Research Paper on Big Data Analytics for Agricultural Development in India

Saumya Pathak[1], Manjeet Kumar Singh[2], Sushant Shekhar Gautam[3], R. Senthil(Guide)[4]
[1,2,3]*B. Tech*, [4]*Assistant Professor*
Information Technology, SRM - Institute of Science and Technology

Abstract - Now-a-days we are getting flooded with information, largely deriving from the World Wide Web. This information is dispersed and no significant relationship may be obtained from it and neither can this great rate be managed by conventional computer storage. It is considered that organizations that are best capable to establish real-time business decisions applying Big Data solutions will flourish, whilst those that are ineffective to adopt and make the best of this change will progressively find themselves at a competitive disfavour in the market and face possible bankruptcy. Big data analysis assures adequate capacity in terms of computer storage and processing power to elastically deal with data of such magnitude and by the use of analytics to acquire value from it. This study focuses on agriculture and forestry data and the use of particular bid data analysis tools used to get some substantive information which can be utilized for strategic and successful agriculture and forestry. Preceding analogous studies are discussed and recommendations are given.

Agricultural production system is an outcome of a complex interaction of seed, soil, water and agrochemicals (including fertilizers). In India, dominant parts of provincial inhabitants are reliant on agriculture for their occupation. Be that as it may, the current farming practices are not prudentially suitable neither naturally supportable and the yields of numerous agrarian items in India are basically low. Sooner rather than later, it will get to be the key for the nation to fabricate a high yielding, focused, and shifted agricultural part and speed up country, non-ranch business enterprise. This paper recognizes the culminations of conventional cultivating practices and delivers how to build the yield of the agrarian things by utilizing present day PC innovations. Further, it additionally recognizes the basic figuring and analytic capacity of Big Data in preparing colossal volumes of value-based information continuously circumstances. The target of this paper is to display the revisions in the rural area and supports the dialogs on how government can cultivate developments in the enormous information examination to enhance the rustic agricultural framework.

Keywords - Big Data Analytics, Rural agrarian systems, Precision Agriculture, Electronic farm records.

I. INTRODUCTION

A. Overview - Big data refers to the ability to collect and analyze the huge amounts of data that is being generated by different departments working directly or indirectly involved in agriculture. Every day the World generates 2.5quintillion bytes of data[1]. Big Data in the context of agriculture refers to new means of collecting and analyzing data generated from the farm to the end consumer. Big data is a set of methods and technologies that require new forms of combination to uncover large hidden values from large datasets that are diverse, complex, and of a massive scale. The processing of such data using common database management tools or conventional data processing applications is a very strenuous task. Everything around us is contributing to the generation of Big data at every time instance. Every social media exchanges as well as digital processes involving systems, sensors, mobile devices and every other digital device present are transmitting it. To extract significant value from big data, you need optimal processing power, analytics capabilities and skills. For proper understanding of this continuously growing data we need a new fundamental approach to architecture, tools as well as practices. To feed the world's rapidly expanding population in the coming decades, agriculture must produce more. A farmer knows the ill effects of weather such as excess/deficit rainfall, temperature, wind velocity, sunshine hours etc., but he does not know how to interpret them to make smart decision for profitable farming.

B. Research Objectives - The target end results of this effort are:

- To increase the agricultural production towards the increasing world's population.
- To reduce the expenses on agricultural farming.
- To identify the problems of facing the famers in India.
- To increase the market for the Agricultural products of India all over world.
- To identify the climatic seasons changes.
- To Forecast and historical weather information fine-tuned for agricultural decisions.

II. LITERATURE REVIEW

Available studies on the application of big data analytics in agricultural commodities reveals different methods of adoption and use cases. Certain comprehensive reviews focus on methods that centre on crop cultivation in precision agriculture and include the upstream input segment of the value chain that supplies farm machines, chemicals and seeds to farms. Detailed methods used in the application of

big data analytics is investigated such as machines equipped with navigation systems, sensors and internet of things capability and are able to collect and transmit live data captured incrops, soil and air to centralized data centres or cloud storage solutions where they can be analysed for enhanced farm yield and crop quality **(Xuanand Martin, 2018).**

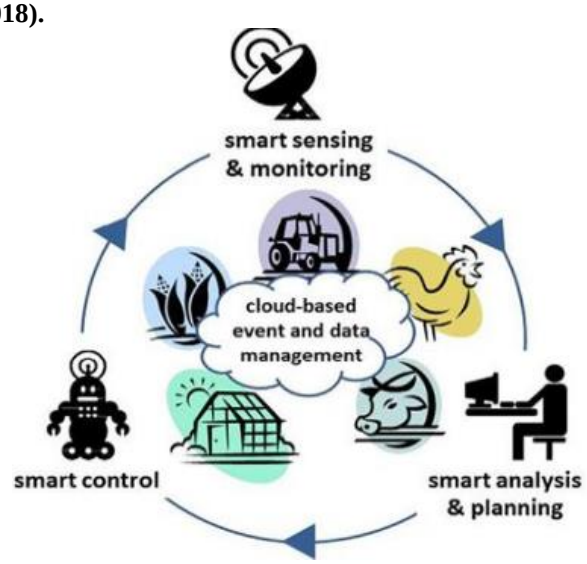

Figure 1

Other studies are more focused on the ways the 3 V's of big data affect aspects and major themes in agriculture **(Andreaset al, 2017).** Certain studies have investigated how the remote application of big data enabled technology such as IoT platforms can be used to address problems in precision agriculture and the ecology **(Tomoet al, 2017).** They describe the use of IoT enabled nodes, camera nodes and gateways, satellite imaging and cloud servers for data acquisition, transmission, storage, preparation, prototyping, and analytics. A Comprehensive review of the methods and use cases of big data analytics in the practice of agriculture should first identify the area of practice the application is focused on, secondly, it should describe the sources of big data in the defined agricultural area. Lastly, the techniques used to capture and analyse the data should then be reviewed as explained below. Soil Moisture content and salt levels are captured from soil sample using ground sensors which also detect and collect data on underground electricity charges **(Meyeret al, 2004).** The sensors are internet of things IoT enabled and transmit live data to remote cloud servers where they are studied and analysed using machine learning and artificial learning applications **(Armstrongetal, 2007).**

Crops Sensors have diverse uses in farm practices; both underground and above the ground sensors are used to collect crop data through a process known as metabolite sensing, satellites can also be used to remotely sense and capture data in crops **(Waldhoffet al, 2012).** Historical datasets that document the history of land use, cropping practices, and yields are also sources of crop data. Machine learning technologies, normalized difference vegetation index NDVI which is a graphical indicator used in the analysis of remote sensing measurement data are among the technological tools used to collect and analyse crops **(Urtubiaet al, 2007; Sakamotoet al, 2005).**

Land Satellites, drones, and radar are some of the tools used to remotely capture land data in combination with other non-remote means (Barrettet al, 2014). Land data is captured to evaluate and project on the suitability of land use for the purpose of agriculture. Diverse technological tools are employed to process and analyse land data, they include big data analytics solutions such as machine learning which gives clearer insight and better understanding inland degradation (Schuster, 2017). Clarityin the qualities of land and crop phenology are gained in the use of these big data analytics tools **(Gillianet al, 2008).** Commodity trading companies can gain insight that is valuable in trade with insightful knowledge of farmlands and the implication on future crop yield. Weeds Big data analytics automates the process of weed control in agriculture through systems that integrate autonomous vehicles with advanced GPS systems, drones, and digital library to control weeds in farms. The systems are enabled by machine learning applications in neural networks and logistics regression. Other technologies employed include image processing **(Gutiérrezet al, 2008).** Decision Support Systems Big data analytics use case in this regard extends beyond field practices in agriculture and includes the agricultural value chain. Data sources are diverse and are captured from official government surveys and data reports, weather stations, sensors, satellites, news feeds, social media, etc. Internet of things IoT, cloud computing, mobile applications and big data storage are technologies used to accomplish functions **(Sawantet al, 2016).** Applications in the logistics, storage and processing functions of a commodity trading company are also enhanced through knowledge discovery. Insurance/ Finance Organisational financial records when combined with farm yield records and weather report are sources of big data that can be harnessed stored and analysed to generate intelligent insights. This can be done using technologies such as artificial intelligence, cloud computing solutions, and mobile applications (Akinboro, 2016; Syngenta Foundation for Sustainable Agriculture, 2016).

III. BIG DATA ANALYTICS IN AGRICULTURAL SYSTEMS

A. Use Of Big Data Analytics In Agricultural Systems - We have gone into the time of huge information. Enormous information gives a ground to gathering, putting away and breaking down information to uncover the data not already known by astutely utilizing the ever-increasing amount of data available we could grow new vision by reexamination of the information or combining it with other accessible data. In agriculture this implies not simply mining crop records, precipitation maps, and symptomatic reports and so on. For experiences, judgments and choice bolster gadget, additionally persistent examination of the information

streams (fully fledged records) created for and by the predetermined territory at each time moment. The objective of this paper is to provide top notch Farming methods furthermore means to guarantee expanded efficiency of the yields to rustic individuals and defeat the issues in the rural frameworks like utilization of hurtful pesticides, exorbitant utilization of composts, giving appropriate watering system offices and extortion administration in the horticultural framework. The proposed idea empowers agriculturists, enormous information examiners and staff to have part constructs access to data in light of electronic homestead records.

In detail, the Big data in agriculture refers to the Electronic Farm Records (EFR) which incorporates soil temperatures maps and information, precipitation maps and information, electrical conductivity maps and information, dampness content information, air penetrability maps the supplement substance and pH level information, past development records, protection and yield related data and online networking posts including tweets, websites, new sustains and articles in agribusiness diary. The occupation of the huge information researcher is to mine the huge information and find the affiliations, comprehend examples and patterns to enhance the horticultural frameworks, build crop profitability and lower costs included by appropriate diagnosing the different variables.

B. Data Mining With Big Data - In production environment big data mining process does not end. A good big data analytics platform has factors like speed of development, robustness, easily analyze huge amount of data. Growth of data in terms of size and number of users has increased in past few years. In 2010 there were only 4 data analysts working at twitter but now there are thousands of employees working at hadoop cluster node data centers of twitter. Twitter increased the analytics power before the exact time and if an organization does not do this before it needed then these issues will become nightmares [7]. Extracting information from the stream data at real time is the good way to come to know what is happening at the spot. Stream data arrive at very high speed and it is very difficult to analyze stream data at real time, stream data requires very efficient algorithms for mining , that algorithm should be accurate. [8].Online news, social media and micro blogs are the examples of streams created by the users. Solutions to deal with these streams were not designed. Samoa was a platform for mining these streams. This is a tool for online mining in the cloud environment. Samoa can be run on different distributed stream processing engines like storm. In future Samoa will be open source and that will be evolution in the research area of the big data stream mining. Samoa also provides API for algorithm developers [9]. A data driven model named Hace is also proposed which aggregate the multiple sources of information; analyze data from the data mining perspective [10].

Big data helping Intel for improving their business intelligence; large portion of their data was unstructured which was 90 percent of their enterprise data. Aims of the Intel were make better decisions, increase business velocity, discover and tap new markets. Intel wants to increase their Business intelligence strength from the descriptive analytics to predictive analytics by using data mining from big data [11].

C. Big Data Applications - Big data applications are being used in different industries. Fed BP Disaster response was an application for the government's [USA government] response in the disaster situation. This was built in 2010 when oil rate flow was a key issue. BP and independent groups presented changeable estimates preventing efforts to manage the level and range of the U.S. Government's response. NIST analyzed the estimates and formed actionable intelligence on which to support the final reaction [12].

Applications in oil and gas business could be Equipment maintenance to prevent failure, production optimization, price optimization, safety and compliance. Oil and gas companies have big competition in their field, and facing regular change. Firms need to increase their production volumes and at the other hand they also want the healthy, safety and low risk environment. From exploration and production of the oil, leading companies are using big data for new business values, reduce cost and increase production [13].

Website of Whitehouse consists of all speeches of Barrack Obama. Aim was to find the influence of these speeches on the election. A scrapper was made to collect all speeches from the website. Hadoop and Map reduce both are used for parallel processing of these speeches. Study finds the most spoken or referred words, most referenced countries, personalities and also focus on internal and foreign affairs. According to [14], these all things are the basis for the influence on the elections.

D. Big Data Challenges -

Security and Privacy: Cloud security alliance big data working group identify top security and privacy problems that need to capture for making the big data computing and infrastructure more secure. Most of these issues are related to the big data storage and computation. Some of the challenges are secure data storage [20]. Various security challenges related to data security and privacy are discussed in [21] which include data breaches, data integrity, data availability and data backup.

Dynamic Provisioning: A service of the cloud computing is infrastructure as service in which it provides computation resources on demand, many cloud related companies are implementing this concept and to making it easy for customers to access these services. Current frameworks do not have the property of the dynamic provisioning. Here is an issue that Compute resources can be insufficient for the submitted job, some process may requires more resources. Another issue is scheduling and protection algorithm, current algorithms does not consider these aspects [22].

Algorithms: Organizations were granting the papers by capturing key words from the abstract and titles. Analyzing the science with hand was difficult task. After that work was done by program analyst. They use algorithms to do this work. These algorithms can be varying from each other. This difference can reduce the effectiveness and reliability of the final result. Improvement in the data management will result in better technology but it will face many issues. [23].

Misuse of Big Data: Challenges including potential misuse of big data are here, because information is power. Types of the data which people will produce in the future are unknown. To overcome these challenges we have to strengthen and increase our intent and capacity [24].

Data Management: Data management is also a critical issue for corporation and industries. Data warehouse has efficient data management techniques. In [25], two data warehouse management strategies are discussed; which are Immediate Incremental Management (IIM), Deferred Incremental Management (DIM) but the favor is given to IIM because of its algorithmic implementation.

E. The Role of Cloud Computing - Cloud computing, like several of the other technologies discussed in this paper, covers a wide range of capabilities. One important and growing use of cloud computing is to deploy an integrated on-premises computing environment, or *private cloud.* This allows the many different workloads involved in both operational and analytical processing to co-exist and be consolidated into a single system. Some of these workloads may run as virtualized machines, whereas others may run as native systems. The private cloud approach provides a consolidated, but flexible system that can scale to support multiple workloads. This solution, however, is not suited to all types of analytical processing. Not only does it take longer to implement a private cloud than a standalone appliance, but also it is often difficult to tune and optimize a cloud environment consisting of operational workloads as well as complex analytical workloads. These latter workloads are often best suited to an appliance approach, rather than a cloud-computing environment. It is therefore important to match business requirements and performance needs to the right type of technology solution and budget.

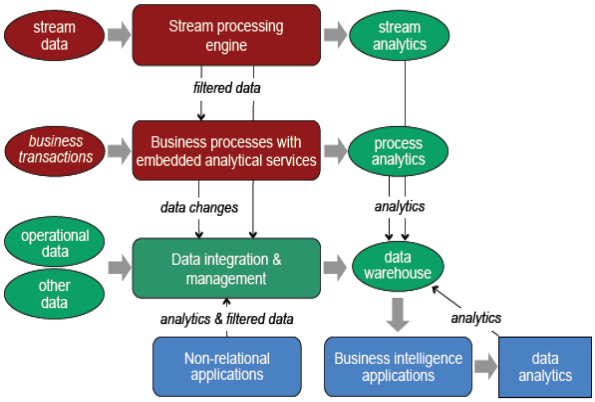

Figure 1: Data Mining Using Cloud Computing

IV. TECHNOLOGIES FOR PRECISION FARMING

In order to collect and utilize information effectively, it is important for anyone considering precision farming to be familiar with the modern technological tools available. The vast array of tools includes hardware, software and the best management practices. These are described briefly in the following paragraphs.

A. Global Positioning System (GPS) receivers - Global Positioning System satellites broadcast signals that allow GPS receivers to compute their location. This information is provided in real time, meaning that continuous position information is provided while in motion. Having precise location information at any time allows soil and crop measurements to be mapped. GPS receivers, either carried to the field or mounted on implements allow users to return to specific locations to sample or treat those areas. Uncorrected GPS signals have an accuracy of about 300 feet. To be useful in agriculture, the uncorrected GPS signals must be compared to a land-based or satellite-based signal that provides a position correction called a differential correction. The corrected position accuracy is typically 63-10 feet. When purchasing a GPS receiver, the type of differential correction and area coverage should be considered.

B. Yield monitoring and mapping - In highly mechanized systems, grain yield monitors continuously measure and record the flow of grain in the clean-grain elevator of a combine. When linked with a GPS receiver, yield monitors can provide data necessary for yield maps. Yield measurements are essential for making sound management decisions. However, soil, landscape and other environmental factors should also be weighed when interpreting a yield map. Used properly, yield information provides important feedback in determining the effects of managed inputs such as fertilizer amendments, seed, pesticides and cultural practices including tillage and irrigation. Since yield measurements from a single year may be heavily influenced by weather, it is always advisable to examine yield data of several years including data from extreme weather years that helps in pinpointing whether the observed yields are due to management or climate induced.

C. Variable-rate Technology (VRT) - Variable rate technology refers to a technology that enables the variable rate application of materials in precision agriculture. Variable rate fertilizer application allows crop producers to apply different rates of fertilizer at each location across fields. The technology needed to accomplish variable rate fertilization includes an in-cab computer and software with a field zone application map, fertilizer equipment capable of changing rates during operation and the Global Positioning System (GPS). VRT describes any technology that enables the variable application of inputs. Therefore, VRT mounted on equipment permits input application rates to be varied across fields in an attempt to site-specifically manage field variability. This type of strategy can reduce input usage and

environmental impacts along with increasing efficiency and providing economic benefits.

D. Scouting - In-season observations of crop conditions may include: Weed patches (weed type and intensity); Insect or fungal infestation (species and intensity); Crop tissue nutrient status; Flooded and eroded areas using a GPS receiver on an all-terrain vehicle or in a backpack, a location can be associated with observations, making it easier to return to the same location for treatment. These observations also can be helpful later when explaining variations in yield maps.

E. Geographic information systems (GIS) - Geographic information systems (GIS) are computer hardware and software that use feature attributes and location data to produce maps. An important function of an agricultural GIS is to store layers of information, such as yields, soil survey maps, remotely sensed data, crop scouting reports and soil nutrient levels. Geographically referenced data can be displayed in the GIS, adding a visual perspective for interpretation. In addition to data storage and display, the GIS can be used to evaluate present and alternative management by combining and manipulating data layers to produce an analysis of management scenarios.

F. Information management - The adoption of precision agriculture requires the joint development of management skills and pertinent information databases. Effectively using information requires a farmer to have a clear idea of the business' objectives and crucial information necessary to make decisions. Effective information management requires more than record-keeping analysis tools or a GIS. It requires an entrepreneurial attitude toward experimentation and education. A large portion of the investigation of the agrarian information is executed by yearly information amusement in social databases that create pre-handled reports. The examination of the information is should be done on the spot. Likewise, information vivification should be done continuously at least once in a month. To offer better administrations to the general population, the agricultural framework needs to advance and innovate ceaselessly.

The information acquired by the big data analysis can be comprehensively used for precision agriculture. Some of them are listed as:

- The information ingested from the different frameworks can be assessed continuously to signal the fundamental values that assume a vital part underway basic leadership.
- The geological maps in this way produced are of high determination recognizing the variety of soil dampness. It would direct to the definitive utilization of watering system.

The thorough focusing of controls will likewise be made conceivable with the assistance of unpredictable pictures of nuisance harm in the field. These utilizations of enormous information can be tried, cleaned and upgraded quickly and financially and will altogether change conveyance and exploration in the rural area. However, the enormous information investigation in horticulture assumes an urgent part to give better agrarian administrations, it give examination on the authentic information to reveal concealed data. The enormous information investigation has challenges like heterogeneity and fragmentation of information, scale, security and human joint effort [7].

V. RESULT AND DISCUSSION

A. Different tools used for the data Analytics - At Present, the tools that can be used for the analysis of the Agricultural data can be listed. The Usage of the different tools that can be used for analytics can be listed below.

1. Tool :- language R

Use: - software environment for statistical computing and graphics

Remarks: - Graphical facilities for Agriculture data analysis and display either on-screen or on hardcopy.

2. Tool :- Hadoop

Use: - Open-source software framework for distributed storage of very large datasets on computer clusters.

Remarks: - software framework for distributed storage of the collected large agriculture data set

3. Tool :- Python

Use: - for data manipulation and analysis

Remarks: - To manipulate the Agricultural data.

4. Tool :- Visualization Tools

a) Tableau, b) D3, c) Data wrapper

Use: - Information that has been abstracted in some schematic form, including attributes or variables for the units of information

Remarks: - By using these tools visualization of the pattern is clear.

At present, high-tech tools are raising the bar, enabling farmers to crunch massive amounts of data collected through sensors to predict the best time to plant, what type of seed to use, and where to plant in order to improve yields, cut operational costs, and minimize environmental impact. John Deere's Farm Sight, Monsanto's Field Scripts, and Pioneer's Field360 are among the tools that allow farmers to collect planting and yield data from motorized farm equipment and input this information into a database that, when aggregated with multiple sources of anonymized data, produces detailed prescriptions.

B. Work Plan - This project links science with technology and big data analytics; we aim to help farmers better adapt to temperature extremes, droughts or excess water in fields so that they can make better decisions for the environment and maximize production and/or profits. The data collection is an important role in the work process. Here data consists of any form, may be image, text, sensor data, audio and video also.

C. Big data analytics in climatic changes discovery - In India the direct impact of climate change would be effect plant growth development and yield due to change in rainfall and temperature .Increase in temperature would reduce crop duration, increase crop respiration rate change the pattern of pest attack and new equilibrium between crop and pest hasten mineralization in soil and decrease fertilization use efficiency. Many crops have become adapted to the growing season, day lengths of the middle and lower latitudes and may not respond well to the much longer days of the higher summers. In warmer, lower latitude regions, increased temperate may accelerate the rate at which plant release CO2 in the process of respiration, resulting in hastened maturation and reduced yield.

D. Actual Seasons - Sowing Season: May to July. Sowing Season: October to December
Harvesting Season: February to April Harvesting Season: September to October.

E. Proposed Seasons - By collecting the data of rainfall and temperature of last 5 years we can analyze the data by using different big data analytics tools to get the exact change in the Indian agricultural climate.

F. The Data that are collected can be used for the following conditions:

1. Historic weather patterns
2. Plant breeding data and productivity for each Strain
3. Fertilizer specifications and Pesticide specifications
4. Soil productivity data
5. Water supply data
6. Market spot price and futures data

Figure 2: Capturing data

Figure 3: live analysis of data

G. Big data analytics in climatic changes discovery - In India the direct impact of climate change would be effect plant growth development and yield due to change in rainfall and temperature .Increase in temperature would reduce crop duration , increase crop respiration rate change the pattern of pest attack and new equilibrium between crop and pest hasten mineralization in soil and decrease fertilization use efficiency. Many crops have become adapted to the growing season, day lengths of the middle and lower latitudes and may not respond well to the much longer days of the higher summers. In warmer, lower latitude regions, increased temperate may accelerate the rate at which plant release CO2 in the process of respiration, resulting in hastened maturation and reduced yield.

H. Sensors used for the data collection - Different sensors used for the data collection is shown in Table(1)
Some of the applications below can be seen in a particular manner of collecting data

Figure 4: Sensor for climatic changes detection

Figure 5: Sensor for pesticide control detection

Figure 6: Sensor for moisture control detection

I. Proposed Framework for the solution to Agricultural problems - The data can be sent to the Agri bank to get the appropriate solution regarding Pesticide Usage

- Seed Usage
- Crop Diagnosis
- Temperature and climate
- Loan Request
- Rain fall

Frame Work to send data to bank and to the farmer is shown in Fig (8)

Benefits of this Framework:

Figure 7: Sensor for disease detection

Figure 8: Using drowns to capture image

The data in the form of pictures can be captured through our smart phones can be sent to the bank. The Agricultural bank contains necessary tools to analyze the data and within a short period, the farmer gets the solution to his problem.

- All the fertilizers and pesticides that are used by the farmers can be supplied by the Agricultural bank only.
- All the Agricultural loans issuing can be done according to the data contains in the bank. By using this approach the right farmer will get the loan.
- Crop Insurance issues can be easily solved by this frame work.
- Crop damage by the natural calamities can be easily estimated by using this frame work.
- Fraud in the loan issuing matters can be reduced because all the accurate land records can be kept in this bank

VI. CONCLUSION AND FUTURE WORK

Big data analytics solution helps farmers minimize their use of fertilizer, chemical and water while maximizing yields by analyzing a wider diversity of real-time sensor and historic data inputs. Through the use of rigorous big data Analytics, that prescription usually enhances the farm's overall profitability.

Precision agriculture gives farmers the capacity to utilize crop inputs more successfully including manures, pesticides, culturing and watering system. More viable utilization of inputs means more noteworthy harvest yield and/or quality, without dirtying the earth. Be that as it may, it has demonstrated hard to decide the money saving advantages of accuracy agribusiness administration. At present, a number of the innovations utilized are as a part of their early stages, and valuing of hardware and administrations is difficult to bind. This can put forth our current financial expressions around a specific innovation dated. Exactness agribusiness can address both monetary and natural issues that encompass creation farming today. Questions stay about cost-viability and the best approaches to utilize the mechanical apparatuses we now have, however the idea of "making the best choice in the correct spot at the ideal time" has a solid instinctive request. The advancement of enormous information examination in the agrarian area is prompting the understanding of new enhancing results from these substantial information sets. Presently, the dirt and product detecting has changed the rural framework to wind up a great deal more proficient, less costly and accomplish preferable quality over some time recently. In the mean time, numerous new businesses are creating both physical and satellite-based sensors which are accelerating the move to 'connected' agriculture [8]. The spread of shrewd sensors with the compelling investigation of big data will lead us a step forward towards freeing farmers from the constraints of uncertain weather. The utilization and selection of Big Data, inside legislative procedures, is advantageous and permits efficiencies regarding cost, profitability and advancement. Be that as it may, this information examination frequently requires numerous parts of government (central and local) to work in cooperation and make new and inventive

procedures to convey the fancied result [2]. Through the execution of this paper utilizing Hadoop HDFS and Map Reduce we could reveal the data lying in the huge agribusiness information sets. At last, the achievement of accuracy agribusiness depends to a great extent on how well and how rapidly the information expected to manage the new innovations can be found. The future research is all about to get through the obstacles and use big data analytics in agriculture for unveiling the proficiency from the raw unstructured data.

VII. REFERENCES

[1]. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung , 2014. In Text Book Big Data: Related Technologies, Challenges and Future Prospects.

[2]. Thomas Davenport, 2013. Text Book. Big Data at Work: Dispelling the Myths, Uncovering the Opportunities

[3]. Stephens ZD, SY Lee, F Faghri, RH Cambell and C Zhai.2015. Text Book. Big data: astronomical or genomical?

[4]. Tekiner, F.; Keane, J.A., "Big Data Framework," Systems, Man, and Cybernetics (SMC), 2013 IEEE International Conference on , vol., no., pp.1494, 1499, 13-16 Oct. 2013.

[5]. Venkatareddy Konasani, Mukul Biswas and Praveen Krishnan Koleth, "Fraud Management using Big Data Analytics", A Whitepaper by Trendwise Analytics.

[6]. Tekiner, F.; Keane, J.A., "Big Data Framework," Systems, Man, and Cybernetics (SMC), 2013 IEEE International Conference on , vol., no., pp.1494, 1499, 13- 16 Oct. 2013.

[7]. K. Priyanka and Kulennavar Nagarathna, " A Survey on Big Data Analytics in Health Care", International Journal of Computer Science and Information Technologies, Vol. 5(4),2014, pp. 5685- 5688 [6] W. Liu and E.K. Park, " Big Data as an e-Health Service" ,

[8]. Zaiying Liu; Ping Yang; Lixiao Zhang, "A Sketch of Big Data Technologies," Internet Computing for Engineering and Science (ICICSE), 2013 Seventh International Conference on , vol., no., pp.26,29, 20-22 Sept. 2013

[9]. Yadav R; Rathod J; V Nair. "Big data meets small sensors in precision agriculture". International Journal of Computer Applications.0975-1,4.2015.

[10]. Venkatareddy Konasani, Mukul Biswas and Praveen Krishnan Koleth, "Fraud Management using Big Data Analytics", A Whitepaper by Trendwise Analytics.

[11]. Soumendra Mohanty, Madhu Zaiying Liu; Ping Yang; Lixiao Zhang, "A Sketch of Big Data Technologies," Internet Computing for Engineering and Science (ICICSE), 2013 Seventh International Conference on , vol., no., pp.26,29, 20-22 Sept. 2013.

[12]. Geraldin B. Dela Cruz, Bobby D. Gerardo, and Bartolome T. Tanguilig III, "Agricultural Crops Classification Models Based on PCA-GA Implementation in Data Mining", International Journal of Modeling and Optimization, Vol. 4, No. 5, October 2014.

[13]. Environment Change Prediction to Adapt Climate-Smart Agriculture Using Big Data Analytics, Ramya M G, Chetan Balaji.

[14]. Applications of Smartphone-Based Sensors in Agriculture: A Systematic Review of Research Suporn Pongnumkul, Pimwadee Chaovalit, and Navaporn Surasvadi

[15]. Different Techniques Used in Data Mining in AgricultureJyotshna Solanki, Prof. (Dr.) Yusuf Mulge.