SOME ASPECTS OF DATA FOR AGRICULTURAL DECISION SYSTEM SUPPORT

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Abstract

The pressure to produce more food has led to the need for accelerate innovation in the agriculture. These innovations are primarily related to the digitization of agriculture and the implementation of precision farming techniques with the help of new technical achievements such as IoT (Internet of Things), AI (Artificial Intelligence), Big Data, Cloud and Decision System Support.

The digitization of agriculture from the point of view of the DSS consists mainly of the acquisition of the data from the sensors through IoT or other applications, their storage in Big Data realized in the Cloud, their processing in the Cloud with the help of AI and the sending to the DSS for final processing and visualization. Decision support systems, data analysis and data mining have become significant tools for precision agriculture to increase production and lower costs.

The absence of legal and regulatory frameworks around the collection, sharing and use of agricultural data contributes to the range of challenges currently being faced by farmers considering adoption of smart farming technologies. Farmers' concerns arise from data licenses, lack of privacy, security, and benefit-sharing.

This article gives a brief overview of the issue of agricultural data and the importance of using DSS for an efficient implementation of precision agriculture.

Key words: DSS, AgriDSS, IoT, precision agriculture, Big Data, Data Management.

INTRODUCTION

The pressure to produce more food, due to population growth at the same time as the decrease in the labor force and its qualification, has led to the need for identification of applicable solutions to improve the sustainability of production processes and accelerate innovation in the agriculture. Sustainable agriculture production and processing systems have become more complex with involvement of biological, chemical, physical processes such as soil, water, climatic scenarios and crop management practices respectively. Agricultural Decision Support System (AgriDSS) offers a framework within which complex systems is more easily understood and helping to draw out additional information and new insights. It is an interactive, computer-based expert system, which helps decision makers to utilize data and models to solve unstructured problems. The applicable use of successful decision support, based on the important parameters in agriculture such as type of soil, seed, irrigation, fertilizers, and climatic data, can assist in the sustainability of agricultural resources.

By integrating and analyzing the captured data, DSS are meant to

become more accurate as well as reliable. Companies from the sector have the ambition to make AgriDSS more ergonomic and user-friendly.

MATERIAL AND METHOD

Farmers can only be able to make optimal decisions if they have correct climate, soil and plant data.

AgroDSS bridges the gap between agricultural systems and decision support methodology. AgriDSS are software-based systems that gather and analyze data from a variety of sources. Their purpose is to smoothen the decision-making process for management, operations, planning, or optimal solution path recommendation. It helps farmers to solve complex issues related to crop production. As tools for diagnosis, risk assessment and reasoning assistance, AgriDSS use agronomic models and calculations based on water, climate, energy and genetic data but they also take into account other factors such as human and economic inputs.

Data is collected nowadays from practically everything and "Big Data" is the latest buzzword, so used because enormous quantities of data are involved.

The agricultural sector is already gathering and making use of big data. Data collection is also increasingly an accepted phenomenon that happens automatically, as more of us embrace automation and 24/7 connectivity. The GPS system, the autopilot, machines and implements are, in fact, recording what they are doing and where at any given time for every square centimeter. The manufacturers are also recognizing the importance of this, and are assisting users to access and analyze this data using cloud environments and online software applications.

Because of pay for wireless communication, for the storage, analysis and processing of data, is increasingly giving rise to resistance from farmers across the world against data collection and processing. There is also the fear that their data will be used against them.

Some tractors and other machines are already constantly connected, and send their data to manufacturers' cloud environments. This can be useful for the purposes of service, preventative maintenance, and track & trace, but, in spite of privacy legislation, questions are being raised as to what is happening to all of that data.

There are a number of AgriDSS systems on the market today. Although the current acceptance of such products among farmers is low, it is expected to change in the future. As world population grows and the availability of arable land diminishes, there is an increasing need to make a smart use of each piece of land.

John Deere Field Connect™ system uses a system of probes and

environmental monitors installed in the field, which are connected to the web and provide data on soil moisture, soil and air temperature, humidity, solar radiation, leaf wetness, rainfall, and wind speed. The data can be seen on a computer or on mobile.

TopCon is a diversified manufacturer of geospatial solutions - both software and hardware - for use across a variety of industries. Their catalogue of agricultural decision support system products includes solutions for preparation and planning, planting and seeding, growing, harvesting, and animal feeding.

Best known for GPS technologies, Trimble has an array of agricultural products, including both field solutions (such as guidance and steering, correction services, flow and application control, yield monitoring, and water management), as well as software's (farm software, crop advisor software, ag retail software, and food processor software), and agronomics services.

SMART! Fertilizer Management is a unique web platform for optimizing and managing fertilizer use in agriculture, enabling farmers to increase crop yields and reduce fertilizer costs, while protecting the environment. The platform enables growers to manage fertilizer utilization for any crop at any stage, under any condition and growing method, taking into account the multiple dynamic factors required for optimizing fertilizer use. Using the right fertilizers and the right amount of fertilizers, on the right timing, will allow better control of the field outcome, and can improve yields significantly. It is difficult as it is for farmers to find a reliable source for unbiased fertilizer recommendations.

PLANET (Planning Land Applications of Nutrients for Efficiency and the environmenT) is a free nutrient management decision support tool for use by farmers and advisers in England/Wales and Scotland for field level nutrient planning and for assessing and demonstrating compliance with the Nitrate Vulnerable Zone (NVZ) rules.

Agricolus DSS is a cloud platform available on web and mobile devices. It provides weather data and very innovative forecast models of the spread of phytopathology's on crops. These data promptly support farmers in fighting phytopathology that could attack crops, suggesting the best time to do treatment also in a specific part of the plot. Forecast models provide precise information about circumstances nurturing the spread of a phytopathology, often before it will appear.

Simulation based DSS models are widely applied in agriculture, as these models provide viable input to the management decisions because of their effective predictive capability. The main DSS models developed and applied in different areas of agriculture are:

- CROPWAT, for land and water management,

- SWASALT, for Soil and Water Resource Management,
- CROPMAN, for Crop Production and Management,
- DSS-ET, for soil evapo-transpiration estimation,
- DSS-FS, with Fertigation Simulator for application of fertilizers.
- IPM, for Integrated Pest Management.

There are a range of initiatives under way to collect tractor data and transmit it wirelessly. Such as the Dutch initiatives Agrobox from FARM24 and an ISOBlue derivative from Trekkerdata.nl. Purdue University in the USA developed this ISOBlue box for the North American market. Technical experts from FarmHack, Trekkerdata.nl and Purdue adapted it to enable it to 'understand' European tractors. The slogan on the website www.isoblue.org reads 'Freeing Ag Machinery Data', and that is also essentially what it is: 'freeing' tractor and machine data from the CAN bus / Isobus to render them independent of any brand and making them available for use by the farmer free of charge. The Agrobox works in a similar way. Both boxes use 4G to continuously send the data that has been recorded. The data from the Agrobox becomes available on MyFarm24. Recently, a number of Dutch arable farmers and contractors have started testing these solutions. Contractors regard it mainly as a means of being accountable to customers (as well as the Government) with regard to fuel consumption, use of fertilizers and crop protection chemicals, and the impact on soil and the environment.

In order to protect the data of the farmers, a document was created that stipulates the way of sharing the agricultural data. Following its launch on 23rd April 2018, the EU Code of Conduct on Agricultural Data Sharing by contractual agreement, has received the support of two additional international federations: Centre de Liaison International des Marchands de Machines Agricoles et des Reperateurs (CLIMMAR) and Animal health Europe. One year after its release, the EU Code of Conduct on Agricultural Data Sharing has been accepted and signed by over ten key European agricultural sector organizations. All signatories are convinced of the importance of setting transparent principles and guidelines to support the development of digital farming, which demonstrates the need for increased data sharing in agriculture.

To fully benefit from digital farming, data must be shared between all partners in the agri-food chain in a fair and transparent way. This Code of Conduct, designed in 2018, aims to promote the benefits of sharing data and enabling agri-business models, including agri-cooperatives and other agri-businesses, to swiftly move into an era of digitally enhanced farming. The Code of Conduct explains contractual relations and provides guidance on the use of agricultural data, particularly on the rights of access and use of the data. All signatories of the Code of Conduct recognize the need to grant

the data originator a leading role in controlling access to and the use of data. The guidelines also underline that the right to determine who can access and use the data should be granted to the data originator. In practice this means that the rights to data collected on the farm or during farming operations are granted to the farmer and may be used as he or she sees fit.

So far, Copa and Cogeca, CEMA, Fertilizers Europe, CEETTAR, CEJA, ECPA, EFFAB, FEFAC, ESA have agreed to sign the contractual arrangement which is part of this Code of Conduct. CLIMMAR and Animal health Europe, which represent the Agricultural Machinery and Equipment Dealers and the manufacturers of animal medicines and health products respectively, have decided to show their support by becoming the latest signatories of the Code of Conduct.

RESULTS AND DISCUSSIONS

Most farmers feel there is value in their data. The proof of this is that almost every farm has a stack of paper records, old planter notebooks, binders of printed spreadsheets, and soil test results from days gone by. They keep this "data" because, that stack of paper is a concrete reminder of the annual battles fought with nature, people, money, and chance. They keep it because as years pass by and details of our memories begin to fade, They could go back to those hard copies and revisit the lessons of all those ideas, successes, and failures. The other proof of the farmer's belief in the value of their data is the rapid adoption of yield monitors in harvesters.

Several models exist that are or could be used for DSS involving precision agriculture data. However, for DSS some data is needed in real-time or near real-time and some is not. Decisions and definitions of minimum data is different for each scale. Thus, starting with the decision to be made and working backward to come up with the supporting dataset should improve effectiveness and efficiency. Once pertinent decisions are identified, usable crop models and DSS for on-farm sub-field management decisions with spatial accuracy need to be created.

CONCLUSIONS

We can conclude that the agricultural industry is about to be disrupted and will transform into a high-tech industry and will need a high skilled farmers. Some of the best techniques for extracting information from data include the use of traditional techniques for data mining that are linked to but not constrained by biophysical processes. Thus, machine learning (e.g., decision trees, neural networks, random forest), geospatial statistics and time series analyses need more testing and validation within the precision agriculture sphere. Ultimately, data mining techniques need to turn data into

action or decisions.

Useful agricultural data will help to fight food scarcity and empower small farmers, help managing crop diseases and pests, investigating agricultural niches to identify patterns and relationships that may otherwise remain hidden, help to cope with climate change, help to make yield predictions and help to provide images of crops and land for inspection.

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