FERARI
FERTILIZER RESEARCH & RESPONSIBLE IMPLEMENTATION

IFDC
Developing Agriculture from the Ground Up

4TH QUARTER – JANUARY 2021

QUARTERLY newsletter

FERARI FARMERS

FARMERS' YIELD RESPONSES TO NFBs

The PFJ program supplied New Fertilizer Blends (NFBs) NPK 15-20-20+0.7Zn, NPK 12-30-17+0.4Zn, and NPK 17-10-10 for cereals, legumes, and cassava respectively, during the 2019 planting season. FERARI, supported by the University for Development Studies (UDS), conducted a survey of 1,038 NFB users and 226 non-users in early 2020. The findings are very preliminary, as the data have not yet been analyzed in detail.

Overall, maize yields in 2018 were higher than in 2019, even though most of the NFBs were applied to maize. Yields of rice and soybean revealed the same trend, suggesting that other factors, such as rainfall and pest and disease infestation, impacted yield. Maize farmers who used the NFBs recorded slightly higher yields in 2019 than non-users, but this difference was observed in 2018 as well, when no NFBs were used, suggesting categorical differences in farm management as overriding determinants.

Farmers indicated the following challenges in using the NFBs:

- ✓ Difficulty in physically accessing the fertilizers;
- ✓ Expense of the fertilizers, even with subsidies;
- ✓ Inadequate information on how the fertilizers should be applied; and
- ✓ Tedium in the application of the fertilizers.

FERARI FOCUS

FERARI COLLABORATES WITH THE GOVERNMENT OF GHANA TO DEVELOP AND IMPLEMENT THE GHANA FERTILIZER EXPANSION PROGRAM

The Ministry of Food and Agriculture (MoFA) plans to implement the Ghana Fertilizer Expansion Program (GFEP) that will operationalize the existing national fertilizer policy and regulations, building on other ongoing initiatives to increase crop yields and jobs across Ghana. MoFA, with support from the Alliance for a Green Revolution in Africa (AGRA), recruited consultants to develop a five-year strategic plan for the GFEP. One-day stakeholder validation workshops for this strategy will be held in Tamale, Kumasi, and Accra in January/February 2021.

The GFEP strategic plan (2020-2024) intends to increase public and private investments in fertilizer production for domestic and export markets (Result 1); optimize the fertilizer value chain (Result 2); improve fertilizer sector development and management (Result 3); and improve public-private investments to drive fertilizer demand (Result 4).

The approaches developed by the FERARI program strongly hinge upon our collaboration and coordination with GoG in the implementation of the GFEP. FERARI's initiatives for increased domestic fertilizer blending and research and development (R&D) for local raw materials for fertilizer production are crucial to the achievement of the GFEP's Result 1. Our interventions with national subsidy program reform (that will eventually establish a competitive private sector-led fertilizer market), reduction of inefficiencies in domestic fertilizer distribution along the value chain, and capacity building of actors are outlined for achievement of the GFEP's Result 2. Our actions in the area of R&D for balanced soil and crop nutrition and the establishment of the Ghana National Fertilizer Platform work in conjunction with GFEP strategies toward the realization of its Result 3.

FERARI is also facilitating farmers' access to reliable and remunerative markets and improved public perception and knowledge of fertilizer use through our on-farm, on-station,

and farmer-managed field trials and demonstrations for targeted farmers and value chain actors. These efforts aim to achieve GFEP's Result 4. FERARI also shares in executing cross-cutting issues, such as increased access to finance by fertilizer value chain actors, increased youth and women empowerment, and improved actor database development and management.

In view of these strategic collaborative efforts in the fertilizer sector by FERARI and the GoG, FERARI will present implementation updates and progress thus far in establishing the Ghana Multi-Stakeholder Fertilizer Platform at the GFEP validation workshop. This platform is envisaged as the foundation for the GFEP institutional architecture, supporting the smooth implementation of the GFEP and contributing meaningfully to the successful achievements of its goals. ■

▲ *Yakubu presenting progress on Ghana Fertilizer Platform at GFEP validation workshop.*

DISTRIBUTION OF NEW FERTILIZER BLENDS IN THE 2019 PLANTING SEASON

FERARI developed an overview of the distribution of new fertilizer blends (NFBs) containing zinc in eight regions in Ghana under the Planting for Food and Jobs (PFJ) program for the 2019 growing season. Data for this review were obtained from the Crop Services Directorate in Accra and the respective regional and district Departments of Agriculture of the Ministry of Food and Agriculture (MoFA) responsible for the fertilizer subsidy program.

A total of 337,000, 247,000, and 331,000 metric tons of fertilizer were supplied by PFJ in 2017, 2018, and 2019, respectively. These included both compound fertilizers and urea in 25- and 50-kg bags. The NFB NPK 15-20-20+0.7Zn was distributed most, and NPK 15-20-10+0.7Zn the least. Among the various fertilizers, only urea and NPK 20-10-10 were supplied to all regions. The Upper West and Upper East regions of Ghana received the highest quantities of fertilizer, while Ahafo and Savannah received the lowest quantities supplied by 42 companies, both importers and distributors. A total of 732,000 (527,000 male and 205,000 female) farmers benefited from the 2019 PFJ fertilizer distribution.

While large amounts of NFBs were distributed, the study revealed that district Department of Agriculture officers had inadequate knowledge of the NFBs in terms of NPK blend categories, the need to combine NPK compounds with urea, target crops, and rates of application, all of which are important for effectiveness. Optimization of the fertilizer distribution chain is recommended to ensure that fertilizer types and quantities are distributed to the correct areas at the right time. District officers should be actively involved in subsequent fertilizer validation trials and demonstrations of fertilizers intended for the PFJ program. ■

TABLE 1. *Regional Distribution of Fertilizer for the 2019 PFJ Cropping Season*

REGION	BAG SIZE (KG)	NPK 12-30-17 +0.4ZN	NPK 15-20-10 +0.7ZN	NPK 15-20-20 +0.7ZN	NPK 15-15-15	NPK 17-10-10	NPK 20-10-10	UREA	TOTAL*
Ahafo	50	-	-	-	-	1,947	7,503	9,773	19,223
Bono	50	-	-	1,810	-	720	20,641	11,419	34,590
Bono East	50	-	-	30,780	3,000	40,381	57,127	65,777	197,065
North East	25	7,600	-	73,966	-	-	18,066	8,340	107,972
Northern	25	6,860	-	113,427	18,446	-	11,330	50,159	200,222
Savannah	25		-	20,138	2,400	-	5,594	5,230	33,362
Upper East	25	67,035	3,400	420,200	25,100	-	95,543	110,536	721,814
Upper West	25	24,500	-	488,362	44,680	-	103,963	168,309	829,814
	25	105,995	3,400	1,116,093	90,626	-	234,496	342,574	1,893,184
Total	50	-	-	32,590	3,000	43,048	85,271	86,969	250,878
	Kg‡	2,649,875	85,000	29,531,825	2,415,650	2,152,400	10,125,950	12,912,800	59,873,500

** Number of bags.* *‡ Total amounts in kg*

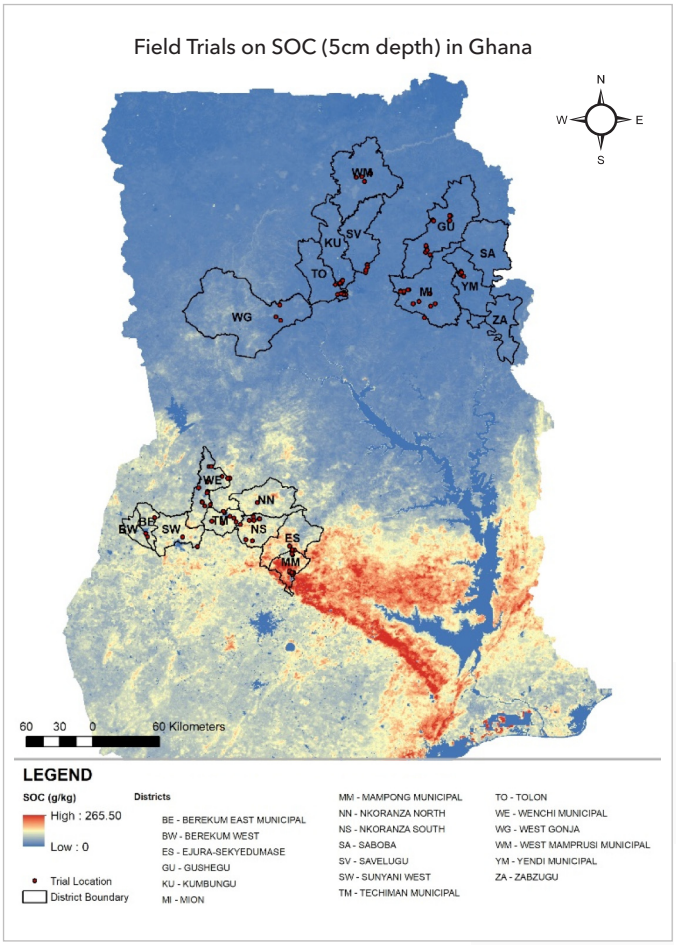
FIELD TRIALS TO ASSESS NUTRIENT IMPACT ON CROP YIELD AND QUALITY

FERARI conducted 45 on-station trials in the first season of 2020 to determine the impact of various nutrients on the yield response of maize, rice, and soybean and the nutritional content of the grains. Field trials across the target regions in Ghana, as reported in journal articles and by local sources, have revealed that N, P, K, S, and Zn (and, to a lesser extent, B, Ca, and Mg) increase crop yields. Nutrients have thus far been applied to the soil. Our trials have been limited to include N, P, K, S, and Zn, given their large impact. Treatments with foliar application of Zn, Fe, and P were also included, with the aim of reducing phytate content and increasing Zn and Fe in grains. High phytate content in grains (due to high P uptake) fixes grain Zn and Fe, which hampers uptake of these essential nutrients by humans, causing malnutrition. Foliar applications may decrease the amount of micronutrients needed for the same yield impact. Micronutrients have been coated onto compound fertilizers for better distribution. The effects of (poorly soluble) phosphate rock and water-soluble P fertilizers have been tested, while sulfur-omission trials should confirm or reject the reported impact on yield. A similar treatment logic has been applied to the on-farm trials, yet with fewer treatments, that aim to capture the essence of the objectives.

Most trials have been harvested, and we expect to compile the data soon. Thorough analysis of this vast amount of data will be done with master's-level students who have been engaged in conducting these trials and some additional students for overall generic analyses. They will be supervised by their local university lecturers, FERARI staff, and researchers from other universities as needed.

Some of these trials will be repeated in 2021 to confirm the findings and to allow publication in peer-reviewed journals. The findings from the current trials will help in determining the treatments for 2021 trials.

FERARI seeks to advance the way it approaches farm practices. Preliminary analyses reveal that the type of seed and fertilizer used, the amount of hired labor, and whether or not herbicide is used heavily impact farm yields. Local NGOs may be engaged to coordinate farmer-managed trials, i.e., trials in which farmers are supported with seed, fertilizers, and labor to be used according to their best judgment. This would establish whether improvement of these factors boosts yields. Engagement of buyers and processors in our demonstration efforts will expand the base of stakeholders interested in higher yields, who might support such activities or create market opportunities. ■



▲ *Map of organic carbon content in the upper 5 cm of soil (from ISRIC) with superimposed trial locations.*

GAPS, FARMER FIELD DAYS, AND ON-FARM DEMONSTRATION TRIALS

The adoption of good agronomic practices (GAPs) is necessary for improving the productivity and livelihoods of farmers. As such, one strategy of FERARI is to demonstrate the effect of different fertilizer combinations and application methods on the yield of maize, rice, and soybean through on-farm trials.

Farmer field days (FFDs) as an agricultural extension approach provide a venue for information sharing to farmers, enhance innovation learning, and speed the adoption process. Because FFDs are conducted in the local languages and the farmers interact with

▲ *Farmer field days offer information in local languages.*

each other on-site, it is easier to quickly disseminate information to many farmers.

To gauge the perception of the participating farmers, FERARI conducted interviews, in addition to focus group discussions, with 191 participants and key informants, such as agricultural extension agents and MoFA district directors. The farmers showed much enthusiasm during the FFDs.

The participants indicated that there were observable differences between the demonstration farms and their own farms. The farmers admitted that the demonstration farms have less weeds than their own farms. They acknowledge that the demonstration farm crops are better quality and general agronomic management is superior. The farmers recommended that the demonstration trials be repeated in order to reinforce proper understanding and adoption of the practices. The AEAs expressed optimism that the farmers would soon adopt the demonstration practices. District MoFA directors also voiced confidence that the FERARI demonstration activities would lead to improved yields in their districts. ■

▼ *Checking soybean condition in a demonstration plot.*

BASELINE STUDY ON FERTILIZER USE, CROP YIELDS, FOOD SECURITY, AND POVERTY

To provide a basis for monitoring and evaluation of FERARI's progress in transforming the fertilizer and food system, the program established baseline data on fertilizer use, crop yields, and food security and poverty in the Guinea Savannah, Sudan Savannah, and Transitional zones of Ghana.

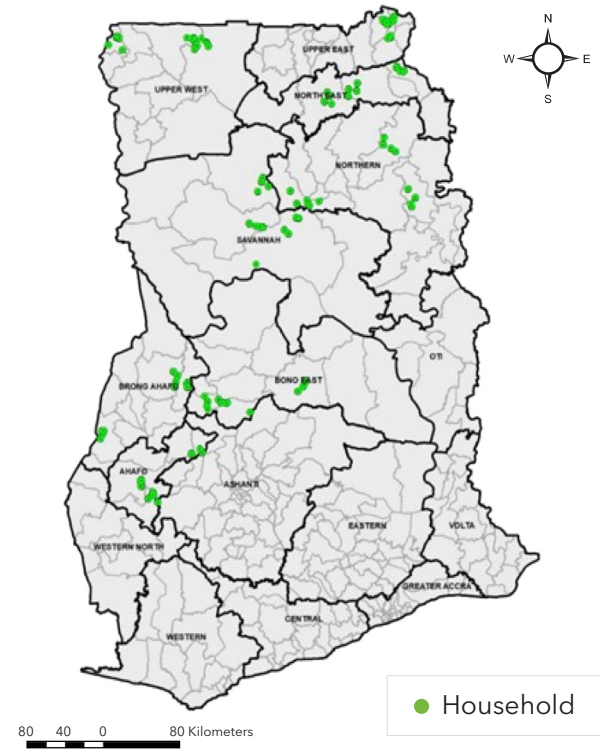
A total of 1,450 farmers from 24 districts were selected and interviewed. A questionnaire was designed, and field enumerators were recruited, trained, and deployed to the various locations. The data were collected using a computerized system that allowed for effective data monitoring and management and ensured minimal error in data collection. The analyses raised several critical insights.

The survey established that eight of every 10 farmers used at least one type of fertilizer in the Ghanaian market. NPK 15-15-15, urea, ammonium sulfate, and NPK 15-20-20+0.7Zn were the fertilizers primarily used.

Overall, the farmers have applied fertilizers at less than the recommended rate because of challenges such as lack of credit. Socioeconomic factors, the farmers' perception of their soil conditions, and regional location influenced the rate of fertilizer applied. Yields of maize, rice, and soybean differed among regions and were dependent on fertilizer application. However, few of the yield differences appeared to be due to different fertilizer types at first glance, but the data need to be analyzed thoroughly for detailed insight.

More than half of the farmers interviewed have high probabilities of being poor, while close to one-third were severely food insecure. The baseline results identified a number of indicators that will monitor in subsequent years. Overall, the findings raised further scientific questions that the program seeks to answer through research and implementation activities. ■

Farm locations in the baseline study



▲ *Farmer interview in Namangu.*

▲ *Technician interviewing a farmer.*

YIELD CUT AND SOCIOECONOMIC SURVEY

To demonstrate farmers' potential to increase their yields and offer recommendations and training on how to achieve this, FERARI established 180 on-farm maize, rice, and soybean demonstration farms. However, a preliminary observation, as described in the section on FFDs, was that the yield potential of the demonstration farms differed greatly than farmers' own farms. Surveys and experimental trials demonstrated the need to gather data on the actual yields of the farmers.

Thus, 160 farmers who had crops ready for harvest were selected based on the proximity of their farm to the demonstration sites or their involvement in FERARI's baseline study. Qualified technicians conducted the yield cut and surveys. On each farm, data from three yield cuts, each from 4 square meters, were gathered. The data includes the plant stand per hill count, cob count and weight, paddy/grain weight, and stock/straw weight. Samples were taken from each farm for processing and laboratory analysis.

To understand the production process and relate the farmers' yields appropriately, the yield cut data were complemented with a socioeconomic survey on the farmers' production and labor decisions. These datasets are currently being analyzed. ■

NEW MASTER'S STUDENT RESEARCHERS SELECTED FOR 2021

Under the FERARI Master's Student Research Internship Program, new students have been competitively selected to undertake research on carefully developed topics relevant to advancing the program starting in January 2021. The students, including four from Mohammed VI Polytechnic University (UM6P), will conduct this research to fulfill requirements for their master's degree and to produce FERARI reports and, if feasible, research articles for publication in scientific journals. Policy briefs will allow access of the findings to a wider audience.

The following master's-level students have been selected for the program:

1. **Joshua Atwi Boasiako**, studying agricultural economics at Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana, was selected for the ***Assessment of Agricultural Development Programs in the Northern and Middle Belt of Ghana: Successes, Drawbacks, and Lessons Learned***. Joshua will determine the impact of the various agricultural development programs implemented in Ghana's northern and middle agroecological belts, drawing on findings to better guide the implementation of current and future programs.
2. **Abukari Anass Neindow**, studying agricultural economics at UDS, Nyankpala, Ghana, will research ***Farming Systems and Farm Investment Decisions***. Abukari's research touches on farming systems and production decisions of the farmer, as well as farmers' investment decisions in crop farming. This research aims to unfold why farmers do what they do in order to help fine-tune future program activities to better target interventions to farmers' needs.
3. **Christina Appiah Adjei**, a student of agricultural economics at UDS, Tamale, Ghana, will undertake research on the ***Maize and Soybean Value Chain and Market Intelligence among Farmers in Northern Ghana***. Agricultural marketing is an important driver of agriculture sector sustainability and improvement in farmers' living conditions. Hence, market information and intelligence are crucial to enabling farmers and traders to make informed decisions about what to grow, when to sell, and where to sell. Christina, who has work and research experience in agricultural value chains, will assess the players and their linkages, analyze farmer access to marketing and information, and examine the effect of market intelligence on farmer behavior and farm income in the value chains.
4. **Williams Opoku-Agyemang**, an agricultural economics student from the University of Cape Coast (UCC), Ghana, was also selected to undertake research on the ***Maize and Soybean Value Chain and Market Intelligence among Farmers in Northern Ghana***. Williams, who has relevant research experience and qualitative/quantitative analytical and data processing skills, will assess the linkages among players, analyze farmer access to marketing and information, and examine the effect of market intelligence on the farmers' behavior and farm income.
5. **Mohammed El Moussaidi**, studying fertilizer science and technology at **UM6P** in Morocco, was selected for the ***Assessment of Soybean, Maize, and Rice Yield Trends in the Northern and Middle Belt of Ghana: Impact of the Ghana Fertilizer Subsidy Program***. With his experience and expertise in qualitative and

quantitative analysis, Mohammed will collect and review secondary data on yield trends over the year and the fertilizer distributed by the Government of Ghana's PFJ fertilizer through MoFA. He will establish the link between the distribution of the subsidized fertilizer and yield trends.

6. **Edmund Odjawo**, a crop science student at the University of Energy and Natural Resources (UNER), Sunyani, Ghana, will also work on the ***Assessment of Soybean, Maize, and Rice Yield Trends in the Northern and Middle Belt of Ghana: Impact of the Ghana Fertilizer Subsidy Program***. With strong research experience and expertise, Edmund will work with Mohammed El Moussaidi, though in another region.

7. **Pierre Pascal Diene**, a student of fertilizer science and technology at **UM6P**, was selected to research ***The Impact of (Changing) Power Relations on Fertilizer Sector Issues in Ghana***. Power plays a major role in decision making and implementation in a fertilizer sector multi-stakeholder platform, as members have various resources due to their location and activities in the fertilizer value chain. Thus, (changing) power relations play out in benefit distribution and may have potential negative effects for actors along the value chain. Pierre's research will use political science theories and prevailing practice to critically analyze the power relationship among actors to determine who really benefits and what potentially negative effects are at scale.

8. **Harrisane Ikram**, a fertilizer science and technology student at **UM6P**, will research ***Framing and Discourse Analysis of Fertilizer Sector Issues in Ghana***. With her passion for addressing communication issues, especially among multistakeholders, including smallholder farmers, Harrisane's research will seek to identify and develop appropriate modes of effective communication among the fertilizer sector audience in Ghana. Her research will include review, analysis, and survey of framing and discourse theories as well as current communication modes of the fertilizer sector in practice and their effects on multistakeholders.

9. **Koume Kuakou Kan Anselme**, studying fertilizer science and technology at **UM6P**, will research ***Fertilizer Use and Yield Response***. Currently, the complexities between low yield and underapplication of fertilizer in Ghana require a review of existing literature and statistical analyses of fertilizer/nutrient use and yield to assess the effect of soil management practices and other co-variates on the yield of maize, rice, and soybean. Auxiliary variables, including soil type, various soil properties, and rainfall, will be gathered from maps to perform multivariate and spatial analyses. Koume has demonstrable expertise and experience in spatial and statistical analysis.

10. **Oduro Agyapong Anane**, a student of agricultural economics at KNUST, will undertake further analysis of ***Fertilizer Use and Yield Response***. Oduro will add value to this research topic by reviewing existing literature, conducting statistical analyses, and assessing the effectiveness of soil management practices and other co-variates on fertilizer/nutrient use and yield of maize, rice, and soybean. His research tasks also include gathering auxiliary variables from maps, including soil type, various soil properties, rainfall, etc., to perform multivariate and spatial analyses.

11. **Dorcas Agbakwuru Chidinnma**, studying agricultural economics at the University of Ibadan, Nigeria, will work to ***Synthesize the Impact of Fertilizer Deep Placement on Crop Performance and Farm Socioeconomics and the Required Fertilizer Value Chain Dynamics for Large-Scale Adoption***. Dorcas will analyze existing data, synthesize available information, and gather additional information if needed to formulate recommendations for large-scale adoption of fertilizer deep placement. With her remarkable field research experience and demonstrable analytical and data processing skills, Dorcas's findings will be used to design FDP technologies and approaches for possible large-scale adoption in Ghana. ■

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