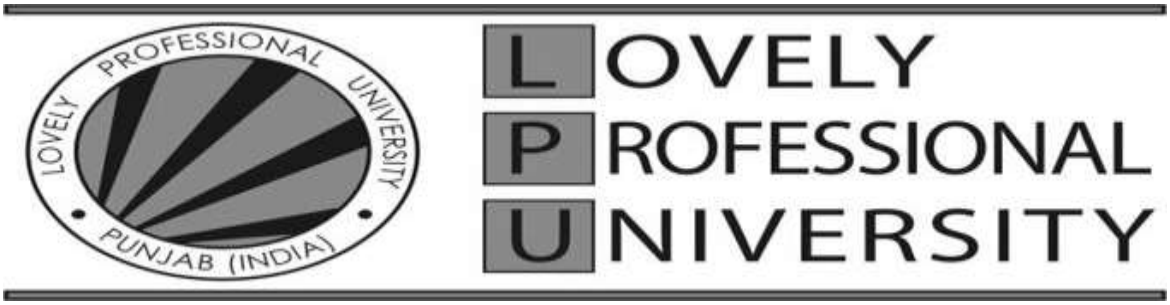

Crop Acreage and Production Estimation

A Dissertation submitted

By

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Registration no- 11311568

To

Department of Computer Science and Engineering

In partial fulfilment of the
Requirement for the

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Master of Technology

In Computer Science and Engineering

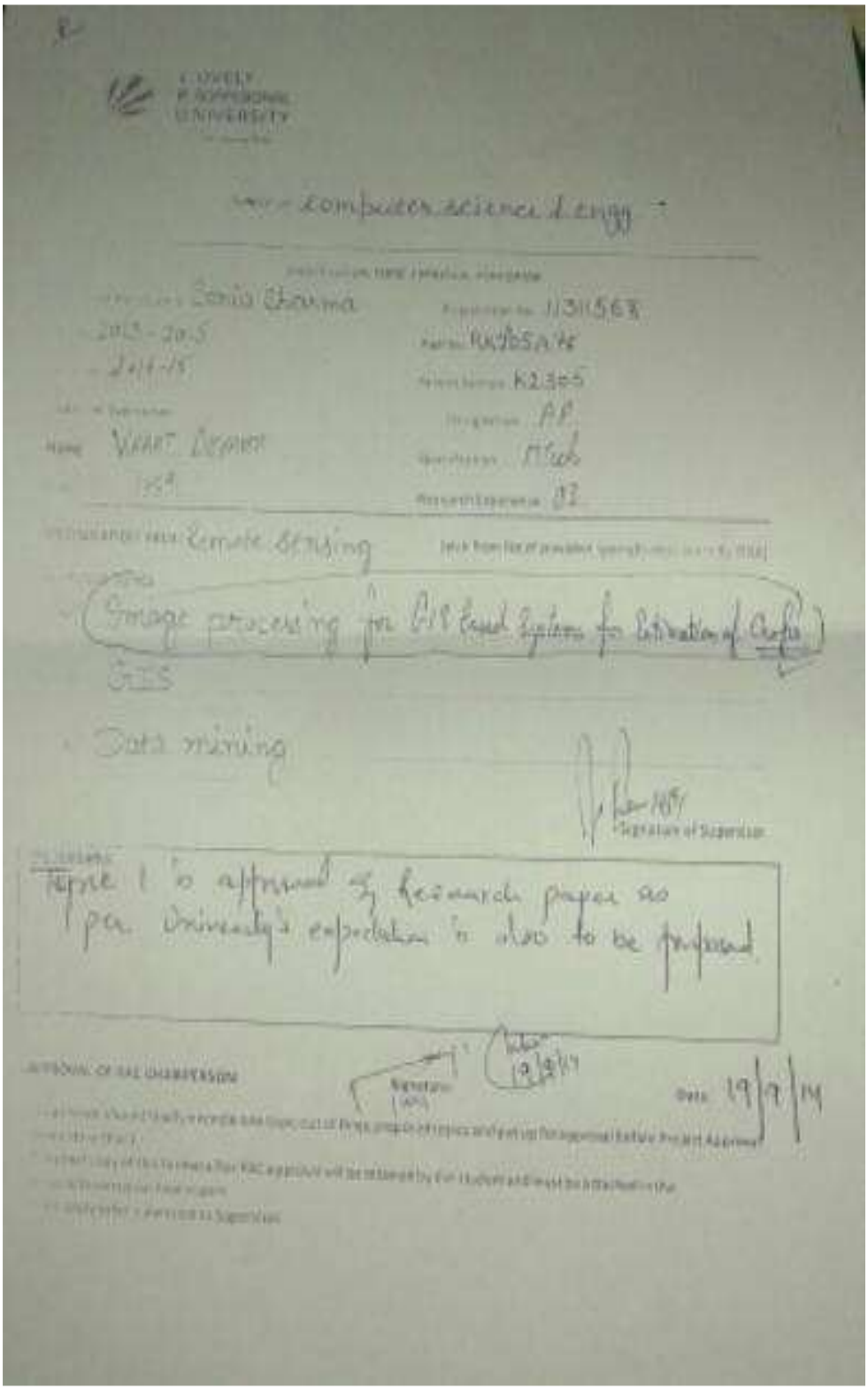
Under the guidance of

MR.VIRRAT DEVASER

(May 2015)

Crop Acreage and Production Estimation

PAC Approval page



ABSTRACT

The crop acreage is used to measure the number of yield per unit area. We estimate the crop acreage with the help of remote sensing and geographic information system technique. In remote sensing, we acquire information related to the earth surface and to determine the crop acreage with the help of remote sensing images. We extract the useful information related to the yield estimation. In image processing, it is used to analyze or manipulate the features of an image. Geographic Information System is widely used in crop acreage and production estimation to find out the locations of a particular image. We used K-mean clustering and Self Organizing Map algorithms are used in crop Acreage and production estimation as a comparative approach to measure out acreage for a specific area image.

Keywords: Remote Sensing, Geographic Information System, SOM algorithm.

CERTIFICATE

This is to certify that Sonia Sharma has completed M.Tech dissertation proposal titled "Crop Acreage and Production Estimation" under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of the dissertation proposal has ever been submitted for any other degree or diploma.

The dissertation proposal is fit for the submission and the partial fulfilment of the conditions for the award of M.Tech computer science and engineering.

Date: 2-05-2015

Signature of Advisor
Name: Virrat Devaser
UID: 14591

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of the task would be incomplete without the mention of the people whose ceaseless cooperation made it possible, whose constant guidance and encouragement crown all efforts with success. I sincerely owe our gratitude to our respected Mentor, **Mr. Virrat Devaser** who provided us the opportunity to work in this field. I am again indebted to him for giving me proper guidance regarding related subjects and being a source of inspiration and encouragement. His competent guidance, inexhaustible patience steered us towards the selection of the dissertation topic "**Crop Acreage and Production Estimation**".

Sonia Sharma

Registration no.-11311568

DECLARATION

I hereby declare that the dissertation entitled, "**Crop Acreage and Production Estimation** submitted for the M.Tech Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

Date:

Investigator

Regn No. 11311568

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

Production estimation is used for measuring the size of land in crop acreage. There are many approaches to crop area estimation in agricultural statistics that are collected with the help of census. This is one of the cheapest method which is used in statistical analysis in which a predetermined number of observations have been taken from a large sample. The method from a larger sample which depend on the types of analysis being performed. This process is known as sampling. Crop area and product estimation describes a "pure pixel sampling" in image. It is used for multiple methods such as area sampling, point sampling and list sampling. In area, sampling is sub-divided into smaller blocks. Point sampling is also known as the nearest neighbor in image. Combining area and list frames is known as multiple frame sampling. It provides good qualities and solves some of the problems. In the word 'estimate' will be used interchangeably for estimates or forecasts.

The most significant challenges in estimating crop production are:

- Area estimation can create problems in countries prone to drought or flooding problems.
- Landscape factors are used such as elevation or soil type problem.

There are many approaches to crop area estimation. Agricultural statistics are collected by censuses, which require enumeration of the total population of interest. Samples requires enumeration of a small part of the population.

Geographic information system and remote sensing. It is designed to capture, store and manage the geographic data. It is used to find out the locations in the earth space time may be recorded, in a graph. Remote sensing is used for acquiring information related to the earth surface and atmosphere using a sensor. It involves the different activities of observing the objects. The important part of remote sensing is electromagnetic radiation. Remote sensing images represent a form of digital images. It is used to extract a useful information for image processing technique. Remote sensing is used to acquire information about the land, earth, and atmosphere using sensors or satellite platforms. Its Estimates have progressed from sums of local area information, direct expansions of statistically sampled data, classification of crop

specific pixel. Small area estimation is much more accurate and timely as compared to large area estimation.

Remote Sensing:

Remote sensing is the activity of recording, observing or sensing the objects at a remote places. Sensors are not directly interconnect with the objects has been observed. Electromagnetic radiation is mostly used in remote sensing. The output is generally seen as the image has been observed. Image analysis is required to acquire the useful information of an image.

Example of remote sensing is human visual system. To acquire information about the earth surface, atmosphere using sensors or satellite, space platforms.

SATELLITE REMOTE SENSING: These are equipped with sensors looking down to the earth. They observing the earth they go round in predictable orbits.

EFFECTS OF ATMOSPHERE:

Sensors are looking with a layer of atmosphere separate the sensors from the earth surface has been observed. The effect of atmosphere on the electromagnetic radiation travel from the earth to the sensor with the help of atmosphere. It constitutes cause wavelength dependent to absorb and scattering of radiations. These effect degrade the quality of images. Atmospheric effects has been corrected with the help of further analysis and interpretation of an image.

Wavelength band in the electromagnetic spectrum is strongly absorbed by the atmosphere. To determine the remote sensing by the penetrate atmosphere. The wavelength region are known as the atmospheric Transmission windows. Remote sensing are design to operate with one or more of the atmospheric transmission windows. These window apply in the microwave region, wavelength band, visible region and part of the ultraviolet region.

Optical and Infrared Remote Sensing: Optical sensors detect solar radiation is effected for the earth. The wavelength region is converted from the visible and near infrared to the short wave infrared. Different materials used as water, soil, vegetation buildings reflect visible and infrared light. Interpretation require the knowledge of the spectral reflectance signature cover the surface of the earth.

Microwave Remote Sensing: They carry active or passive microwave sensors. These sensors emit pulses of microwave radiation to clarify the area of an image. Advantage of microwave remote sensing is they can penetrate clouds.

It can produce high resolution image of the earth is the Synthetic Aperture Radar. It depends on the amount of microwave backscattered by the target and received by the SAR antenna. It is responsible for backscatter is different from microwave compared to the radiation, interpretation of SAR image require the knowledge of how microwave interact with targets.

Remote Sensing Images

It is represented in the form of digital images. It is used to extract the useful information from the image. It may be employed to improve the image with the help of visual interpretation, to correct or restore the image has been blurred, degradation.

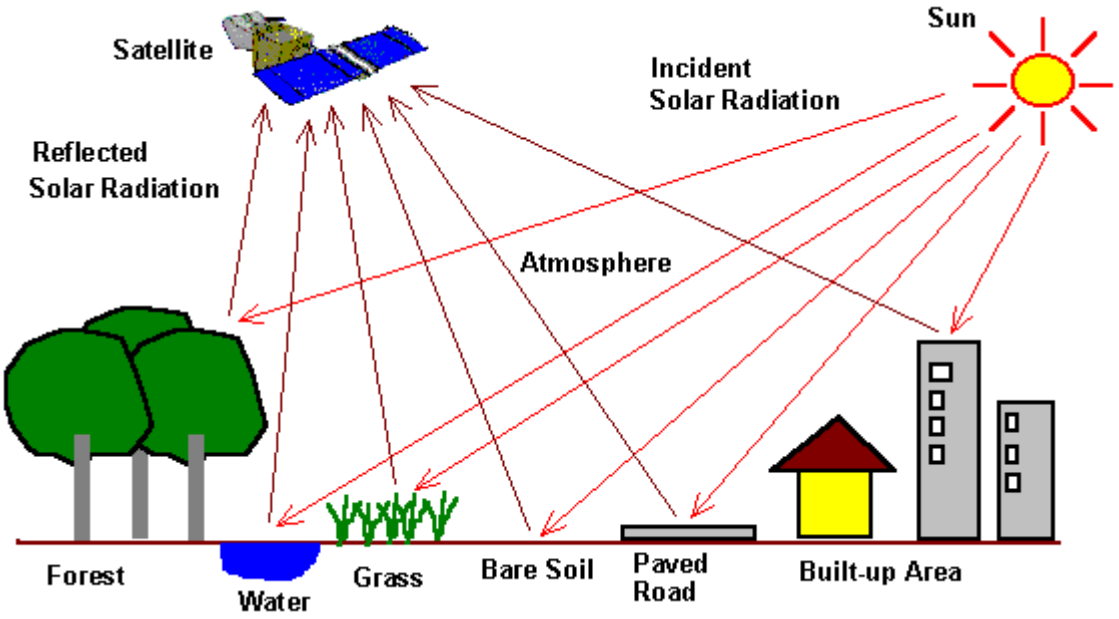


Figure 1: Optical Remote Sensing.

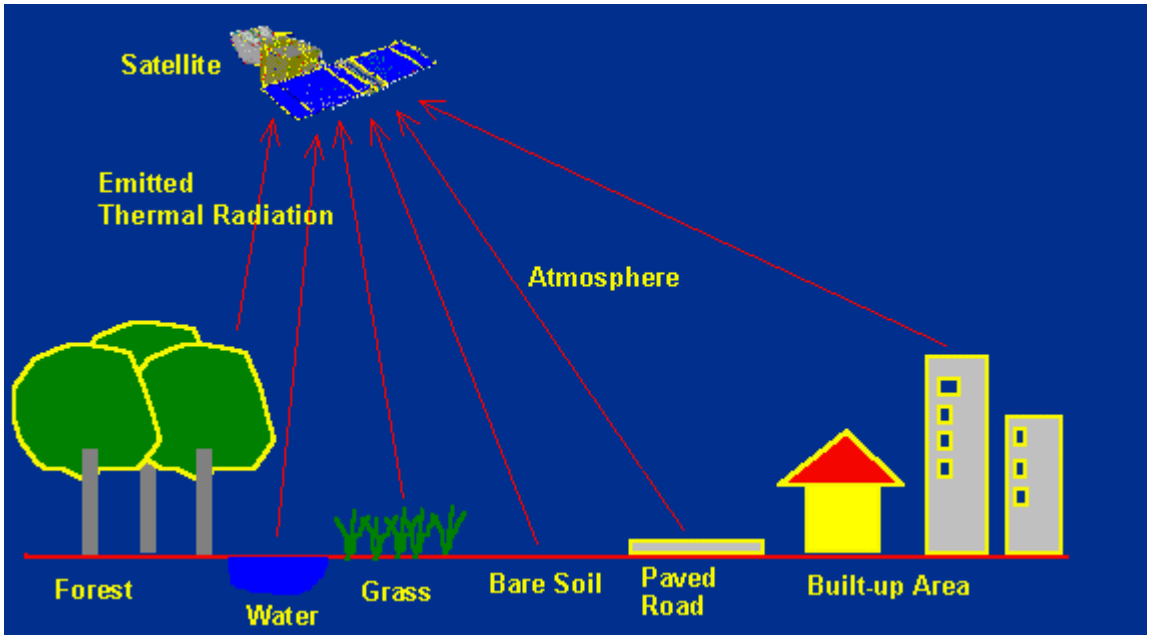


Figure 2: infrared remote sensing

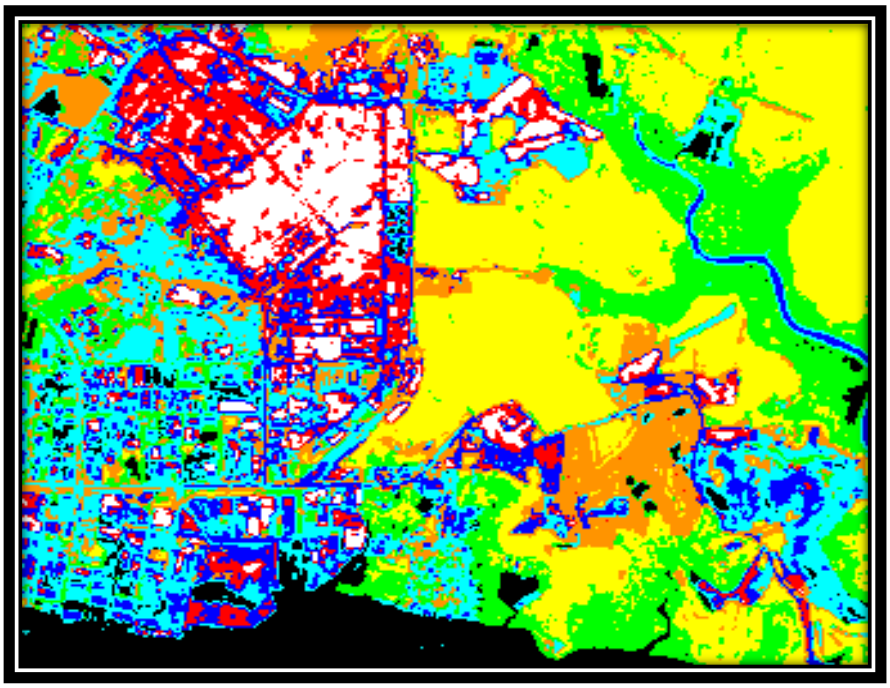


Figure 3. Image of remote sensing

Figure 4. Infrared radiation emitted from the earth.

To improve the quality of an image with the help of some clustering algorithms:

- Hierarchical clustering
- K-means clustering
- Gaussian mixture models
- Self-organizing maps

- **Hierarchical clustering**: It is a method to analyze the cluster of an image. It is also known as hierarchical cluster analysis in data mining. Data are not divide into a particular cluster in a single step. Items are arranged in hierarchy with a tree like structure. It consist of two types.

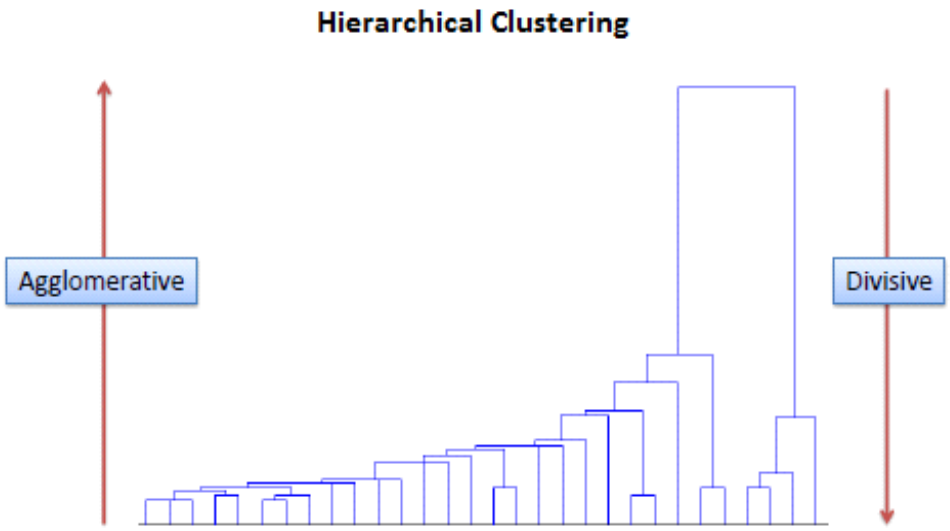


Figure 5.Image of Hierarchical Clustering

- **Agglomerative**: It is based upon the bottom up approach. It begin from bottom to top. It is used to measure the distance between nearest data point or centroid distance.
- **Divisive**: It is a top down approach. It start from top to bottom.

Advantages and disadvantages of hierarchical clustering:

Advantages are:

- It provides best results.

- It is easy to implement.
- Information about the number of clusters required.
- It comes at the cost of lower efficiency

Disadvantages are:

(1) It does not directly minimize the goals of a function.

(2) It is difficult to find the number of clusters

(3) Time complexity is less.

(4) Algorithm can never be undo.

(5) It is difficult to identify the correct number of clusters in dendogram.

K-means clustering: K–mean cluster is used to choose the one data item in a cluster. These clusters are non-hierarchical in nature. They do not overlap with each other. The data is partitioned into the k-mean clusters. It calculates the distance between two clusters. It is a method of vector quantization based from processing the signal that is show for cluster analysis in data mining. It is easy to implement and apply on large data sets. It has been mostly used in agriculture, segmentation, and computer vision.

Advantages of K-mean clustering are:

- K-mean clustering is faster than the hierarchical clustering.
- It produces tightly cluster.

Disadvantages of K-mean cluster are:

(1) It is difficult to compare the quality of the clusters produced.

(2) It produced fixed number of clusters.

- **Gaussian mixture model:** To acquire a data in between the sub part into the overall part of a data. It is mostly used in biometric systems. It consist of a mixture of one or more multivariate components. Each component is defined by its mean, co-variance.

Advantages of Gaussian mixture model are:

(1) It is easy to learn.

(2) Model is very easy to compact.

(3) It provides good and better result.

Disadvantages of Gaussian mixture model are:

- Inflexible
- It is more complicated.

- **Self-organizing map**: It is a data visualization method which is used to reduce the dimensions of a data with the help of self-organizing neural network. It is helpful to create the high dimensional data. It provides for reduce the dimensions and display the similarities. It has two components sample data and weights. It is a type of artificial neural network that is trained using unsupervised learning to produce a low dimensional, discrete representation of the input space of the training samples called a map. It is different from artificial neural network because they use a neighborhood function to preserve the topological properties of the input space. SOM is useful for visualizing low dimensional views of high dimensional data into the multi -dimensional scaling.

  A component of SOM is nodes or neurons. It describes a mapping from a higher dimensional input space to lower dimensional input space.

Advantages of self-organizing map are:

- It is easy to understand.
- It is easy to find out the quality of an image.
- It is a simplest form.

Disadvantages of self-organizing map are:

(1) It is very difficult to estimate the missing data of an image.

(2) It is more expensive.

CHAPTER 2
LITERATURE SURVEY

S. Grunwald), K. McSweeney et.al. [2001]

Many types of challenges will be occurred to precise the systematic classification principles, to describe the distribution of soil material and three dimensional layers. We have compared hierarchical clustering with k – mean classification to create soil layer models. The classification method is used to identify the soil layer attributes. Validation show that higher accuracy of the crisp layer model in comparison with the fuzzy soil layer model. This model describe the spatial variables in soil layer material among a landscape. Crop growth is dependent in soil characteristics like that texture, bulk density or penetration resistance. Three dimensional soil layer models is more beneficial for farmers to manage the soil or land. Scientists and researchers to describe the distribution of soil layers.

P.Defourny, X.Blaes, P.Bogart et al., (2003)

To find the various sources of errors in the production estimation and to compare a relative errors associated to a yield. To improve the forecasting system with the help of two variables.

(i) The product and a surface trend model for each field, country using a polynomial function.

(ii) The production of each year was estimate for two ways: - multiply the someone product by the surface estimated from the trend. Multiply the observed surface by the product estimated from the trend.

Accuracy for the variables can be used to support the production forecasting. Statistical study was widely used in complex data not a simple data. To improve the accuracy of forecasting system based upon the statistical trends.

Wu Bingfang et al., (2004)

A China crop watch system publishes the information related to growing the crop, crop Acreage, produce a crop and to define a crop structure. Methodology supported by remote

sensing, to integrate a technique of remote sensing and sampling method work each other. Using sampling method it provides an efficient way to control the accuracy of estimation. Crop area estimation, use of remote sensing has create some problems:

(1) Small area is not validate at large region.

(2) To grow a plant and gathering grain are all concerned in the specific period for the end of year.

(3) Large area can be applied because of their less cost.

It have some properties related to crop acreage estimation methodology:

(1) Accuracy is sufficient to support decision.

(2) Application section is required in sufficient way.

(3) Having something standard of judgment and it can be operated easily.

(4) To estimate the crop acreage method is used in China Crop Watch System (CCWS). It supports in Chinese Resource and environment database.

(5) Crop acreage estimating technique is accuracy and reliable.

Estimating crop acreage at large region. It occurs three difficulties:

Remotely sensed data cannot cover the whole country. It has no ability to access a large number of Images in China. China is a large country. We cannot receive high resolution of images. To receive the data is very limited for crop acreage estimation. It is very difficult to identify the crop plot of ground or field from remotely sensed data directly.

Xiangming Xiao, Stephen Boles, Steve Frolking, William Salas, Berrien Moore III et al., (2005)

A paddy rice means a field full of water in which rice is grown. Paddy rice was developed in the 1980's. It is based upon a partially agricultural statistical data. It does not apply the need of science and geo-spatial database. It was improved a spatial and temporal resolutions. The new approach is used for vegetation and moderate resolution imaging spectro-radiometer.

Features of paddy rice fields are: a flood and rice transplantation a set, growing a seed period, to estimate the water depth in between 2 to 15 cm. To estimate the change in combination of water surface and growth of vegetable that are responsive to both water and vegetation.

Testing is needed, for estimate the results of the MODIS based algorithm to produce the updated data sets of flooded field of agriculture on a timely basis. In this algorithm to identify the small pieces of flooded fields. In this field it is a combination of open water and green grass. It is much difficult to estimate the mean and standard deviation of cluster in an image. It depends upon space distribution and total area of a field. The space distribution of rice is useful for the process of irrigating, food security estimates in those countries.

Anup K. Prasad , Lim Chai , Ramesh P. Singh , Mena's Kafatos et al., (2006)

Recording of field conditions is important for show a development of farming. It is used to record the growth for agriculture crops. The production of crop vary from year to year national level. Using remote sensing for data normalized are commonly used for to estimate the time period for rainfall, weather forecast, evaluation of vegetable growth or productivity. NDVI use for various methods from simple image to more complicated image. Methods can be used for to select a crop region in Iowa represents the form of a rectangle. Data is categorized as NDVI, Precipitation, and temperature, soil moisture.

Methodology used: Quasi-newton model is used to estimate the distance between the two points on a line. It evaluates the derivation of first and second order. This method can be use for high resolution data. This method provides some factors for add or delete a variables depends upon the region of the earth.

Dian Pratiwi et.al[2007]

Crop acreage estimation is an essential to estimate the crop production using remote sensing. It is a technique to classify the images into a number of clusters with mean of self - organizing map, artificial neural network method. SOM is a kohonen neural network is a unsupervised learning model that classify the units in the same class. This paper will be used of two methods named by Principal component analysis and Latent semantic analysis. We can reduce the dimension of the image matrix producing a high level accuracy between 61% to 88%. SOM method is more required for classifying the images to be applied with principal component analysis. It provides more accurate or better results than latent semantic analysis. With the database will be able to speed the image retrieval system because the image can look into the reserved class.

Yun Shao, Xiangtao Fan, Hao, Liu et.al, (2008)

It represents the study of rice recording and estimate the product using a software. In SAR synthetic aperture radar provides information about the shapes of triangle and content of the moisture vegetation, which is necessary for agronomist. In ecology of rice, the most important factor to determine the distribution of rice plantation. Water equipment is an important term to determine the distribution of rice plantation. Backscatter studies, image processing methods are used. There are many advantages: It provide timely and accurate information about crop distribution. Ecological system provides more information about a world. In this study to examine the act as a function of time using multi-temporal data. The objectives of this study were to understand the backscatter behavior of rice, calculate the improvement of land, to identify rice crop with different portion of crop and quality to evaluate the capability for rice crop identification and estimate the crop.

RADARSAT data is capable for rice distribution and it can provide input to output results. Methodology was categorized in two phases Backscatter studies and Image processing.

Two factors that determine the backscatter co-efficient of rice were developed which worked on calculation of moisture of the crop in large area and to calculate plant height. The drawback has required multi-frequency and multi-polarization data to resolve this problem.

Xuefei Hu et.al,(2009)

It has two neural networks have applied self - organizing map and multilayer perception neural networks. It is based upon to classify the images at pixel level and sub-pixel level. We are applied to three ASTER images which are covered with Marion County ,Indiana, United states. The performance of the Self-organizing map is better estimation surface than the multilayer perception. The aim of the study is to estimate the percentage of impervious surfaces. SOM generated better results than multilayer perceptron. Self- organizing map help to be established to achieve the best result of impervious surface estimation.

Xin Cao, Qiangzi Li,Xin Du,Miao Zhang, Xinqi Zheng et al.,(2010)

Identified two main issues for crop production estimation are crop identification and acreage estimation. In object oriented classification provides good quality in crop identification. Key segmentation is used in object oriented classification. A multi - scale segmentation schema was conducted to evaluate the different crop at different scale using a HJ-1 CCD image. The objectives of this study are:

(i) To analysis the effect of segmentation scale for crop identification.

(ii) To inspect the crop identification accuracy with the help of HJ-CCD imagery.

(iii) To draw a schema for crop mapping in China using HJ-CCD image.

Image segmentation represents a fundamental object based image analysis.

Du Xin, Wu Bingfang*, Meng Jihua, Li Qiangzi et.al [2010]

Huang-huai-hai is the main grain region in the land. It is used to access land productivity, supports the decision making process. Land quality was monitored by crop yield estimation to calculate the remote sensing and single crop season. Land productivity is divided into three parts that is high, medium, low productivity. It is based on different standard zone. Methods had been applied estimation of yield was calculated with ground biomass and harvest index with remote sensing data. The efficiency of light is affected by soil moisture and heat. It is difficult to find the distinct spatial and temporal variability. Estimation of harvest index based upon the two factors high temperature and shortage of water. Results has been observed that low, high and medium productivity using remote sensing which gives the production of grain increases. To improve the gain production with the help of increasing a cultivated area, increasing the proportion of grain crops, improved a multiple cropping index and improve a crop yield.

Kumar Maurya Abhishek et al., (2011)

Worked on crop acreage and expected yield based on the types of sampling. In sampling we analyze the results of crop acreage and yield information. Yield depends on various factors like climate, physical condition may or may not change. Remote sensing is an important tool for soybean field.

MODIS satellite data and topographical sheets were used for remote sensing and GIS analysis.

GIS technology was supported by spatial information management. The methodology consists of selection of the datasets, processing of the satellite data, incorporation of ground information, and analysis of the satellite data and generate the output product.

Goswami S.B., Dr. Aruna Saxena et al., (2012)

Agriculture is the oldest technique of human life. Indian people depends upon the development of agriculture. It is very essential part for planning of resources in the agriculture field. Crop acreage estimation is important part for agricultural statistical system. Wheat is important food grain of human life. India produces 70 million tons of wheat per year. A project on crop acreage and production estimation (CAPE) becomes under the remote sensing applications mechanism (RASM) with a large area. The 7 advantage of this system are: It is estimated using remote sensing and geographical information system. Technologies. It was analyzed for crop acreage estimation using supervised classification and ground truth information.

BASIC WORKING: LISS-III image data set is used in image to image registration with master images. To extract a pixels of complete enumeration through systematic sampling is done. There are many steps involved:

(1) To summarize the large area of an image.

(2) To generate a subset of cells in a cluster.

(3) Remotely sensed image is used for supervised classification

Davide Ballabio, Mahdi Varighi et al. (2012)

Kohonen maps are also known as self -organizing maps. It is able to solve the supervised and unsupervised problems in easier way. Artificial neural network are much similar to self-organizing map model. Kohonen maps can be done by means of sequential algorithm or batch training algorithm.

The important feature of kohonen maps are the collection of function and algorithms are provide as matrix laboratory source files. Data scale variables are always range between zero and ones. In self-organizing map toolbox can be run via the graphical user interface. It can be easy to analyzed, loaded results in the graphical user interface. In supervised

classification model can be calculated by using CP – ANNS, SKN's, and XY-FS with the Matlab command window.

Anup Vibhute et.al.[2012]

Image processing technique is an important tool for agriculture domain. It is used to estimate the vegetation indices,canopy will be measured, irrigation land mapping and for analyse the different parameters. Application of image processing is widely used in agriculture field such as imaging technique, weed detection, fruit grading. Factors apply in agriculture are irrigation method, fertilizer method, pesticides and quality of yield. It can improve decision making process by applying the applications of image processing.

S.S.Baskar et.al [2013]

It has two algorithms was applied artificial neural network, unsupervised learning algorithm to determine the insect outbreak data. To classify the sampling sites using brown plant hopper. We are try to predict the brown plant hopper data using the Artificial neural network and SOM. SOM was used to apply the variability of a data. To find out the quality of the trained maps. SOM method provides quick analyse data and classification and pattern analysis. Results : Articial neural network SOM are useful to predict the brown plant hopper insect outbreak and distributed with respect to a climate factor.

Pierre Chopin & Jean-Marc Blazy et.al [2014]

Agriculture provides many types of ecosystem services such as food, water and fiber services. It depends on farmer decisions. It is focus on allocate the crop processes at the rotational scale. It had different methods are applied : to build the geographical database, to reduce the number of variables in a sample, classification and regression trees are used, to identify the factors controlling the yield, to observe the tendency of each farm type such as increase or decrease, to determine which type of transition temporal trends are observed, to identify the area whose transition have been occurred, to detect the spatial autocorrelation analysis, to identify the determinant of changes in a cropping plans and regression analysis. It has been observed the results we generate the biophysical characteristics using a geographic information system and raster format.

Zhang Huanxue, Li Qiangzi* et.al[2014]

Crop acreage estimation is used to estimate the crop production using remote sensing. The effect of resolution based upon quantitative and qualitative view. Spatial statistics method were used to analyze the data with different spatial resolutions. In this paper methodology contains three ways maize area extraction, to establish the rescaling series data, to analyze the accuracy of crop acreage estimation of different scales. To evaluate the accuracy of standard deviation and RMSE. It has been observed the results spatial resolution will be decreased, average regional accuracy will also be decreased due to acreage estimation is effected by the mixed pixels. To find the accuracy with the help of crop estimation.

CHAPTER 3

PRESENT WORK

3.1 PROBLEM FORMULATION

To analyze the crop acreage with the help of GIS and Image processing. We will apply different steps to use for compare the data with the previous year images. The steps used in this research methodology are: geo-referencing, administrative boundary overlaying, sub setting study area, classification and calculate the acreage estimation with the help of the mathematical equations. Agriculture Resources are the important renewed dynamic natural resources.

I have compare the data with the previous year with the help of different clustering algorithms such as K-Means clustering, Self - organizing maps, hierarchical clustering, Gaussian mixture models. I have find the accuracy between each other. In self – organizing map is a type of artificial neural network that is learn using unsupervised learning to produce a low dimensional, discrete representation of the input space of the training samples, called a map.

By using self – organizing map is used to classify input vectors how they are grouped into the input space. It is a two dimensional or three dimensional layer. It is represented as a grid form.

I have analyze the accuracy of an image, to find the area of an image, value of the pixels in image.

3.2 OBJECTIVES

To estimate the crop acreage and product estimation with the help of unsupervised learning. Common clustering algorithms include:

(1) Hierarchical clustering
(2) K-Means clustering
(3) Gaussian mixture models
(4) Self-Organizing maps

(1) **Hierarchical clustering:** It is a method of cluster analysis which seeks to build a hierarchy of clusters.
(2) **K-Means clustering:** It is a method of vector quantization. It is used in cluster analysis for data mining. It provides to partition and observations into K clusters, in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster.
(3) **Gaussian mixture models:** It is a multivariate distribution that consist of a mixture of one or more multivariate Gaussian distribution components. It is defined by mean and covariance.
(4) **Self-organizing maps:** It is a type of artificial neural network that is learn using unsupervised learning to produce a low dimensional, discrete representation of the input space of the training samples, called a map. It consist of component called nodes or neurons. It is based on unsupervised, competitive learning.

3.3 METHODOLOGY

(1). **Geo-referencing**: Physical space that associated with some locations refers to as geo-reference. The process is associated to physical map or raster image of map that is in geographic information system. For example points of interest, buildings are the geographical locations where geo-referencing can be applied.
(2) **Administrative Boundary Overlaying:** It includes the list of land make use of ecological requirements. Agro ecological technique is based upon the list of land resources including climate and soils. To estimate about a land. The important application is land productivity assessment.
(3) **Sub setting study area:** multiple area is divided into single ones.

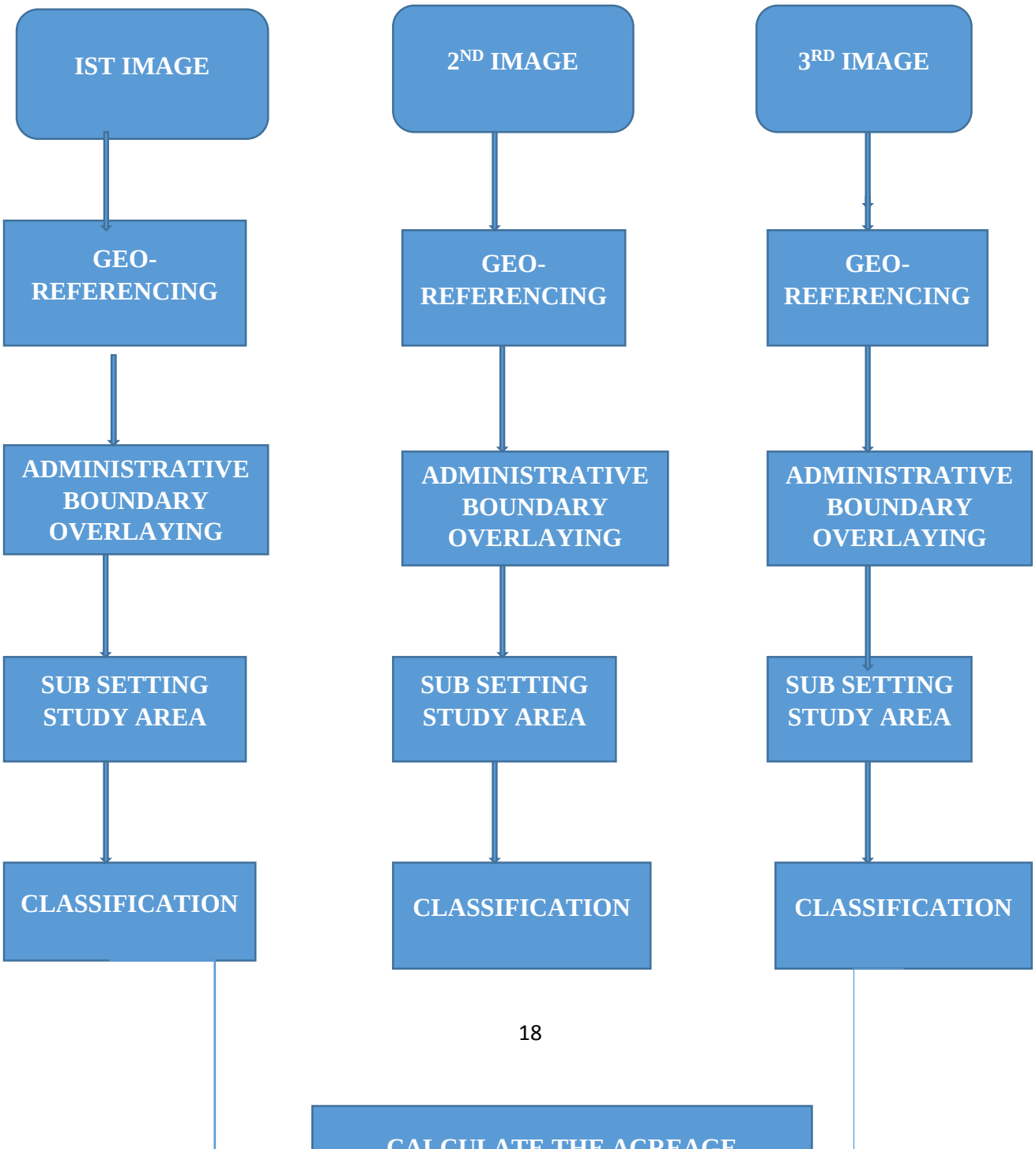
(4) **Classification:** To classify the data in different fields. It includes supervised, unsupervised and time series based techniques.

(5) To calculate the acreage estimation with the help of mathematical equation:

Production = estimated acreage * predicted yield

FLOW CHART

Figure 6: Flowchart of acreage estimation.



SAMPLE SATELLITE IMAGES

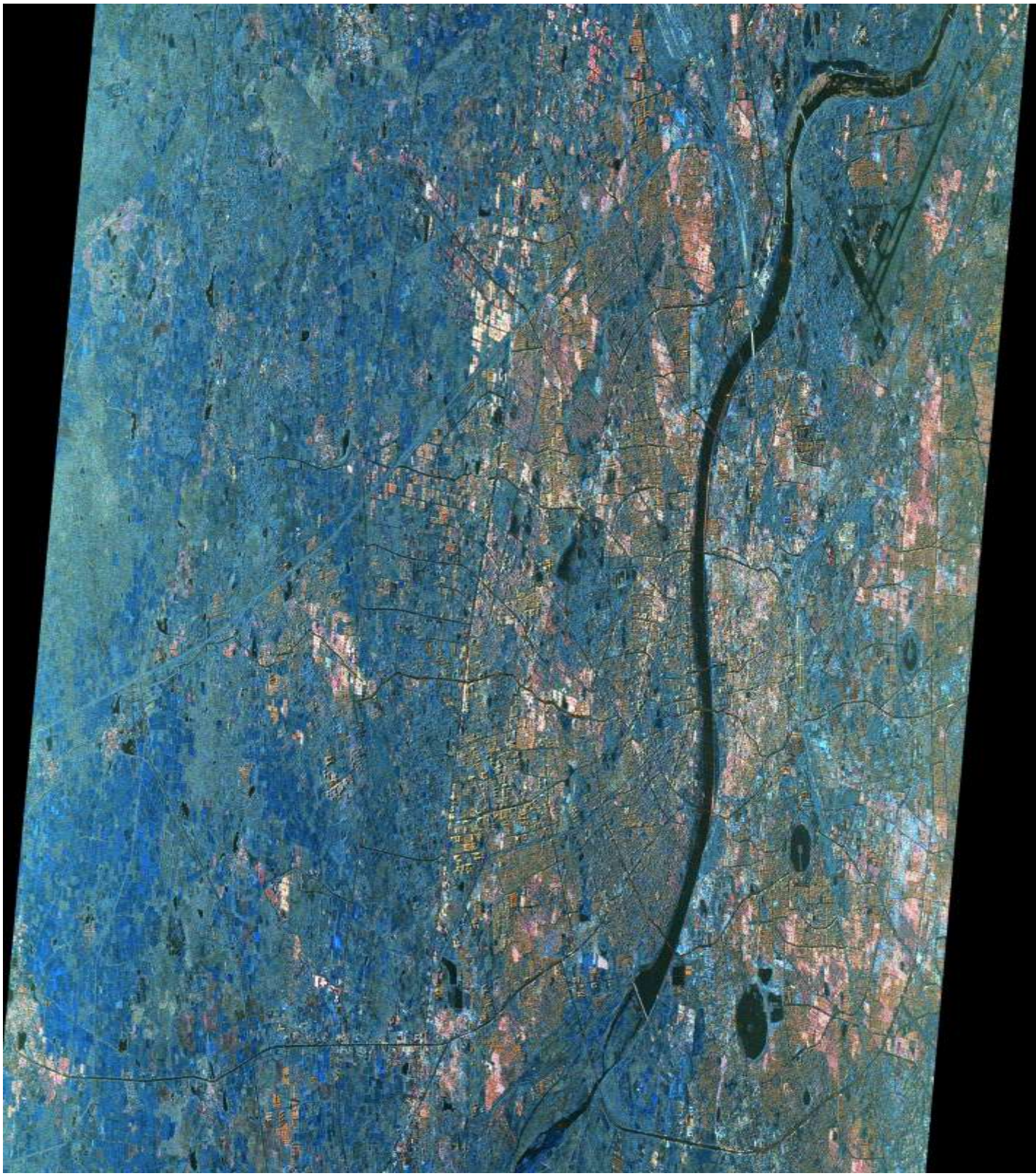


Figure7: Sample Satellite Image

Figure 8: Los_Angelesh Sample Satellite Image

Figure 9: Vijawadah Sample Satellite Image

Figure 10: Sample of Satellite Image

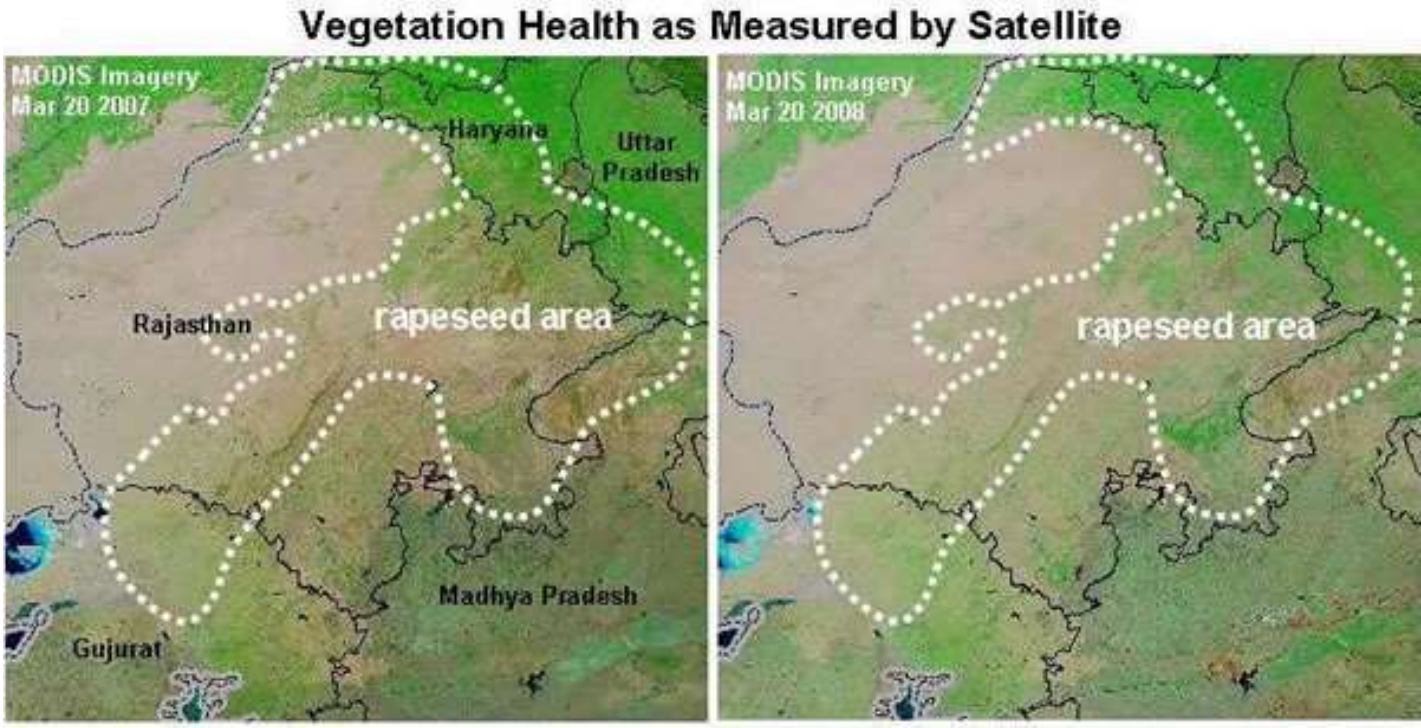


Figure 11: Vegetation Health as Measured By Satellite

CHAPTER-4

RESULTS AND DISCUSSIONS

The area of sample image is 80 square kilometer. To find the estimate of rice crop we measure the signature of pixels through image processing and found that the crop area is 56.5 square kilometer. This area is not correct as it includes the fodder and other type of vegetation. Therefore in order to find accurate Rice Crop area we calculated a factor by taking previous data and applied a proportionate factor that is proportion to the image of the pixels is measured as 0.885. Thereby the total estimate of the rice area is 52.1 square kilometer.

Area	**Crop area for Rice**	**Crop area Proportion**	**Estimated area for Rice**
80 sq km	**56.5 sqkm**	**0.885**	**52.1 sq km**

CHAPTER-5

CONCLUSION & FUTURE SCOPE

There is a lot of scope and alternatives to enhance the accuracy of the predictions made by the clustering algorithms. Agriculture resources are the important reusable natural resources. They help in making strategic decisions towards achieving food security. We can also apply similar techniques to measure out an estimate of damage done to specific crops as a result of unwanted rains.

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APPENDIX

(1) GIS -- Geographic Information System is designed to capture, store and manage the geographic data. It is used to find out the location in the earth space time may be recorded. It can show many different kinds of data on one map. Geographic information system that allow users to create interactive queries, to analyze spatial information, edit data in maps, and present the result of all these operations.

(2) CAPE -- Crop acreage and production estimation. It describes a pure pixel pixel sampling in image.
It is used for multiple methods such as area sampling, point sampling and list sampling.

(3) SOM -- It is a self-organizing map. It is a data visualization method which is used to reduce the dimensions of a data with the help of self-organizing neural network. It is helpful to create the high dimensional data.

(4) CCWS -- To estimate the crop acreage method is used in China Crop Watch System (CCWS). It supports in Chinese Resource and environment database.

(5) SAR -- In SAR synthetic aperture radar provides information about the shapes of triangle and content of the moisture vegetation, which is necessary for agronomist.

(6) RADARSAT -- It is a radar satellite. It is capable for rice distribution.

(7) CART – Classification and Regression tree. It is used to identify the factors to controlling yield variability.

(8) NASA – National aeronautics and space administration. It is used for forecasting the wheat production of the world.

ABBREVIATIONS

Sr. No.	Abbreviations	Meaning
1	CAPE	Crop Acreage and Production Estimation
2	CCWS	China Crop Watch System
3	EU	European Union
4	EUROSTAT	Statistical Service of the European Commission
5	FSA	Farm Service Agency
6	GIS	Geographic Information System
7	GPS	Global Positioning System
8	LRC	Land Record Commissioner
9	MXL	Maximum Likelihood
10	NASS	National Agricultural Statistic Service
11	NDVI	Normalized Difference Vegetation Index
12	SAR	Synthetic Aperture Radar
13	SADC	Southern African Development Community
14	TCI	Temperature Condition Index
15	VCI	Vegetation Condition Index