



Sensors in field send data to a mobile phone app.

Sensors Detect Changes In Soil

The Earth Rover Program applies the principles of seismology to better understand soil and subsoil conditions. It sends a sound wave into the soil, records it, and converts vibration data into detailed 3D images of soil structure and related factors.

These images are integrated with resistivity measurements and ground-penetrating radar to reveal and measure key properties such as density, moisture and porosity, as well as variations in soil composition, compaction and root systems, all without disturbing the ground.

"We've shown that we can measure soil bulk density and the depth of peat effectively," says Simon Jeffery of the Earth Rover Program. "Our plan is to help farmers identify where they have subsoil compaction and how deep it is, as well as whether the soil is sufficiently dry that remediation by subsoiling is likely to be effective rather than making it worse."

Jeffery, a soil ecologist at Harper Adams University in the U.K., is the soil lead for the Earth Rover Program, a nonprofit dedicated to improving farmers' understanding of

their soils. The effort is multidisciplinary, multi-institutional, and international in both its team and scope. Another founder is Tarje Nissen-Meyer, a professor of geophysics at the University of Exeter, also in the U.K. He previously used seismology to study elephant behavior in Kenya. His research team discovered that they could identify an animal species walking through the savanna by its signature footfall.

Adapting that ability to soils has required developing new technologies in terms of sensors and other components, as well as adapting existing technologies from other fields, such as music.

Gathered data will be analyzed using AI tools such as SoilGPT. AI and machine learning will integrate diverse datasets to make soil insights searchable, interpretable and useful. All work is conducted in an Open Access environment, allowing others to contribute to the effort. Source code, blueprints and designs are publicly available.

"Currently, all our components are built in-house and aren't commercially available," says Jeffery. "Our plan is to have different offers available, cheap components a farmer can buy and deploy, as well as an app that would allow a farmer to place their mobile phone on the soil and let it sense the vibrations."

The ultimate goal is to develop a free app that identifies soil conditions and provides

suggestions for improving soil. They're well on their way, with research hubs and survey sites in the U.K., Kenya and Colombia.

"We've shown that it's possible to measure water flow and retention through soils in research led by colleagues at the University of Washington," says Jeffery. "This approach has the potential to make precision irrigation at the farm scale possible, maximizing the efficiency of water use."

In "Between Two Furrows," a published research paper, the Earth Rover Program team demonstrates that they can detect changes in soil structure caused by differences in soil management.

"The next step is to run intervention plots to investigate which improvements we can and cannot detect and whether we can develop this to be able to give farmers advice beyond just identifying subsoil compaction," says Jeffery. "Can we identify soil that would benefit the most from organic amendments, or whether a soil is likely to be able to transition to no-till without large yield penalties, for example? Work on these elements is still ongoing and likely still several years away from being available to farmers, but watch this space."

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Handy Mobile Garden Water Pump

Don Bogardus delivers rainwater to thirsty vegetables using his mobile waterer. The 2-wheel cart is equipped with an electric pump, a pressure tank, and a fail-safe pressure controller. It even includes a homemade one-way valve made from hose ends and a marble.

"I use my watering system during our occasional dry spells," explains Bogardus, a retired engineer and all-around handyman. "The pump hooks up to my rainwater collection system and fills the tank, which is a recycled fire extinguisher. An old well pump controller prevents overfilling."

The pump was a centrifugal pump he found in an uncle's barn. The controller had been on Bogardus' well until he installed a new well pump and a new controller.

"I have the pressure on the controller set at around 45 to 50 psi," notes Bogardus. "When it reaches that, the controller cycles water back through the system."

As extra protection for the pump, Bogardus installed a one-way valve between the pump and the controller. He used steel hose ends, welding the male connector to a pipe connector on the controller. After dropping a glass marble from a paint spray can into the male connector, he drilled holes near the top of the connector for a short piece of #12 copper wire. Once inserted, the copper wire prevents the marble from rising too high.

Bogardus then dressed the ends of the wire protruding from the connector threads with a triangular file. He applied joint compound

and screwed the female hose end connector, attached to the hose, onto the pressure tank.

"The marble rises as the water comes through," he says. "If the pressure builds up higher in the tank, the marble is pushed back down and blocks incoming water. It may be overkill, but I wanted to be sure the system would work the first time."

When he wants to fill, Bogardus simply plugs the cord into an outlet near the rainwater collector. At 45 to 50 psi, he has plenty of pressure to water his garden beds.

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Garden waterer consists of a fire extinguisher tank mounted upside down, connected to a controller and a centrifugal pump.

Bolus reads internal body temperature, rumination, water intake, activity and calving alerts connected to the temperature assessment, and can determine health status.



Inside-The-Cow Monitoring Offers Health Data

As dairy producers seek practical tools to improve animal health, labor efficiency, and day-to-day decision-making, the smaXtec internal bolus offers a clear example of where livestock technology is headed. Designed to monitor adult bovines from inside the body, the system provides a steady stream of information to help producers respond earlier to issues and manage more confidently.

The bolus is administered like a calcium bolus and settles in the reticulum, next to the rumen, where it can detect rumen contractions. It's heavy enough to remain in place, so it won't pass through the cow, allowing it to collect ongoing data from a consistent

internal location.

"This Classic bolus reads internal body temperature, rumination, water intake, activity and calving alerts connected to the temperature assessment and can determine health status, from temperature increase or decrease," says Allissa Frisley, smaXtec Dairy Management Advisor.

The bolus is powered by an internal battery that typically lasts 4 to 5 years, depending on how far it must transmit data to the farm's base station. The base station uses an AT&T SIM card, so no Wi-Fi is required. Data moves from the bolus to the station, then to the cloud, and back to a phone or computer. The system updates regularly within about a 200-ft dia.

The company's customer support model is built on four steps: analysis, installation, onboarding and community.

"This is important because data alone isn't enough," Frisley says. "Producers need to understand what the information means and how to use it in real time."

During the analysis stage, a salesperson evaluates the farm to determine the number of base stations required.

"On the install date, when we administer the boluses, our dairy management advisor will come out, set up the base station, and help bolus the cows," Frisley says. "If a cow outlives the bolus, another one can be given."

After the installation stage, the onboarding process is central to making the system useful.

Frisley explains that the dairy management advisory team works closely with producers to help them interpret data and ensure the system runs properly. Onboarding is typically an intensive 3-mo period, followed by monthly or quarterly check-ins to address questions and prevent problems.

The community portion extends this support through the digital smaXtec Academy, expert webinars, and exclusive networking and exchange events. The customer success team is also available by phone, email or directly through the smaXtec software.

Because the system is cloud-based, producers don't need to rely on a single farm computer. Owners, herdsman and other team

members can access information through an app with individual logins, while veterinarians and nutritionists can be granted read-only access. A web browser option is also available.

"Each bolus stores data up to 6 days, and when the information is transmitted into the computer or app, it's there for a cow's lifetime. Clients see everything from a current install through archived cows years later," Frisley says.

Headquartered in Austria, smaXtec has subsidiaries in the U.K., Ireland, New Zealand and across Europe, with expansion into the U.S. Its dairy management advisors can support customers nearby or remotely.

"We have a tried-and-true product supported by people who grew up in the industry to help you understand the cow side, plus a whole team of data scientists using AI and algorithms to assist in farm practicality," Frisley mentions.

Boluses are long-lasting and include rumination data as part of a single service, rather than a confusing set of add-ons. Because each farm is unique, Frisley recommends that interested customers contact smaXtec directly to discuss short and long-term pricing that fits their operation.

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