APPLY ELECTROMAGNETIC INDUCTION METHOD IN PRECISE AGRICULTUR

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ABSTRACT

Electromagnetic induction method (EMI) has proven to be a great tool for soil characterization and monitoring thanks to it's notable advantages including rapid data acquisition, large data coverage, high data density, nondestructive and inexpensive survey implementation. However, in Viet Nam the applications of this method in agriculture have received little attention probably due to the lack of suitable equipment and data processing techniques.

This poster gives an overview of Electromagnetic induction method being applied in agriculture in several countries to characterize and monitor soil properties such as moisture, salinity, density, texture, porosity with the aim to suggest similar applications in Viet Nam. A case study is also presented when the equipment EM38- MK2 was used for the first time in Viet Nam to study soil properties.

The experiment of the Electromagnetic induction method (EMI), was carried out by the authors in Quynh Luu, Nghe An to reveal that EMI method has great potential applications in precise agriculture.

ELECTROMAGNETIC INDUCTION METHOD (EMI)

Electromagnetic induction (EMI) method measures vertical or horizontal components of an EM field forming in the soil by induction in response to a prescribed EM field. Electrical conductivity of the soil affect the measured voltages or EM induction. The EMI method is suitable for soil research because the equipment is light and easy to use (Figure 1). Since the machine does not require direct contact with the soil, data collection is fast and inexpensive that allows to measure a large area with dense data points.

Figure 1: EMI equipment is easy to move and compact

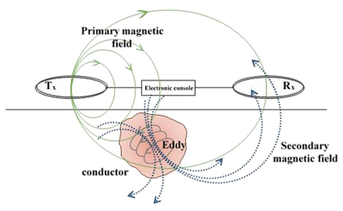


Figure 2: physical principle of EM 38-MK2

Principles of induction: (1) a magnet moving through a loop causes current flow in the coil; (2) current generated in one wire loop causes a magnetic field that induces current flow in a second coil; and (3) the combination of Ampere's and Faraday's laws as used in geophysical electromagnetic equipment.

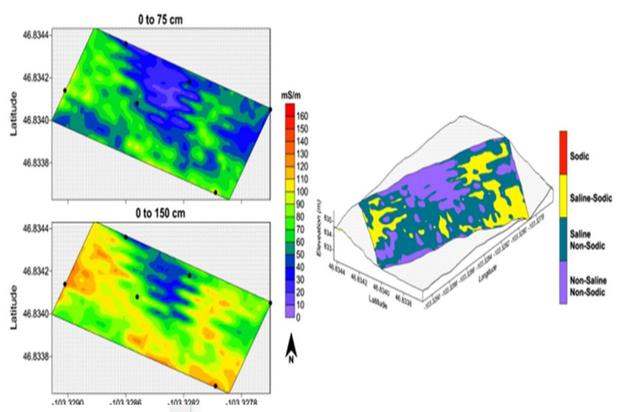
Figure 3: EM38-MK2

The EM38-MK2 provides measurement of both the quad-phase (conductivity) and in-phase (magnetic susceptibility) components within two distinct depth ranges, all simultaneously, without any requirement for soil-to-instrument contact. With a maximum effective depth of exploration of 1.5 m, applications in agriculture, archaeology and general soil sciences are common.

POPULAR APPLICATION OF EMI FOR SOIL PROPERTIES

Salinity

Figure 4: ECa measurements for 2 different depths (on the left), classification according to the salt content of southwestern North Dakota on the right (Corwin, 2008).



Moisture

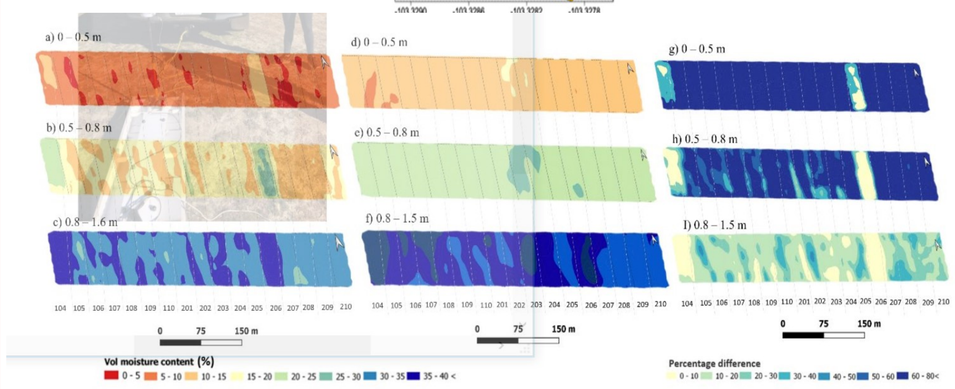


Figure 5: Predict volumetric moisture content at Cunderdin (Shaukat, 2022)

Texture

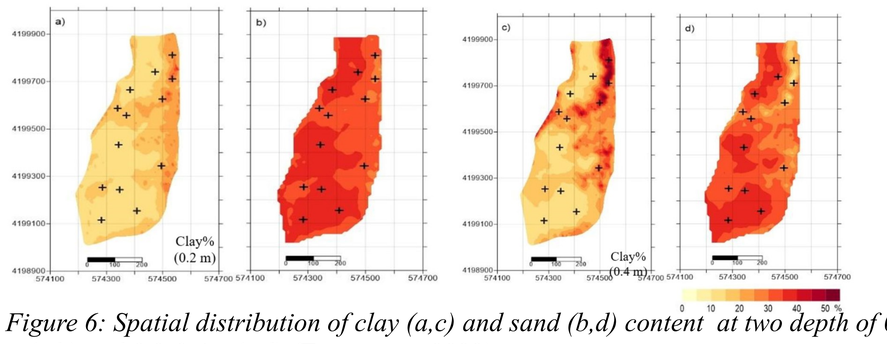


Figure 6: Spatial distribution of clay (a,c) and sand (b,d) content at two depth of 0-0.2 m(a,b) and 0.2-0.4 m(c.d) (Farzamian, 2022)

A CASE STUDY IN VIETNAM

Predict spatial distribution of moisture and salinity at DiemNghiep Farm – Quynh Luu –Nghe An

Figure 7: Field trips at Nghe An provice: a) locations; b) EM38-MK2 instrument; 3) equipment calibration; d) a map of measurement points at Diem Nghiep Farm

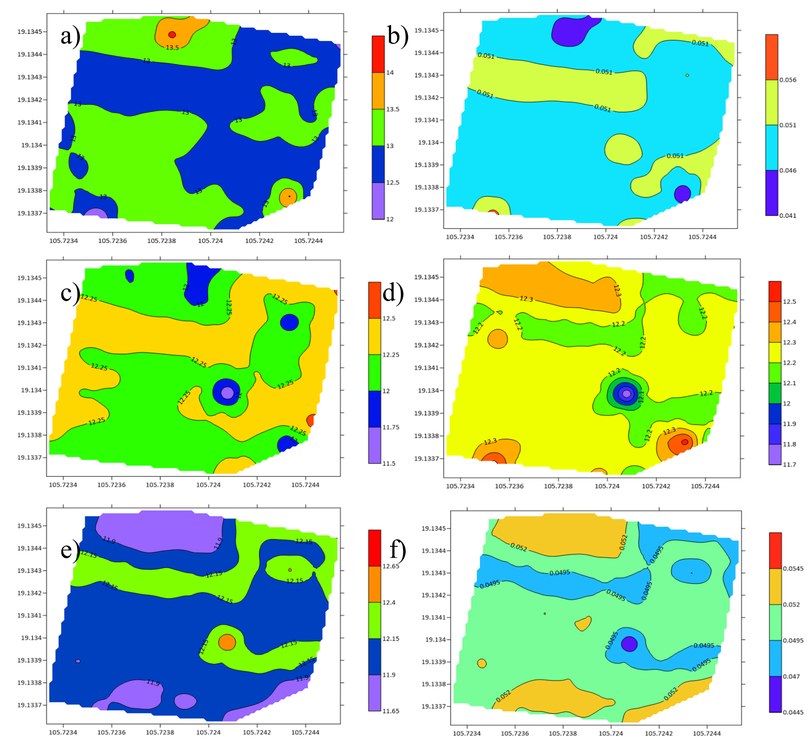


Figure 8: The moisture properties (a,c,e) and salinity properties (b,d,f) of soil in depths 37 cm, 70 cm and 150cm at Diem Nghiep Farm – Quynh Luu – Nghe An provice (field trip in August 2023)

EMI is sensitive to soil salinity and moisture, if being calibrated with soil sample analyses, an EMI survey can be used to infer these properties for the study area at different depths.

CONCLUSION

A field experiment of EMI method reveals that it can be used to determine soil properties, including salinity, moisture and texture. These soil characteristics are important for precise agriculture or agriculture 4.0.

The main challenge is that soil properties cannot be directly indicated by measured geophysical parameters, instead they are inferred from them by sophisticate data analysis and data modeling techniques, that are not readily available in Vietnam. This is probably the main reason why geophysical methods have not been applied for agricultural purposes in the country so far. A combination of varied suitable geophysical methods and the use of industry 4.0 technologies can be a solution to provide more reliable information about soil properties.

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