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Assessing Soil Moisture Estimation with NaI 3"X3" Detector: Potential for Agricultural Applications in Peru

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Agriculture plays an important role in the economies of developing nations, serving as a basis for economic stability, food security, employment generation, and rural development. However, optimal agricultural practices not only depend on favorable climatic conditions and soil fertility but also on efficient water access and irrigation management. In regions lacking sophisticated tools or technologies for water management, such as many parts of Peru, there is a growing need for cost-effective solutions to aid farmers in soil moisture management. Drawing inspiration from gamma spectroscopy techniques employed around the world [1,2], this study explores the potential of exploiting a commonly available and inexpensive the 3 x 3 inch NaI detector for soil moisture estimation. Field measurements were conducted from October 2023 to January 2024 in a grass-cultivated area at the PUCP campus, Lima, Peru. The NaI detector, typically utilized for laboratory and educational purposes, was positioned at a one-meter distance to estimate the gamma radiation intensity of ^{40}K. Comparative analyses were performed with gravimetric methods and gamma soil moisture stationary sensors like gSMS-100 from Medusa Radiometrics [2], demonstrating a good agreement. This underscores the viability of employing the NaI detector for continuous soil moisture estimation, with the aim of education and implementation in agricultural zones across Peru. The study not only depicts the practicality of this approach but also motivates for the establishment of national monitoring networks to safeguard water consumption and preserve food production in resource-constrained areas throughout Peru. By facilitating access to soil moisture monitoring technologies, this initiative seeks to foster sustainable agricultural practices and mitigate environmental degradation, thereby contributing to long-term food security and economic resilience in the agricultural regions.

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