ICBAA2017-5

BIG DATA FOR SMALLHOLDERS

Abdul Rashid bin Mohamed Shariff

Department of Biological and Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia
rashidpls@upm.edu.my; rashidsnml@gmail.com

Abstract: This paper provides an insight into how big data can be applied for smallholders in the settings of developing or underdeveloped country. It begins by giving an introduction on big data and shows how big data can be utilized. Specific examples on how big data can be used to help smallholders are provided, particularly relating to paddy and oil palm. Some recommendations for future applications are provided at the end of the paper.

Keywords**:** big data, smallholders, GIS, Remote Sensing, GNSS

INTRODUCTION

This brief paper highlights the Big Data technology and explores how it can be applied for beneficial use of small holders. Our objective is to show that recent advances in technology can be creatively crafted and made practically suitable for use by a large number of farmers who have small cultivation plots. The approach is meant to bring technology to beneficial use by people who don't enjoy the economic advantages of large farms or plantations. The last three decades have seen an explosion of technologies and this is highly visible in the space technologies which has not only witnessed vast improvements in spatial and spectral resolutions but re-visit times or temporal intervals between imaging has also made significant improvements. Data capture, data transmission, data storage and analysis have made advances with greater processing power and higher capability software.

Big data has been discussed by Gill Press (2014) and some of the definitions he highlighted are as follows:

(1) "Data of a very large size, typically to the extent that its manipulation and management present significant logistical challenges."
(2) "An all-encompassing term for any collection of data sets so large and complex that it becomes difficult to process using on-hand data management tools or traditional data processing applications."
(3) "Datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze,"
(4) "The ability of society to harness information in novel ways to produce useful insights or goods and services of significant value" and "…things one can do at a large scale that cannot be done at a smaller one, to extract new insights or create new forms of value."
(5) "The broad range of new and massive data types that have appeared over the last decade or so."
(6) The new tools helping us find relevant data and analyze its implications.
(7) The convergence of enterprise and consumer IT.
(8) The shift (for enterprises) from processing internal data to mining external data.
(9) The shift (for individuals) from consuming data to creating data.
(10) The belief that the more data you have the more insights and answers will rise automatically from the pool of ones and zeros.

(11) A new attitude by businesses, non-profits, government agencies, and individuals that combining data from multiple sources could lead to better decisions.

None of the above definitions addresses the farming community particularly. However, 4-7 can be merged to form a useful definition that may benefit the farmers:

The ability of society to harness information in novel ways to produce useful insights or goods and services of significant value and things one can do at a large scale that cannot be done at a smaller one, to extract new insights or create new forms of value. This is supported by the broad range of new and massive data types and the new tools helping us find relevant data and analyze its implications within a data sharing environment.

This definition will be further explained during the oral presentation at this conference.

At the international level, steps are being taken to benefit farmers through the Big Data initiative. One of these projects is the CGIAR Platform for Big Data in Agriculture. According to CGIAR, 2017,

The Platform's focuses on:

Organize – data on soils, climate, crops and more will be organized, standardized and made publicly available by the organizations that generate it. The Platform will begin by prioritizing the free and open sharing of data held by researchers at the 15 CGIAR centers – the world's largest network of agricultural research organizations.

Convene – foster new partnerships between the agricultural science and technology sectors in order to bring together the best minds, and accelerate progress towards achieving the United Nations' Sustainable Development Goals (SDGs).

Inspire – put the data and partnerships into practice via a USD 4 million fund to support innovative projects with big data approaches at their core, such as real-time monitoring of pest outbreaks, or site-specific recommendations for farmers on water and fertilizer use.

METHODS

An overview of the conceptual approach is shown in Figure 1 below, which is taken from *SjaakWolfer et al* (2017). Good agriculture practices need access to a host of information, such as soil type, soil parameters, soil nutrients, weather data, irrigation scheduling, pest identification, appropriate pesticides, just to mention a few. Smallholder farmers are generally not in a position to collect or have direct access to these data themselves. Thus, a system needs to be designed and implemented to enable access to the right alternatives in decision making.

In the figure below, data from various sensors, including weather and imaging satellites, can be obtained and a smart analysis system operated within a cloud based computing environment. Controls on the ground can be carried out by automated means or by the farmers themselves in the case of lack of automation.

In order to successfully carry out the farming support for the smallholders, an integrated system of support involving a multitude of agencies need to be in place. The department of agriculture/Ministry of agriculture have a pivotal role to play to further enhance the support currently given as much data resides within these organizations. Satellite related agencies such as Malaysian Space Agency (ANGKASA), Malaysian Meteorological Department (MMD), Malaysian Remote Sensing Agency have an important role to collect and disseminate timely sensor data to the system. In addition, research agencies such as MARDI, MPOB, UPM and other universities, MIMOS need to be at the forefront in creating decision support tools and applications which will help the farmers implement the best decision alternatives proposed by the system. An important consideration in working with the illiterate and semi-literate farming community is the design of user interfaces in implementing the technology. This is a fertile area of research as much can be done according to the needs and requirements of the different communities which have their own cultural bias and varying mental models. The role of farmer organizations such as Lembaga Pertubuhan Peladang (LPP) for example, will be a backbone for the implementation stage. Details of the proposed virtual working structure involving MACGDI and examples of the implementation of the methodology will be elaborated during the presentation.

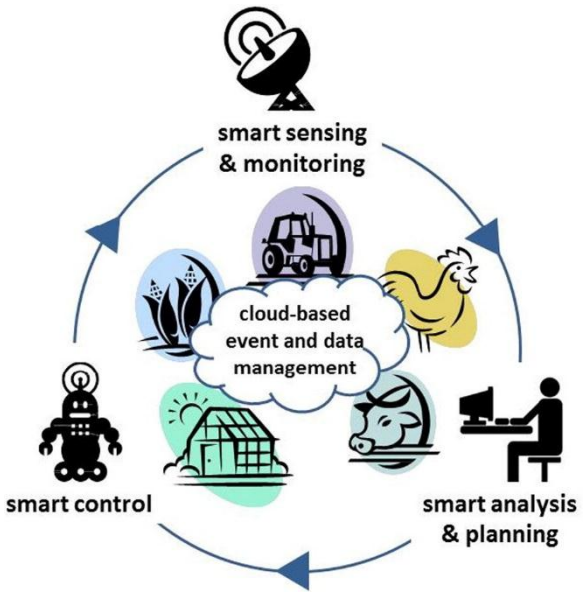

Figure 1: Big Data in Smart Farming.

Source: Agricultural Systems, Volume 153, May 2017, Pages 69-80
Big Data in Smart Farming – A review
SjaakWolfert[ab]LanGe[a]CorVerdouw[ab]Marc-JeroenBogaardt[a]

RESULTS AND DISCUSSION

Ranya et al (2013) researched and designed a Land Suitability Evaluator which can determine the best crop for a particular piece of land. Use of this technology can aid farmers in determining and deciding which crop to plant for optimum yield. Goma (2017) found that tracts of land more suitable for rubber were planted with oil palm. Such practices will not help our country's optimum use of land resources. The Land Suitability Evaluator should be a fundamental part of the core technologies to help farmers.

Nik Norasma et al (2013) designed and implemented a sytem to support paddy farmers in Sawah Sempadan, Selangor, Malaysia. The system called Web Precision Farmer has unique characteritics of supporting fertilizer applications, information on water scheduling, pest control information, yield reporting and a host of facilities to aid farmerd in the use of internet based technology. Although there was apprehension at the beginning of the project on the uptake of the technology by the semi-literate farmers, the project was successfully carried out as the the farmers school going children turned out to be an asset in helping farmers assimilate and use this technology.

Yadegary (2017) researched and determined quantum of nitrogen that need to be applied for oil plam trees based on the analysis of multispectral bands on board the SPOT satellite. Work on using similar bands on board UAV is currently in progress and has great promise for successful implementation. It is envisaged that in future, such service can be uberized and farmers can benefit from using of this technology at economical rates.

CONCLUSIONS

The presentation in this paper has sought to further the thesis that cooperation among the big players in government agencies through Digital Technology, focusing on the smallholders can lead to a practical and beneficial implementation of the Big Data technology. We have elaborated on the use of the conceptual model that can tie in the respective agencies and set up a communication link with the farmers. Challenges such as acceptability and user interfaces have been highlighted. Societies interested in harnessing the benefits of this modern technology can benefit and move ahead with the approach provided in this paper.

Recommendations and Future Work

- Greater collaboration between the government agencies such as Ministry and Department of Agriculture, MARDI, Lembaga Pertubuhan Peladang (LPP), Survey and Mapping Department Malaysia, Remote Sensing Agency of Malaysia, Malaysian Space Agency, other land related agencies, MIMOS and MACGDI. This cooperation is vital for building a sustainable E-Lifeline with the farmers.
- Efforts must be made to enhance and enrich current data and this data should be made freely available. Greater efforts and investments in creating useful and usable data should be encouraged as it will pay due dividends in future.
- The availability of smallholders farming data can help in the planning and financing of agricultural programs and catalyze micro-credit to deserving farmer groups.
- Software developers should focus on cultural and communication issues in creating easy to use user interfaces

REFERENCES

CGIAR, 2017, http://www.icrisat.org/global-initiative-to-harness-the-power-of-big-data-for-smallholder-farmers/ accessed on 5th November 2017.

Goma Bedawi A.A., 2017, Land Evaluation for Rubber Using GIS and Multi Criteria Decision Based Model, PhD Thesis awaiting viva at Universiti Putra Malaysia.

G.Press, 2014, https://www.forbes.com/sites/gilpress/2014/09/03/12-big-data-definitions-whats-yours/#2963555913ae accessed on 5th November 2017.

Nik Nor Asama, C. Y, A. R. M. Shariff, A. R. Mahmud, M.A.M. Soom, S. K. Bejo. 2013. Web-Based Decision Support System for Paddy Planting Management. Pertanika J. Sci. Tech.

Ranya Elsheikh, Abdul Rashid B Mohamed Shariff, Fazel Amiri, Noordin B Ahmad, Siva Kumar Balasundram, Mohd Amin Mohd Soom, 2013. "Agriculture Land Suitability Evaluator (ALSE): A decision and planning support tool for tropical and subtropical crops." Computers and electronics in agriculture 93 (2013): 98-110.

SjaakWolfert, LanGe,CorVerdouw, Marc-JeroenBogaardt, 2017, Big Data in Smart Farming – A review, Agricultural Systems, Volume 153,Pages 69-80.

Yadegary K, 2017, Multispectral Remote Sensing for Nitrogen Fertilizer Management in Oil Palm, Master Thesis awaiting viva at Universiti Putra Malaysia.