ling, 2007)

Sr. No.	Technologies	Activities
1.	Mapping	The plotting of maps for yield and soil properties is vital and is early on step in exactness agribusiness.
2.	Global Positioning System (GPS)	Overall Positioning System satellites transmits EM wave that license GPS gatherers to find their range.
3.	Yield monitoring and mapping	In exceptionally progressed motorized frameworks, a grain yield screen reliably gives the data of grain in the spotless grain lift of a solidification.
4.	Grid soil sampling and variable-rate fertilizer (VRT) application	Soil test from self-assertive regions from field are sent to an examination place for testing. Network soil looking at uses the same measures of soil reviewing yet fabricates the power of inspecting.
5.	Remote sensing	Remote detecting is collection of data from a detachment. Information sensors can fundamentally be mounted on air art or satellite-based. Remotely detecting data gives a mechanical assembly to evaluating information about harvest wellbeing.
6.	Geographic information systems	Geographic information structures (GIS) are Computer gear and

	(GIS)	programming that usage highlight ascribes and zone data to make maps.
7.	Quantifying on Farm Variability	Each homestead introduces an interesting administration issue.
8.	Soil Variation	Soil assortment is a spatial variable. Water-holding breaking point or characteristic matter assortment, close by geology, gives even an all the additionally entrancing viewpoint of a field in which a creator spots inputs or irritates the dirt.
9.	Variability of Soil Water Content	It is dug in truth that dirt water content in a field changes after some time and range and this transient and spatial variability in soil water content illustrations may have critical implications for Precision Agriculture when all is said in done and water administration particularly. generation proficiency.

Table Showing Technologies used in Precision Agriculture

Different opportunities will take place in picture related to strategy of Precision Agriculture. Devices and instruments will be used for application of composts, seeds and chemicals in different manner in the field getting the expected yield from the field. Remote sensing developments will enable us for assessment the development in the field throughout the season without physically going to the fields. The future of Agriculture will depend upon the

ability of investigator for carried out such studies, with agreement of agriculturist and biological groups for the global benefit and gaining adequate agriculture yield. (Francis J. Penetrate and Peter Nowak 1999)

Agriculture Architectural Model

In this research Remote sensing data is extracted for analysis the productivity of lands of India’s certain regions. It is found that land’s productivity depends on lot of, certain and dominant factors, which we include in our research work. We are able for explanation to the production cost of an area and agriculture’s net Profit, using analysis of productivity related to land extracting different data for input and its related output. Most favorable combination may be predicted for inputs for a region of land in hectare. This result may be taken as reference and used for increasing the land’s productivity.

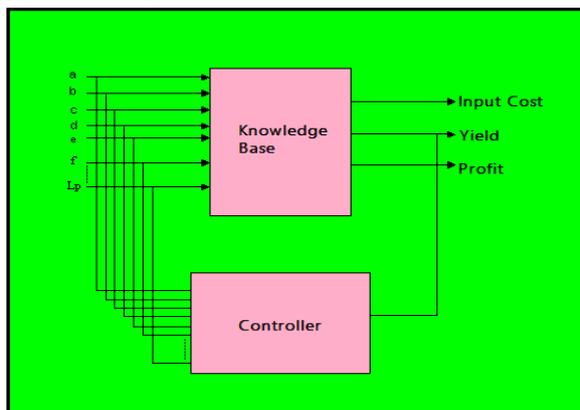


Figure 19 System Model to determine agriculture yield

For the developments of crops in ideal manner, farmers are required to know about the developments of yields in a region, planning for seed quality improvement relative to climate and local problems and consideration of natural impact upon seed planting. For example if we are planting a field which is close to stream, the choice of seed which requires less compost will be best as it contaminate less. After the plantation of seeds, improvements in the quality of soil for growing harvests are time bound and climate dependent. If large amount of precipitation is expected in next days, there is a

choice for delay in preparing of soil to stop escape. The idea of possibility of rain may enable us the choice for opportunity for ideal watering system. As 70% hard water is used in farming, hence the planning in this area may change to new water supply at global label. Climate has the impact upon the crops development and transportation for carry out it. For example in the case of sugar cane collection, soil is expected to be dry for boosting the good reaping. In the case if it is sticky and wet soil, the crops will be destroyed using hardware. With the knowledge of the climate and the fields, relatively better choices may be adopted well in time. Hence pre examination work is required by advancing the required information parameters for agriculture.

Modeling parameter

There are 15 types of input parameters used in this agriculture model, as given below:

S.No	Parameters	S.No	Parameters
1	Man Power	9	Relative humidity of land
2	Type of Land	10	Solar energy
3	Total amount of fertilizer	11	Wind
4	Pesticides needed	12	pH of land
5	Seed amount	13	Fencing
6	Irrigation needed	14	Rainfall
7	Technology	15	Quality of minerals
8	Temperature		

Optimized graph

The final graph that indicates the effect of all the parameters on the yield is shown below.

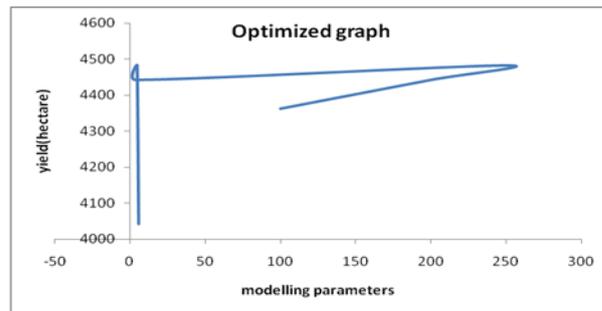


Figure 20 Graph between modeling parameters vs. yield

After solving all equations obtained from different graphs we get the following equation:

$$Y = -0.8a - 6.67b - 0.103c - 13.33d - 0.267e - 0.84f - 1.6g - 1.1053h - 1.6i - 106.67j - 13.33k + 1.67l - 3.33m + 0.067n - 3.33o + 4503.468 \dots\dots\dots 5.1$$

The above equation is the approx. optimized equation.

Where a= Man power; b=Land; c=Fertilizers; d=Pesticides; e=Seeds; f=Irrigation; g=Technology; h=Temperature; i=Relative humidity; j=Solar radiation; k=Wind velocity; l=pH; m=Fencing; n=Rainfall; o=Minerals

Now, substituting the optimized value of all the modeling parameters

We have. **Y= 4060.489**

- This is the maximum yield obtained from graphs.
- But the value of maximum yield obtained from optimized value is: **Y=4482**
- Hence the percentage error = $\frac{(4060.489 - 4482)}{4482} * 100 = -9.4\%$
- Total vegetation pixels = 108956 pixels
- Area covered by one pixel = 2200 square meter
- So Total vegetation area = $108956 * 2200 = 239703200$ square meter = 23970.32 Hectare
- Maximum Yield per Hectare = 4482Kg or 44 Quintal
- So **Total yield = 23970.32 * 44 = 1054694.08 Quintal = 10546940.8 Ton**

As we can see, any nation/region may be modeled related to production of any crop using these

methods which may be helpful for decision makers or researchers for making an understanding of the extent and status related to field and crop management, soils and climate. Method used for the analysis of the productivity of Land has a lot of advantage to improve the productivity of Land of certain region by adopting certain combination of Inputs and suitable Technology for that Land.

V CONCLUSION

In this Research, we have used Remote sensing application for species recognition and spatial information. Training samples preparation choice is made based upon prior assumptions for the land cover regions. Suitable classifier for the training samples is applied for classification of land covers related to an image. It involved the use of different multispectral images of remote sensing from IRS-A. Also an image of synthetic type is used for supporting our results though the classification of remote sense data. Our results may not concluded relative for any species, if we supervise the results of different algorithms e.g. NDVI, DWT and DCT applied upon multispectral image, which is able to provide outline only. The errors in classification are minimized using algorithms e.g. Fuzzy C-means, FCM and Artificial Neural Network, ANN as they include Artificial intelligence. ANN and FCM have convincing results as compare to NDVI, DWT and DCT. Further research shows that combining both the algorithms ANN and FCM, known as NEURO FUZZY SYSTEM, NFS, provides more convincing results with respect to previous one if all the pixels are trained in much efficient way. The results may be used in calculation of concrete structure, vegetation etc.

We have used Bareilly region for model of expectation for product yield, which may be shift to other regions marginally. The results of our calculated yield are much efficient as compared to real yield upon the grounds fundamentally, hence this model related to farming, is able to supply endlessly of different parameters. We can forecast

the agriculture yield using this model which is created through this research.

Let us illustrate a normal yield of agribusiness in India which is 2961 kg/ha which is lower in the light of average yield at global level to 3851 kg/ha. Hence research in agriculture model should be able to do increment for the farmers in India as enhancing the yield in production using this model is 4482 kg/ha which is 51% increment to normal Indian yield. Hence our model is capable to increase the yield of agriculture for not only in India but through the globe.

Agriculture sector's development is depends upon the analysts capacity leading this type of research, from the ecological and farmers communities which progress the environment and farming yield. Precision agriculture is able to provide a stage for modern corporate and may extent social exercises which further help our country India to increase the employment through cultivation of cutting edge. Government of India may encourage this procedure by providing advance technologies and concessions for small business having a goal of occupation of precision agriculture exercises. This cutting edge precision agriculture is able to carry out next green revolution in India and May made this large country wealthy by naturally and feasibly stable method.

REFERENCES

1. A. Rai 2007 Remote Sensing and GIS Applications in Agriculture - IASRI
2. A.J.W. de Wit and C.A. van Diepen (2007) "Crop model data assimilation with the Ensemble Kalman filter for improving regional crop yield forecasts" Agricultural and Forest Meteorology, Volume 146, Issues 1-2, 11 September 2007, Pages 38-56
3. A.Jalobeanu, L.Blanc-Feraud, J.Zerubia ,(2000)" Estimation of Adaptive Parameter for Satellite Image Deconvolution." IEEE Trans. International Conference on Pattern Recognition. Vol-3, PP (3322), Sept 2000.
4. A.K. Prasad, L. Chai, R. P. Singh, and M. Kafatos, "Crop yield estimation model for Iowa

- using remote sensing and surface parameters,” International Journal of Applied Earth Observation and Geoinformation, vol. 8, no. 1, pp. 26–33, 2006.
5. Ashbindu Singh (1989) “Digital change detection techniques using remotely-sensed data” International Journal of Remote Sensing Volume 10, Issue 6, 1989
 6. Ashish Mishra, Sundaramoorthi, K., Chidambara Raj, P., Balaji, D.(2003) “Operationalization of Precision Farming in India” Map India 2003 Map India Conference 2003
 7. Attema, E.P.W. and Ulaby, F.T. (1978). “Vegetation modeled as a water cloud”. Radio Science Journal, 13: 357–364
 8. Bina Agarwal (1986) “Women, poverty and agricultural growth in India” The Journal of Peasant Studies Volume 13, Issue 4, 1986
 9. Bischof, H. ; Schneider, W. ; Pinz, A.J. (1996) “Multispectral classification of Landsat-images using neural networks” Geoscience and Remote Sensing, IEEE Transactions on (Volume:30 , Issue: 3)
 10. C.Toomey, William marks, (2005) “Satellite Image Dissemination” via software agents” IEEE Trans.,Vol 10, no. 5 ,PP (44-51), Oct 2005.
 11. C.Unsalan , K.L. Boyer , (2005)“ A Theoretical nad Experimental Investigation of graph theoretical Measures for land sdevelopment in Satellite Imagery.” IEEE Trans Pattern analysis and machine intelligence, vol.27, no.4 PP (575-589), April 2005.
 12. Caiyun Zhang and Fang Qiu (2012) "Hyperspectral Image Classification Using An Unsupervised Neuro-Fuzzy System", by Journal of Applied Remote Sensing Volume 6 Issue 1, 2012
 13. Campbell, J.B. (1996). Introduction to Remote Sensing. Taylor and Francis, London.
 14. Campbell, James B. and Wynne, Randolph H. (2011). Introduction to Remote Sensing (5th ed.). The Guilford Presss. 667 p.
 15. Caswell, J.A. (2013) “Certifying the quality of agricultural and applied economics”, American Journal of Agricultural Economics, 96(2): 367-384. DAE (Division of Agricultural Economics, IARI) (2010) Fifty Years of Research and Education in Agricultural Economics, New Delhi.
 16. Chand, Ramesh and S S Raju (2009). Instability in Indian Agriculture during Different Phases of Technology and Policy. Journal of Agricultural Economics, 64 (2): 283-88.
 17. Chand, Ramesh and Sonia Chauhan (1999). Are Disparities in Indian Agriculture Growing?. Policy Brief No. 8. New Delhi: National Centre for Agricultural Economics and Policy Research.
 18. Chand, Ramesh, P Shinoj, Ashok Gulati and Kavery Ganguly (2011). Managing Food Inflation in India: Reforms and Policy Options. Policy Brief 35. New Delhi: National Centre for Agricultural Economics and Policy Research (NCAP).
 19. Daniel L. Civco (1993) “Artificial neural networks for land-cover classification and mapping” International Journal of Geographical Information Systems Volume 7, Issue 2, 1993
 20. Elachi, C. 1987. Introduction to the Physics and Techniques of Remote Sensing. Wiley Series in Remote Sensing, New York.
 21. F .Russo (1998) “Edge Detection In Noisy Images Using fuzzy reasoning” IEEE Trans. on instrumentation and measurement,Vol 47,1998, pp 1102-1105
 22. F. Roli, S.B. Serpico, and G. Vernazza, “Multisensor Image Classification by Structured Neural Networks”, IEEE Trans. On Geoscience and Remote Sensing, vol. 28, no. 4, pp. 310-320, 1993.
 23. F. Russo, and G. Ramponi, “Fuzzy methods for Multisensor Data Fusion”, IEEE Transactions on Instrumentation and Measurements”, vol. 43, n.2, pp. 288-294, 1994.
 24. Fabrizio Russo (1998) “Recent Advances in Fuzzy Techniques for Image Enhancement”, IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 47, 1998, pp 1428-1439.
 25. Francis J. Pierce and Peter Nowak (1999) “Aspects of Precision Agriculture” Advances in Agronomy, Volume 67, 1999, Pages 1–85
 26. G. Giacinto, and F. Roli,(1997) Ensembles of neural networks for soft classification of remote sensing images, Proceedings of the European Symposium on Intelligent Techniques, Bari,

- Italy, pp. 166-170, 1997
27. G. Simone A. Farina F.C. Morabito S.B. Serpico L. Bruzzone (2002) "Image fusion techniques for remote sensing applications" Information Fusion Volume 3, Issue 1, March 2002, Pages 3–15
 28. G. M. Foody (1997) "Fully fuzzy supervised classification of land cover from remotely sensed imagery with an artificial neural network" Neural Computing and Applications, December 1997, Volume 5, Issue 4, pp 238-247
 29. H. Bishcof, W. Schneider, and A.J. Pinz, "Multispectral Classification of Landsat-images using Neural Networks", IEEE Transactions on Geoscience and Remote Sensing, vol. 30, no. 3. pp. 482-490, 1992.
 30. I.P. Abrol (2000) "Agriculture in India" Report from Centre for Advancement of Sustainable Agriculture, 2000
 31. J. Zhang and G. M. Foody (2001) "Fully-fuzzy supervised classification of sub-urban land cover from remotely sensed imagery: Statistical and artificial neural network approaches" International Journal of Remote Sensing Volume 22, Issue 4, 2001
 32. James J. Buckley and Yoichi Hayashi (1994) "Fuzzy neural networks: A survey" Fuzzy Sets and Systems Volume 66, Issue 1, 25 August 1994, Pages 1-13
 33. Jensen, John R. 2007. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Prentice Hall. John Wiley, New York.
 34. Jiong You, Zhiyuan Pei and Dongliang Wang (2014) "Crop Mapping of Complex Agricultural Landscapes Based on Discriminant Space", IEEE Journal of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 11, November 2014.
 35. John G. Lyon, Ding Yuan, Ross S. Lunetta, and Chris D. Elvidge (1998) "A Change Detection Experiment Using Vegetation Indices" February 1998 PE and RS 144-150
 36. L. Zhang, X. Huang, B. Huang, and P. Li, (2006) "A pixel shape index coupled with spectral information for classification of high spatial resolution remotely sensed imagery," IEEE Trans. Geosci. Remote Sens., vol. 44, no. 10, pp. 2950–2961, Oct. 2006.
 37. LI Hang-yan, XIE Yao-wen, and MA Ming-guo (2009) "Reconstruction of Temporal NDVI Dataset: Evaluation and Case Study" Journal of Remote Sensing Technology and Application 2009
 38. M.I. Chacon, and L. Aguilar (2001) "A fuzzy Approach to Edge level detection". The 10th IEEE International Conference on Fuzzy system Melbourne, Australia, December 2001, pp 809-812.
 39. M.Recce , J.Taglor , A.Plebe , G.Tropoiano, (1996)" Vision and Neural Control for an orange harvesting Robot." IEEE Trans. 1996 International Conference Workshop on Neural Networks for Identification, Control, Robotics and Signal/Image Processing." P 467, Aug 1996.
 40. M.S. Moran Y. Inoue E.M. Barnes (1997) "Opportunities and limitations for image-based remote sensing in precision crop management" Remote Sensing of Environment Volume 61, Issue 3, September 1997, Pages 319–346
 41. Monika, Sandeep Mann, Anil K. Dixit and Surya (2014) "Precision Farming: A Pathway to Attract Youth in Agriculture" Popular Kheti Volume -2, Issue-3 (July-September), 2014
 42. Munther N. Baker , Ali A. Al-Zuky (2008) "Colour Image Noise Reduction Using Fuzzy Filtering", Journal of Engineering and Development, June 2008, Vol. 12, No. 2, 157-166
 43. N. Suresh Kumar and M. Arun (2015) "Enhanced Classification Algorithms for the Satellite Image Processing" Indian Journal of Science and Technology, Vol 8(15), 56390 , July 2015
 44. Natascha M. Oppelt (2010) "Use of remote sensing data to assist crop modeling" Journal of Appl. Remote Sensing 4(1), 041896 (August 31, 2010).
 45. National Remote Sensing Agency 2004 IRS-P6 Data User's Handbook
 46. Nerlove, M. (2014) Agricultural Economics and Economics: Influence and Counter-Influence, 1910-1960, Applied Economic Perspectives and Policy. pp. 1-30
 47. Nikhil R Pal and Sankar K Pal (1993) "A review on image segmentation techniques" Pattern Recognition Volume 26, Issue 9, September 1993, Pages 1277-1294.
 48. Nikhil R Pal and Sankar K Pal (1995) "A review on image enhancement techniques" Pattern

- Recognition Volume 28, Issue 4, April 1995, Pages 1051-1059.
49. O.Badini, L.Dioni,(2001) "Application of Rain fall Analysis, Biophysical modeling and GIS to AgroClimate Decision support in Madiama Commune." CRSP Research Scientific Synthesis Conference, Nov 2001.
50. Patil Shirish S. and Satish A. Bhalerao (2013) "Precision farming: The most scientific and modern approach to sustainable agriculture" International Research Journal of Science and Engineering, 2013, Vol.1(2)
51. Ping Zhong and Runsheng Wang (2007) "Using Combination of Statistical Models and Multilevel Structural Information for Detecting Urban Areas From a Single Gray-Level Image" IEEE Transactions on Geoscience and Remote Sensing, Vol. 45, No. 5, May 2007 Pp1469
52. Pohl and J. L. Van Genderen (1998)"Review article Multi-sensor image fusion in remote sensing: Concepts, methods and applications" international journal remote sensing, 1998, vol. 19, no. 5, 823-854
53. Pohl and van Genderen, (1998) "Review article Multisensor image fusion in remote sensing: Concepts, methods and applications" International Journal of Remote Sensing Volume 19, Issue 5, 1998
54. Puja Mondal (2015)"Types of Agricultural Regions of India" The scheme suggested by the Indian Council for Agricultural Research (ICAR)
55. R.E.E. Jongschaap, 2006. Integrating crop growth simulation and remote sensing to improve resource use efficiency in farming systems. Ph. D. Thesis, Wageningen University, Wageningen, the Netherlands, 130 pp.
56. Rafael C. Gonzalez and Richard E. Woods, (2009), Digital Image Processing, Third Edition, Pearsoned Prentice Hall, Pearsoned Education, Inc.
57. S. Shams, (1996) Neural network optimization for multi-target multi-sensor passive tracking, Proceeding of the IEEE, Special issue on Engineering Application of Artificial Neural Networks, v. 84, n. 10, pp.1442-1458, 1996
58. S. Zhang, X. Xue, and X. Zhang, (2005)"Feature extraction and classification with wavelet transform and support vector machines," in Proc. IEEE Int. Symp. Geosci. and Remote Sens., 2005, vol. 6, pp. 3795–3798.
59. Srinivasa Rao D(2012) "Comparison of Fuzzy and Neuro Fuzzy Image Fusion Techniques and its Applications" by International Journal of Computer Applications Volume 43– No.20, April 2012.
60. Stephen W. Wharton, Yun-Chi Lu, Bruce K. Quirk, Lyndon R. Oleson, Jeffrey A. Newcomer, And Fred M. Iran (1988) "The Land Analysis System (Las) For Multispectral Image Processing" IEEE Transactions on Geoscience and Remote Sensing, Vol. 26, No. 5, September 1988 pp693
61. Susanna T.Y. Tong and Wenli Chen (2002) "Modeling the relationship between land use and surface water quality" Journal of Environmental Management Volume 66, Issue 4, December 2002, Pages 377–393
62. Sushant Panigrahi and Toran Verma (2013) "Texture Image Classification using Neuro-fuzzy Approach" International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 2 Issue 7 (July 2013), Page No. 2309-2313
63. T.K. Ho, J.J. Hull, and S.N. Srihari, Decision combination in multiple classifier systems, IEEE Transactions on Pattern Analysis and Machine Intelligence n. 18, pp. 66-75, 1994
64. Tai Wai Cheng, Dmitry B. Goldgof and Lawrence O. Hall (1998) "Fast fuzzy clustering" Fuzzy Sets and Systems, Volume 93, Issue 1, 1 January 1998, Pages 49–56
65. Thomas Villmann, Erzsébet Merényi and Barbara Hammer (2003) "Neural maps in remote sensing image analysis" Neural Networks, Volume 16, Issues 3–4, April–May 2003, Pages 389–403
66. Tizhoosh, H.R. (2002) Fast and Robust Fuzzy Edge Detection, Fuzzy Filters for Image Processing, M. Nachtgael, D. Van der Weken, D. Van De Ville and E.E. Kerre (Eds.), Springer, Studies in Fuzziness and Soft Computing, 2002
67. Tizhoosh, H.R.(2000) Fuzzy Image Enhancement: An Overview, Fuzzy Techniques in Image Processing, Springer, Studies in Fuzziness and Soft Computing, pp. 137-171, 2000
68. U.K. Shanwad, V.C. Patil and H. Honne Gowda (2004) "Precision Farming: Dreams and Realities

- for Indian Agriculture” Map India 2004, Proceeding Map India Conference 2004
69. Uma Shankar, and Ashish Ghosh (2007) “Wavelet-Feature-Based Classifiers for Multispectral Remote-Sensing Images” IEEE Transactions on Geoscience and Remote Sensing, Vol. 45, No. 6, June 2007 pp1881
70. Vini Malik, Aakanksha Gautam, Aditi Sahai, Ambika Jha, Ankita and Ramvir Singh(2013) “Satellite Image Classification Using Fuzzy Logic” International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-2, Issue-2, May 2013
71. Wei Zhou, Jinshui Zhang, Yaozhong Pan, Rong Zhu.(2003) “Remote Sensing Assisted Multi-Level Crop Acreage Estimation--an Application of Small Area Estimation in Heilongjiang Province”, International Journal of Remote sensing Dec, 2003 volume 12 pp 1023-1028
72. Xavier Ceamanos, Bjorn Waske, Jon Atli Benediktsson, Jocelyn Chanussot, Mathieu Fauvel, et al. (2007) A classifier ensemble based on fusion of support vector machines for classifying hyperspectral data. International Journal of Image and Data Fusion 1 (4), pp.293-307
73. Yu Liu, Jun Xia , Chun-Xiang Shi and Yang Hong (2009) “An Improved Cloud Classification Algorithm for China’s FY-2C Multi-Channel Images Using Artificial Neural Network” Sensors 2009, 9(7), 5558-5579
74. Yufeng Ge, J.Alex Thomasson, Ruixiu Sui, (2011) “Remote Sensing Of Soil Properties In Precision Agriculture: A Review” Frontiers of Earth Science September 2011 Springer Verlag Berlin Heidelberg 2011.