A Survey on Wetland, Land Degradation, Agriculture and Data Mining Techniques

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ABSTRACT:
Data related to wetland, soil degradation and agriculture is now becoming essential research in field of data mining. Wetlands perform the ecological function of nutrient cycling, carbon storage, flood reduction and provisioning of habitat for wildlife. Wetlands make 6% of the world's total land surface, but it contributes nearly 40% of the yearly global ecosystem services. Now-a-days wetlands are under high pressure because of the land is altered and used for different purposes, while it is essential for achieving food security and rural livelihoods. It is found from the recent study that more than 50% of the world's wetlands have disappeared due to agriculture and urbanization. This survey aims to suggest how the agricultural sector can be enhanced in Ethiopia by using data mining techniques in assuring food security, economical growth of the smallholder farmers and the country. The study also aims to analyze about the possibility of expanding the agriculture, to meet the future demand of the country's fast growing population without disturbing the environmental ecosystem. The data processing techniques in agriculture require evaluating, storing, monitoring and retrieving of the resources used. The data mining techniques used for this survey include K-means, Support Vector Machines (SVM).

Keywords: Ethiopia, Agriculture, Data Mining, K-means, Support Vector Machines (SVM), Wetland, Land degradation, smallholder farmers.

I. INTRODUCTION
Data Mining
Data mining is the method of extracting useful information from large amounts of data [1]. It is the process of analyzing data from different perspectives and organizing it for easy human understanding.

Any type of data can be analyzed by using the data mining techniques. It can be data contained in a database, relational database, a data warehouse, a web server log or a simple text file, image file. It is essential to understand about the appropriate techniques of data mining for analyzing our data set. The below chart shows different data mining techniques related to four major subdivisions.

![Data Mining Techniques](image)

**Figure 1.1: Different data mining techniques.**

Methods
**Classification:** Data analysis is of two types: 1. Classification and 2. Prediction. They are used to predict future data trends and extract models describing about different and important data classes. Three different learning approaches are followed in data mining classification namely supervised,
unsupervised and semi-supervised learning. The classification techniques used for extracting the useful information from the given data sets are Support Vector Machine (SVM), Decision Tree (DT), Nearest Neighbour (NN), Bayesian Networks (BN), Artificial Neural Network (ANN), Fuzzy Logic etc., [26].

**Clustering:** This is the process of forming the data records into clusters so that the points inside each cluster are close to one another. Then similar data instances are grouped together. Hierarchical, Partitioning, Density-based, Model-based, Grid-based and Soft-computing [fuzzy, neural network based], Squared Error—Based Clustering (Vector Quantization), Clustering graph and network data are some of the clustering methods. [27][28][29].

**Association Rule Mining:** It is the efficient technique of data mining to search for the desired pattern. The different algorithms include Apriori Algorithm (AA), Partition, Dynamic Hashing and Pruning (DHP), Dynamic Itemset Counting (DIC), FP Growth (FPG) [30].

**Regression:** It is learning a function that maps a data item to a real-valued prediction variable. The methods for prediction are Linear Regression (LR) and Nonlinear Regression (NLR).

<table>
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<tr>
<th>Methodology</th>
<th>Applications</th>
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<tr>
<td>Support Vector Machine</td>
<td>Analysis in the changes of the weather scenario</td>
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<td>K-means</td>
<td>Pollution forecasts, Classifying soil by means of GPS</td>
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<tr>
<td>Unsupervised Clustering</td>
<td>Generate cluster and determine any existence of pattern</td>
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Table: 1.1 Data mining methodologies and its use in Agriculture domain

**II. RELATED WORK**

Ethiopia is an African country where agriculture forms about 50% of country’s GDP. The total foreign exchange earnings (about 90% of the exports) go to agricultural sector; 70% of raw materials are supplied to agro-industries. It also employs 85% of the labor force. 80% of the Ethiopian people live in rural areas. Therefore agriculture has to be properly carried out as it helps for food security, economic growth and the livelihood of mankind. Since agriculture is having its importance in Ethiopia, this study tries to give solutions for the challenges faced by agriculture sectors and the farmers. The Data Mining technique can be implemented giving useful information to the farmers, and the government.

**Challenges Related to Agriculture in Ethiopia**

Smallholder farming is the livelihood activity for the majority of Ethiopians living in rural areas. Poverty, food insecurity and their consequences leads to famines, malnutrition, and premature mortality. The backbone for the country’s economy is agriculture. This means that the land is the ultimate ‘safety net’ for the rural farmers and the people. Therefore they are to be protected from losing their land – by preventing them from selling it [3].

**Loss of Wetlands**

Wetlands are the main cause to perform the ecological functions like nutrient cycling, carbon storage, flood reduction and habitat for wildlife. In the world wetlands occupy only 6% but it contribute up to 40% of the annual globe's ecosystem services. The Wetlands in Ethiopia are used for making cultivation, food production, collection of drinking water, cutting down trees for construction, cooking, furniture and extraction of clay for pottery and brick making [4][5][6]. Wetlands are under high threat due to change in the land use, while it is essential for food security and rural livelihoods [7][8]. The main threats for the human community are Climate change and global population which is expected to reach nine billion by 2050, so water resources have to be increased [9]. The main reasons for wetland loss and land degradation are because of sewage influx and waste dumping, grazing, urbanization, overharvesting, drainage for agriculture and climate change [7]. It is disturbing the aquatic ecosystem which is a rare resource [10]. Agriculture is the identified primary cause for global wetland loss [11].

In Ethiopia, fast growing population rate creates a need to expand agricultural lands, misuse of wetland areas [12]. So, studies on wetland hydrology [6][13] and socio-economic aspects [14] have been
initiated. The diversity and abundance of macro invertebrates provide information on ecosystem impairment [15][16] and also it makes important role in the overall functioning of wetland ecosystems [17].

Land Degradation
Land degradation is the next severe problem in the Ethiopian highlands. Soil erosion is approximately 42 tons/hectare on vegetation land [18] and Ethiopia has one of the highest rates of soil nutrient depletion in sub-Saharan Africa. It results in low agricultural productivity. This low productivity affects the smallholder farmers. The factors for land degradation are low rainfall, uncertain climatic conditions in the highlands, less marketing scope, farmers credit constraints, land tenure insecurity, lack of technology usage [19][20]. The soil degradation in Ethiopia explains how the natural and man-made restitution done in soil formation conservation. This is done on data collected in Soil Conservation Research Project (SCRP) of the Ethiopian Ministry of Agriculture in co-operation with Berne University, Switzerland [21]. Highlands of Ethiopia produces five major cereals—teff (Eragrostis tef), wheat, maize, sorghum and barley—and enset (Ensete ventricosum) the cropping systems relying on elevation, rainfall, and market access [22]. (International Food Policy Research Institute (IFPRI), 2013).

Market policy change and infrastructure development is necessary to reduce food transaction costs and to improve production [23]. The studies show that Ethiopia face many new challenges unlike those faced by Asian countries, it cannot bypass a broad-based agricultural revolution to successfully launch their economic transformations [24].

Ethiopia need five essential characteristics for success- namely 1. Reduction in people engaged in agriculture 2. Increase in urban and rural population 3. Population reduction living far from coastal and urban areas 4. increase in the labor productivity in agriculture and 5. A considerable increase in overall agricultural production, especially in those countries and areas relatively inaccessible from coastal areas [25].

III. DISCUSSIONS AND SUGGESTIONS
Applying k-means algorithm in the field of agriculture:
The k-means algorithm is used for soil classifications using GPS-based technologies. The classification of plant, soil, and residue regions of interest are displayed by color images, monitoring water quality changes, Detecting weeds in precision agriculture.

Applying SVMs in the field of agriculture:
The application of support vector machine is the used in the crop Classification, analysis of the climate change scenarios.

To the Farmers
Produce different varieties of crop, vegetables, fruits based on the soil, yield, and weather conditions (Identifying the crop by using data mining techniques)
2. Avoid Tea, coffee plantations as it causes deforestation and reduces the rainfall

To the Government
1. Smallholder farmers has to be supported by making changes in the land policy
2. Avoiding urbanization rather than develop infrastructure in the rural areas especially related to transportation of agricultural products
3. Changes in the market functioning to support rural people’s livelihood
4. Protecting wetlands, avoiding soil erosion and Land degradation

Agriculture is the most important application area particularly in the under developed countries like Ethiopia. Use of data mining techniques in agriculture can help farmers, government, private organizations in forecasting the expected problems in the near future, and can make proper decision. This is also helpful to increase the yield of different crops.
IV. CONCLUSION
In this study it is discussed about the role of data mining in expanding agriculture without disturbing the ecosystem. This survey also highlighted several data mining techniques and their related work in context to agriculture domain.

V. REFERENCES


