

# A Review on the Impact of Climate Change on Agriculture in India using Big Data Analytics

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**Abstract**— The analysis of Agriculture data would be good support for making effective decisions to improve the future food security concern. Nowadays the adaptation of big data analytics in various fields are very effective to predict the future value and estimate them with high accuracy. Agriculture is also one of the area where the massive amount of data generated with huge volume, high dimensional space, and different variety of crops. To adopt the real-time analysis and get perfect essential results in this type of data sources big data analytic is one of the key platforms. This paper mainly focused on reviewing various analysis done in agriculture in India to develop a Big Data predictive model to find various useful information to enhance the sustainability of fulfillment in food security. This analysis will give the detailed impact of development in various levels of agriculture in different period with supported climatic changes. Results discussed in variety of situations can be matched with the analysis of climate changes in various locations is the key problem to solve it in future. This paper highlighted the foundation for analyzing impact of climate change and making the predictive model to support the formers as a decision-making support system to adopt smart climate agriculture in India.

**Keywords:** Food Security, Big Data Analytics, Decision-Making, Smart Climate Agriculture.

## I. INTRODUCTION

Asia is the most populous continent on earth accounting for 63% of the global population. The contribution of Asian formers in overall global agriculture production is about 67%. It is more likely big account in green revolution. The population of India approaching towards 1.5 billion (2017). Nowadays growth of crop production is not enough to give food for all citizens of India. Climate change is one of the key problems for not getting the enough sustainable food. Agriculture depends on the factors of rainfall, climate, cultivation, soil type, fertilizers used, humidity, period of harvesting, and others [7]. Development in Agriculture domain will generate enormous data with high velocity in nature with different variety. It is very tough to handle that huge sized data in nature. Normally the use of traditional infrastructure and computing resources will not able to handle the growth in amount of data in agriculture. The properties of data must be handled properly to get good results. Big Data term is used very commonly nowadays to refer the way to handle the data from different sources. To provide very efficient and scalable support in agriculture domain we have to face the challenge of handling huge data. The traditional way of approaching this data will not be more useful and it will suffer because of inefficient in

analyzing such large and variety of knowledge. The process of gathering and analyzing data that is generated from different sources will be approached in multi-dimensional way is used to predict and summarize the future information is called as data analytic process.

Data processing and analytic software is contributing to evaluate the power of data. The use of those tools will able to provide different perspective and summarization of different relationship exists in that data. Identifying the patterns or correlation among huge number of fields in big relational databases is technically mentioned as data analytic. Extraction of useful insights from the large volumes of data is the very essential process in Big data analytics. It consists various data analysis methods which can be applied traditional way. Incorporating different efficient algorithms will gives more accurate and valuable information. To help farmers by providing well defined forecasting information about the crop yield based on the past records can be achieved by coupling Big data analytics with agriculture area. This will provide better risk management and support government in making insurance policies for supply chain operations.

## II. RELATED WORKS

Big data analytics process is an exploratory analysis of information and identifying patterns from large volume of data. This process needs very new innovative approached architecture for collecting data, storing data, processing and analyzing the data. More creative visualization methods have to be used to project those results. This data investigation technologies are playing an vital, mutual role in this development: machines can be equipped with different kind of input devices that quantity data to gather required information with clean and approachable format. Agriculture will be a noticeable field for big data. Discovery of finetuned parameters to take full advantage of the crop yield production using data mining techniques is proposed in [7]. [10] reviewed the applications of Big Data in smart farming and its influences in entire food supply chain. Further the author gives the research significance to organizational issues regarding governance issues and appropriate business models for data distribution in different supply chain circumstances.

India is predicted to be especially vulnerable because of increase in global temperature level. India is the 7<sup>th</sup> largest agricultural exporter worldwide and the 6<sup>th</sup> largest net

exporter [3]. From the perspective of global level, the climate changes play vital role and its impacts are more on the developing countries. Developing countries having huge population and lesser ability to predict the effects of climatic changes. Economics of developing countries including India are agriculture based. Those nations are directly exposed to their agriculture fields, it will impact them very badly. Climate change impact on agriculture development and production will occur mainly because of natural disasters, unable to predict rainfall pattern, improper water and land management systems and increase in temperature [1]. In [8] they mentioned that fresh water resources exhausted and growth of world population will create greater demand in food production in future.

Overall country level analyzing of climate is most important for the solution of agriculture demanding problems due to climate change [2]. From the perspective of above review makes our attention to focus on developing predictive model that support decision making on the changes in climate that affects the agriculture production rate. In [6] proposed a common statistical model approach is used to estimate and evaluate the yield responses to changes in climate and precipitation. Also, they simulated process-based crop model. Finally concluded that application of statistical approaches is prospective to continue to play vital role in anticipating future impacts of climate change. [4] Explains the smallholder farmers managing climate risk in India. The results give us various simulation results can produce applied and fruitful adaptations to climate variability is the important in Agriculture. [9] Employed statistical based climate envelope models (CEMs) and boosted regression trees to estimate changes in climate fitness for rainfed farming at a county level and projected the results will help for analyzing the drought-resilient rice varieties.

In food security concern climate-smart agriculture (CAS) is explained in [5]. In that research, they promoted coordinated actions among researchers, farmers, private sector, policy makers toward climate-resilient approaches in agriculture. They focused on four main areas to develop the effective CAS. It is highlighting the capacity to develop leveraging, domain-based solutions, reinforced by state-of-the-art policy and funding actions. That research work concluded like if the investments across public, private and civil society sectors targeted to develop the CAS with right pathway will be better choice to reduce poverty in developing countries. The main advantage of that work is given an architecture for developing agriculture modeling based on the climate changes around the globe. In point of giving data level representation not identified the suitable evidence to proof how climate changes impact with agriculture society.

### III. GENERAL CHALLENGES IN AGRICULTURE

The main challenges generally present in agriculture highlighted by Big Data Europe is Mechanisms for Strategic Agenda Setting on data Driven Agriculture and Nutrition. Impact of interoperability, big data analytics for beneficiaries in agri & nutrition. Coherent evolutionary

development of standards-as-a-service. Big data technologies and machine learning with open data in agriculture & nutrition. FAIR Data ecosystem to support open science in Food 2030. Farmer participation in data value chain. (Nidhi Dwivedy, et. al, 2011) Pointed that investment is very low for developing infrastructure and services in India. Maintaining and owning big sized farms has been held by single family mostly, this will not give large scale development to take advantages of growth in economics of cost per unit production. It also impacts indirectly the owners will not care mostly the development of productivity of farmers in progressive manner. They also will not look forward to develop crop yields in lands the laziness in investment and carelessness in growth of farmers wealth. The amount of spending time and money will be very less. Crop yields will be affected because they not ready to invest more in their lands.

### IV. CLIMATE CHANGES IN INDIA

According to the Trends in Global CO<sub>2</sub> Emissions 2015 Report. (PBL Netherlands Environmental Assessment Agency) India is emitting 2.34 billion tons of CO<sub>2</sub> per year and Emission of CO<sub>2</sub> per Capita is 1.8 tons person in a year. This will give the alert to the ecological systems to maintain the level of green house gas emission under control. Based on these activities the following are the projected impacts in India. Increase in extreme rainfall events, mean and extreme precipitation during monsoon. Changes in more than 1/3rd of forest area by 2100, mostly from one forest type to another. Reduction in monsoon sorghum yield by 2 to 14% by 2020, with worsening yields by 2050 and 2080. Reduction in wheat yields in Indo-Gangetic Plains. Estimated countrywide agricultural loss (more than US\$7 billion) in 2030; severely affect income of 10% population. Extreme events are expected to be more catastrophic for east coast. The Fig. 1 depicts the impact of Climate change and agriculture [13]. It shows that Agriculture pays to climate change by greenhouse gas emission and by the influence of non-agriculture lands into agriculture development areas. Global annual emission in 2010 is around 20 to 25% covered by forestry and agriculture land usage. In Figure 2 agriculture sector emission of GHGs is 24% on the whole emission rate. The climatic change could disturb agriculture through uncommon irrigation practices and agricultural inputs. In 2013 the world bank news [12] says that climate change impacts in India is predicted that uncommon and unique spells of high temperature climate condition changes are expected to arise in most of the areas in India. It may happen frequently and also covers larger areas. It shows that rapid changes in monsoon will come as big challenge, it also creates a way to accelerate the occurrence of droughts various parts of India. Droughts are likely to come more often in maximum areas in north side of India. It is predicted that extreme will create a great impact in crop yields. The emerging demand and development of industry sectors will create considerable changes in water tables.

Estimation of ground water level will further decrease because of the life style of humans are changing day by day. Scarcity of water can come in seasonal manner, increase in heat, and increase in sea water level will be a great impact

of reduction in crop yields. Indirectly these things will challenge the food security in India. If the existing situation continues we can expect measurable reduction in production of wheat and rice very near future. It gives a warning to the country that in 2050s the temperature will increase up to 2°C. This signs that food grain import will be twice the amount. Climate change impacts on agronomy and livelihoods will increase the number of climate migrants.

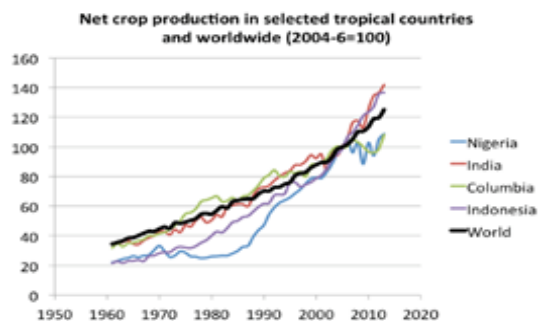


Fig. 1. Graph of net crop production

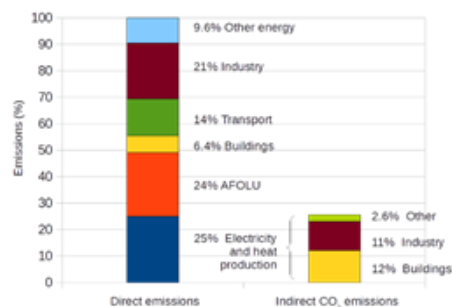


Fig. 2. Human greenhouse gas emissions by sector, in the year 2010

## V. BIG DATA ANALYTIC IN AGRICULTURE

Big Data analytics is an influential, indication – based technology for long term justifiable development by civilizing financial opportunities for farmers by analyzing various factors that comes in crop production activities and suggesting the appropriate recommendation to improve the yield of crop in each sector. Data analytics is well suited to the agriculture field to analyze the climate changes and various dimensions of data that impacts to create some smart agriculture applications. Various models have been developed and adopted but the big data analytics supports by handling the data in huge amount with less effort to store and process on the go. The variety of data is also playing vital role when developing a model for agriculture recommendations. Changes in climate happens every time in different so the speed of data arrival also very difficult to handle in normal models deployed in agriculture. From the perspective of above points novel system implementation using the big data analytics method can help the agriculture

sectors in India to improve the protectivity and ensure the food security in future.

## VI. CONCLUSION

Big Data analytic is the current trending technology that is adopted in various fields of industry development. Data analytic process is much needed for the development of agriculture sector in growing countries like India. In this paper we have reviewed the different perspective of climate changes in India that affects the agriculture sector. And, we pointed the generalized the challenges present in agriculture that can be addressed in future works. Finally, we presented the importance and modelling of Big data analytics in agriculture field. In future we can develop a recommender system based on the data analytics from the climate changes variables and impart the insights from the analysis that supports formers to get the better yield in their lands and ensure the food security in India.

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