Fertilizer Use Optimization in Sub-Saharan Africa

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Contents

Foreword

Low soil fertility costs Africa's farmers US$4 billion a year in reduced yields. This usually results in low incomes and poor livelihoods. Part of the problem is that fertilizer use in the continent is only about 12 kg/ha/yr.

Africa's smallholder farmers are mostly very poor and have little financial ability to invest in inputs such as fertilizer. However, they are generally responsive to perceived high profit opportunities with little risk. The key to increased fertilizer use is to improve the profitability of its use with little risk. Achieving this gives farmers the opportunity to reduce the severity of their financial constraints and to gradually improve their crop management.

Fertilizer recommendations are available for some crops in most African countries, but too often these are decades-old blanket recommendations that cover large regions or even whole countries, are not well supported by field research and are more oriented to achieving high yields rather than high farmer profits.

The AGRA-funded project 'Developing and fine-tuning fertilizer recommendations within an integrated soil fertility management framework', abbreviated as the Optimizing Fertilizer Recommendations in Africa (OFRA), was implemented to develop the basis for fertilizer use optimization, that is, more profitable fertilizer use.

Through OFRA, national research institutes of 13 sub-Saharan African countries partnered together, and with CABI and the University of Nebraska-Lincoln, to develop the field research-based information needed for fertilizer use optimization decisions. Results of past research and OFRA-supported research were compiled and systematically analysed. This was applied to determine crop nutrient response functions for the important food crops in each of 67 agro-ecological zones (AEZ) or recommendation domains across the 13 countries. When several response functions for an AEZ are considered, it becomes apparent that profit potential varies according to which nutrient is applied to which crop and the rate of application. Therefore, especially for financially constrained farmers, the crop-nutrient-rate choices are very important to maximizing profitability. The choice of fertilizer types may include blends but maximizing profit potential requires adequate availability of single- (such as urea and triple superphosphate) and multi-nutrient, compound fertilizers (such as diammonium phosphate and potassium chloride).

Country teams integrated the crop nutrient response functions into decision tools that use linear programming to determine recommendations specific to a farmer's context intended to maximize profit from fertilizer use (see Chapter 1 and country chapters 4-16). These decision tools are called OFRA Fertilizer Optimization Tools (FOT); computer versions are available and also paper versions for use when a computer is not available. The FOT considers the farmer's financial ability, choice of crops and land allocation, crop values and fertilizer costs to determine the crop-nutrient-rate choices expected to maximize farmer profit from fertilizer use.

Sharing of research results across countries was enhanced with the development of the GIS tool called the OFRA Inference Tool. This tool uses GIS layers for soil properties of Africa Soil Information Service (AfSIS) and climatic properties, elevation, latitude and crops of HarvestChoice in geo-transfer of research results within and across countries between areas of similar growing conditions (see Chapter 2).

Fertilizer use optimization is within the framework of integrated soil fertility management with recommended fertilizer rates adjusted according to soil property information and the use of complementary practices (see Chapter 3).

Much early progress in enabling fertilizer use optimization with farmers and their advisors has been made, but this still requires a tremendous effort with much stakeholder support. Many more government and non-government extension staff and input retailers need to be trained in advising farmers in fertilizer use optimization. Farmers need training in the use of the paper FOTs to make fertilizer use choices according to the 4Rs (right type, rate, time and method of nutrient application) of nutrient stewardship and with proper calibration of

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application). Extension training resources have been developed and applied and many advisors have been trained. This is addressed in Chapter 17 with lessons learned for more effective progress in the future.

AGRA is delighted with the success of the OFRA partnership of 13 countries in 1) developing a strong database of crop nutrient responses while recognizing that more research is needed to address secondary and micro nutrients, intercropping and rotations, and otherwise fine-tuning existing information, 2) providing computer and paper FOTs for 67 recommendation domains, 3) effectively applying GIS in sharing research results across recommendation domains and countries, 4) capturing in the 17 chapters of this book a great deal of information applicable to fertilizer use optimization within integrated soil fertility management framework, and 5) training many extension staff and other stakeholders, realizing that much more of this is needed to achieve fertilizer use optimization throughout sub-Saharan Africa.

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