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Impact of Climate Change in Agriculture with Data Mining Concepts

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Abstract - *Crop management of certain agriculture region is depends on the climatic conditions of that region because climate can make huge impact on crop productivity. Real time weather data can helps to attain the good crop management. This work surveys about the impact of climatic disasters in agriculture, agriculture vulnerability to climate and climate change vulnerability and so on. Also identified that how the data mining helps to analyze and predict the useful pattern from huge and dynamically changed climatic data.*

Key Words: *Efficient crop management, Weather data, Agriculture vulnerability, Climate change vulnerability and Data mining*

1. INTRODUCTION

Data mining is a useful technique to find the useful pattern from the huge dataset. So it secured an important place in agriculture because the field agriculture contains the many data such as soil data, crop data, and weather data so on. Real time weather data is difficult to analyze and manage so various algorithms in data mining like K-Means clustering, Apriori algorithms and other statistical methods are used to analyze the agriculture data and provide the useful pattern. The climate create the great impact on the agriculture so the crop growth and crop yield level are depends on the climate. Real time weather data can helps to the farmers for planting a particular variety of crop because it gives high yield and also this real time data helps to alert the farmers for protecting their agriculture field from the climatic disasters. Agro climatic research centers and meteorological departments provide real time data to the farmers.

If the particular crop has planting on suitable climate it will provide the good yield so the economic level of our country can improve. So we need to predict the suitable climate for planting a crop because the climatic vulnerability and agriculture vulnerability to climate can affect the yield level. Elicitation and analysis of historical weather data and crop yield level of the particular region can helps to predict the future climatic condition of that particular region. Analysis is required for finding the future climatic conditions of particular region where the data mining plays an important role for analyzing historical weather data and find the required solution.

2. LITERATURE REVIEW

The following authors has analyzed about the geographic and climatic data and their impact on crop growth by using data mining techniques.

Swati Hira et al (2015) suggested that generally the agriculture data is Spatio-Temporal data. These data has includes agriculture parameter, environmental attributes and geographic attributes. These data has to be analyzed by Multidimensional analysis, Statistical analysis and Data Mining Techniques (Association Rule Mining) for obtaining a useful pattern which helps to analyze the agriculture productivity. Multidimensional model has been constructed before the performing the multidimensional analysis. IDASM is a tool used to construct multidimensional model and perform the statistical and data mining techniques, which provide the correlation among the various agriculture parameters.

M. Das et al (2015) identified the climate zones in a huge region by using Multi Fractal Detrended Cross Correlation Analysis (MF-DXA) based on Spatio-Temporal data of particular place, which can obtained by Multi Fractal Correlation. Climate zone among the large region (Eastern and North region of India) was accurately detected by the K-Mean Clustering. Two climatic attributes such as land surface temperature and precipitation rate were taken into account.

A. Holz Kamper et al (2011) suggested that spatial and temporal variability in climate is one of the major events in agriculture productivity. This research examines the suitable climate for various crops based on Spatio-Temporal evaluation and climate analysis. Grain maize crop in the Switzerland was taken into account for investigating the climate suitability with respect to time and space. Very basic factors such as, Average solar radiation, Average minimum temperature, Average maximum temperature, Water deficit

and Phase length were used to find the maize growth and yield. Non-linear Least Square Regression was applied on the above mentioned climatic factors. These factors were observed on the different phases of maize growth. Based on this observation maize suitability was predicted. This approach can also used to analyze the crop growth limitations of specific crop in the particular region.

Harln D. Shannon (2015) Inspected that the various weather and climate related natural disasters in the agricultural lands of North America, Central America and Caribbean. Recent history of climate and weather data helps to the formers for managing the agriculture risk. Climatic risks in agriculture such as droughts, flood, hurricanes, extreme heat and freezes were discussed in this research. So the Decision Support System was used to the farmers for preparing the risk management event before the occurrence of disaster. Agro climate and agro meteorological department plays a major role in the agricultural based risk management activities.

H.Kremer et al identified that climate change variability over the time period is known as multivariate time series data. Novel Clustering and tracing methods are used for analyzing the multivariate time series data. Clustering was used to group the similar objects and tracing. Periodically trace the cluster and it to be analyzed, which used to map the similar clusters with respect to time for detecting the climate change over the time period.

Mallari et al (2016) predicted that vulnerability assessment is a helpful method for increasing an agriculture sector adaption to climate change. Method can improve the decision making process of farmers, which may increase the resilience of agriculture systems during the hazard events. The Mabalact city was considered for this research for evaluating vulnerability by using following methods: 1.Index method and 2.Geographic Information Systems (GIS). In Index method three types of vulnerability indicators were chosen such as Sensitivity indicators, Exposure indicators and Adaptive capacity indicators. GIS helps to predict the location with high vulnerability to climate change. Finally the index map was generated, which helps to the farmers to access the efficient cropping pattern.

Shengcai Tao et al (2011) predicted that climate change vulnerability is one of the huge phenomenon's which create great impact on the agricultural management system. Climate changes also produce the agriculture vulnerability. Problems in evaluation of agriculture vulnerability were encountered. Capacity of adaption, analysis and evaluation are the problems in the climate change vulnerability assessment. An Indicator System is a method used for evaluation of agriculture vulnerability. Learning about climate context can helps to assess the future agriculture vulnerability to climate change.

Pedro Valverde et al (2015) suggested that soil water balance model framework was used to quantify the crop yield. Particularly the herbaceous crop yield was examined by the ISAREG model. Water balance approach and spread shed based model used to estimate the yield level of rain fed woody crops which derived for the future (2011-2040) and (2041-2070) by using Climate Change Scenario (CSS). The crops in the Guadiana river basin was considered for evaluate the climate change and the yield level. Winter wheat, Sunflower, Grain legumes, Pastures, Olive, Grapevine and almond are the crops used in this research. This research has been concluded as Herbaceous crops provide good yield level under rain fed condition and the future crops yield level may depends on the crop specific management.

V. Vagh (2012) constructed a visual data mining framework for analysis agriculture based geographic data (Soil and climatic data of Australia) which was made by Digital Elevation Model (DEM). Soil variability of the selected area was identified by the monthly rainfall. Finally this system used to analyze the soil and rainfall of the agriculture lands in Western Australia.

Table-1: Software and Techniques used for constructing visual data mining framework

Software and Techniques used	Purpose
ArcGis, Quantum GIS and Microsoft access database	For data preprocessing
GRASS software package	For generating the map
Viasual data mining	For predicting the pattern of agricultural land soil type
WEKA of Microsoft Excel	For used to analyze the data.

Alvaro Calzadilla et al (2014) assessed that impact of climate change in agriculture in South Africa by using CSIRO (Common Wealth Scientific and industrial research organization) and MIROC (Medium resolution General

Circulation Model). GTAP-W model was used for the data analysis which shows the difference between the rain fed and irrigated agriculture. Two main factors such as climate change and the yield change were identified by using CSIRO and MIROC model.

Table-2: Summary of the Analysis

Researchers	Particulars		
	Methods and software used	Crop taken for experiment	Considered regions
Swati Hira et al	Multidimensional analysis, Statistical analysis and Data Mining Techniques (Association Rule Mining)	-	Eastern and North region of India
M. Das et al	Multi Fractal Detrended Cross Correlation Analysis (MF-DXA), K-Mean clustering	-	-
A. Holz Kamper et al	Non-linear Least Square Regression	-	-
Harln D et al	Decision Support System	-	North America, Central America and Caribbean
H.Kremer et a	Novel Clustering	-	-
Mallari et al	Index method and Geographic Information Systems (GIS)	-	Mabalact city
Shengcai Tao et al	Indicator System	-	-
Pedro Valverde et al	ISAREG model. Water balance approach, spread shed based model	Winter wheat, Sunflower, Grain legumes, Pastures, Olive, Grapevine and almond and herbaceous crop	Guadiana river
V. Vagh et al	DEM, ArcGis, Quantum GIS, Microsoft access database, GRASS software package, Viasual data mining, WEKA of Microsoft Excel		Western Australia
Alvaro Calzadilla et al	CSIRO, MIROC, GTAP-W model	-	South Africa

3. CONCLUSIONS

This analysis provides the good decision support to the farmers for planting the crop and also helps to alerts the farmers for protecting their field from disaster. The various clustering algorithms such as Multidimensional analysis, Statistical analysis, Association rule mining, Novel Clustering, Multi Fractal Detrended Cross Correlation Analysis (MF-DXA), K-Mean clustering and Non-linear Least Square Regression were identified. Climatic parameters such as Average solar radiation, Average minimum temperature, Average maximum temperature, Water deficit and Phase length were encountered in this survey.

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