A publication of SMARTSOIL Project

SMARTSOIL DIGEST

Volume 1, Issue 1 (Maiden Edition)

July, 2022

SMARTSOIL Project;

...soil mapping for optimum crop yield

Inside this issue:

SMARTSOIL Project; ...Healthy soil, Great 2

Background Information on the Project 2

Background Information on the Project Cont'd 2

SMARSOIL Project KickOff Seminar; A huge Success. 3

What is Digital Soil Mapping? 3

KickOff Seminar in Pictures 4

Special points of interest:

- FUNAAB SMARTSOIL, a modern soil information system for Southwest Nigeria using digital soil mapping and artificial intelligence techniques.
- The application of artificial intelligence techniques in soil science research has increased rapidly, especially in the last decade. New advances in digital soil mapping techniques have used machine learning (ML) models to predict soil distribution in space and time (McBratney et al., 2019) using soil data.

Soils provide the foundation for healthy food production and sustainable rural development, thereby contributing to global and national food security. As complex and dynamic systems, soil properties vary greatly and are susceptible to deterioration as the intensification of production and demand for productive soils increase. It is imperative to consider soil health for a shortage of any one of the 15 nutrients required for plant growth can limit crop yield.

To maximise agricultural productivity in Nigeria, the importance of a soil information platform that is user-friendly, easily accessible, and affordable to millions of Nigerian farmers and other users such as policymakers and researchers is important. This information will be a guide to farmers and policymakers on efforts to improve the fertility and biodiversity of Nigerian soils and ultimately, improve crop yield and agricultural productivity for millions of Nigerian farmers.

This project is aiming at developing "SMARTSOIL", a modern soil information system for Southwest Nigeria using digital soil mapping and artificial intelligence techniques and provides hyper-local soil information in a way that is easily accessible and affordable to farmers and other resource-deficient target groups (youth and women) and other interested end-users.

SMARTSOIL will guide farmers for the sustainable use and management of soils resources as well as agronomic advisory service to improve agricultural yield and productivity, food security, promote soil biodiversity conservation, and adaptation to climate change among smallholder farmers.

Food security for the large and ever-increasing population of Nigeria has been an important issue in recent years. To show the urgency of the problem, the latest data from the Nigerian Bureau of Statistics put food inflation at 23% (NBS, 2021). Thus, the need for sustainable food production and food security has never been more urgent. Increasing agricultural crop yields sustainably appears to be the only way out of the chronic decline in food and nutrition security in Nigeria and indeed Sub-Saharan Africa given the growing populations, shrinking farm sizes due to urbanization and rapidly degrading soil fertility.

Group Picture of SmartSoil Team Members

Background Information about the Project

To maximize agricultural productivity in Nigeria, the importance of a soil information platform that is user-friendly, easily accessible, and affordable to millions of Nigerian farmers and other users such as policymakers and researchers is important. This information will be a guide to farmers and policymakers on efforts to improve the fertility and biodiversity of Nigerian soils and ultimately, improve crop yield and agricultural productivity for millions of Nigerian farmers.

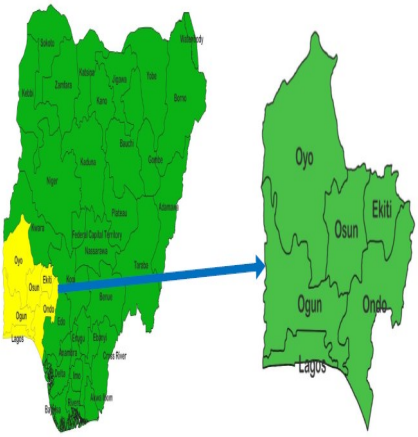
The application of artificial intelligence techniques in soil science research has increased rapidly, especially in the last decade. New advances in digital soil mapping techniques have used machine learning (ML) models to predict soil distribution in space and time (McBratney et al., 2019) using soil data. The increasing availability of soil data that can be

Background Information about the Project Cont'd

efficiently acquired remotely and proximally, combined with using freely available open-source, artificial intelligence algorithms such as random forest, support vector machine, convoluted neural network, etc. have led to accelerated adoption of ML techniques to analyze soil data and draw conclusions on soil properties such as soil pH, acidity, organic carbon content, cation exchange capacity (CEC), texture, bulk density, moisture retention, hydraulic conductivity, soil parent material, etc., therefore, giving us insight into soil fertility and soil biodiversity in a large area. This project intends to use advanced modelling techniques such as random forest and Support Vector Machine (SVM) that have been established to yield better results (Sirsat et al., 2018; Jeong et al., 2017, Camera et al., 2017).

This project is aiming to at developing SMARTSOIL, a modern soil information system for Southwest Nigeria using digital soil mapping and artificial intelligence techniques and provides hyper-local soil information in a way that is easily accessible and affordable to farmers and other resource-deficient target groups (youth and women) and other interested end-users.

SMARTSOIL will guide farmers for the sustainable use and management of soils resources as well as agronomic advisory service to improve agricultural yield and productivity, food security, promote soil biodiversity conservation, and adaptation to climate change among smallholder farmers.



The project is scheduled to take place in 6 states of SouthWest Nigeria

SMARTSOIL Project KickOff Seminar; A huge Success.

… targets women, youths, researchers, extension agents and agricultural policy makers for capacity building
… only FUNAAB Smartsoil project was successful among higher institution submissions from Nigeria that applied for the grant.
… VC pledges continued support of the University to the project.

SmartSoil Project Leader, Professor Olusegun Folorunso, delivering his address at the seminar.

"the SmartSoil project offers to solve this fundamental issue by utilizing existing cutting-edge techniques in soil science coupled with new technology in computer science (development of mobile App with Artificial Intelligence Techniques) to provide site-specific fertility status of soils especially in southwest Nigeria. This will enable farmers to have an idea of the nutrient status and crop suitability of their land"

To signal the official commencement of activities of the SmartSoil Project, the team organized a seminar tagged "SmartSoil KickOff Seminar" to explain to all stakeholders what the project is all about and what it intends to achieve at the end of its tenure.

The one-day seminar was properly attended by invited dignitaries which includes the Vice Chancellor of FUNAAB, Professor F. K. Salako ably represented by DVC Academics Professor C.O.N Ikeobi and the DVC Development, Professor O. B. Kehinde.

Other invited stakeholders include Extension Agents from the Ogun State Agricultural Development Program (OGADEP), Oyo State Ministry of Agriculture, and Rural Development (OYMA&RD) and Institute of Agricultural Research and Training (IAR&T), Ibadan.

Farmers who are majorly youths and women were also invited from Oyo, Ogun and Osun States to have an idea of the proposed innovation since they will be the greatest beneficiary of the product.

In his remarks, the project leader, Professor Olusegun Folorunso, stated that ***"the SmartSoil project offers to solve this fundamental issue by utilizing existing cutting-edge techniques in soil science coupled with new technology in computer science (development of mobile App with Artificial Intelligence Techniques) to provide site-specific fertility status of soils especially in southwest Nigeria. This will enable farmers to have an idea of the nutrient status and crop suitability of their land".*** He further appreciated the VC and University management stating that the grant was won principally because of the University's good records, performance and due diligence on past projects.

DVC Academics, Prof. C.O.N Ikeobi representing the Vice-Chancellor FUNAAB at the event.

The Vice Chancellor, ably represented by DVC Academics, Prof. C.O.N Ikeobi pledged his continued support for the project and encouraged the team members to give their best to the success of the project.

SMARTSOIL Project KickOff Seminar; A huge Success Cont'd

SmartSoil Project Co-Leader and Acting Director, DRIP-FUNAAB, Dr Mutiu A. Busari making salient points about the project.

While making his presentation on the project overview, the Project Co-leader aand Head of the Soil Science sub-group team, Dr. Mutiu A. Busari revealed the project objectives which includes;

- Increased access to user-friendly soil information for optimal agricultural yield for farmers in Southwest Nigeria,
- Manpower development for agriculture innovations and adoption in Nigeria,
- Increased awareness of climate change adaptation strategies, soil biodiversity management and soil fertility conservaton methodologies among farmers in Southwest, Nigeria
- Improved collaboration between University researches and agricultural policy makers on providing policy and institutional support for the adoption of digital innovations in Nigeria.

Mr. Adebayo M. Adebayo who is the Project manager also took the center stage to make a presentation on some project outputs and expected beneficiaries. Some of the expected outputs includes;

- Baseline Survey
- SmartSoil app (Android and Web app)
- Training courses for farmers and extension agents on the use of the SmartSoil app / Soil biodiversity management.
- Policy briefs on sustainable soil management to policy makers
- Soil fertility status report for policy makers
- Capacity development for young researchers and students on digital innovations development.

He also stated that some target beneficiaries includes:

- 600 farmers (50% female, 60% below 35 years)
- 40 Extension Agents (50% female, 60% below 35 years)
- Agric Policy Makers (6 States in SW, Nigeria) and
- 50 Researchers/Students (50% female, 60% below 35 years)

Also in his remarks, he stated that the expected impact is to "achieve improved sustainable soil management for agricultural production in Southwest, Nigeria"

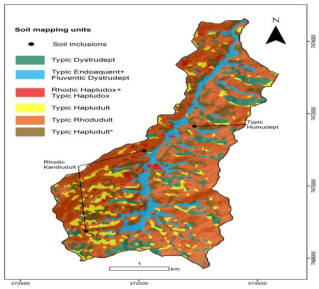
SmartSoil Project Manager Mr. Adebayo M. Adebayo

What is Digital Soil Mapping?

Digital Soil Mapping can be defined as the creation and population of spatial soil information systems by numerical models inferring the spatial and temporal variations of soil types and soil properties from soil observation and knowledge from related environmental variables (Lagacherie and McBratney 2007).

Digital soil mapping (DSM; a sub discipline of soil science is an active and successful with an active research output. Its success is hinged on a confluence of several factors including the increased availability of spatial data (digital elevation model, satellite imagery), the availability of computing power for processing data, the development of data-mining tools and GIS, and numerous applications beyond geostatistics. In addition, there was an increased global demand for spatial data including uncertainty assessments, and a rejuvenation of many soil survey and university centres which helped in the spreading of digital soil mapping technologies and knowledge. Minasny and McBratney (2016).

In the 1990s, quantitative techniques for soil survey and mapping were developed based on an analysis of relationships between soil properties and soil formation factors (environmental variables). This can be seen as the beginning of digital soil mapping. A range of techniques were used in this stage: linear regression, generalised linear models, classification and regression trees, neural networks,fuzzy systems and geostatistics (McBratney et al. 2003). For example, Moore et al. (1993) used linear regression to model soil properties (soil organic matter content, pH, soil texture) and terrain attributes (slope, aspect, and topographic wetness index (TWI)). McKenzie and Austin (1993) used linear regression to model the relationships between soil properties (clay content, cation exchange capacity, pH, and bulk density) and landscape attributes (slope gradient, relief and slope position).



A typical soil map.

Source: Google

KickOff Seminar in Pictures