

# Recent Developments in Soil Fertility Mapping and Fertilizer Advisory Services in Ethiopia

ATA-MoANR Joint Position Paper  
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## Introduction

A consultative workshop was organized jointly by the Federal Ministry of Agriculture and Natural Resources (MoANR) and the Soil Health and Fertility Management program of the Agricultural Transformation Agency (ATA) from 27-29 March 2018 at Rift Valley Hotel in Adama. The title of the workshop was: “Recent Developments in Soil Fertility Mapping and Fertilizer Advisory Services in Ethiopia” and its objective was to discuss the development of soil fertility maps and woreda level fertilizer type recommendation atlases and complementary activities undertaken by the Ethiopian Soil Information Service (EthioSIS) project. The workshop involved senior researchers and leaders from the Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Institutes (RARIs); high-level experts to grassroots implementers (Development Agents) from the regional Bureaus of Agriculture and Natural Resources (RBoANRs); university professors; experts from international agricultural research centers (such as CGIAR) and development partners (GIZ and CASCAPE) and others.

The workshop was officially opened by H.E Dr. Kaba Urgessa, State Minister of Natural Resources at MoALR. After the two-day deliberations, the workshop was concluded with the following ten summary points otherwise called the “Adama Declaration” as named by Dr. Kaba. The ten points of the “Adama Declaration” are explained below as an ATA-MoANR Joint Position Paper.

## Ten Points of the Adama Declaration

### 1. EthioSIS achievements and others’ contributions must be recognized appropriately

The workshop discussion began with recognizing those who conceived the very idea of producing Ethiopia’s soil fertility map and shouldered the daunting task of producing one. In this regard, the late Professor Tekalign Mamo was unanimously bestowed the highest recognition by the workshop participants for conducting a countrywide digital soil fertility status survey of agricultural lands in Ethiopia, which is the most advanced soil fertility mapping on the African continent. Professor Fassil Kebede, President of the Ethiopian Soil Science Society (ESSS) and Advisor to the Minister of MoANR, who was chairing the first session, further explained that many countries assign different eras to prominent scientists who contributed to the advancement of their respective fields. Thus, he suggested Ethiopia’s soil science community to recognize this time as “Tekalign’s Era”. Other participants seconded the idea and declared that it is an achievement for Ethiopian soil scientists to see soil resources taken as an important development agenda by the Government of Ethiopia (GoE) and its development partners.

However, many other individuals involved in the effort of producing the digital soil fertility status maps and fertilizer recommendation atlases also deserve recognition. Soil surveyors often worked in hardship conditions to collect soil samples, while office-based experts coordinated the plans, received samples, coded, analyzed, interpreted and produced maps. In addition, numerous drivers and support staff also deserve recognition for their contributions.

Moreover, workshop participants strongly emphasized that EthioSIS outputs such as the soil fertility map and woreda and kebele level fertilizer recommendation atlases should be recognized by all stakeholders as foundational, and suggested that future efforts should focus on fine-tuning the products. Furthermore, local capacities created in soil surveying; soil sample processing;

analysis (wet chemistry and spectral analysis); soil database management; geo-statistics and machine learning tools for spatial prediction of soil properties and fertilizer recommendations; and mapping should be recognized as being important to undertake such efforts in the future.

## **2. EthioSIS outputs should be understood as soil fertility status maps and fertilizer type recommendation atlases**

There were misunderstandings among stakeholders on what exactly the outputs of the EthioSIS project were and how they were produced. To clear up those misunderstandings, the following five consecutive presentations were made by the EthioSIS team:

1. “Background information and the very purpose of initiating the EthioSIS project and its components” by Dr. Aweke Mulualem, Director for Soil Health and Fertility Management Program
2. “Sampling design and the actual sample collection process” by Behailu Kassahun, Senior Project Officer
3. “Soil sample processing, wet chemistry and spectral analysis, and database management” by Tegbaru Bellete, EthioSIS Project Team Leader
4. “Geostatistics, machine learning and map production” by Hailu Shiferaw, Geo-statistics Expert
5. “Results of demonstration trials on new fertilizers” by Mulugeta Demiss, Senior Technical Expert

Participants’ reflections after the presentations showed that had not been a clear and common understanding among stakeholders. Almost all workshop participants misunderstood the EthioSIS fertilizer type recommendation to be fertilizer rate recommendations that will be expected to be derived from the ongoing fine-tuning activities by EIAR and RARIs. Some participants even misunderstood the soil fertility map produced by EthioSIS as a soil resource map (or soil classification map), which was not the objective of the project.

After the detailed deliberations, a consensus was created among all workshop participants who finally unanimously declared that EthioSIS outputs should be referred to as *soil fertility status maps and fertilizer type recommendation atlases* and suggested that future communications among stakeholders should be made in view of that.

## **3. Critical values used by EthioSIS for each nutrient need to be validated based on soil and crop types**

One of the main discussion points after the presentations was the issue of critical values used by EthioSIS to decide whether the level of a nutrient in a specific soil sample is sufficient or deficient. EthioSIS established the critical levels based on existing literature, with no consideration of soil type and crop type as there were no local research outputs to refer to. As a result, workshop participants recommended that, based on the types of fertilizers and nutrients identified by EthioSIS, nationwide research should be conducted to validate the present values or establish new crop and soil test based critical values if necessary.

#### **4. Generating Ethiopia's soil resource map should be given urgent attention by GoE**

It is a common knowledge among soil scientists in the country that Ethiopia does not have an up-to-date soil resource map. The current one in use is on a 1:2 million scale extracted from the FAO and UNESCO world soil map. This soil map is not useful for two reasons: (1) the scale is too small to be used for practical agricultural planning such as fertilizer recommendations and (2) it is based on obsolete data collected in the 1940s and 1950s that does not reflect the present condition. An updated soil resource map with the right scale, developed with appropriate protocols is very important to overlay the soil fertility map and validate current fertilizer recommendations. Therefore, the workshop participants agreed that generating a new soil resource map for the country should be given priority.

#### **5. Data and atlases generated by EthioSIS should be made accessible to those who need them for research and development**

One of the issues repeatedly raised by participants was the accessibility of EthioSIS data and outputs to the public. Some even had the idea that EthioSIS does not want to share data with others. As such, the EthioSIS team explained that, while the data or outputs derived from the data are public properties and should be available for the public, there are two reasons why data has not been accessible to those requesting it: (1) as a policy, EthioSIS cannot share data before the final outputs (maps and atlases) are produced for a specific woreda or region, and (2) no institution can share georeferenced data without the prior approval of the Information Network Security Agency (INSA); this already entailed the need for a data sharing guideline to be approved by INSA. With regard to the first point, EthioSIS has finished producing the maps and atlases for most regions and is finalizing those for the remaining regions, so the data will be available for sharing soon. With regard to having a guideline, EthioSIS has prepared and submitted one to INSA for approval, immediately after which EthioSIS data will be available for sharing according to the guideline.

After listening to the explanations given by the project team, workshop participants urged the team to expedite the process and make the data and outputs available as soon as possible. Workshop participants have also asked the project team to prepare the maps with better resolutions and additional explanations such that plot level information can be obtained by Development Agents to use for farm level practical advice.

#### **6. In-depth research is required on potash fertilizer**

Some of the data presented during the workshop showed that crop responses to the current potash fertilizer recommendation by EthioSIS are mixed. On-farm demonstration trials in most places in SNNP and Oromia regions showed positive responses to potash fertilizer, whereas in Amhara region results from experimental plots showed less of a response. Workshop participants therefore recommended for potash fertilization to be focused in responsive areas (specific niches) and further in-depth research to be conducted both to identify responsive areas and to establish soil test based and crop specific critical values.

## **7. Poor fertilizer quality and related issues need to be addressed urgently**

One of the issues hotly discussed during the workshop was why poor qualities of new fertilizers, especially the nutrient grades, are being delivered to farmers. Some participants stated that some fertilizer packages distributed to farmers were found to be lower in weight as compared to what was written on the packages. Others affirmed significant reductions in the quantity of fertilizer packages delivered to farmers than what they paid for. These and other related issues were those that workshop participants strongly recommended for the government to take corrective actions against perpetrators to ensure that farmers get the fertilizers they need and have paid for.

## **8. The weak research-extension linkage should be strengthened**

The research system was established over five decades ago to generate and test modern technologies and best agricultural practices. In addition, it was intended to help the extension system to scale these up to modernize agriculture and improve the livelihoods of the agricultural community. In principle, the two sub-sectors are expected to work in tandem, however, in practice the link between the two has been very weak. This problem has also been clearly reflected in testing and validating the newly introduced fertilizers. The extension system demanded fast action in testing and validating the fertilizers but the research system has been very slow in responding to the demand. Workshop participants therefore strongly urged the two sub-sectors to solve this recurring problem by working together more closely (i.e. the research system needs to work at a pace the extension system demands).

## **9. It is necessary to develop standardized national protocols**

Research on soil surveying and management has been going on for several decades in different parts of Ethiopia with data being generated continuously. However, to date there are no standard or agreed protocols for spatial scale, plot experiments, soil surveying and sampling, and laboratory analysis methods, etc. As a result, it has been very difficult to connect the results of those efforts to have a national picture of a specific soil property through metadata analysis in the realm of data integrity and interoperability. For instance, soil resource maps have been developed by research centers for their research sites, and currently there are efforts to develop soil resource maps for some woredas by CASCAPE. However, the results of these initiative cannot be brought together to produce a nationwide soil resource map because they are not executed using agreed protocols. This causes duplication of efforts and waste of time and precious resources. As a result, the workshop participants strongly recommend the necessity of developing standardized national protocols for soil surveys and laboratory and field experiment methodologies.

## **10. Developing nationally coordinated flagship programs is highly recommended for implementing priority initiatives recommended above**

It is a routine practice after workshops to recommend priority activities for further implementation. However, past experience shows that implementing those priority activities is not as easy as recommending them because they need additional time and human and material resources, whereas recommendations are usually made without considering these resource needs. The necessity of developing a nationwide soil fertility database had been recommended for several years on several forums until EthioSIS was launched to bring that idea to fruition. In

view of this, workshop participants strongly suggested the necessity of developing nationally coordinated flagship programs particularly on the following priority activities:

1. Validation of critical values for each nutrient based on soil and crop types
2. Generating Ethiopia's soil resource map

First, MoANR needs to establish a taskforce responsible for developing project documents. Second, it needs to assign capable personnel and allocate sufficient budget, logistics, and other necessary resources for their speedy implementation.

## Conclusion and Way Forward

EthioSIS has produced detailed and practical soil fertility maps, which are instrumental for improved fertilizer recommendations and agricultural policy reforms. For example, in Ethiopia only N and P fertilizers were in use for several decades but the recent soil tests showed deficiencies in four to five additional nutrients. As a result, new fertilizer formulation and blends were introduced into the country and substantial progress has been made in testing of the blends. However, despite the progress made, the country's investment in fertilizer has not fully paid off and growth in fertilizer use has not yet resulted in proportional increases in yield. This is because the soil fertility mapping and the production of woreda based fertilizer recommendation atlases were strongly directed towards identifying nutrient compositions and deficiencies in the soil rather than the fertilizer application rate. Further, nutrient deficiencies were identified using generic thresholds and regardless of the soil types, which need further validation.

Hence, two fundamental works remain: (1) validation of the generic thresholds and critical values for developing soil and crop specific fertilizer recommendations for a targetted yield gain, and (2) developing the country's soil resource map with an appropriate scale and resolution, which is vital to adding value to ongoing soil fertility activities. The workshop participants strongly recommended the government to take urgent actions on the above two initiatives, in a nationally coordinated way, to achieve a balanced soil health and fertility system that helps farmers possess and maintain sustained high-quality and fertile soils through the implementation of appropriate soil-management techniques, the provision of required inputs, and the facilitation of the appropriate enablers, including knowledge and finance.