Fertilizer Use and Farmer Productivity in Nigeria: The Way Forward – A Reflection Piece[1]

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Increasing the use of modern inputs including fertilizer is key for raising agricultural productivity and reducing poverty in Nigeria, particularly and Africa more generally. However, based on recent empirical evidence from Nigeria, simply increasing the quantity of fertilizer used by smallholders is not likely to successfully drive this process. A more holistic approach that addresses the constraints to fertilizer profitability in Nigeria with appropriate consideration of the factors which will increase the efficiency of fertilizer use is necessary. This includes proper attention to soil characteristics and organic matter content, attention to ways of increasing farmer access to and use of good quality complementary inputs such as improved seeds, machines and irrigation as well as ways to improve farm management practices such as the timing of fertilizer application, weeding and pest control, crop rotation and intercropping.

Farmers attending a video projection training session about Urea Deep Placement technology for rice production in Ilorin, Kwara State, Nigeria; July 2014 Photo Credit: Serge Adjognon

This reflection piece is largely informed by a set of empirical studies recently conducted by researchers at University of Ibadan, Nigeria and Michigan State University, USA to tackle the question whether *increasing fertilizer use among cereal farmers in Nigeria is a profitable proposition? T*hese studies made use of recently available data that is nationally representative with rich data on agricultural practices and socio economic conditions for the same set of households over multiple years.

To tackle this questions about fertilizer profitability, the authors considered the agronomics of fertilizer use (e.g. how much more rice does a farmer get from applying one additional kg of nitrogen) as well as the economics of fertilizer use (e.g. how much does it cost to buy and transport fertilizer to the farm) for the production of rice, maize and sorghum in Nigeria. This approach is based on the idea that rural farmers in Nigeria (being rational) will only use fertilizer if the value of using the input (i.e. the higher yield from fertilizer use and the price that the cereal being produced can fetch in the market) is sufficient to cover the cost of acquiring fertilizer (i.e. the sum of the market price for fertilizer and the transportation cost necessary to secure the input).

Key findings: Low yield response and high transport costs reduce fertilizer profitability in Nigeria:[4] These empirical studies consistently found that little extra rice, maize or sorghum is expected from adding more nitrogen at the margin; that is, the Marginal Physical Product (MPP) of applied nitrogen for these crops is quite low. It is about 8kg for maize and 9kg for rice. Though these are within the range found in peer-reviewed published works in other African countries (often between 7 and 14 kg), it is at the low end of the range in Africa and much lower than the potential yield response from plots on which research management protocols are being followed which can be above 50 kg maize per kg nitrogen (N) (Snapp et al, 2014).

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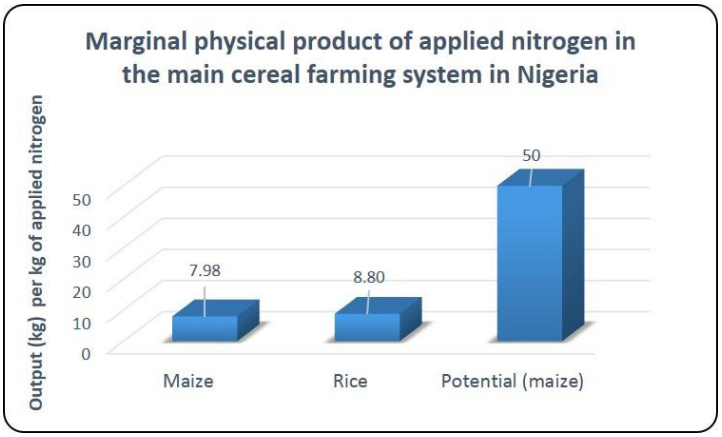
[4] The studies with more detailed policy briefs are available at http://fsg.afre.msu.edu/gisaia/index_Nigeria.htm



These studies also consistently found that Nigerian farmers face very high transportation costs traveling to procure fertilizers from agro-dealers or markets, largely because of poor rural infrastructure and far distances. The two main modes of transport (used by almost 90% of respondents who purchased fertilizer) are motorcycles and minibuses and the average farmer is about 70Km from the market. Consequently, the average transportation cost paid by farmers to transport a bag of fertilizer from the market was about N350 for those using motorcycles and N450 for those using minibuses.

The Way Forward:

The results call for keen attention to two issues faced by smallholder farmers in Nigeria. First, **reducing transportation costs**. While this could obviously be achieved with improved rural infrastructure (an important role of Government), there are other strategies that could be used to reduce the distance farmers travel to purchase fertilizer and other inputs. Empirical evidence from some recent work on fertilizer subsidy programs in Nigeria demonstrates that programs which strengthen the link between rural farmers and agro-dealers to reduce the distance farmers have to travel for the input could significantly increase fertilizer demand. This is because they lower the acquisition cost for fertilizer and increase the profitability of its use for smallholders. Thus, support to rural dwellers (e.g. entrepreneurial youth who can serve as local distributors in the rural areas) including providing them with training, subsidized access to storage facilities and credit are possibilities to explore. Private input supply companies in Nigeria are already taking some innovative steps through the use of "**village promoters"** who are local residents in communi*ties serving as sales agents for input dealers as well as vehicles to transfer knowledge about new technologies to rural farmers.* These and other strategies to subsidize the cost for input dealers to maintain a sales point close to farmers could also go a long way. A well-structured program that provides training as well as financial support to the youth to get engaged in this process could serve a dual purpose of engaging the youth in meaningful employment while exposing farmers to relevant yield enhancing technologies and techniques. Nigeria's extension service is currently severely limited by inadequate personnel with a dire need for relevant training that is regularly updated. Thus programs which are incentive based and work actively with dynamic rural community members including the youth are likely to be more sustainable in skill and technology transfer.

There are some related lessons to be learned from the World Bank funded Fadama Project in Nigeria. Since 1993, the National Fadama Development Project has been supporting Nigeria's farmers through community empowerment and strategic efforts to strengthen agriculture development in states throughout the country The National Fadama Development Project III (Additional Financing) has piloted the use of Advisory Services and Input Consultants (ASICs) based on lessons learnt about the critical importance of Advisory Services for the success of the project.

In view of the near comatose extension services of the Agricultural Development Program at the State level and the lack of suitable private extension services, the Fadama project engaged ASICs to directly assist farmers. The ASICs supported participating farmers to ensure that quality land preparation, quality inputs, quality cultural practices, quality pest and disease management, all necessary on-farm processing, were carried out to enhance value addition, as well as to ensure quality and timely delivery of output to off-takers. The key issues concerning the farmers included under-usage of inputs, mis-application of inputs, poor understanding and uptake of new technology, as well as inaccurate documentation of farm size and yield. The Advisory Services and Inputs Consultants (ASICs) have therefore provided support to put the project on a sound foundation upon which positive results and success can be guaranteed

The ASIC were attached to 5 – 10 clusters of farmers cropping about 150 -200ha of the value chain crop, and are to raise red flags to draw the attention of the National Fadama Coordinating office (NFCO) to critical issues that would militate against the project objective of ramping up production and sustainably increasing the income of the farmers. Preliminary assessment of the ASICs across the various States has shown that this might be a short-term measure to generate quick results when extension agents who are traditionally charged with this mandate are not available. The farmers lauded this strategy reporting that the ASICs were always on ground to guide them on good farm practices that would not have been implemented in their absence.

Farmer managed demonstration plot showing a striking difference between parcel cultivated with UDP (on right) and parcel cultivated without UDP (on left) in Ilorin, Kwara State, Nigeria; July 2014; Photo Credit: Serge Adjognon

The second point these results clearly bring out is that **more attention needs to be paid to understanding and addressing soil health**. Understanding the soil organic matter and soil chemical properties is very important and likely necessary for any increased use of fertilizer in Nigeria to translate to meaningful increase in farmer productivity. Given the low cereal response rates to applied nitrogen, it is essential to increase the efficiency of applying these inorganic fertilizers. Two key soil fertility constraints in many regions of Nigeria and other West African countries are low reserves of inherent nutrients and soil acidification due to continuous cultivation (Jones and Wild, 1975). Though these constraints can be addressed with the application of inorganic fertilizer, the efficiency of these inorganic fertilizers is low on depleted soils. For example, soil organic matter helps to hold on to nutrients (that would otherwise be lost through leaching and runoff) for them to be released to crops as needed. Similarly, the soil pH (potential Hydrogen) level is key for efficient absorption of nutrients in inorganic fertilizers. While the optimum pH level for plant uptake varies across plants and also from one mineral to another, the optimum range for most cereals is said to be between 5.5 and 6.5. Applying fertilizer on extremely acidic soil (without correcting with the use of lime) can result in significant fertilizer wastage, up to 70% for extremely acidic soils with pH level of 4.5 or below (The Mosaic, 2013) http://www.cropnutrition.com/efu-soil-ph#factors-affecting-soil-acidity.

Consequently, proper soil tests are necessary that can clearly indicate the nutrients that are lacking in the soil and the appropriate inorganic fertilizer to be applied. Though soil testing appears to be an easy fix, these soil tests are often expensive to conduct and beyond the reach of the average small holder farmer in rural Nigeria. A routine soil analysis cost about N4,000 per sample. However, for large soil samples, say 200 and above, a reduction of the unit price to N3,000 and N3,500 can be achieved.

In Nigeria, there are several laboratories that can handle soil analysis. Most agricultural research institutes and soil sub-sections of the departments of agronomy in Nigerian Universities will undertake routine soil analysis.

Routine tests include soil pH, organic carbon, total Nitrogen, exchangeable cations (Sodium, Potassium, Calcium, and Magnesium), and extractable micronutrients (Zinc, Manganese, Iron, and Copper). In Ibadan routine tests can be undertaken at the Department of Agronomy in the University of Ibadan, the Institute of Agricultural Research and Training, and the International Institute of Tropical Agriculture.

To successfully expand access to such services, Nigeria might be able to learn something from India. While the Indian Agricultural Research Institute (IARI) has traditionally offered soil testing services to farmers and other clients since the 1950's, the institute has had to reorganize its approach since the services are not adequate to meet the needs of the large number of farmers across the country. The institute thus developed a Pusa STFR meter which can determine six soil parameters (pH, salt content, organic carbon, available phosphorus, potassium and zinc) and can also show crop specific fertilizer recommendations. It is digital and programmable and thus has a high rate of accuracy. It is easy to use and with just two days of training, extension agents, agro dealers, farmers and other agencies working in a community can be equipped to provide this service in rural communities. In India, the the Pusa STFR Meter is currently being promoted for areas where soil testing facilities are not available. It is also convenient for rural areas as it can be operated with batteries or electricity (IARI, 2010) http://www.iari.res.in/files/Divisions/STFR-25022015.pdf.

Can Nigeria learn some lessons from this? Could Nigeria support innovation through the development of a Nigerian soil testing machine? Could Nigeria leverage on the already existing technology in India? Could programs be developed to train extension agents and other stakeholders working or living in rural communities to operate such machines? Could this be another opportunity for the youth in rural communities to be gainfully employed while providing a much needed service? Could the youth get resource support for the purchase of the machine and training?

Ultimately, the results from these empirical studies on fertilizer profitability and use for cereal production in Nigeria make **two** things clear.

1. Reducing the transportation costs faced by rural farmers is an important factor that can significantly increase the profitability of fertilizer use among rural smallholders. *This must not only come by improved infrastructure. There are other innovative and practical ways that this can be addressed, as mentioned above*.

2**.** Promoting only increased use of fertilizer in Nigeria is not likely to take smallholder productivity where the nation wants to go. The average rice, maize and sorghum yield in Nigeria remains much lower than is possible and increasing the efficiency of fertilizer use is imperative.

The suggestions offered in this piece are in no way exhaustive and do not provide a panacea for this problem. They are motivated by a desire to see the discussion on fertilizer use in Nigeria take a different direction. If the efficiency and profitability of fertilizer use among cereal farmers in Nigeria is low, then we must address these issues. Nigerians cannot afford to just continue calling for an increase in the use of fertilizer by our famers. We have to ensure that attention is being paid to whether farmers are using the correct fertilizer and to ensure that these fertilizers are readily available to them as close to their communities as possible. With these alongside improved access to training and other complementary inputs discussed earlier, it thus remains clear that a more holistic approach is a must going forward.