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Big Data Analytics in Developing Smart and Sustainable Solutions for the Agricultural Industry1

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Abstract

Here, the main aim of this paper is to discuss the process and procedure of big data analytics that can develop smart and sustainable solutions for the agricultural industries. This paper also tends to collect relevant and reliable information or data input regarding developing smart and sustainable solutions using big data analytics for betterment of the overall agricultural industry. As many previous researchers have proposed the fact that big data analytics can be used to tackle increasing challenges of agricultural production such as granular data on rainfall patterns, water cycles, fertilizer requirements, and more. Here, this particular study module aims to show the importance of sustainable yet smart solutions for the agricultural industry. Moreover, it has also shown different roles of data analytics in terms of providing smart agricultural solutions that has conversely shown the both beneficial and non-beneficial sides of big data analytics during developing smart solutions for better agricultural prediction.

As it has already been highlighted the main objective of this specific research is to analyse the process of developing smart and sustainable solutions for the agricultural industry different methodologies or random analytical process such as positivism research philosophy, descriptive research design and secondary data collection method has been applied to acknowledge the methods of implementing or developing smart and solutions by using big data analytics in agricultural industry. At the end a brief discussion and analysis has been shown through using two tables of implementation and a big data analytics flow chart in order to outline the steps that needed to be performed for developing smart and sustainable agricultural solutions.

Keywords

Big data analysis, BigData tools and systems, smart and sustainable solution and agriculture industry.

INTRODUCTION

In today's accelerating market such concepts like data science, big data analytics and artificial intelligence have become one of the relevant and most popular key trends. Recent research on data analytics have shown that as the rise in both globalization and digitalization is impacting current business's streamlines, therefore most of the organizations are using data analytics for their business processes. Processing business streamlines with big data analytics seem to retain homogenous growth. However, the use of big data analytics is being more innovative through using it in developing smart and sustainable solutions, for example, assuming the weather pattern through data it can provide proper prediction regarding suitable weather for harvesting crops and performing other agricultural tasks.

IMPORTANCE OF SUSTAINABLE AGRICULTURAL SOLUTION

Agriculture is the main thing that helps in the living process of human beings and other living things. Due to agricultural development, the basic needs of people can be managed such as food, clothes, and others. In this case, to develop agriculture in the global world, sustainable growth is the most important. Sustainable agriculture helps to provide equal weight to societal, environmental, and economic concerns in agriculture [1]. Needless to say, sustainable agriculture is needed to improve soil quality to develop the agricultural industry. Along with that, sustainable solutions help to preserve earth's natural solutions that enable some benefits in agricultural development. Preserving water, reducing erosion, and maintaining soil quality can increase the quality of harvests and that also helps to develop the health of people.

Sustainable development encourages people to enhance and conserve natural resources of earth through changing manners, implementing technologies, and focusing on issues properly. The harvesters can focus on some sustainable agricultural practices to develop the agricultural industry. There are five practices of sustainable agriculture and those are managing the landscapes and systems of agriculture [2]. Along with that, it needs to focus on elimination of tillage and need to apply IPM (integrated pest management). Sustainable development in agriculture benefits to reduce reliance on non-renewable energy. Along with this, it helps to reduce the usage of chemicals in crops and save scarce resources. Sustainable management helps to raise the population and increase the demand for food in society.

ROLE OF BIG DATA ANALYTICS IN DEVELOPING SMART AND SUSTAINABLE SOLUTIONS FOR THE AGRICULTURAL INDUSTRY

Big data analytics is a complex process of CSE that helps in advanced analytic methods against large data, and diverse big data sets. There is a big role in the agricultural development process and improving sustainable solutions. Big data gives harvesters water cycles, granular data on rainfall, fertiliser requirements, and others. This analysis

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method helps to make smart decisions for example, selection process of harvests to crop to allow better profitability [3]. In addition to that, it helps to manage and choose the time to harvest to improve the quality of crops. This technology helps in agricultural procedures to make educated decisions that benefit to meet the demand of people. In addition to that, big data helps in effective soil and pest management.

On the other hand, there is an effective process of big data analytics such as pest monitors and soil sensors that offers great insight into the crop quality and field conditions. Big data analytics helps in the crop management and agricultural process to save costs and increase opportunities [4]. There are some practical applications of big data and it has a major role in meeting the demand of food in society. In addition to that, this technology of CSE helps in the precise pesticide application process to avoid over use of chemicals. Big data has a major role in farm equipment management such as focusing on machinery learning to improve agricultural processes. It helps in the tracking process of growth and development process of crops. Along with that, it helps in the supply chain management problems to make a solution easily.

Big data analytics of CSE also helps in the yield protection process through different algorithms and it gathers information of weather, vegetation, chemicals, and more with the aim of decision -making by growers. This technology helps to determine the percentage of providing water, light, chemicals, and the process to place, space, and the timing of harvest [5]. As per ***technological acceptance model***, it is a useful and effective process that can be accepted by farmers to develop the agricultural industry in the global world. This IT adoption helps in successful sustainable agricultural improvement and this process helps to increase demand of crops in the market. Along with that, it benefits to fulfil the demand of food that is increased in society due to the large population.

MATERIALS AND METHODOLOGY

Materials

In this research, the materials are collected from different procedures and the material of this research is big data analytics information that has a major contribution in the sustainable agricultural process to develop the agricultural industry. Big data analytics helps in the development of sustainable agriculture through improving functions of harvest [6]. Evidently, this IT method focuses on the food safety management process through implementing modern farming in this industry. There are many diseases and illnesses noticed in society due to low quality of food and big data analytics has a role in the quality development process [7]. The quality of crops can be improved through managing soil quality, water quality, and time management of harvesting, proper light and water giving, and reducing use of chemicals.

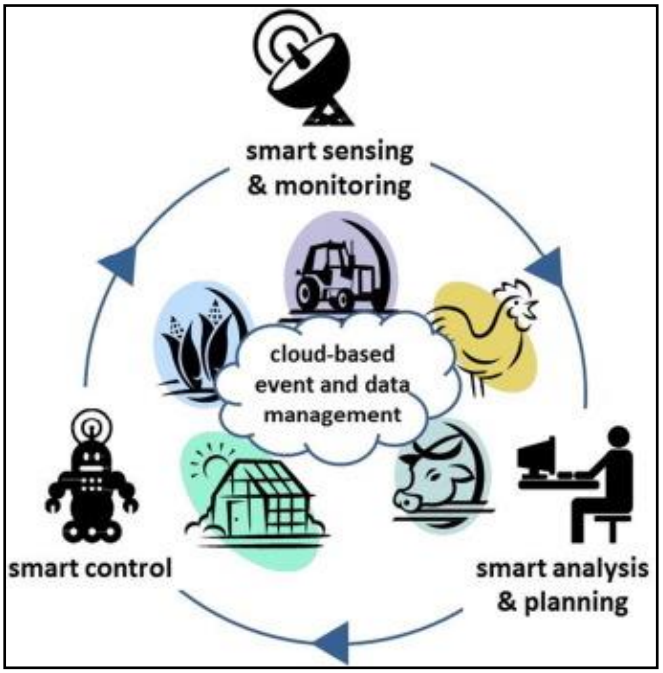

Figure 1: Big Data and Cloud based event in smart farming

(Source: [8])

As per the collected information, big data helps in the modern farming development process to enable detection of microbes and indications of contamination. This management process can be done through collecting information of humidity, temperature, and chemicals to evaluate the growth of crops. Using different online tools of data analytics, the information of the previous harvest process can be accessed. Big data includes smart sensing and monitoring machines to sense the issues, control the problems and plan for harvest to improve the quality [8]. There is a major issue is the low quality of crops that can impact on the health of people. In addition to that, big data manages the real-time assisting configuration that can help the harvesters to focus on the procedures of harvest and reduce the issues of using higher levels of chemical and other components.

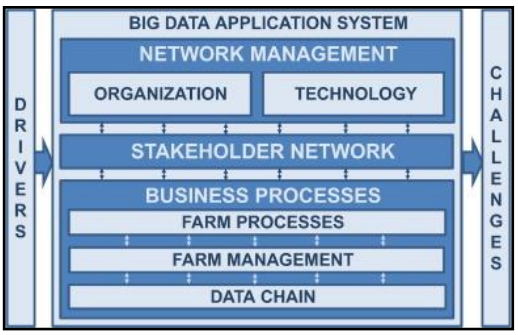

Figure 2: Big Data Application System

(Source: [9])

Big data analytics focus on the network management process that can help to improve the development process of the agricultural industry. Along with that, this network management process can benefit in a smart decision-making

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process and to solve problems in a short instance [9]. Managing networks with organisation and technological development management the output value can be increased. In addition to that, big data has a crucial role in data chain management to capture the information of data marketing and decision-making to improve the process of agriculture [10]. Moreover, the data chain can be developed properly and arranged appropriately to improve the supply chain process of sustainable agriculture.

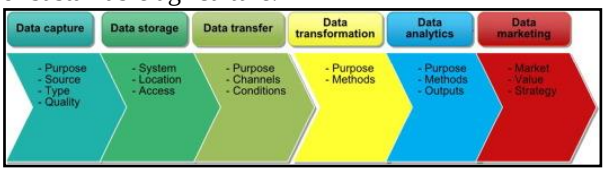

Figure 3: Data chain of Big Data Application (Source: [10])

Methodology

Research methodology refers to the process of collecting information, planning for data collection and the research design process. In this case, there are several methods used to complete this research with proper and factual information. The ***positivism research philosophy*** is used in this research to focus on factual knowledge on big data analytics on sustainable agriculture and smart farming. Positivism research philosophy focuses on the factual and real information on research topics [11]. In this research, the ***descriptive research design*** is used to demonstrate the importance of big data in sustainable agriculture and smart farming. Along with that, a ***descriptive research analysis*** method is used in this research to analyse the collected information of this research topic related to big data analytics.

The information of this topic has been collected from authentic and verified pdfs, journals, websites, and others. This data collection method is called a ***secondary data collection method*** that can be collected from secondary resources [12]. ***Quantitative research strategy*** is used to focus on the acceptance of big data on the agricultural industry. Along with that, this research also focuses on the consumer's demand in using big data in the sustainable growth in agriculture and smart farming.

Analysis, Results and Discussion

As it has been already outlined that this research paper has chosen a secondary quantitative method, a descriptive analysis for summarizing the results and then the discussion. According to recent researchers on the use of big data analytics in the field of agriculture, has stated that data analytics tends to help firm through monitoring health of crops in real-time, able to create effective predictive analysis related to future yields and help farmers to create effective resource management decisions that crucially relies on the proven trends and also able to reduce waste and improve profitable margins [13]. Here, in this section a table has been represented below that has aimed to define big data resources, techniques and analysis that can be amplified in today's agricultural areas.

Agricultural Area	Big Data Resources	Techniques for Big-Data Analysis
Weather and Climate Change	Weather stations, surveys, static historical information, including weather data, climate data and earth observation data. While, remote sensing satellites and geospatial data can be also used as big data resources in this field.	Machine learning such as the use of scalable vector machines, statistical analysis, modelling, cloud platforms, MapReduce analytics and GIS geospatial analysis can be used for big data analysis for recording the weather and climate change.
Land Change	There are several big data resources are available to observe any change in land and that includes remote sensing such as satellites, synthetic aperture radar, geospatial data and use of historical data sets on different types of forecasting such as land and crop, rainfall, temperature and others.	Use of scalable vector machines as a big part of machine learning systems can be effectively used [14]. Moreover, use of K means clustering, Wavelet based filtering, image process, statistical analysis and many other big data analyses can be done.
Fertilization and organic matter management	Different type of resources can obtain in this specific field such as Pesticides use optimization, firm equipment management, yield prediction, data of food safety growth records, measurement of the raw residual of crops, legume rotation can be used as big data resources.	Different systems of crop cultivation that further uses biological methods for fertilization and pest control and use of Prescient Ag Method can be also used.

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Selection of Plan type and Diversity	Information and data reports including museums, herbariums and natural resource management agencies.	Various forms of analysis such as association rule learning, classification tree analysis, use of genetic algorithms, regression analysis and sentiment analysis can be used for defining suitable different types of plans based on temperature or climate diversity.

Table 1: Techniques for Big-Data Analysis based on Agricultural Area
(Source: Self-Developed)

Here, table 1 has aimed to define the major areas of the agricultural industry that can effectively use vast and various types of big data analysis for retaining better results and improvements [15]. The major four areas that can be used in big data analysis includes weather and climate change, selection of plan type and diversity, land change and fertilization and organic matter management. Whereas, the major type of big data analytic techniques can be used in this field such as callable vector machines, statistical analysis, modelling, cloud platforms, MapReduce analytics, Wavelet based filtering, image process, genetic algorithms, regression analysis and beyond [16]. Apart from that, over the years several cases have been highlighted based on food-related illness and disease that has affected millions of people. Thereby, most of the researchers have found that due to lack of detection of microbes and signs of contamination has been the major reason. In such instances, it has been proposed that use of big data analytics can be helpful for providing food safety using different techniques such as field monitoring, field zoning, using remote scouting management and others [17].

In addition to this, it has been also proposed that use of big data analytics can be also useful to find the key issues within a specific agricultural industry that has been formed into a table below,

Level of Data Chain	**State of Different Data**	**Key findings**
Data Collection	Sensor, open data, data captured through UAV's Biometric Sensing, Genotype information reciprocal data	Obtaining availability and quality formats.
Data Resource and Gather	Cloud-based platforms, Hadoop Distributed File System, hybrid-storage system and cloud-based data warehouse	Quick and safe access to data
Data Transfer	Wireless, cloud-based platforms, linked open data machine learning algorithms	Safety agreements on the responsibilities and liabilities
Data Transformation	Normalization, Visualization and Atomization	Heterogeneity of data sources, automation on data preparing and data cleansing
Data Analytics	Use of yield models, planting instruction, benchmarking, decision ontologies, cognitive computing	Implementation of semantic heterogeneity of data sources, automation on data cleansing preparation
Data Marketing	Data visualization	Real time scalability and analytics scalability

Table 2: Data Levels and State of Different Big Data Systems
(Source: Self-Developed)

In this research, table 2, it has aimed to define all the levels of big data analytics that are required in the field of agriculture, as well as the different state of data and key findings. From the above-mentioned table, the required level or steps that have been identified are data collection, data resource, data transfer, data transformation, data analytics and data marketing [18]. Covertly the major type of big data analysis models or systems can be used to provide smart and sustainable solution to today's agriculture industry are such as UAV's Biometric Sensing, Hadoop Distributed File System, use of cloud-based platforms, yield models, decision ontologies and others. It is observed that use of these smart models can help to provide quality formats, quick and safe access to data, heterogeneity of data sources and

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real-time scalability [19].

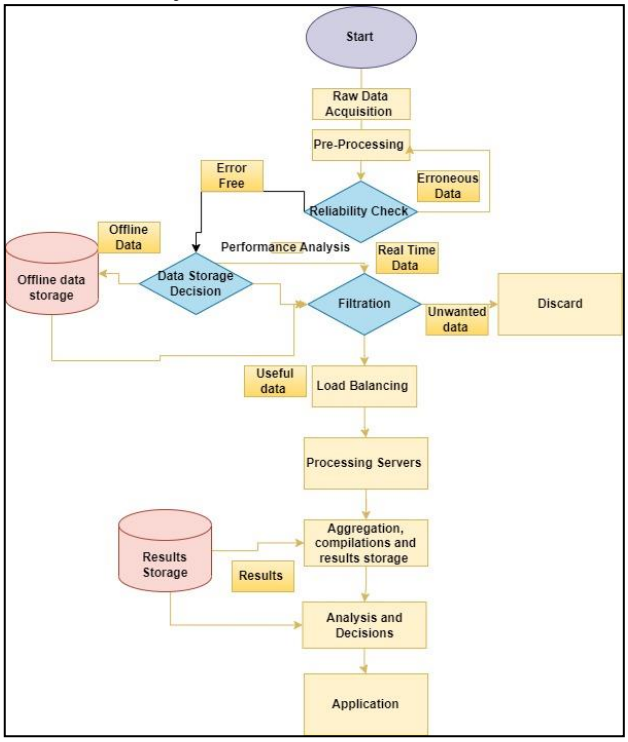

Figure 4: Flowchart with Algorithm
(Source: Self-Developed)

Here, the above attached flowchart with algorithms has shown different processes and steps of implication of big data analysis in the field of agricultural industry. It can be seen that this particular flow chart has been included with multiple processes and algorithms that shows the first step of starting to apply a big data analysis system . As well as the flow chart have also shown methods of results storage, offline data storage and also discard of unwanted or unrequired data. The main purpose of showing a flow chart is to highlight the steps and the overall procedure that are needed to be done for acquiring a certain goal [20]. Hence, the main aim of this particular flow chart is to show the effective steps that are required to be implement or followed for introducing big data analytics in the agricultural industry

CONCLUSION

Throughout the overall research, it has been concluded that use of big data analytics and migrating it systematic process into current agricultural industry can re-formed this industry into a smart agricultural industry. In addition to this it has been also acknowledged that use of big data analytics can also resulted non-beneficial such as unable to provide accurate data analytics, use of complicated data analytics, long system response time and many others. Although, with the right assertive use of big data analytics, will enable farmers and other associated members of the agriculture industry to make smart decisions to improve farm yields and earn better profitable margins.

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