Intelligent System For Predicting Agricultural Drought For Maize Crop

Solomon Mwanjele Mwagha, Peter W. Waiganjo, Christopher A. Moturi, E. Muthoni Masinde

Taita Taveta University Colege, Department of Mathematics and Informatics, Voi, Kenya; University of Nairobi, School of computing and Informatics, Nairobi, Kenya.
Email: soproltd@gmail.com

ABSTRACT: There has been little information in regard to agricultural drought prediction. This paper aimed at coming up with an efficient and intelligent agricultural drought prediction system. By using a case study approach and knowledge discovery data mining process this study was preceded by drought literature review, followed by analysis of daily 1978-2008 meteorological and annual 1976-2006 maize produce data both from Voi Taita-Taveta (Coast Province in Kenya). The design and implementation of an agricultural drought prediction system, was made possible by computer science programming for meteorological data preprocessing, classification algorithms for training and testing as well as prediction and post processing of predictions to various agricultural drought aspects. The study was evaluated by comparison of predicted with actual 2009 data as well as the Kenya Meteorological Department (KMD) 2009 records. The evaluation of this study results indicated consistency with the KMD 2009 outlook. The results showed that the application of classification algorithms on past meteorological data can lead to accurate predictions of future agricultural drought. The recommendation is that future work can be based on designing a solution for multiple regions with multiple crops.

Keywords : Agricultural drought, intelligent system, Knowledge discovery, nearest neighbor classification, Drought prediction

INTRODUCTION

Report by Apollo (2002) stated that agriculture is very important in Kenya as 75% of the country's population is dependent on agriculture for food and income; however, only about one third of the total land area of Kenya is agriculturally productive. Two thirds of the Kenya land is semi-arid to arid, and characterized by low, unreliable and poorly distributed rainfall. Report by Patrick, O. & Rosemary A. (2006) indicated that over 80% of the Kenyan population live in the rural areas and derive their livelihoods, directly or indirectly from agriculture. The development of agriculture is important for poverty reduction since most of the vulnerable groups like pastoralists, the landless, and subsistence farmers, also depend on agriculture as their main source of livelihoods. Report by Southtravels (2010) shows Kenya has climatic and ecological extremes with altitude varying from sea level to over 5000 meters in the highlands. Rainfall occurs seasonally throughout most parts of Kenya. Most parts of Kenya are subject to periodic droughts or delays in the start of the rainy seasons. Rainfall ranges from mean annual of less than 250 mm in arid and semi-arid lands to mean annual of greater than 2000 mm in high potential areas. Catholic Relief Services (2011) reported that failure of seasonal rains in Kenya is coupled with increased food prices leading to emergency food assistance from United Nations and Government of Kenya. Recurring agricultural drought leaves millions with little or nothing to eat. Agricultural drought is the major constraint of Kenyan agriculture sector severely affecting seasonal crops. As Kenya relies heavily on rain-fed agriculture, agricultural drought prediction can play a vital role, as it can provide necessary parameters to use in planning for agricultural drought mitigation measures. There is lack of regular information, education and social mobilization in strategic sectors to mitigate the agricultural drought related shocks. ICT tools continue to produce significant transformations in several sectors of the economy including agriculture. This research purpose was to take these transformations a notch higher; by developing an intelligent agricultural drought prediction system that integrates historical knowledge on droughts, maize production and climate data. The first step towards this research was based on investigations to ensure that there are relevant truths regarding rainfall patterns and agricultural droughts prospects. The design was preceded by the analysis of two sets of historical data; 1) maize production and 2) weather data. The aim was to identify agricultural drought patterns on historical data and use the results for the prediction of future agricultural droughts. The prediction was to provide information on agricultural drought occurrences onset/offset, intensity magnitude and the impact on crop.

Literature Review

Report by Apollo, B. (2002) indicated that two thirds of the Kenya land area is arid and semi arid (ASALs), and characterized by low, unreliable and poorly distributed rainfall. Patrick, O. and Rosemary, A. (2006) acknowledged that the development of agriculture is also important for poverty reduction since most of the vulnerable groups like pastoralists, the landless, and subsistence farmers, also depend on agriculture as their main source of livelihoods. Drought is a serious problems that significantly affect millions of people in the ASALs and it occurs when the rainfall and soil moisture are inadequate to meet the water requirements of crops. In a study by London school of hygiene & tropical medicine, (1986) on predicting famine researchers observed rain and crop data as well as human behavioral patterns with regard to famine. The researchers regarded human responses to drought such as migration, livestock sales, loans, and increase in grain prices as useful famine indicators. In Tanzania Ladislaus B. et al (2010), studied rainfall prediction using environmental indicators through appraisals, interviews, focus groups used to collect data while SPSS was used for analysis. Their study reported that local environmental indicators and astronomical factors pathology are widely used in the region to forecast rainfall. In China Gong Z, (2010), studied agricultural drought prediction. By analyzing the occurrence trend of agricultural drought by using grey catastrophic forecast models the study reported that serious drought can occur in 2012. The study offered decision basis for disaster prevention and risk reduction. Staff of Cook island department of Water Works, (2003) study aimed at monitoring of evolving drought conditions. By using 70 years daily rain data they developed a drought index that compared current condition and previous drought. The study allowed monitory of evolving drought condition as well as de-