ISSN PRINT 2319 1775 Online 2320 7876
Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

GIS AND REMOTE SENSING TECHNIQUES IN AGRICULTURE

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ABSTRACT:

In India Agricultural field is highly changeable because of different in climate, soil and topography of different states. For agricultural management, all these factors need to be analyzed on Ariel basis. The new techniques in Geography like remote sensing and geographical information system can be of great use for their management. Remote sensing and GIS are very important tools having wide range of applications to solved various agricultural issues. These techniques are used in agriculture for crop discrimination, crop growth monitoring, crop inventory, soil moisture estimation, crop evaporate-transpiration, crop acreage estimation and yield prediction. Timely and reliable information on crop acreage, growth condition and yield estimation can be highly beneficial to the producers, managers and policy planners for taking decisions regarding food security and economic impact. Remote sensing and GIS can also be used very effectively in land use, land cover analysis as well as damage assessment because of drought, floods and other extreme weather events. This research paper has been made in the present study to review analyses and evaluate the latest information regarding the application of remote sensing and GIS for crop monitoring, crop condition assessment and yield estimation for sustainability of agriculture.

Key words: Geographical information system, remote sensing, crop discrimination, Crop acreage estimation, Crop growth monitoring, Crop yield prediction.

INTRODUCTION:

Agriculture plays dominant role in economy of India. During the last two decades remote sensing and GIS techniques are applied to explore agricultural application.Global warming effect the sustainability of agriculture in many regions over the earth's surface. Significant rise in extreme weather events has been observed globally in the recent past. Global warming triggered climatic changes and extreme weather events have a significant impact on agriculture. Today because of changing climatic conditions, crops have to suffer from different types of stresses leading to reduced crop productivity and year to year variability. Because of that remote sensing and GIS can be of great help for crop growth

monitoring, identification and management of different types of stresses and regional yield estimations to sustain the natural resources and agricultural productivity.

In Indian agriculture there are small landholdings, inadequate resources and lack of agro-technological information. Under the changing climatic scenarios, agricultural planning and use of agricultural technologies need precise spatial-temporal meteorological and crop information for accurate data analyses, forecasts and their effective application in agricultural Planning and management decisions, irrigation and scheduling.

REMOTE SENSING AND GIS TECHNIQUES:

Although the conventional methods of acquiring weather and crop growth status information are reliable, but they are labour intensive and time consuming. However, recently remote sensing (RS) and geographical information system (GIS) technologies are gaining importance for acquiring spatial-temporal meteorological and crop status information for complementing the traditional methods. Under the changing climatic conditions, quick spatiotemporal assessment of extreme weather events and crop growth status including crop stress detection and damage assessment is difficult using conventional methods. Under such conditions, geospatial technology i.e. remote sensing and GIS are highly applicable for acquisition and management of huge spatial-temporal data by using satellite information, digital maps and simulation models etc. This technology is highly advantageous because of rapid and repetitive data availability, quick analysis and generation of valuable information for decision-makers and policy planners.

1. Remote sensing technology has the potential of revolutionizing the detection and characterization of agricultural productivity based on biophysical attributes of crops.
2. Data recorded by remote sensing satellites can be used for yield estimation, acreage estimation, crop phonological information, detection of stress situation and disturbances.
3. Remote sensing provides a cheap alternative for data acquisition over large geographical areas
4. Remote sensing along with GIS is highly beneficial for creating basic informative layers and generating valuable integrated information by superimposing different basic layers.

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5. This technology can be successfully applied to diverse fields including flood plain mapping, hydrological modeling, and surface energy flux, urban development, land use changes, crop growth monitoring.
6. Today, remote sensing is potentially a practical management tool for site-specific crop management in precision agriculture.

APPLICATION OF RS AND GIS IN AGRICULTURE:

1. SPECTRAL REFLECTANCE

The basic concept of data acquisition through remote sensing revolves around the spectral reflectance characteristics of different surface features. The advent of multispectral and hyper spectral remote sensing technology has widened its applications in different fields. These technologies are highly applicable in agriculture because multispectral reflectance and temperatures of the crop canopies are related to two important plants physiological processes i.e. photosynthesis and evapotranspiration. Chlorophyll pigment absorbs mainly in the Blue and Red part of the electromagnetic spectrum and reflects the green. The percentage of radiation reflected from the leaf is higher in the NIR than in the green. The spectral behavior of the leaf changes during senescence and in plants subjected to stress by reflecting more red light and absorbing more NIR. Opposite behavior is shown in healthy plants with high values of reflectance in the NIR region and low values in red.

2. CROP INVENTORY

The science of remote sensing can play a pivotal role in crop identification and area estimation and, therefore, has a significant role in inventorying data base on different crops. A number of studies using aerial photographs and digital image processing techniques have been reported in literature. It helps in reducing the amount of the field data to be collected and provides higher precision of the estimate. Grazing intensity categories were defined based on percentage of bare soil, sward height and standing dead material. Correlation analysis between spectral ratio, i.e. Normalized Difference Vegetation Index (NDVI) and above ground biomass was significant.

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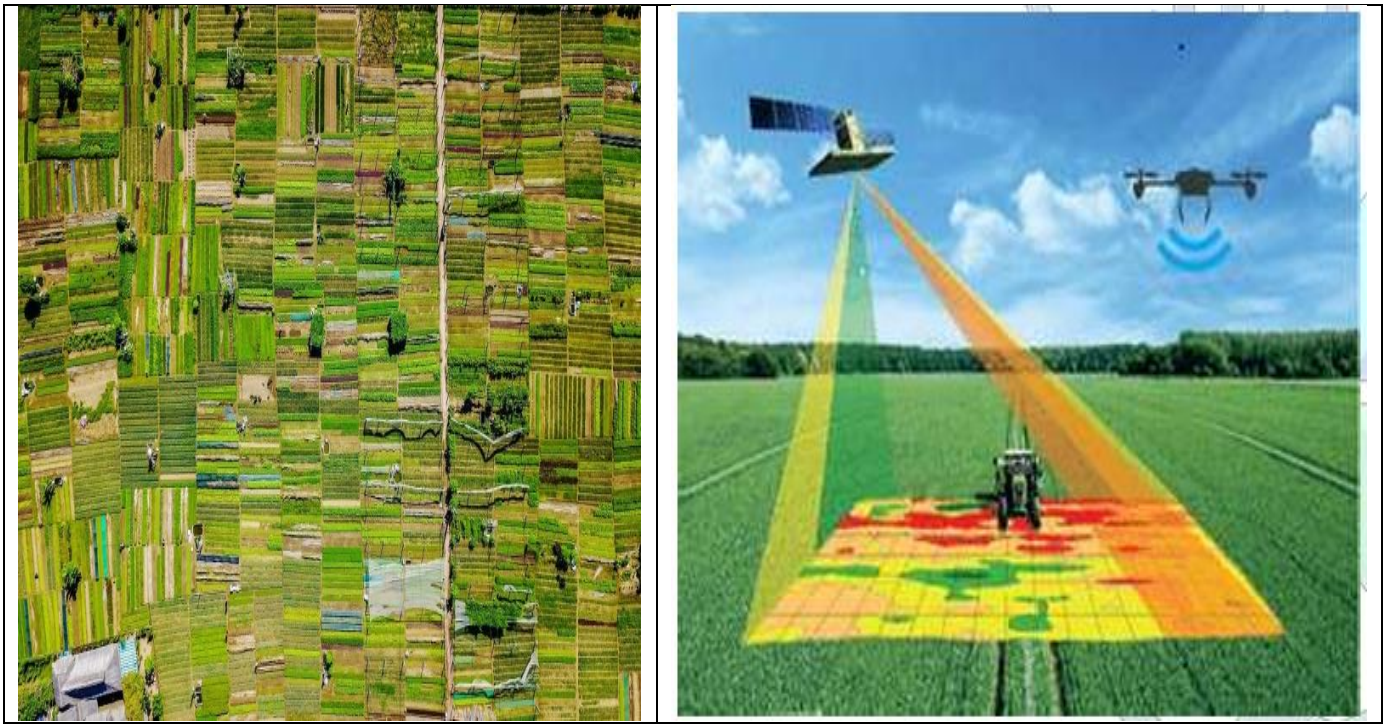

FIG: Remote Sensing Technique

3. PHYOLOGICAL STUDIES

These studies indicated the potential use of vegetation spectral indices derived from various scales of remote sensing data for determining plant physiological properties and improving estimates of plant physiological and structural characteristics from hyper spectral data, allowing for much more detailed spectral analyses and hence more accurate estimates Remote sensing data have been exploited to estimate canopy characteristics by using empirical approaches based on spectral indices estimated using hyper spectral imagery. These studies investigated the spectral reflectance properties of the plants, identifying key spectral wavebands related to specific plant physiological and structural characteristics, hence deriving sensitive vegetation spectral indices for their non-destructive estimation. Analysis of hyper spectral remote sensing data has been carried out to estimate LAI for agricultural crops and forests.

4. MONITORING OF VEGETATION STATUS

Remote sensing of soil and crop can be an attractive alternative to the traditional methods of field scouting because of the capability of covering large areas rapidly and repeatedly providing spatial and temporal information necessary for sustainable soil and crop management The potential of remote sensing in agriculture is very high because of its ability

to infer about soil and vegetation cover as a non-destructive mean. Numerous spectral vegetation indices have been developed to characterize vegetation canopies. A most significant intellectual challenge to ecologists and bio-geographers is to understand spatiotemporal patterns of vegetation.

5. PRECISION AGRICULTURE

Remote sensing technology is a key component of precision farming and is being used by an increasing number of scientists, engineers and large-scale crop growers. Precision farming aims at reduced cost of cultivation, improved control and improved resource use efficiency through information received by the sensors fitted with the farm machineries. Variable rate technology is the most advanced component of precision farming. Sensors are mounted on the moving farm machineries containing a computer which provides input recommendation maps and thereby controls the application of inputs based on the information received from GPS receiver

6. NUTRIENT AND WSM

Nutrient and water stress management is one of the most important fields where we can opt for application of remote sensing and GIS through the application of precision farming. Detecting nutrient stresses using remote sensing and GIS can help in site specific nutrient management and thereby can reduce the cost of cultivation as well as increase the fertilizer use efficiency. In the semi-arid and arid regions, judicious use of water can be possible through adaptation of precision technologies. Development in remote sensing data acquisition capabilities, data processing and interpretation of ground based, airborne and satellite observations have made it possible to couple RS technologies and crop management systems to improve nutrient and water use efficiency.

7. PEST INFESTATION

Remote sensing approach in assessing and monitoring insect defoliation has been used to relate differences in spectral responses to chlorosis, yellowing of leaves and foliage reduction over a given time period assuming that these differences can be correlated, classified and interpreted. The range of remote sensing applications has included detecting and mapping defoliation, characterization of pattern disturbances etc. and providing data to pest management decision support system .Remote sensing technology as an effective and inexpensive method to identify pest infested and diseased plants. They used remote sensing

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techniques to detect specific insect pests and to distinguish between insect and disease damage on oat.

8. WEED IDENTIFICATION AND MANAGEMENT

Based on the variation in spectral reflectance characteristics of weeds and crops, remote sensing technology provides a means of identification of weed infestation in the crop stand and further aids in the development of weed maps by detecting the location of weeds within an agricultural field, so that site-specific/need based herbicide can be applied. Higher radiance ratio and NDVI values in solid stand or pure wheat and minimum under solid weed plots.

9. FLOOD EFFECT ON AGRICULTURE

Satellite remote sensing allows timely investigation for large regions and provides frequent imaging of the region of interest. Until recently, near real-time flood detection was not possible, but with sensors such as Hyperion on board the EO-1 satellite, this has been significantly improved. Automated spacecraft technology has reduced the time to detect and react to flood events in a few hours. Advances in remote sensing have resulted in the investigation of early warning systems with potential global applications. Detected flooded areas with satellite data and investigated moisture classes in flood plain areas in relation to water changes, accumulation of sediments and silts for different land-use classes and erosive impacts of floods.

10. EVAPO-TRANSPIRATION

Evapotranspiration is essential for water resource management such as water and energy balance computations, irrigation scheduling, reservoir water losses, runoff prediction, meteorology and climatology (Medina et al., 1998). Estimation of spatial variability in evaporate-transpiration is possible over a wide area by using remotely sensed information coupled with surface energy balance algorithms. The energy emitted from cropped area has been proven beneficial in assessing crop water stress as the temperature of most plant leaves are mediated by soil water availability and crop evapo-transpiration

11. CLIMATE CHANGE

Understanding and forecasting climate change a challenging task. The climatic conditions on the earth have been and will ever be changing. Amid the dire warnings of

severe weather perturbations and global warming, scientists and policy makers have been searching for ways to tackle the threats of climate change. For climate change analysis, remote sensing is a required tool for up-to-date environmental data acquisition both at local and synoptic levels

CONCLUSION

Remote sensing and GIS application of agriculture expanded into different domain. With avaibility of SAR sensors monitoring of crop during kharif season become a reality. India is dominant country in agricultural application of remote sensing and has carried out capacity building by Indian scientist. The agro ecosystems analysis and climatic change impact would be the focal theme in which variety of components can come from remote sensing data. The Remote sensing and GIS communications technologies would use in the future to deliver the service to all stockholders of agriculture. The application of Remote sensing and GIS in agriculture is extremely complex, However, this technology provides many advantages over the traditional methods in agricultural resources survey.

REFERENCES

1. Asner G P 1998. Biophysical and biochemical sources of variability in canopy reflectance. Remote Sense Environ 64: 234-53
2. Basso B, Cameroon D and De Vita P 2004. Remotely sensed vegetation indices: theory and applications for crop management.
3. Cassidy W W and Palm H L 2002. Precision agriculture: Remote sensing and ground trothing.
4. Daughtry C S T and Goward S N 2000. Plant litter and soil reflectance.
5. Franklin S 2001. Remote Sensing for Sustainable Forest Management. Lewis publisher, Boca Raton, Florida
6. GIS Applications in Agriculture Book: David Clay, Francis J. Pierce
7. Journal of Emerging Technologies and Innovative Research (JETIR)
8. Shrikant karlekar,Remote sensing and GIs
9. Wójtowicz, M., Wójtowicz, A., & Piekarczyk, J. (2016). Application of remote sensing methods in agriculture. Communications in Biometry and Crop Science, 11, 31-50
10. Shrikant Karlekar: Remote Sensing Book