Zapping the ground with electricity to create detailed soil maps for farms

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Erasmus Oware, PhD, assistant professor in the University at Buffalo Department of Geology, holds a multiple-depth soil moisture probe in his laboratory. Credit: Douglas Levere

A University at Buffalo professor has devised an ingenious way to more

quickly test soil in farm fields to make detailed maps of differing soil types. Those maps can then be used to design more efficient farming practices.

Erasmus Oware, PhD, assistant professor in the Department of Geology in the UB College of Arts and Sciences (CAS), has designed a system to quickly measure the electrical conductivity of every square yard of a field to determine the boundaries of different types of soil. Then, a few traditional boring and testing techniques can ascertain the soil make up of a broad area. The project is in collaboration with Darcy Telenko, PhD, of the Cornell Cooperative Extension.

The method greatly reduces the time to make a soil map—conventional techniques take a day to map 1 acre, but that time is reduced to 20 minutes with the new method—and produces a much more detailed map.

"It's faster, and you get a higher resolution soil map," Oware said. "We are collecting a lot of data points, many more than with traditional soil sampling."

His method won an $84,840 grant from the New York Farm Viability Institute, which has been augmented with support from the CAS. The money was used to purchase the equipment and will help pay for students to do field work on the project this summer.

Oware's system involves dragging an electronic wave emitter behind an ATV that traverses every yard of a field. A receiver in the vehicle records the conductivity of the soil and its precise location. The result is a detailed map of the different soil types, generated with thousands of data points.

Traditional field tests are then performed to determine the water holding capacity of the different soil types. Knowing how the soil holds water is

crucial in determining how much irrigation and how much fertilizer is required.

"We will tell the farmer, 'This part of the field holds water for a longer time, so you can irrigate it less frequently. The other area does not hold water, so it needs to be watered less, but more frequently,' " Oware said.

Too much watering can cause several problems.

"If you over-irrigate a farm, the water will either create runoff and wash the fertilizer into nearby surface water bodies, or it will induce drainage whereby the fertilizer drains beyond the root zone and will contaminate groundwater resources," Oware said. "On the other hand, under-irrigation will create water stress of the plant, affecting plant quality and yield."

Thus, getting a precise handle on irrigation saves water, reduces the amount of fertilizer used and saves energy, he said.

"We are trying to design a sustainable and environmentally friendly way of farming."

The device measures soil conductivity at 20 and 40 centimeters deep, the heart of the vegetable "root zone."

Oware said farmers are eager to participate in his study. One farm in Niagara County and two farms in Erie County have been studied, and 12 more are going to be added.

He said farmers know from experience which areas of their fields produce differently, but the detailed maps give them much more accuracy and detail as to why.

Once the water needs of a farm field is mapped, the next step is to modify the irrigation system so that different areas of the field can be watered at different rates. Oware said he is working on developing a valve system for that purpose.

Because Oware's mapping method is so rapid, it can be used on large, industrial-sized farms, he said. He recently mapped a seven-acre field in three hours, generating more than 50,000 data points.

Provided by University at Buffalo