Wireless Sensor Network Deployment for Soil Moisture Monitoring at Farm Scale in Hill Country

Istvan Hajdu[1], Prof Ian Yule[1]
[1]*Massey University, New Zealand Centre for Precision Agriculture (NZCPA)*

Soil moisture (SM) monitoring and mapping of hill country pastures has traditionally not been cost effective due to the time- and labour-intensive field measurements required to accurately describe the landscape. Hill country farming often faces challenges due to the variability of soil types, landscapes and precipitation. Continuous data acquisition of environmental variables for precision agriculture purposes would be extremely valuable for critical pasture management decisions such as species selection, feed budgeting and fertilizer placement.

Wireless Sensor Networks (WSN) is a promising, new, in-situ measurement technology for monitoring SM dynamics with high temporal resolution in agricultural soils. Geographical Information System (GIS) assisted spatial methodologies were used to determine potential sensor locations, and to design a WSN-topography to detect soil conditions on a 2,600 ha hill country farm in the Wairarapa region of the North Island of New Zealand. As SM distribution varies both vertically and laterally, 60cm long subsurface type multi-sensor probes were installed at 20 sites and attached to transmission nodes to take capacitance based readings at four consecutive depths. The network utilises a hybrid topology, therefore line-of-sight analysis was applied to assess node visibility and ensure stable connectivity within the telemetry range. Site selection was based on zero, first and second order topographic derivatives as part of the geomorphometric analysis.

This research found that three dimensional visualization techniques and geomorphometry integrating various landscape parameters are powerful tools in planning and deploying WSN's on large hill country farms. The interpretation of detailed geoinformation provides a clear depiction of the research area. Near real-time monitoring of soil variables will make it possible to better understand the dynamics of drying and wetting events in the rooting zone. Through the application of geostatistical methods, SM distribution and prediction maps can be obtained and so spatial information can be included in pasture growth models.