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Yield Estimation of Major Oil Seeds using Remote Sensing and GIS technique at Lalgola block in Murshidabad, West Bengal

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Introduction

The need for crop yield forecasting -

In many countries, the estimation of crop yields is based on the conventional techniques for collecting data for the crop based on ground-based field inspection and reporting. These national reports are often prone to major errors due to subjective, cost-effective, time-saving, and incomplete ground monitoring, leading to crop yield assessments and crop field estimates (Reynolds et al. 2000), to arrive at data too late to take appropriate steps to avoid food shortages in most countries.

Weather data is also used in some countries (De Witt & Bougard 2001, Liu and Cogan 2002) and models have been developed based on weather parameters. This approach involves the spatial distribution of weather stations, incomplete and/or timely weather data, and weather observations that do not accurately represent weather variations in large areas where crops are grown. 2002, Rouge 2002).

A well-intentioned, standardized, and possibly inexpensive/quick method that can be used to monitor crop growth and estimate early crop yields.
Many experimental models have been developed to estimate the yield before harvest. However, most methods demand data that is not readily available. The complexity of the models, their data needs, and methods of analysis represent these models inappropriately, especially at the field level.

With the development of the satellite, remote sensing images provide access to spatial information worldwide; Features, and events on earth on an almost real-time basis. They have the potential not only in identifying crop class but also in determining crop yield (Mohamed et al. 1994); They can identify and provide spatial variability information and allow for greater efficiency in field scouting (Schuler 2002). Remote sensing can be used for crop growth monitoring and yield estimation.

Yield estimation in India -

In the 1970s and 1980s, the "green" revolution of wheat and rice, the "white" revolution in milk, and the "yellow" revolution of oilseeds in the sixties led to a successful agricultural revolution in India. Despite these major changes, the agriculture sector continues to be dominated by a large number of small landowners (3% dependent on rural people and 5% urban households), although the country is characterized by large fluctuations in agriculture, despite the development of irrigation facilities, the adoption of new technologies and the use of crop varieties.

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The traditional methodology for grain estimation in India involves complete calculations for determining crop yield based on crop harvesting and determination of sample surveys (several states where sampling surveys are employed). Crop fields and corresponding yield estimates data are used to derive yield estimates. This yield survey is extensive; Plot yield data is being collected under complex scientifically designed sample designs based on a stratified multistage random sampling (Government of India 212, Singh et al. 12, Singh et al. 2002).

Final production estimates based on this sampling method are available after the actual harvest of the crop. Although the method is fairly broad and reliable, there is a need to reduce costs, and improvements should also be made on the accuracy and timeliness of grain production statistics. Estimates of predicted yields before actual production are required for various policy decisions. Thus, a preliminary assessment of crop yields is necessary, especially as a source of major economies in countries that depend on agriculture. It increases the provision of timely information for use in food security.

In India, there is a growing need for molecular-level planning, and especially the demand for crop insurance (Singh et al. 212), which increases the need for field-level yield statistics.
Currently, no model deals with field-level yield NDVI and any simple method that generates quantitative pre-harvest data accurately and on time. With the successful launch of satellites and other earlier satellites such as IRS-1A and 1B, respectively in 1998 and 1991, great efforts are being made to use remote sensing for yield estimation.

To obtain accurate and accurate information on crop and crop yield status, an up-to-date crop monitoring system should be provided that provides accurate information about crop yields before the harvest period. The higher the value of earlier and more reliable information (Hammer et al. 1969, Reynolds et al. 2000). Remote sensing data has the potential and capability to achieve this.

Significance

Murshidabad is the central district of West Bengal. Berhampur is the district headquarter. Due to the partition of Bengal, the flux of refugees increases the population of West Bengal overnight. Murshidabad is not out of the effect. The migrated people rapidly proceed to agricultural activity for survival. As the rural development is not adequate, the people gradually concentrated in district headquarter for various services like education, health, legal service. In course of time to feed people, from primary activities gradually reduced.

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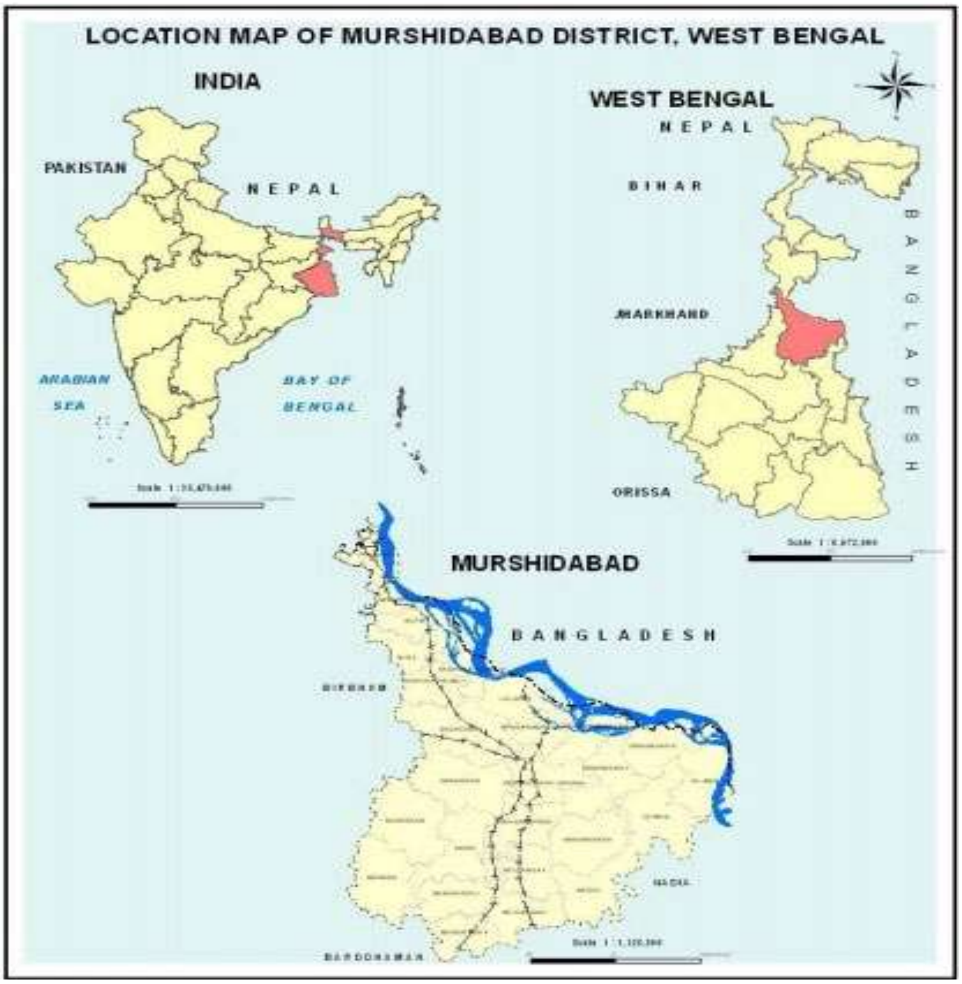
Location of Study Area

The Bagri or the eastern part of the district is a low-lying alluvial plain with the shape of an isosceles triangle. The Ganges/Padma and the Bhagirathi form the two equal sides; the Jalangi forms the entire base; other offshoots of the Ganga meander within the area. It is liable to be flooded by the spill of the Bhagirathi and other rivers. The main rivers of this region are Bhairab, Jalangi, Chhoto Bhairab, Sialmari, and Gobra Nala. All these rivers are distributaries of the main branch of the Ganges. The rivers are in their decaying stages.Lalgola is located at 24°25′N 88°15′E.



Literature Review

HAIG L. A. SAWASAWA(2003): This study applied space-borne satellite-based NDVI to predict crop yield at the field level. It was carried out in India, Andhra Pradesh state (Birkoor and Kortgiri Mandals, Nizamabad district). The purpose of the study was to investigate the relationship between space-borne Satellite-based NDVI and rice yield in irrigated fields and combine NDVI with management and land factors for yield prediction at the field level.

P. STEINBAC, et.al (2004): Two methods for estimating the yield of different crops in Hungary from satellite remote sensing data are presented. The steps of pre-processing the remote sensing data (for geometric, radiometric, atmospheric, and cloud scattering correction) are described. In the first

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method developed for field-level estimation, reference crop fields were selected by using Landsat Thematic Mapper (TM) data for classification. A new vegetation index (General Yield Unified Reference Index (GYURI)) was deduced using a fitted double Gaussian curve to the National Oceanic and Atmospheric Administration (NOAA) Advanced Very High-Resolution Radiometer (AVHRR) data during the vegetation period. The correlation between GYURI and the field level yield data for corn for three years was R2~0.75. The county average yield data showed a higher correlation (R2~0.93).

Rajesh K. Dhumal, et.al (2015): Remote sensing is an efficient technology and worthy source of earth surface information, as it can capture images of a reasonably large area on the earth. Due to advancements in the sensor technologies, there is the availability of high spatial as well as spectral resolutions imageries, and also non-imaging Spectroradiometer. With the use of these imaging and non-imaging data, we can easily characterize the different species. In this article we have reported work done by worldwide researchers for spatial as well as spectral feature extraction from remote sensing data; specifically, we have focused on the classification of crops and use narrow-band vegetation indices. It may be observed from the report that both spatial resolution and hyperspectral imageries need to be used for better classification.

Hemant Sahu, et.al (2018): A study was conducted in the Saharanpur District of Uttar Pradesh to assess the potential of Sentinel-1A SAR Data in orchard crop classification. The objective of the study was to evaluate three different classifiers that are maximum likelihood classifier, the decision tree algorithm, and the random forest algorithm in Sentinel-1A SAR Data. An attempt is made to study Sentinel-1A SAR Data to classify orchard crops using this approach. Here the rule-based classifiers such as decision tree algorithm and random forest algorithm are compared with conventional maximum likelihood classifiers. Statistical analysis of the classification shows that the distribution of the crop, forest orchard, settlement, and waterbody was 17.47 %, 0.47 %, 28.3 %, 28.3 %, and 25.5 % respectively in all the classification algorithm but root mean square error for maximum likelihood classifier (1.278) is more than decision tree algorithm (1.196) and random forest algorithm (1.193). Out of three, a percentage correct prediction is highest in the case of decision tree algorithm (73.4) than random forest algorithm (72.5) and least for maximum likelihood classifier (66.8) in December 2017. The accuracy for the orchard class is 0.81 for the maximum likelihood classifier, 0.80 for the decision tree algorithm, and 0.78 for the random forest algorithm. Thus Sentinel-1A SAR Data was effectively utilized for the classification of orchard crops.

Nosin,J.J. 1989 Aerospace survey of natural hazards: the new possibilities, ITC journal 1989-PP 183-188. In this paper, some of the modern methods of estimation are introduced.

Problem Statement

Remote sensing has been widely used as a tool for evaluating and monitoring plant parameters, grain strength, and yield estimates. Africa's regional and national primary alert systems have been established in Africa (Rasmussen 1), which may be due to temporary or prolonged food shortages.Most studies have proven that there is a correlation between NDVI and green biomass and yield, therefore, NDVI can be used to estimate yield before harvest (Gat et al. 2000, Groten 1993, Liu & Cogan, 2002, Rasmussen 1997).

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However, these studies were mostly done covering very large regions at the regional/national level. Since they cover very large regions, low-resolution images were used as a result of the generalization of crop conditions and yield estimates. The coarse resolution consisted of a mixture of grains and other cropless plants that contributed to the NDVI value, which was subsequently associated with the final crop yield.

Other studies were performed at the field level and reported a high correlation between NDVI and yield. However, most of these studies involved very small plots in the study scenarios in which spectral data were collected with ground-based platforms on either the plot or the lower flying platform. Such conditions enable a greater degree of control over the extracellular components and generally result in higher quality data and a great correlation between the measured and remotely sensitive data (Stagenberg and Taylor 2000). Quarombey et al. (1993) showed that NDVI can be used to estimate yield from a test field in Greece, and Verma et al (1998), working in the village, found a high correlation between NDVI and dry matter. The potential of regression models to more accurately estimate crop yields under variable management was established.

However, relatively few studies have been conducted on the relationship between remotely sensitive data and field-scale crop yields (Stagenberg and Taylor 2000). The consequences of complex environmental stresses, including the management of agricultural production farmers at this stage, have a great impact on the final yield, which cannot be detected with very low-resolution satellite imagery or highly controlled experiments.

This study, therefore, proposes to estimate the crop yield at the field level where the final yield is a translation of different external environment and management factors by applying remote sensed NDVI.

Objectives of the study

Many studies on the relationship between remotely sensitive data and crop yields were conducted on very small areas with very high degrees of control of many parameters affecting crop growth and production, or in very large areas, which tended to generalize the data. Few studies have applied remote sensing data to farmers at the field level to estimate yields. In this survey, remotely sensitive data were used to estimate yield at the field level where the translation of complex environmental factors, including crop growth and yield management.

The primary goal is to establish a relationship between remotely sensed NDVI measurements and field level yields by integrating other production factors (land and management) at the field level.

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Specific objectives

1. To establish the relationship between NDVI and field-level crop yield in irrigated pulses.
2. To assess and establish the relationship between NDVI, field-level management practices, and land factors for crop yield estimation.
3. To assess the possibility of using a single date multi-spectral image for yield prediction.

Research questions

To achieve the stated objectives the following questions will be answered.

1. What is the relationship between remote sensed NDVI and crop yield at the field level?
2. Does NDVI reflect crop management practices at the field level and the quality of land?
3. Can NDVI derived from a single date multi-spectral image be used to explain yield variability at the field level?

Methodology

Satellite images with various RS and GIS tools & models will be used as evidence. In this field, various software on GIS will be used like ERDAS, Global Mapper, GEOMATICA to estimate the satellite imagery of USGS and Earth Explorer point cloud images. In many cases motivated campaigning confuses people and administration. Many motives are involved in those movements. Careful observations only can solve the problems.In the fieldwork possibilities of identification may be compared by null hypothesis and alternative hypothesis, the alternative type of hypothesis is very common and divided into two types- directional and non-directional. In case of testing hypothesis, the following steps should be followed-

1. Proper formation of the null hypothesis with anticipation of it being rejected.

2. Proper formation of an alternative hypothesis.

3. Decision about rejection label.

4. Proper flow chart for getting a suitable forecasting result.

Materials

The following materials will be used for the analysis and evidence.

1. New cadastral map prepared by NRSC on Block and panchayat label provided in Bhuban.

2. Map of population density,

3. ISGPP maps per panchayat

4. Vegetation Index satellite imagery

5. LANDSAT images for DEM, vegetation, land use, communication etc. from 2004, 2006, 2008, 2010, 2014, 2016, 2018 1: 10. 000

6. Soil analysis kit,

7. Ph meter.

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8. Satellite imagery analysis software - ARC GIS 10.1, ERDAS 9.1, GEOMATICA 12, GLOBAL MAPPER 12, PHOTOSHOP CC, etc.

9. GARMIN - GPS

Hypotheses

The density of the plant is the most obvious physical representation of the post-harvest yield. Density and health can be monitored using remotely sensitive images that measure chlorophyll activity and vegetation vigor. Spectral reflection is the expression of all-important factors affecting crops and the environmental impacts on crop growth (Liu and Kogan 212, Singh et al. 212), so remote sensing data can be used to monitor crop conditions through NDVI.

The methods of production and the management of how land is used will have an impact on overall productivity. In this case, the type of crop growth and crop yield management and the response to the quality of the land unit.

Based on the above, hypothesis adopted in this study are as follows:

There is a significant relationship between NDVI, and yield at the field level.

Yield = (NDVI)

There is a significant relationship between NDVI, field-level management, and land.

NDVI = (Land, Management)

Single-date multi-spectral images can be used to predict yield at the field level.

Integrating hypothesis 1 and 2 leads to:

Yield = (NDVI, Land, Management)

Where only those land and management factors remain relevant that have no impact/relation with NDVI, the rest are now no longer relevant.

Analysis and outcomes

The spectral reflectance of the crop is mainly related to the canopy parameters, which are related to the final yield. These parameters are influenced by genotype, soil characteristics, cultural practices, and other biological factors i.e., the integration of all factors that affect crop growth of the spectral data.

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