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Application of Remote Sensing & GIS in Agriculture

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Abstract*—This article provides an overview of some of the recent research in agriculture involving remote sensing and GIS. Attention focuses on application of remote sensing and GIS specially in agriculture including geography, land surveying, most Earth Science disciplines, parent child relationship, unique identification, attributes, technical parameters, 2D/3D view and any other requirement customized. These advances have been made over recent years and foundations for future research established and can be efficiently used in Agriculture for better results.*

Keywords*— *Agriculture, GIS, Information, Remote sensing, Satellite.

I. INTRODUCTION

Agriculture is the backbone of Indian economy and the pivotal sector for ensuring food security. Timely availability of information on agriculture is vital for taking informed decisions on food security issues. India is one of the few countries in the world that uses space technology and land-based observations for generating regular updates on crop production statistics and providing inputs to achieve sustainable agriculture.

Satellite-based optical and radar imagery are used widely in monitoring agriculture. Radar imagery are especially used during monsoon season. Integrated use of geospatial tools with crop models and in-situ observation network enables timely crop production forecasts and drought assess-ment & monitoring.

In India, Agriculture plays a vital role in the Indian economy. Over 50 per cent of the rural households depend on agriculture. Agriculture is an important sector of Indian economy as it contributes about 17% to the total GDP and provides employment to over 60% of the population. Government recently launched some major schemes like crop insurance, per drop more crop, Rashtriya Krishi Vikas Yojna to enhance the productivity of the crops. Initiatives like organic farming and increase in the production of pulses are also been taken.

II. REMOTE SENSING

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation. Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines (for example, hydrology, ecology, oceanography, glaciology, geology); it also has military, intelligence, commercial, economic, planning, and humanitarian applications.

In current usage, the term "remote sensing" generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on propagated signals (e.g. electromagnetic radiation). It may be split into "active" remote sensing (i.e., when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor) and "passive" remote sensing (i.e., when the reflection of sunlight is detected by the sensor).

Who needs remote sensing for agriculture?

Govt. authorities or local agencies can use remote sensing data, in order to make important decisions about the policies they will adopt or measures to tackle national issues regarding agriculture. Individual farmers can also receive useful information from remote sensing images, when dealing with their individual crops, about their health status and how to deal with any problems.

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III. GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Geographical Information System (GIS) combines location data with both quantitative and qualitative information about the location, allowing you to visualize, analyze, and report information through maps and charts. Using the technology, you can answer questions, conduct what-if scenarios, and visualize results. **GIS** is identified as a system used to manage infrastructure assets, natural resources and any objects as per requirement. It is easier to analyze and manage facility and asset data stored in GIS, making design, construction, and maintenance more efficient and profitable.

GIS is a software based system which facilitates end to end information of assets or any type of objects as required by end user on maps having desired accuracy in raster and vector forms. GIS aids geographical location, parent child relationship, unique identification, attributes, technical parameters, 2D/3D view and any other requirement customized. GIS information/data is most adoptable, accurate and user-friendly to meet general requirements of operations and other **software applications**. Using main **GIS application**, other GIS based applications can be easily developed to meet specific requirements of users. Such systems are essential in Utility (Water, Electric, Gas), Local Government Authorities, Defense Services, Aviation, Roads, Transportation Services, Space, Mining and any multi-location business operations requirements. These utilities are managed under various GIS based domains like **Utility GIS**, Municipal GIS.

In ancient India apparently had a clear concept of remote sensing. For instance epic 'Maha Bharata' Sanjaya had been endowed, presumably with some equipment which enabled him to report (in real time) all the events at the distant "Kurukshetra" battle field, whether they were open or camouflaged and occurred in day or by night.

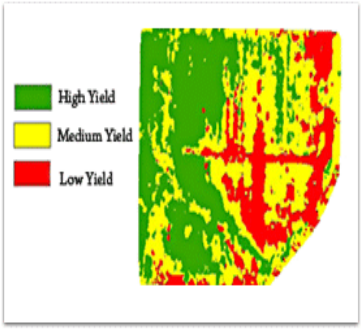
In recent times, Frenchman Mr. Tournachen took photographs for the first time from a balloon which floated over Paris in 1858. The term "Remote sensing" was first used in 1961 when U.S. Naval project on the study of Aerial photographs was renamed as "remote sensing".The application of remote sensing technology to agriculture and forestry was presented in couple of papers in 1968 at the occasion of U.N. conference on peaceful uses of on the space uses and the first satellite in remote sensing technology was launched in July 1972 in U.S.A. In India the remote sensing activities

Agricultural plants, as living organisms require water and nutrients in order to grow and are sensitive to extreme weather phenomena, diseases and pests. Remote sensing can provide data that helps identify and monitor crops. When these data is organised in a Geographical Information System (GIS) along with other parameters, they become an important tool that helps in making decisions about crops and agricultural strategies.

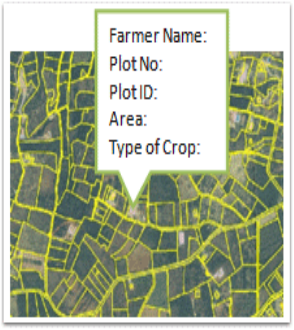
IV. IMPORTANCE OF REMOTE SENSING AND GIS

To identify the potential land for any particular crop, GIS is the best technique as it brings all the data on a single platform for the analysis. Different vegetation indices like NDVI, FPAR and TVI. are widely used to monitor crop health which is also directly proportional to yield. In case of crop insurance, actual damage can be assessed. Claims and compensations can be given on fair basis.

To monitor crop health, its growth and production various factors come into play such as temperature, irrigation facilities and the most important soil health condition. For this purpose government has launched a nation-wide scheme called soil health card.



Crop Yield Map



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Under this scheme mapping of soil is done along with its nutrient and sub-nutrient information like pH content, nitrogen, phosphorus, soil moisture etc.

Mapping of soil has been done by Ceinsys in Jharkhand, state of India. The project was successfully implemented in 06 districts of Jharkhand state covering 13000 Sq. Km. area.

V. CONCLUSION

In order to implement these programs effectively it is vital to use the latest technologies like remote sensing and GIS. The decision makers can visualize all the farmlands with their allied information and current situation on one click. The tasks like yield estimation & crop damage assessment done by traditional means take month or two and a whole lot of manpower to complete the work. By using these technologies the same task can be completed within half or even in lesser time frame with minimum number of resources and high accuracy. Balancing the inputs and outputs on a crop farm is essential to its success and cost-effectiveness. The ability of GIS to study and envisage agricultural environments and workflows has proved to be favourable to those involved in the farming industry. While natural inputs in farming cannot be

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measured but, can be better understood and managed with GIS applications such as crop yield estimates, soil amendment analysis, erosion identification and remediation.

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