Machine Learning Techniques for Handling Geo Spatial Agricultural Data

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Abstract:- *Machine Learning and Data Analytics is having a major impact in the agricultural world. The Geo – Spatial Agricultural data exceeds voluminously and is increasing exponentially day by day. Utilizing these data to their fullest, not only improve the growth of farmer but also improve economically the developing countries. The data are mainly induced by videos, images and are generated by mobile devices and high resolution imaging systems. Managing these data effectively gives* ***Accurate Crop Prediction, More Potential and Stronger crops*** *and* ***Precision Agriculture****. Further advanced statistical learning techniques are used which provides* ***historical weather forecasts*** *and new opportunities to enhance* ***forecasting accuracy****. The fundamental tasks of statistical learning for a data are: classification, regression, and probability density modelling. Various Energy balance models are used to quantify the amount of water required by crops. The evaporate-transpiration is calculated as the difference between the input radiation from the sun and heat absorbed by soil and heat transfer from crop to air. The models developed can calculate the irrigation that needs to be provided to a crop in order to maintain the required amount of water in the field. The several energy balance methods developed combines* ***1) the crop vegetation information 2)soil temperature information, 3) Weather data integrated into evaporate-transpiration.*** *The energy balance method was experimented to give an improved assessment of water amount that is required for irrigation based on Landsat data and weather data modeling. Finally, Agricultural Big data are being used not only for primary production but also to provide predictive insights in farming operations, drive real-time operational decisions, and redesign business processes for game-changing business models.*

Key words: Geo Spatial Data Analytics, Machine Learning, Data Management System, GIS

INTRODUCTION

Machine learning and Big Data Analytics are used to analyze data of the country's agricultural market. This deals with different crops sown in several different states, their output gained, profit earned in differenrt season in last 30–40 years. Machine Learning Statistical models and algorithms are used to analyze the data to predict which Crop will be best suitable in which region and in which season to get the best profitable to produce good yield. This really helps farmers in the country to become more advanced and developed also gain much better yield for their hard work. As smart machines and sensors crop up on farms and farm data grow in quantity and scope, farming processes will become increasingly data-driven and data-enabled. Rapid developments in the Internet of Things and Cloud Computing are propelling the phenomenon of what is called Smart Farming (Sundmaeker et al., 2016). While Precision Agriculture is just taking in-field variability into account, Smart Farming goes beyond that by basing management tasks not only on location but also on data, enhanced by context- and situation awareness, triggered by real-time events (Wolfert et al., 2014). Real-time assisting reconfiguration features are required to carry out agile actions, especially in cases of suddenly changed operational conditions or other circumstances (e.g. weather or disease alert). These features typically include intelligent assistance in implementation, maintenance and use of the technology. Smart devices extend conventional tools (e.g. rain gauge, tractor, and notebook) by adding autonomous context-awareness by all kind of sensors, built-in intelligence, capable to execute autonomous actions or doing this remotely. In this picture it is already suggested that robots can play an important role in control, but it can be expected that the role of humans in analysis and planning is increasingly assisted by machines so that the cyber-physical cycle becomes almost autonomous. Humans will always be involved in the whole process but increasingly at a much higher intelligence level, leaving most operational activities to machines.

BACKGROUND

Farmers in many parts of India are largely dependent on timely rainfall for harvest and subsequent profits. Uncertainty surrounding this phenomenon has also haunted them since the beginning of civilization.

Over time however, this uncertainty had reduced significantly as farmers back in the day could almost accurately plant crops based on previous experience with weather conditions. This wisdom has been passed on from one generation of farmers to the other.

Gradual onset of global warming and climate changes, over the last century, have slowly-yet steadily put this wisdom out of use. As for rain-fed farmers preparing for agriculture, soil-water equation is fragile and any delay in rainfall could easily mar the harvest.

When age old systems fail, look to the future

With the global population projected to exceed Nine billion by 2050 [2], it will be critical to optimize agricultural production and food supply chains to more efficiently produce and deliver food, fiber and fuel to meet growing demand [3] [4]. This goal is further complicated by climate change and urbanization. Agricultural Big Data (AgBD) will be an essential component of the second green revolution that will be required to meet these needs. AgBD sets are already used by many countries and commodity markets for the early detection of disruptions in supply chains for commodity crops such as wheat, rice, corn, and soybean [5] [6] [7] [8] [9]. Precision agriculture has developed with advances in remote sensing data collection, including improved spatial and temporal resolution, spectral resolution, variety of sensor platforms (e.g., satellite, aerial, ground-based), etc. [10]. A recent congressional reception also reported that precision agriculture has shown promise in increasing on-farm yields [11]. In addition, a recent Fortune magzine [12] quoted the potential of increasing farm profits by almost $100 per acre via prescriptive farming that uses predictive modeling and AgBD to optimize farm management practices ranging from customized seed planting density to fertilizer application based on local soil characteristics and long-range weather forecasts. In animal agriculture, AgBD and predictive modeling are critical for surveillance and control of infectious diseases. Beyond agricultural production, GPS-enabled sensors are being used to track food and generate AgBD of supply chains. Such technologies are estimated to help reduce food-borne illnesses by 76 million in the US every year [13]. AgBD can also be used to improve supply chain security. For example, spatial data mining techniques (e.g., hotspot detection) [14] [15] [16] [17] can be used with AgBD to identify crops (e.g., California almonds [18], Cocoa [19]) produced in small geographic regions or a set of regions that are vulnerable to climate change and natural disasters. Their supply chain maps can then predict geographic chokepoints of these sensitive crops and animal-based commodities, informing industry and consumers of risks before they hit. Similarly, spatial data mining may also help select sustainable sources (e.g., avoid deforestation based palm oil) in a supply-chain [20]. In addition, detailed data on consumer and market behavior can be used to improve food access and nutritional outcomes, and geo-social media can be leveraged for timely detection

PROBLEMS IDENTIFIED

The Country's Agricultural growth is affected by various factors such as climate, due to topography, historical, geographical, biological, political, and institutional and socio economic factors. Figure 1 addresses the problems faced by the Agricultural sector and its solution.

The research is implemented for variable rate irrigation, it can **save water** while at the same time **increase yield by maintaining the quality of the crop**.

To maximize the crop yield by **selecting appropriate crop** that will be sown. It depends on various factors like the type of soil and its composition, climate, geography of the region, crop yield, market prices etc.

Scalability and **adapting to other topological area** can be done to provide steady irrigation suggestions for all crop.

An accurate **forecast of weather** can reduce the enormous turmoil faced by farmers in the country including crop selection, watering and harvesting. Improved Weather forecast and suggestions for irrigation can be done ten days in advance.

Using Machine learning methods for **crop disease prediction** which when compared to the traditional methods, provide more accuracy.

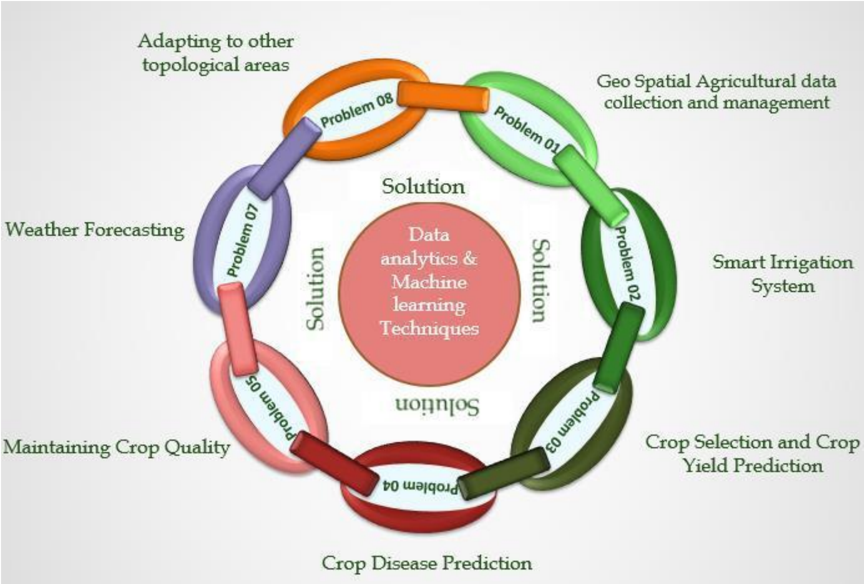

Fig 1. Agricultural Monitoring System

IV. PROPOSED WORK

The main aim is to reduce the human impact on natural resources and to determine an appropriate land use, it is necessary to carry out scientific land evaluations. Such kind of analysis allows determining the main limiting factors for the agricultural production and enables decision makers to develop crop management inorder to increase the land productivity.

To utilize current technologies and advancement in machine learning to create a platform that empowers the discovery of rapid data by automatically updating, assembling and authorizing data layers in space and time. And also to enable the use of Machine Learning techniques for renewable energy by forecasting irrigation and hyper local weather forecasting. Monitoring Vegetation and high resolution evaporate-transpiration for agriculture.

Using Big Data to improve agricultural productivity is the major focus in developed countries. Sustainable agriculture and development experts are working day and night to expand access to important data related to agriculture inorder to support millions of farmers in developing countries. With Technologies dominating in almost every field available in the world, usage of **i**nternet-based geospatial data management for the entire region. It aims to implement a centralized hub and single-window access mechanism to assist users discovering geospatial datasets.

1. Data Computation can help farmers better manage their operations – the more information they have, the more they can make decisions that are utilized in their farm's specific needs.
2. The information obtained can help farmers identify efficiencies that lead to higher productivity and profitability, lower input costs, and optimized fertilizer use.
3. Data help farmers eliminate volatility and risk which is beneficial not just to the grower but also to the supplier. The more a farmer knows about his farm, the better their opportunities to strengthen supply chain relationships.
4. Data collection allows farmers to approach conservation at a landscape-scale, versus at the farm or even the country level.

Managing Geospatial technology won't be successful if incorrect data is collected and not analyzed properly.

To achieve this, several Data Analytic techniques have been used which are based on remote sensing. Remote sensing is necessary in dividing a large farm into management zones. Each zone has specific requirements that require the use of GIS and GPS to satisfy its needs. Thus, the first step of precision farming therefore is to divide the land into management zone.

The division of this land into zones is mainly based on:

- Soil types
- pH rates
- Pest infestation
- Nutrient availability
- Soil moisture content
- Fertility requirements
- Weather predictions
- Crop characteristics
- Hybrid responses

The data that is collected from remote sensing acts as a source of point data. Once point data has been collected, it needs to be stored and analyzed for it to be useful to the farmer.GIS software can be used to develop digital maps that transform spatial information that has been collected on the ground into digital format. Once spatial data has been mapped, comparison of the results that are presented with the field notes is necessary. With the use of remote sensing, GPS and GIS, Agricultural stake holders and farmers can be able to understand site-specific needs of their farms.With these information they are capable of formulating and implementing management techniques that will ensure the optimal use of inputs to maximize their output and profits. Further use of Machine learning algorithms gives more analysis on crops and weather forecasting.

The work uses the computer vision and deep-learning algorithms to process data captured by drones and/or software-based technology to monitor crop and soil health. Machine learning models are being developed to track and predict various environmental impacts on crop yield such as weather changes.

Machine learning algorithms uses a decade of field data—insights of how crops have performed in various climates and inherited certain characteristics. The collected data is used to develop a probability model. With this information, machine learning can predict the genes that will contribute a beneficial feature to a plant.

VI. CONCLUSION

The work aims to provide an improved and hyper localized weather forecast model will be developed based on machine learning algorithms.

The use of remote sensing, GPS and GIS, farmers will understand site-specific needs of their farms. With the collected information, they are capable of formulating and implementing Data management techniques that will ensure the optimal use of inputs to maximize their output and profits. Evapo-transpiration/irrigation forecasting can be done easily.Early Identification of plant diseases is done by visual examination. A machine learning algorithm can spot disease type, severity, and in the future, may even recommend management practices to limit loss from a disease. Machine learning can also aid in plant breeding, soil types and other factors.

V. IMPLEMENTATION TECHNIQUES

S.No	Techniques / Methodologies used	
1	Agricultural Geo spatial Data Management	Separate Cloud database to maintain the Big data , Hadoop and Hbase, Map Reduce
2	Crop selection and Crop yield prediction	Machine Learning Classification algorithms / Neural Networks
3	Weather Forecasting	Support Vector Machines
4	Crop disease prediction	Drones are used to identify and monitor the crop repeatedly. Support Vector Machines/ Pattern Recognition, Image Processing, Artificial Neural Networks, Regression Trees, Random Forest
5	Smart Irrigation System / Nutrients in Soil Irrometer Tensiometers is the standard in accurate soil moisture measurement.	General Machine Learning Algorithms, Sensors to determine nutrients in soil. • Frequency Domain Reflectometry (FDR) • Time Domain Transmission (TDT) and Time Domain Reflectometry (TDR) • Neutron moisture gauges • Soil resistivity • Galvanic cell • Electrochemical Sensors for Soil Nutrients

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