

## FERARI FOCUS

### FERARI COLLABORATES WITH CIAT ON FERTILIZER RECOMMENDATIONS FOR GHANA



FERARI met with CIAT to collaborate on the development, validation, and dissemination of fertilizer recommendations in Ghana. The meeting took place Monday 25<sup>th</sup> September at Airport View Hotel, Accra.



Discussions centered on the CGIAR initiative in Excellence in Agronomy (EiA) and the FERARI approach in fertilizer recommendations using modelling.

FERARI presented a review of advances in digital soil information and agronomic solutions, and an exploration of the data available and the advanced analytical approaches that support fertilizer recommendation in Ghana. CIAT gave a presentation on design advisory services that consider user experience in the ease of access to published recommendations.

Both programs agreed to work together to deliver a common fertilizer recommendation and soil maps for Ghana, to be hosted by the Soil Research Institute (SRI) of the Council for Scientific and Industrial Research (CSIR). ■

## FERARI FEATURE

### UNIVERSITY OF CAPE COAST ESTABLISHES MASTER OF SCIENCE PROGRAM IN FERTILIZER SCIENCE AND SOIL HEALTH



▲ Nana Serwaa Amoako (middle left) visited the Vice Chancellor of the University of Cape Coast, Mr. NAME NAME (middle right).

The establishment of a Fertilizer Science and Soil Health masters' program at the University of Cape Coast took place during the July-September period. Two-stakeholder meetings were held to discuss the content of the course. Participants included professors from the University of Cape Coast, the University for Development Studies-Tamale, the Kwame Nkrumah University of Science and Technology, a representative from the Ministry of Agriculture-Directorate of Crop Services, and Nana Serwaa Amoako, an Adviser to the President of Ghana. A team from University of Wageningen also joined online during the meetings. A core team led by Nana Serwaa also paid a curtesy call on the Vice Chancellor of the University of Cape Coast, where she emphasized the importance of the course to the Government of Ghana. Currently, the draft program has been revised at the graduate school of the university for submission to the Ghana Accreditation Board for approval. Enrollment is expected to begin in January 2024. ■

## FERARI PUBLISHES DATA TO SUPPORT ITS FERTILIZER RECOMMENDATIONS, USE EFFICIENCY, AND ECONOMIC VIABILITY OF FERTILIZER FOR FARMERS IN GHANA

FERARI has painstakingly analysed its experimental and survey data to further understand fertilizer recommendations and use by farmers. The analysis of the experimental data supports FERARI's earlier findings highlighting the importance of sulphur in maize production. It also showed that optimal maize yield of 5-7 tonnes per hectare can be achieved with NPK 70-50-50 kg/ha in the Guinea Savannah zone and NPK 95-50-50 kg/ha in the Transitional zone. These are lesser application rates than the NPK 90-60-60 kg/ha and 100-40-40 kg/ha current national recommendations for these zones, respectively.

FERARI survey data on farmers' fertilizer uses and associated yields also confirmed that most farmers (about 72%) are economically unviable and generally inefficient with their use of fertilizers. Given the current production practices and systems of farmers, the economic viability of fertilizers can be achieved at an even lesser rate of NPK 51-50-25 kg/ha.

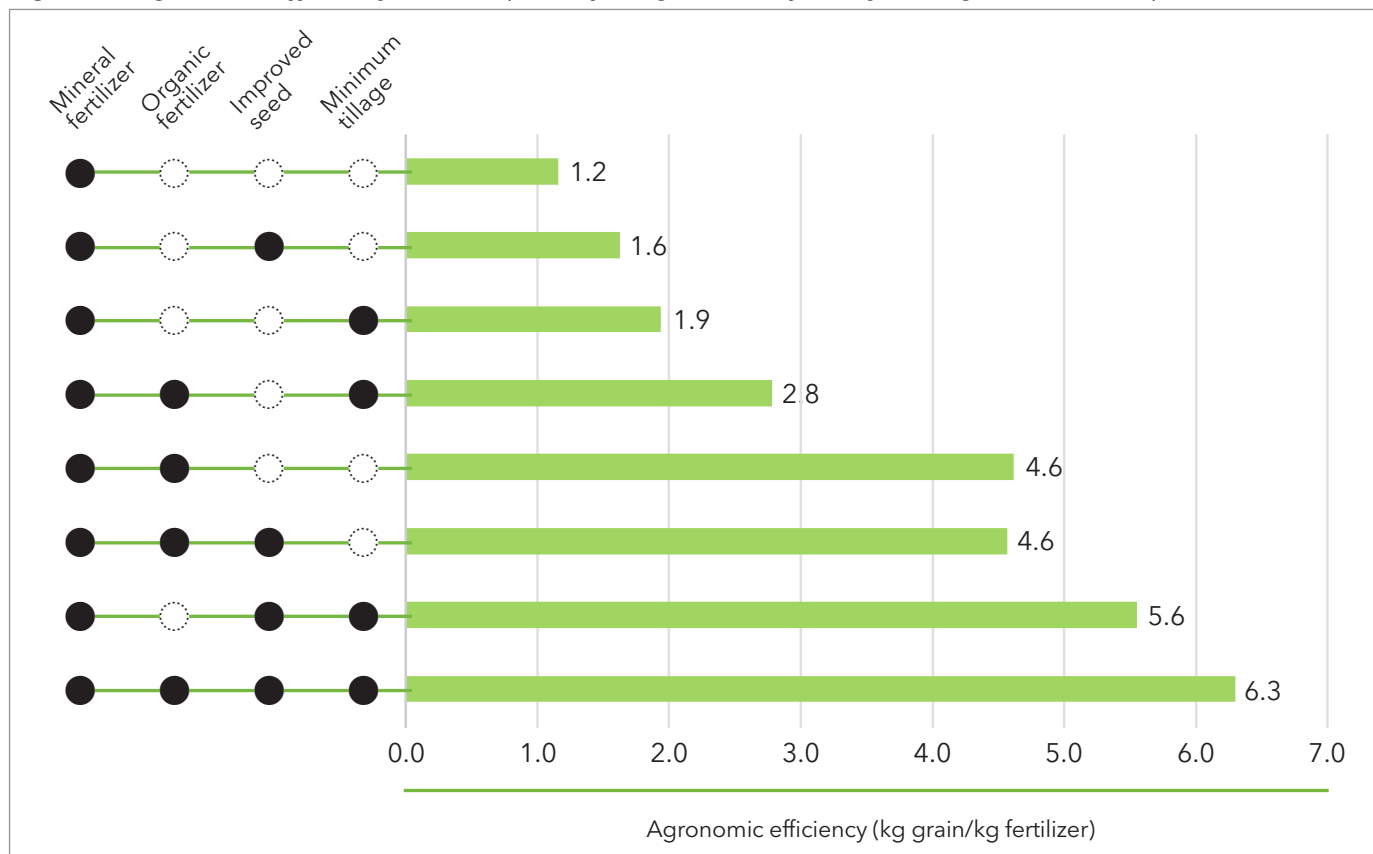
To improve the economic viability of fertilizers, the yield response on farmers' fields must be improved through the combine promotion and use of mineral fertilizers with organic fertilizers, improved seeds, and minimum tillage must be promoted and adopted by farmers (Figure 1). Pricing of maize grain and fertilizers are also critical in making fertilizer use economically viable on the farmers' fields.



▲ FERARI staff Geoffrey Amaniampong and Jephtha Nimo Marfo prepare a drone to collect survey data.

Both macro and microeconomic price policies are necessary to improve fertilizer and output pricing. Strengthening farmer associations can help farmers improve their yields under fertilizer application and be able to negotiate better prices for their produce to improve their economic viabilities. Implementing national policies including an improvement in feeder roads and reducing taxes on fertilizer products can also enable Ghanaian farmers to become more economically viable with fertilizer application. ■

**Figure 1.** Agronomic efficiency with adoption of integrated soil fertility management (ISFM) practices.



## UPDATES ON CURRENT WORK BY FERARI STAFF & STUDENTS

### ERIC ASAMOAH: FERTILIZER RECOMMENDATION VALIDATION TRIALS



As part of his PhD thesis, Eric Asamoah reviewed the current status of FERARI's ongoing field validation trials for fertilizer recommendations.

Eric explained, "the recommendations were derived from a machine learning model in addition to three other methods: QUEFTS-derived recommendations, FERARI-derived recommendations, and the existing national recommendation for maize in Ghana." He continued, "the aim of the validation trials is to compare the accuracy and effectiveness of recommendations from those four different sources."

The FERARI trials have been successfully established in fourteen locations distributed across the breadbasket of Ghana: Guinea Savannah (four trials), Forest Savanna Transition (six trials), and Semi-deciduous (four trials) agroecological zones. Trials in the Forest Savanna Transition and the Semi-deciduous Forest zones began in April and ended in August. Major activities performed included planting, fertilizer application, pest controlling, monitoring and collecting data on crop growth parameters, and harvesting of the matured maize and biomass. All the ten trials in the Forest Savanna Transition and the Semi-deciduous Forest zones have been harvested. The remaining four trials in the Guinea Savannah zone which commenced in late July are still on-going and will be due for harvesting in November.

Eric reports, "Additional activities being carried out concurrently include soil analysis (soil characterization, soil sampling, and soil profiles description) for the trials site and preparation of soil samples collected for laboratory analysis. Biomass and grain samples from the already harvested plots have also been prepared for analysis to determine the nutrient uptake of nitrogen, phosphorus, and potassium by the maize plant." ■



FERARI PhD student Eric Asamoah collecting data in the field.



▲ Eric with farmers and scientists in a field after application of basal fertilizer application at Nahaa (Guinea Savannah AEZ).



▲ Eric describing a profile on the soils of a experiment site at Amantin (Forest Savanna Transition AEZ).

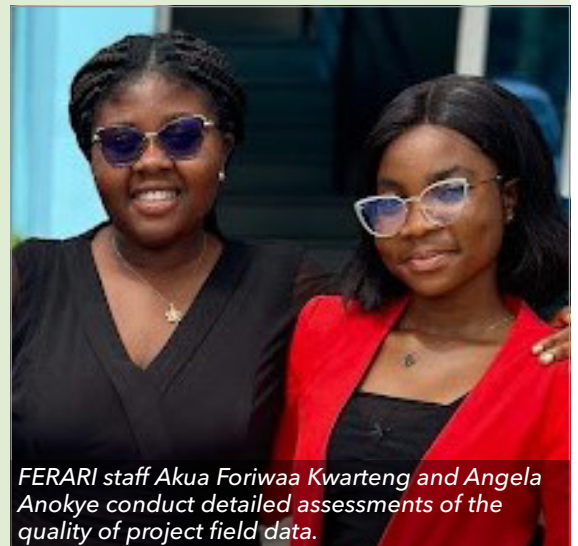
## DATA QUALITY CONTROL TEAM: AKUA KWARTENG AND ANGELA ANOKYE



Akua Foriwaa Kwarteng teamed up Angela Anokye with to assist FERARI in validating field data from the project's activities. Angela explained, "The data collected for agricultural field experiments can be riddled with errors due to various factors such as human error in data recording, environmental fluctuations, measurement inaccuracies, and equipment malfunctions."

"These errors can be in the form of missing values, outliers, inconsistent measurements, or even mislabeling of variables," Akua added. She and Angela help FERARI address these issues. "Data cleaning is essential," Angela stated. "The rationale for data cleaning in our agricultural experiments is to ensure the reliability and accuracy of our research findings. By identifying and rectifying errors, data cleaning helps to eliminate misleading data points that could skew results or conclusions."

In FERARI's quest to recommend effective fertilizers for farmers, Akua pointed out, "accurate research data with minimal errors is a must because it serves as the foundation for robust statistical analyses, precise model predictions, and informed agricultural decisions." Their work with FERARI has allowed both women to acquire knowledge and become well-versed in statistical software applications such as Excel, GenStat, R, Python, and various other applications they use in data cleaning and data transformation. ■



*FERARI staff Akua Foriwaa Kwarteng and Angela Anokye conduct detailed assessments of the quality of project field data.*

## ON-FARM MANAGEMENT OF SOIL FERTILITY: EUGENE DELA SETSOAFIA



Eugene Dela Setsoafia, FERARI PhD student, reported on his research progress: "As I round-up field work for this growing season, I have been focusing on understanding the barriers and enablers to soil fertility management amongst smallholder farmers. I have been investigating issues related to availability, access, collection, storage, transportation and application of manure and mulch. Issues related to labour and the timing of these activities are also under investigation." He explained how this year, on-farm farmer managed trials were repeated with 81 farmers across the Savannah, Northern and Northeast regions. "54 out of the 81 farmers received fertilizers and 27 of them had improved maize variety added to the fertilizers," Eugene said.

The purpose of the trial was to uncover the effect of fertilizer and improved varieties on crop yield, when these inputs are complemented with mulching and organic manure application. During the trials, some members of the supervisory team from Wageningen University and Research and University of Ghana, visited the fields to interact with the farmers participating in the FERARI trials and with the students, to have a firsthand appreciation of how activities were unfolding and to offer some perspectives for further research and approaches for the analysis and interpretation of findings. ■



*Co-promoters from Wageningen University visit FERARI PhD student Eugene Setsoafia and engage with smallholder farmers.*

## UM6P VISIT GIVES VALUABLE INSIGHTS: KASSIM BABA



Kassim Baba is one of FERARI's PhD candidates, and he visited the UM6P Ben Guerir campus from 1st February to 31st March 2023. During this period, Kassim took a PhD course in "Soil Fertility Management in Acidic Soil" which was organized by the Chair of Soil Science in collaboration with the University of São Paulo in Brazil. He categorized his lessons learned from the course in three areas: (i) that crop growth can cause soil acidity even without applying fertilizers that release hydrogen into the soil, because plants release hydrogen into the soil in place of the cations absorbed; (ii) that a good soil should have a base saturation of 60-80 %; and (iii) that the C:N ratio of soil organisms that decompose organic matter is 10:1 and around this same ratio is the stable form of C (humus) in soil. Kassim explained, "this has important implications when organic materials with C:N ratio greater than 10:1 are applied during crop production, because N needs to be applied to mitigate the N immobilization by decomposing organisms." He continued, "this gave me an important perspective on my study as to what I should expect as an organic material with C:N ratio of 21:1 is being applied as mulch."

Kassim gave seminar presentations at the Agricultural Innovation and Technology Transfer Centre (AITTC) and at CEDoc on the topic "In-season dynamics in canopy cover and leaf chlorophyll content in maize as influenced by agronomic practices under N, P, and K fertilization." The AITTC presentation was meant to get feedback/input from colleague students and staff to enable Kassim to finetune his presentation to be made at CEDoc at a later date. During the presentations, Kassim used data from his first year of



field activities to show that (i) the productivity of soils in northern Ghana can be enhanced by mulching, ridging, sulfur application, and a 25% increase in planting density; (ii) the tested interventions increased the agronomic NUE of N by 100-256% in maize, and of P by 11-233% in soybean; and (iii) available soil moisture was highest when mulch application and ridges were implemented.

Initial analysis of the current year's data showed plots that were ridged, mulched, or ridged and mulched had increased rain-water infiltration into the soil. The increased water infiltration in the ridged, mulched, or ridged and mulched plots led to higher soil moisture content compared to plots that did not receive any of these treatments. Soil moisture content in the ridged plots was higher in the furrow than on the ridge, but when the height of the ridge was accounted for, similar moisture content was found, suggesting there was lateral water movement from the furrow to underneath the ridge at the deeper depths. For both maize and soybean, plants in ridged plots were taller and had a larger stem diameter with lower height-to-diameter ratio, suggesting the ridges enhanced vegetative vigor. ■



▲ Soybean experiments using mulch were undertaken at Gauwogo (Guinea Savannah zone) in 2023.



▲ An experiment with maize was also established at Gauwogo. Mulching has been applied to conserve soil moisture.

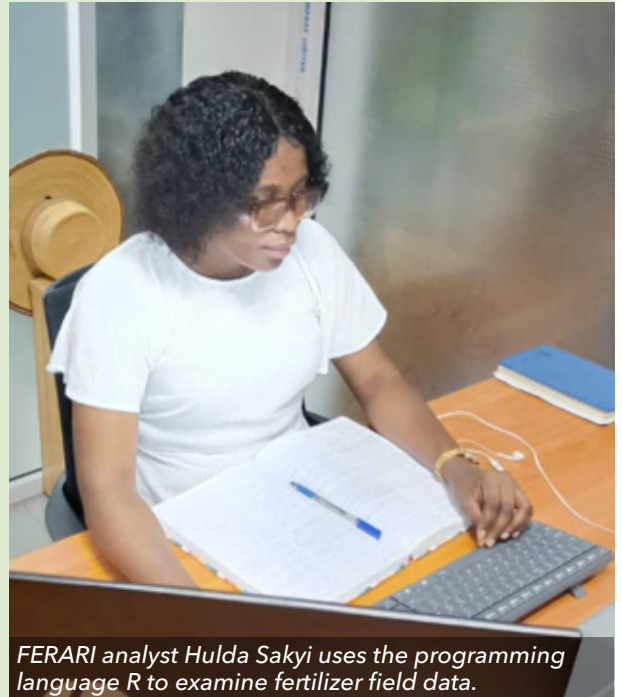
## FROM TACIT TO FORMAL KNOWLEDGE: HULDA SAKYE



Hulda Sakyi serves on the FERARI project as the Agronomy and Crop Science Analyst with an expertise in Fertilizer Science. She joined FERARI in February 2023 and has since contributed significantly to the program. In her role as analyst, she aims at determining the impact of fertilizers - particularly the role of blended fertilizers with micro- and secondary nutrients - on key crops, maize, soybean, and rice, in Ghana.

According to Hulda, recognizing the significance of micro and secondary nutrients as limiting nutrients would enable farmers and researchers to optimize fertilization strategies, improve crop productivity, and promote sustainable agricultural systems towards improving food security in Ghana. She noted, "FERARI's approach is novel towards holistically addressing the food crop production challenges in the country."

Hulda is currently working with the field data of FERARI using the R programming language (a programming language she learned after joining FERARI) to facilitate her analysis. Specifically, she is extracting meaningful insights and identifying key factors influencing fertilizer performance and crop productivity from the FERARI dataset for the purpose of publishing in scientific journals and engaging policy makers. She explained, "The past few months have taught me that continuous learning, collaboration, and having an open-minded approach are key to improving knowledge in the research field." ■



*FERARI analyst Hulda Sakyi uses the programming language R to examine fertilizer field data.*

**FERARI**  
FERTILIZER RESEARCH & RESPONSIBLE IMPLEMENTATION

**IFDC**  
Developing Agriculture from the Ground Up

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