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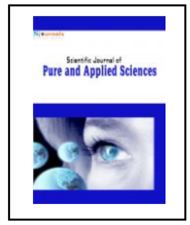

Original article

Application of geographical information system for farm mechanization education and training

R.M. Hudzari[a,*], W. Aimrun[b], M.A.H.A. Ssomad[a], M.S. Norazean[c]

[a]*Faculty of Agriculture and Biotechnology, University Sultan Zainal Abidin, 21300, Gong Badak, Terengganu, Malaysia.*
[b]*Faculty of Engineering, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia.*
[c]*Pahang Skills Development Centre, Kampus PSDC, 25350, Pahang, Malaysia.*

[*]Corresponding author; Faculty of Agriculture and Biotechnology, Innovative Design and Technology, University Sultan Zainal Abidin, 21300, Gong Badak, Kuala Terengganu, Terengganu, Malaysia.

A R T I C L E I N F O

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A B S T R A C T

Precision farming is managing each crop production input such as fertilizer, water, lime, herbicide, insecticide and seed on a site-specific basis to reduce waste, increase profit and maintain the quality of the environment. Without some remarkable enabling assisting technologies, the individual treatment of each plant is impossible and the concept of precision farming would not be feasible. Based on the trip, we can gain more information about the new technology that applies nowadays in agriculture. By using remote sensing that transmitted data from GPS, we can used to determination of generic object type, character and property as well as it's abstract meaning. Besides, the application of remote sensing has been used in soil electrical conductivity sensor which used for show the variability of soil properties in detail and rapidly using simple equipment with less cost and labor force. Action maps will then be produced for farmers to apply fertilizers at different rates according to the delineated zones.

1. Introduction

The essentialness of agriculture shown within the righteous book of Al-Quran which is there are about eighty three sentences mentioning about agriculture as indicated as benefit of mankind (Hudzari, 2012; Hudzari et al., 2011). The agricultural landscape has seen an increase in the adoption of modern technologies, be it in small scales, including those in the Agra-based manufacturing sector. This, to some extent, has increased the productivity and at the same time decreased the labor dependency (Wan Ishak and Hudzari, 2010; Hosiery Razali et al., 2010). One of the contemporary aspects of modern technology is the ubiquitous application of Smart Farming which applied electronic and computer- assisted mechanical manipulation through which science and technology could contribute endlessly.

Smart Farming Community Centre (PKPP) is the persistence of the international community in the exploration of knowledge and also accumulated a lot of knowledge around the world in various forms (Aimrun et al., 2011). Through ICT, rural communities should also be exposed to the facilities of the knowledge search. ICT facilities available in the community are paddy farmers need high enthusiasm from the community itself to increase his knowledge in various fields. With a high desire to learn and have the opportunity and ability, community farmers can increase their knowledge about science and technology, religion, and survival to increase family economy (Teoh, 1996; FAO, 1994) Life balance between seek lawful and righteous daily practice will ensure happiness in this world and the hereafter. PKPP developed to become a community center in the search for knowledge, especially with respect to modern farming methods. Community farmers will learn to adopt precision agriculture methods to increase the quantity and quality of agricultural products while protecting the environment and increasing incomes (Amin et al., 2004; Aimrun et al. 2007).

1.1. Development in farmer community

By developing such effort on providing ICT to the community rice farmers to learn and practice precision agriculture methods and Smart Farming as practiced in developed countries. This will reduce wastage of agricultural inputs such as fertilizer and water as well as improve the quality of the harvest and income Williams and Hoey, 1987). Community rice farmers can take advantage of ICT in everyday life activities such as e-government, e-learning, e-banking and e-commerce. Community ICT literacy rice farmers more easily add their knowledge about religion, careers, income and economic opportunities for families and get together through social networks (shahrizaila, 1995).

2. Literature review

2.1. Spatial variability

Soil sensor such as the VerisEC sensor is a useful tool in mapping soil electrical conductivity (EC) in order to identify areas of contrasting soil properties. In non-saline soils, EC values are measurements of soil texture – relative amounts of sand, silt and clay. Soil texture is directly related to both water holding capacity and cation exchange capacity, which are key ingredients of productivity

Soil spatial variability also natural occurring and or management induced feature that is important for site specific management practices such as variable rate fertilization. Since rice paddy fields are flooded and flat, apparently they should be homogeneous and therefore, it had been thought that spatial variability both in yields and soil properties might be negligible. However, significant levels of variability in soil general properties, soil nutrients and rice yields. A paddy field is a flooded parcel of arable land used for growing rice. Therefore, rice fields require large quantities of water for irrigation. Flooding provides water, essential to maintain the growth of lowland rice. Water also provides a favorable environment for the rice strains being grown as well as discouraging the growth of many species of weeds. Paddy fields remain dry between successive rice crops. Changing from aerobic to anaerobic conditions in paddy fields leads to strong variations in pH and other related soil attributes such as available nutrients.

Precision farming is also known as site-specific crop management. Site-specific crop management can be viewed as a cyclical process from within field data collection, data analysis and optimum decision making, variable rate application, and evaluation. Yield, crop growth status, and soil properties are necessary data inputs to the system. As in other crops, in typical rice fields, describing spatial variability of within-field properties are a fundamental first step toward determining the size of management zones and the interrelationships between limiting factors, for the development of management strategies. Site variables in interest are soil properties, crop growth status, and crop yield.

2.2. Electrical conductivity sensor

Soil electrical conductivity, which is known as EC, is the ability of soil to conduct electrical current. EC is expressed in milliSiemens per meter (mS/m). Traditionally, soil scientists used EC to measure soil salinity. However, EC measurements also have the potential for estimating variation in some of the soil physical properties in a field where soil salinity is not a problem. Recent developments in EC sensors and their ability to produce EC variation maps has attracted much attention among producers about potential applications of this sensor for improving field management. The goal of this fact sheet is to provide the producer with facts and information about EC sensors. Figure 1 shows the simulation of Veris EC soil electrical conductivity sensor

Veris EC soil electrical conductivity sensor is used for detecting the ability of soil in conducting electricity. In the Veris Soil EC Mapping System the electrodes are rotating discs placed 6cm into the soil. As the cart is pulled through the field, one pair of electrodes passes electrical current into the soil, while two other pairs of electrodes measure the voltage drop. The system is set up to switch between two configurations A (shallow) and B (deep). Figure 2, 3 and 4 shows the simulation and component used during trip explanation.

Configuration A uses the four inner discs (2, 3, 4 & 5). The voltage is measured between the two innermost discs (3 & 4) which are d = m apart. In Configuration B the four outer discs (1, 2, 5 & 6) are used and the voltage is measured between discs 2 and 5. When the electrodes (discs) are d meters apart the conductivity is measured to a depth of roughly 1.5d meters.

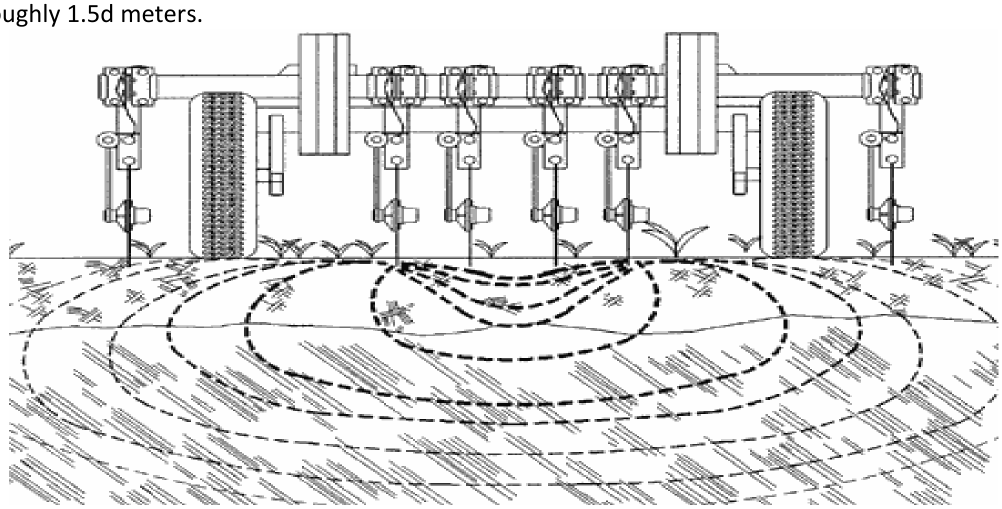

Fig.1. Simulation of veris EC soil electrical conductivity sensor.

Fig. 2. The System components of veris soil EC mapping-model: Veris3100.

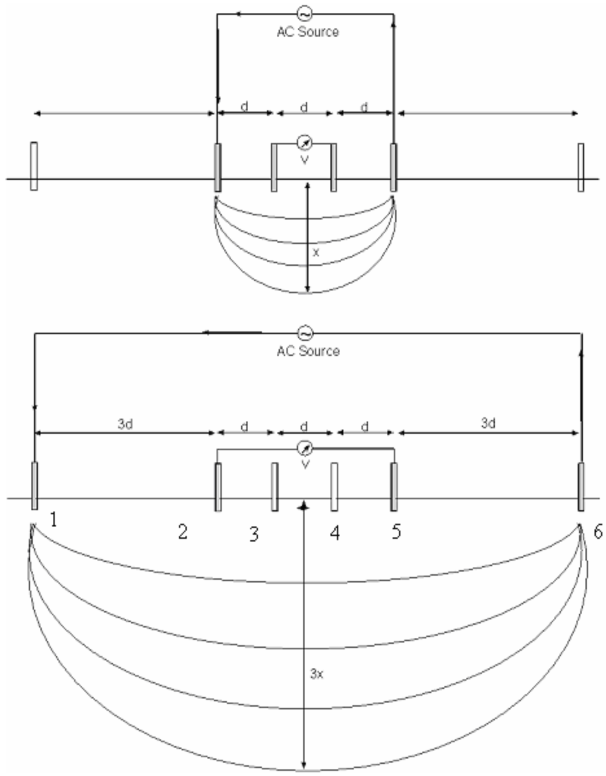

Fig. 3. Schematic of configuration A-shallow <30 cm (top) and B-deep <90 cm(below).

Fig. 4. Complete component of receiver that receive data from GPS and Veris Soil EC controller.

The advantages of using Veris Tech are;

- Determine the layout of the site
- Used in the interpolation of yield maps
- Guide soil sampling, design on farm trials
- Help derive input recipes for seed
- Nutrients and crop protection chemicals

3. Result and discussion

3.1. Development of EC map

As a vehicle equipped with an EC measuring device drive through the field, data are collected at one-second intervals. Figure 5,6,7 and 8 shows the simulation map of the data. The data are recorded in a file and stored on a PCMCIA card. An EC data file from the Veris unit has four columns. The first and second columns contain longitude and latitude information. The third and fourth columns contain EC data at shallow depths and deep depths, respectively. Below shows where the vehicle was in the field as it drove through the field, and the color shows the EC variation for shallow depths. A software program is needed to create an EC map. There are different software programs available on the market that can create maps from datapoint files such as, Surfer (Golden Software, Inc.), ArcView (ESRI), and Global Mapper (Global Mapper).

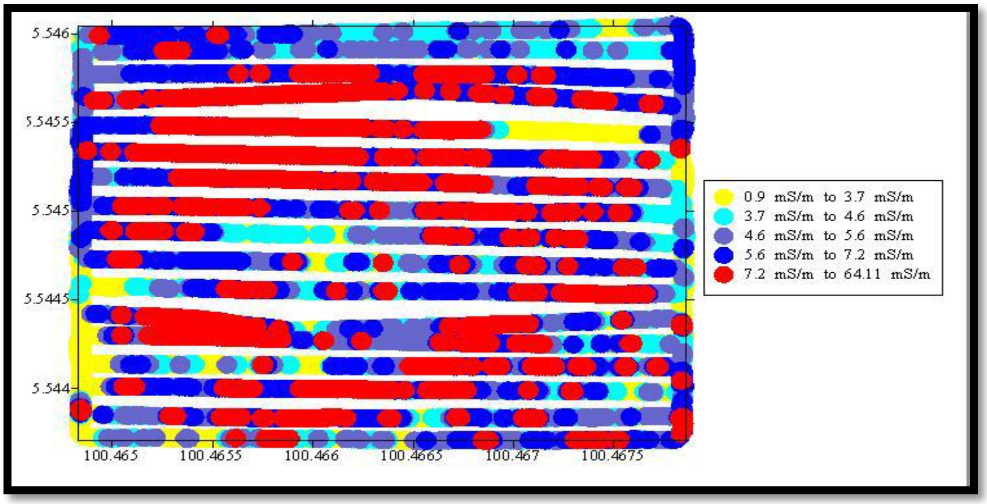

Fig. 5. Map of shallow ECa for the 9 ha plot.

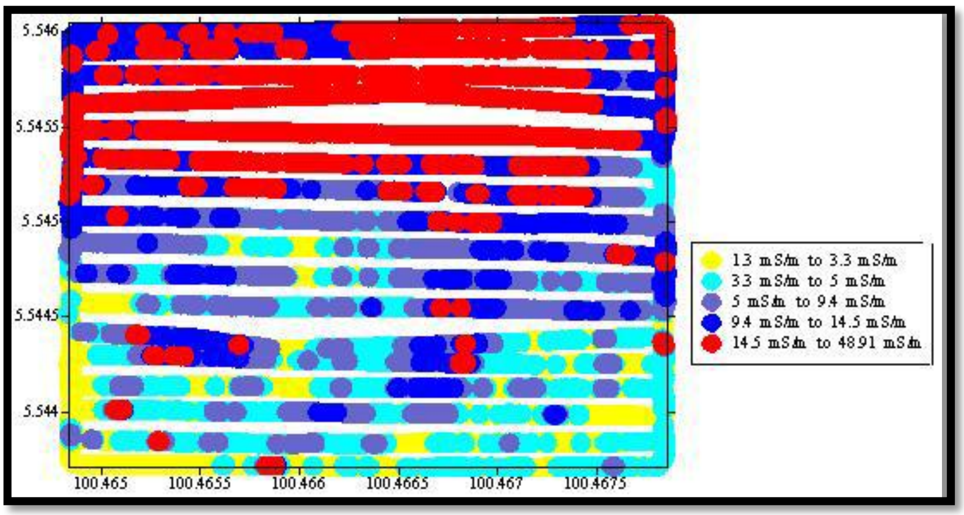

Fig. 6. Map of deep ECa for the 9 ha plot.

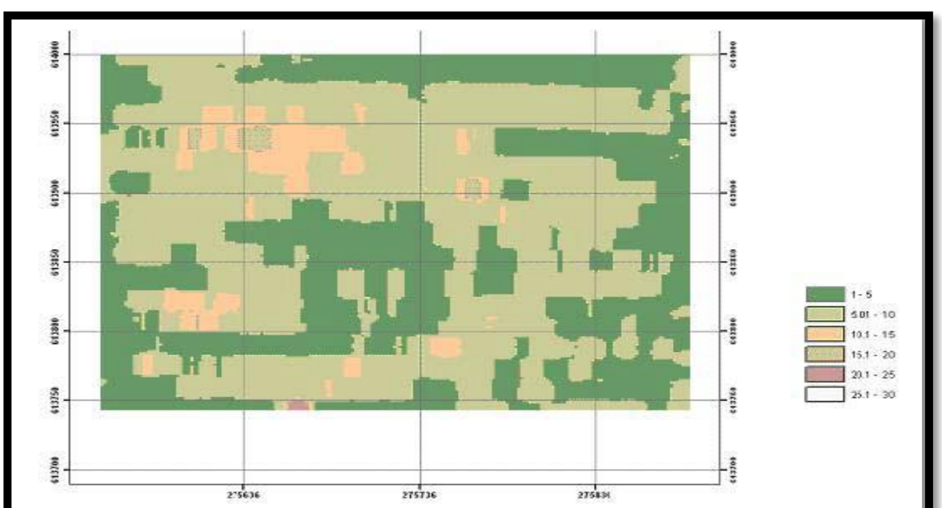

Fig. 7. Kriging map of shallow ECa for the 9 ha plot.

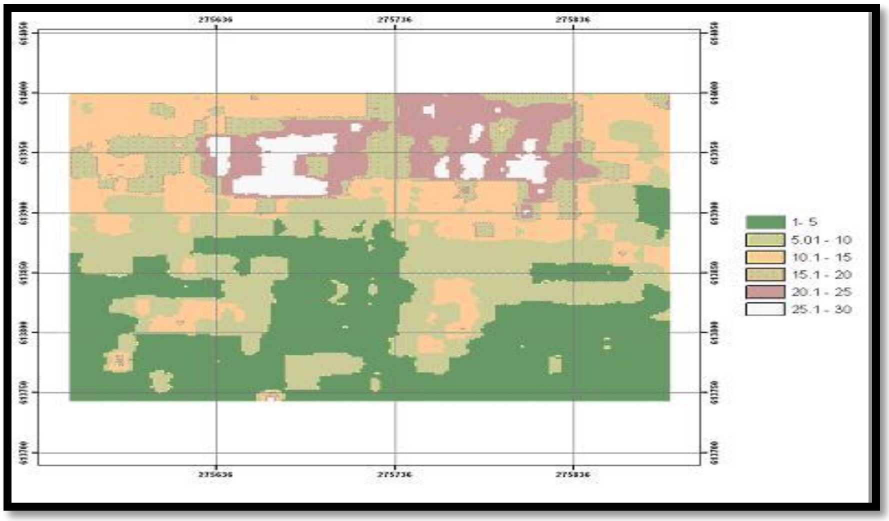

Fig. 8. Kriging map of deep ECa for the 9 ha plot.

3.2. Factors affecting EC

The conduction of electricity in the soil takes place through the moisture-filled pores that occur between individual soil particles. Therefore, the EC of soil is determined by the following soil properties:

- Porosity: The greater soil porosity, the more easily electricity is conducted. Soil with high clay content has higher porosity than sandier soil. Compaction normally increases the soil EC.
- Water content: Dry soil is much lower in conductivity than moist soil.
- Salinity level: Increasing concentration of electrolytes (salts) in soil water will dramatically increase soil EC. The salinity level in most Corn Belt soils is very low.
- Cation exchange capacity (CEC): Mineral soil containing high levels of organic matter (humus) and/or 2:1 clay minerals such as montmorillonite, illite, or vermiculite have a much higher ability to retain positively charged ions (such as Ca, Mg, K, Na, NH4, or H) than soil lacking these constituents. The presence of these ions in the moisture-filled soil pores will enhance soil EC in the same way that salinity does.
- Temperature: As temperature decreases toward the freezing point of water, soil EC decreases slightly. Below freezing, soil pores become increasingly insulated from each other and overall soil EC declines rapidly.

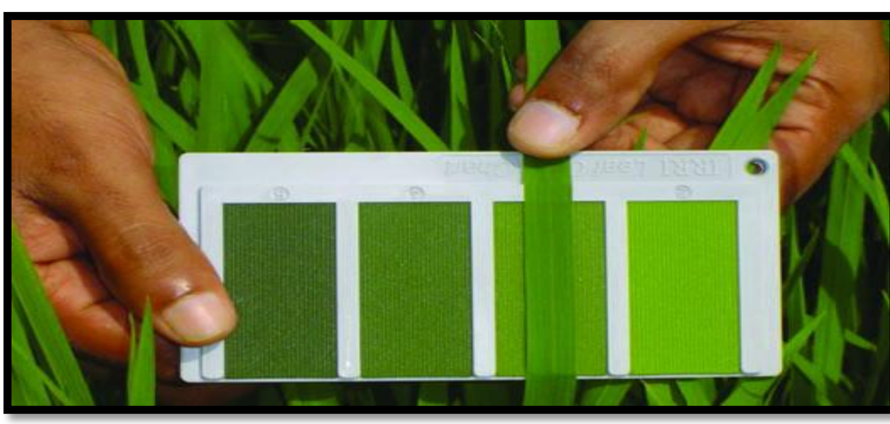

Fig. 9. The application of LCC.

3.3. Application of leaf color chart

The leaf color chart (LCC) is a plastic, ruler-shaped strip containing four panels that range in color from yellowish green to dark green. It is an easy-to-use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant N status. Figure 9 and 10 show the LCC during trip experiment.

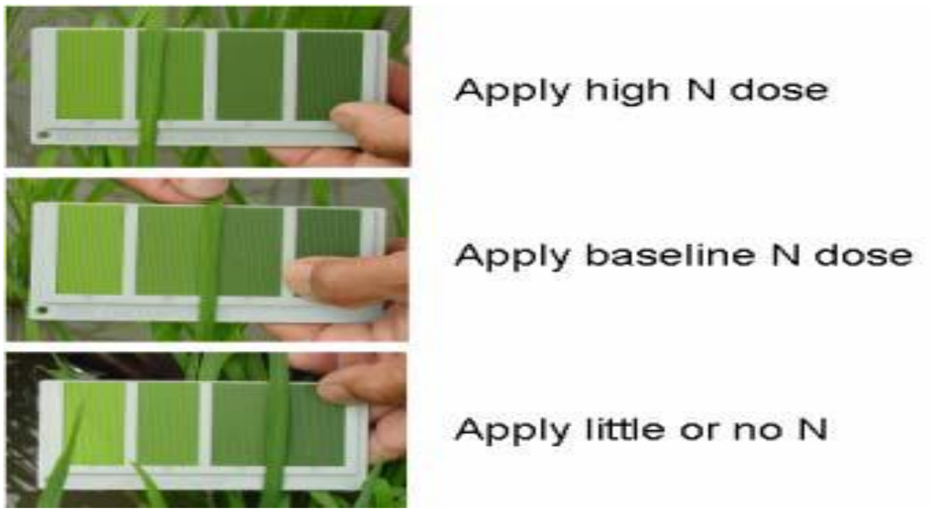

Fig. 10. The application of LCC.

Leaf N status of rice is closely related to photosynthetic rate and biomass production, and it is a sensitive indicator of changes in crop N demand within a growing season. The LCC can be used to rapidly assess leaf N status and thereby guide the application of fertilizer N to maintain an optimal leaf N content, which can be vital for achieving high rice yield with effective N management.

The LCC is used to monitor leaf N status from tillering to panicle initiation or later, by either of two equally effective options. The decision on which option to use can be based on farmers' preferences and location-specific factors, such as frequency of visits by farmers to their fields and their knowledge of critical growth stages for N application. The fixed-time/adjustable-dose option saves time, and is thus preferred by farmers who have gainful alternative activities. The real-time option is generally preferred when farmers lack sufficient understanding of the critical stages for optimal timing of fertilizer N.

Application of nitrogen depends on the color of the chart which mean the yellow color chart show that low of nitrogen dose and dark green shows that highest nitrogen.

3.4. Application of AD-502Plus (chlorophyll meter)

SPAD-502Plus (Chlorophyll Meter) is a simple machine which performs quick measurements of the chlorophyll content of leaves without damaging the leaf. Its lightweight, splash proof design makes it ideal for measurements in the field. The Chlorophyll meter can be displayed from -9.9 to 199.9 SPAD units. The meter can calculate a relative value (in SPAD, from Soil Plant Analysis Development, units), showing how green the leaf is. It is though expensive and the SPAD- 502 (KONICA MINOLTA 1989) records digitally the relative amounts of chlorophyll molecules, and is highly sensitive and accurate. SPAD values are calculated on the amount of light transmitted by the leaf in two wavelength regions in which the observance of chlorophyll is different.

4. Conclusion

Based on the trip, we can gain more information about the new technology that applies nowadays in agriculture. By using remote sensing that transmitted data from GPS, we can used to determination of generic object type, character and property as well as it's abstract meaning. Besides, the application of remote sensing has been used in Veris EC soil electrical conductivity sensor which used for show the variability of soil properties in detail and rapidly using simple equipment with less cost and labor force. Action maps will then be produced for farmers to apply fertilizers at different rates according to the delineated zones. The used of leaf color chart also important in determining the nutrient in crop such as in paddy especially the application of nitrogen in crop. Tandem with technological advances, the leaf color chart has been replaced by the SPAD meter that function same as LLC as a new creation for technology.

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