Soil Health Research and Development in Kenya: Challenges, Opportunities and Policy Options

Executive summary

Agricultural production has stagnated over the years in Kenya while food consumption continues to increase with increasing population. The stagnation of agricultural production is as a result of poor soil health, driven by inadequate use of Integrated Soil Fertility Management (ISFM) inputs and innovations, poor extension service and uncoordinated research and development.

Key messages

- Agricultural crop production has stagnated due to poor soil health
- Integrated Soil Fertility Management (ISFM) innovations have the potential to alleviate the problem of poor soil health
- ISFM innovations have not been fully effective due to inaccessibility of inputs, poor extension service, un-coordinated research and development programs.
- There is need to improve access to and adoption of appropriate ISFM knowledge, information and innovations by smallholder farmers.
- For sustainability purposes, there is need for creation of a platform for collection, collation, synthesis, harmonization, sharing and dissemination of harmonized ISFM knowledge, information and innovations among stakeholders.

Only ‘living’ things can have health, therefore viewing soil as a living ecosystem reflects a fundamental shift in the way we need to take care for our soils - Kenya Soil Health Consortium

The Kenya Soil Health Consortium is a partnership of experts cutting across all the key national and international institutions working in vital areas of agricultural production value chain in Kenya.
programmes leading to low adoption of ISFM innovations. While excellent progress has been made in improved seeds and planting materials and crop pests and diseases control, limited access to and low adoption of ISFM innovations has continued to hinder achievement of optimal agricultural production. The analysis in this policy brief recommends: Improvement of access to and adoption of ISFM innovations through appropriate government policies that would ensure availability and affordability of ISFM inputs through support of relevant supply markets.

This therefore calls for interventions to ensure improved access of ISFM inputs and adoption of ISFM technologies by smallholder farmers for increased and sustainable crop production.

The current expenditure in public-sector agricultural research is around 0.7 per cent of the GDP compared with about 2 per cent recommended by NEPAD. There is need for increasing investments in soil health funding. Although Kenya has many ISFM research and development institutions with fully operational training, research and extension programmes, the operations and activities across institutions are not harmonized. Often, this has led to contradictory advisory messages. There is need

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**Integrated Soil Fertility Management, Soil Health and Ecosystem functions**

**Integrated Soil Fertility Management** (ISFM) is defined as the use of farming practices that involve the combined use of inorganic and organic inputs, improved seed and other planting materials combined with the knowledge on how to adapt these practices to local conditions so as to maximize the plant nutrient use efficiency while improving crop yields. All inputs need to be managed following sound farming principles.

**Soil health** (or soil quality) is defined as the capacity of a soil to continue to function as a vital living ecosystem that supports and sustains plants, animals, and humans. Ecosystem is described as a community of living organisms (plants, animals and microscopic life forms) in conjunction with the non-living components of the soil such as air, water and nutrients interacting as a system. Critical ecosystem functions or services include increasing the following: carbon storage, crop productivity, nutrient cycling between plant, soil and animals, water capture and infiltration and biodiversity (range and number of plants, animals and micro-organisms).
Poor soil health and nutrient decline are the major constraints to agricultural production in Kenya. Among the root causes of this includes poor availability, access and low adoption of Integrated Soil Fertility Management (ISFM) inputs, knowledge, information and technologies (KIT).

Due to continuous cultivation without adequate nutrient replenishment, there has been nutrient depletion in agricultural soils. Thus crop nutrients mining and sole continuous use of four inorganic fertilizers (Di-ammonium Phosphate (DAP), Triple Superphosphate (TSP), Calcium Ammonium Nitrate

Plate 1: N, P, K, S and Zn deficiency symptoms in maize found in most farms in Kenya.
Growing Africa’s Agriculture (CAN) and Urea) has resulted in deficiencies of potassium (K), Sulphur (S), Zinc (Zn) and other micronutrients in Kenyan soils. This means research needs to be undertaken to determine economic rates of fertilizer types that will supply Nitrogen (N), Phosphorus (P), K, S, Zn and other micronutrients and advice Kenya on the type of fertilizer material to import or manufacture and distribute to farmers.

ISFM technologies are farming practices that involve the combined use of modest quantities of inorganic and organic fertilizers, improved seed and planting materials. ISFM improves soil fertility and restores desirable soil health and can boost crop yields by more than 300%.

Continuous use of inorganic fertilizers especially the nitrogenous ones (DAP, CAN and Urea) without guidance from soil advisory services leads to poor soil quality or acid soils that require the use of lime.

Soil Health Challenges

- **High cost of ISFM inputs**
  The cost of 50 kg bag of DAP fertilizer costs between KES 3,000 and 4,500. With the recommended rate of 4 bags per ha, a farmer requires between KES 1,2000 and 18,000 per ha respectively to apply the recommended fertilizer rate. The recommended rates of organic fertilizer are between 5-10 tons/ha which costs the farmer between KES 7,000 to 16,000. This is too expensive for most smallholder farmers to afford.

- **Lack of coordination in ISFM research and development programmes**
  There are many actors (Universities, National Research Institutions and International Research Organizations such as CGIAR centers, and others) in Kenya engaged in ISFM research and development, but they work individually resulting in duplication of work, waste of resources and often
conflicting ISFM technology recommendations. This calls for measures aimed at coordinated research platform for efficient utilization of resources and harmonization of ISFM research and development in the country.

• Uncoordinated dissemination of ISFM technologies in Kenya
  Both public and private organizations are involved in the dissemination of ISFM technologies aimed at reaching as many farmers as possible. However, the dissemination process has become disjointed with some actors using less effective ISFM dissemination approaches. This therefore requires urgent steps to be taken to streamline the dissemination of ISFM technologies to improved adoption.

• Inadequate funding for ISFM research for development and extension
  Funding of ISFM research for development and extension is mainly by donors who work independently of the National Agricultural Research Systems (NARS) and in isolation of each other. This results in ISFM technology recommendations that may not necessarily be in tandem with national interest.

• Lack of standardized and harmonized research approaches and methodologies
  Development of appropriate ISFM recommendations is constrained by lack of standardized methods for generating ISF technologies. For instance no consensus on what constitutes, the appropriate soil sampling depths, soil extraction and analytical methods.
  For example the analysis of phosphorus can be done using Bray, Mehlich, and Olsen. This calls for harmonization of the approaches and methodologies in order to develop more precise soil health recommendations.

• Scattered data—lack of databases
  The many players in ISFM research have generated good
ISFM technologies. However these technologies are found in different places and shelves making it difficult for end users to access them. For example, ISFM technologies in Kenya Agricultural and Livestock Research Organization (KALRO) can be found in the shelves of the different libraries at research stations such as Muguga, National Agricultural Research Laboratories Kabete, Njoro, Kitale, Kakamega, Embu, Mtwapa and others. There is therefore need to assemble these technologies into one database at a central place and devolve the relevant ones to the Counties.

- **Availability and accessibility of laboratories**
  The national research institutions (NARS) have the highest number of laboratories located throughout the country. These labs include 11 in KALRO, 5 in other NARS (Kenya Forestry Research Institute, National Museums of Kenya, Kenya Plant Health Inspectorate Service, Kenya Industrial Research and Development Institute, Kenya Marine and Fisheries Research Institute), 7 in Universities (3 in University of Nairobi, JomoKenyatta University of Agriculture Technology, University of Eldoret, Egerton university) 1 government chemist Lab, 3 Consultative Group International Agricultural Research labs and 8 private laboratories (Mea Ltd, Crop Nuts Laboratory Services, Mumias sugar Co, Catholic secretariat, Aqua Lab, Delmonte, Quest and SGS).
  The national laboratories analyse most of the samples. Except for the 6 labs found in Mumias Sugar Co, University of Eldoret and Egerton universities, and 3 of KALRO, the rest of the labs are located in Nairobi and its environs. Most of these labs are used for research work and therefore not easily accessible and the analysis costs are prohibitive to farmers. This situation calls for steps to be taken to bring labs services closer and affordable to farmers in Kenya.
• Capacity building of ISFM specialist, extension workers and farmers
There are about 64, 76 and 30 PhD holders in Soil Science, Agronomy and Social Science, respectively in Kenya. Institutional limitations and lack of adequately trained manpower has prevented the transformation of existing research data into locally adapted farming technology. This therefore calls for the establishment of a Forum to ensure that Kenya has adequate trained ISFM specialists to transform the existing research data into useful and easily adoptable farming technologies and undertake further research to address any gaps; ISFM extension providers to effectively disseminate ISFM technologies to all ISFM players (Agro-dealers, Fertilizer manufacturers, Credit providers and farmers).

• Technology transfer and dissemination
Although a substantial database on ISFM exists in Kenya, the information flow between the various stakeholders and across institutions is poor and may account for low use of ISFM inputs, low adoption of available ISFM technologies and conflicting approaches in soil fertility management. There is no comprehensive inventory and clear channels of communication necessary for strengthening information flow between collaborators. Networking and collaboration is important for technology development and transfer. In addition, there is no national forum on ISFM where collaborators can exchange information and experiences.

Farmer networks that play a key role in sustaining the up scaling and dissemination process and linking farmers to other service providers and marking opportunities do not exist in most areas and where they exist they are weak. The link between KALRO, CGIAR Centres, Universities and active NGO is weak, and therefore do not take advantage of synergies.
Opportunities

For several decades, ISFM attempted to solve the problem of poor soil health in Kenya. These research efforts have generated ISFM innovations and technologies with a potential of more than tripling crop yields (Figure 1).

By 2008 there were about 64, 76 and 30 PhD holder Soil Scientists, Agronomists and Social Scientists, respectively working in soil health research and development programmes in Kenya. They were based in national and international research institutions; public universities, NGOs and private sector. Hence Kenya has the capacity to undertake adequate ISFM research and dissemination for increased crop production. What is missing is a policy framework that will ensure this capacity works in a coordinated manner.

**ISFM human capacity**

By 2008 there were about 64, 76 and 30 PhD holder Soil Scientists, Agronomists and Social Scientists, respectively working in soil health research and development programmes in Kenya. They were based in national and international

**Government support**

Through programmes and institutions such as the National Accelerated Agricultural Inputs Program (NAAIP), Agriculture Sector Development

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The Kenya Soil Health Consortium is a partnership of experts cutting across all the key national and international institutions working in vital areas of agricultural production value chain in Kenya.
Support Program (ASDSP) and Agricultural Market Development Trust (AGMARK) the government of Kenya is improving access to inorganic fertilizers, for the smallholder farmers. Long term use of some inorganic fertilizers without retention of crop residues results in increased soil acidity, lowers soil organic matter leading to poor soil health. ISFM innovations and technologies have the potential of alleviating this problem and boost crop yields. Therefore promotion of and enhanced adoption of ISFM inputs and technologies by smallholder farmers will enable Kenya realize food security and significantly reduce poverty.

Donor Investment on ISFM
Through financing of projects such as the Kenya Soil Health Consortium (KSHC), African Soil Health Consortium (ASHC), Optimizing Fertilizer Recommendations in Africa (OFRA), Kenya Cereal Enhancement Programme (KCEP) N2Africa, Commercial Products (Compro-II) and others with a total funding exceeding 100 million USD. It is clear that, donors and government recognize the importance of ISFM in Kenya. However such an investment which is channeled through different organizations needs a good coordination policy that will ensure efficient utilization of these resources to generate maximum benefits for smallholder farmers in Kenya and reduce poverty.

Policy recommendations

- Improvement of access to and adoption of ISFM innovations
  Two key issues important for agricultural input policy are: i. availability and, ii. affordability. For farmers to access inputs, the inputs must be available within accessible distances. Agro-dealers play an important role as intermediaries between input producers and farmers by bringing inputs closer to locations of use and in sufficient quantities. The number, growth and distribution of agro-dealers in Kenya are too low to effectively serve the smallholder farmers located far away from major trading centers. The government needs to
develop and implement policies that would ensure availability and affordability of fertilizers. This can be done through establishment of effective public-private partnerships with agro-dealers and input producers.

- Increase investment in Soil health Research Funding
  There is need for increasing investments in soil health funding. Current expenditure in public-sector agricultural research is around 0.7 per cent of the GDP compared with about 2 per cent recommended by NEPAD. This is unfortunately low and therefore need to be improved.

- Create ISFM Innovation platform
  Kenya is fortunate to have many ISFM research and development institutions such as National Agricultural Research Systems relevant departments in the local Universities and CGIAR centers. Currently these institutions work in isolation resulting in duplication of efforts and a waste of financial resources. The many players involved in ISFM research use different ISFM approaches to generate the technologies. This calls for development of a platform for sharing of information, resources and harmonization of approaches and methodologies. The Kenya Soil Health Consortium through the funding of AGRA was established in 2013 and is in the process of undertaking the creation of such platform but needs to be mainstreamed into core government operations.

- Decentralization of national laboratories to the counties
  Most of the soil and plant analysis laboratories and advisory services are hosted in the national research systems (NARS). These labs include 11 in KALRO, 5 in other NARS (KEFRI, NMK, KEPHIS, KIRDI, KEMFRI), 7 in Universities (3 in UoN, JKUAT, University of Eldoret, Egerton University) 1 government chemist Lab, 3 CGIAR labs...
(ICRAF/TSBF, ICIPE, ILRI) and 8 private laboratories (Mea Ltd, CNLS, Mumias sugar Co, Catholic secretariat, Aqua Lab, Delmonte, Quest and SGS). Except for the 6 laboratories located in Mumias Sugar Co, University of Eldoret, Egerton University, and 4 in KALRO, the rest of these laboratories are located in Nairobi and its environs. Most of these laboratories are however focused on research work and therefore not accessible for providing services to the farmers. This situation underscores the importance of expansion and devolution of the laboratory services to benefit farmers at county levels.

Further reading


