Data Mining through Modelling in Irrigation Commands

Pradeep Kumar Majumdar
Adama Science and Technology University, Ethiopia

INTRODUCTION

Supplying water naturally or artificially to soil, essentially for the growth of plants of crops is the basic purpose of the activity called "Irrigation". Using nature, it could be carried out through flow irrigation using perennial and/or flood irrigation system. Uncertain potentiality of the erratic natural systems led to the investments in man-made resource mobilisation aimed at food safety. Artificial ways of doing it comprised of construction of storages and canal conveyance systems sometimes including lifting mechanisms. Generations survived with such a use of natural resources like land, water and air, however synthesised as exploitation once production started losing its grip and number of thrust habitants started increasing. To spare more water for drinking, it became necessary to maximise the productivity of the irrigated water through unlimited use of fertilisers and pesticides. Sprinkler irrigation made the major breakthrough due to its consumptive water spreads and almost no draining scope. Canal Systems were converted in to water tight lined conveyance instruments. Possibility of vertical flows now exist only when precipitation exceed the initial soil moisture requirements and has the capacity to infiltrate the soil masses having voids filled with excessive fertilisers and pesticides.

Soil consists of finely divided organic matter and minerals formed by disintegration of rocks as well as soil colloids and soil solutions. Sandy soil is known as light soil, loam as medium or normal soil and clay as heavy soil. Different types of soils are good for different crops. Crops requiring more water are nicely grown in heavy soils like clay. Light soils containing sand through which water quickly passes down can grow crops with lesser water requirements. Normal soils are well drained and ventilated, ideal for crops with average water requirements. The salts commonly met with in the soil crust are the sulphates, chlorides, carbonates and nitrates of sodium, potassium and magnesium and also chlorides and nitrates of calcium. If the percentage of the total harmful salts does not exceed 0.18%, the yield from the soil is not generally affected. But if it exceeds 0.25%, the soil becomes infertile. For normal yield of crop, the PH value of the soil should lie between 6 and 8.5. When it exceeds 11, the soil becomes useless and unable to grow any crop. Interesting to note that the fall out of the irrigation efforts, if in one hand could ensure the food security, on the other hand agricultural commands gradually became infertile in many places visibly diagnosed as water-logging and salinity of soil causing efflorescence. Soil erosion due to floods, rains and winds segregates the chemical fertilisers with top soil, not allowing it to be consumptively used and improve fertility. The United Nations Food and Agriculture Organization (FAO) estimate that 60–80 million hectares are affected to varying degrees by water-logging and salinity (FAO, 1996). It must have been increased many folds since then, despite many research and development plans to mitigate the effects. Dry land salinity is an added complexion of the problem, where water supply has limited role to play. However different estimates have shown that worldwide only 20 to 24% of the irrigated lands suffer infertility due to salinity and water-logging (Khan, Rana, & Hanjra, 2007), also reports magical recovery in the situation in India since 1991.

Irrigation command areas do exhibit such condition invariably and many times nobody knows whom to blame. The process of soil reclamation is costly and difficult in many occasions. Leaching process requires open or covered drains connected to some natural drains or river, tracing of which is a hard job in present groundwater table conditions. Scrapping of the top surface even for a minimum depth of 1 cm to 2 cm would require huge waste lands to dump out the useless soil. Addition of chemicals like gypsum works only in the cases of sodium carbonate etc., otherwise bioremediation is the present day technique, widely used; still not acceptable in general. Mathematical implications of command area problems concentrate more towards the water and salt balances in a domain and less to deal with the flow and transport phenomena. Suggesting artificial recharge or conjunctive use of water resources as a permanent solution many times has aggravated the problem rather than providing rescue. Earlier lack of data used to be in the core of not able to diagnose the problem. Now that enough hydrological data base have been generated and accessible to handsome amount of users, need is to realise where the possible use and threat of data mining occurs and how the same could be delimited to have appropriate use of conceptual modelling in the irrigation command areas.

In this chapter, we aim to look at the prospects of using numerical modelling techniques as a tool for data mining in the area of irrigation management and its decision making. This paper is organized as follows: section 2.0 explains background of data mining, how it works in case of consumer products and marketing, and finally how similar approaches can fail in case of conceptual processes. Section 3.0 deals with main focus of the chapter highlighting the limitations of data mining in irrigation management issues. Main theme of the chapter is discussed in section 4.0, recommending numerical modelling as a solution. Conclusions are narrated in section 5.0 and future course of action is delineated in section 6.0.

BACKGROUND

Data Mining

Generally, data mining is the process of analyzing data from different perspectives and summarizing it into useful information that can be used to increase revenue, marginalize costs, or both. Data mining software is one of the number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases. Although data mining is a relatively new term, the technology is not. Companies have used powerful computers to shift through volumes of supermarket scanner data and analyzed market research reports for years. However, continuous innovations in computer processing power, disk storage, and statistical software are dramatically increasing the accuracy of analysis while driving down the cost.

Different levels of analysis are available:

1. **Artificial Neural Networks:** Non-linear predictive models that learn through training and resemble biological neural networks in structure.
2. **Genetic Algorithms:** Optimization techniques that use process such as genetic combination, mutation, and natural selection in a design based on the concepts of natural evolution.
3. **Decision Trees:** Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID). CART and CHAID are decision tree techniques used for classification of a dataset. They provide a set of rules that you can apply to a new (unclassified) dataset to predict which records will have a

16 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/data-mining-through-modelling-in-irrigation-commands/107266

Related Content

Artificial Bee Colony Algorithm
Ömür Tosun (2014). *Encyclopedia of Business Analytics and Optimization (pp. 179-192).*
www.irma-international.org/chapter/artificial-bee-colony-algorithm/107226

All About Analytics
Hugh J. Watson (2013). *International Journal of Business Intelligence Research (pp. 13-28).*
www.irma-international.org/article/all-analytics/76909

Analysis of Maintenance Operations: A Case Application
Mehmet Savsar (2014). *Encyclopedia of Business Analytics and Optimization (pp. 85-95).*
www.irma-international.org/chapter/analysis-of-maintenance-operations-a-case-application/107217

Organizational Characteristics of Middle Managers' Deterioration as Sources of Organizational Decline
Masaru Karube, Toshihiko Katoand Tsuyoshi Numagami (2012). *Managing Dynamic Technology-Oriented Businesses: High-Tech Organizations and Workplaces (pp. 209-227).*
www.irma-international.org/chapter/organizational-characteristics-middle-managers-deterioration/67437

Artificial Intelligence in FinTech: Understanding Stakeholders Perception on Innovation, Disruption, and Transformation in Finance
Farida S. Rasiwalaand Bindya Kohli (2021). *International Journal of Business Intelligence Research (pp. 48-65).*
www.irma-international.org/article/artificial-intelligence-in-fintech/269446