Kenya’s arable soils are threatened by deteriorating soil health resulting in low crop production even in the traditional breadbasket areas. To increase crop production, there is need to avail widely, blended fertilizers for specific locations and crops to supply the wide array of nutrients required.

There is need for widespread use of organic materials, however, they are bulky and low in nutrient levels and thus relevant research is needed to increase their effectiveness.

There is need to harmonize and prioritize the research agenda of the many players involved in soil health research in Kenya (private, public and international organizations) so that key soil health issues are tackled with speed.

There is need to increase funding for soil health research for development and extension.

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.
Growth in Africa’s agriculture is resulting in declining crop yields and compromised soil health. There is need to blend fertilizers with a wide array of nutrients to address the specific crop needs at specific locations following soil test recommendations.

Further, soil acidity has increased and organic matter levels declined to such low levels that the nutrient and water holding capacity of soils arable soils has been compromised consequently, yields have declined. Use of farmyard manure and other organic materials such as composts and green manures partly provide a solution to the limitation associated with inappropriate use of inorganic fertilizers, therefore it is recommended that these should be used together in an integrated manner in what is known as Integrated Soil Fertility Management (ISFM). However, the quantities recommended are high (5-10 tons/ha). Research is required to find ways to increase the nutrient concentration in organic resources and reduce bulkiness to improve their effectiveness and reduce application costs.
Decline in the productivity of our soils has attracted many players to soil fertility research and a host of recommendations that are neither harmonized nor prioritized to reflect the reality on the ground. There is need to form a national participatory stakeholder forum to guide the research agenda on soil health so that key issues limiting crop productivity are tackled with speed. Moreover, ISFM should be mainstreamed into all research agenda affecting soil health and ecosystem services. This calls for increased funding by the government as well as other donors.

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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).

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**Overview of Soil Health Research in Kenya**

To date, numerous studies have been undertaken on ISFM research in Kenya in an effort to increase crop yields, improve soil health and ecosystem services for sustainability of crop production in future generations. However, such studies have largely focused on nitrogen (N) and phosphorus (P) which are deficient in the soils leading to countrywide recommendation for use of four fertilizers, namely Di-Ammonium Phosphate (DAP), Triple...
Superphosphate (TSP), Calcium Ammonium Nitrate (CAN) and Urea. Nutrients such as potassium, magnesium, sulphur, and the micronutrients such as zinc, copper, boron, iron, manganese and molybdenum are currently not identified as deficient, however, their widespread deficiencies are evident to experts and farmers alike. Continued cultivation without nutrient replenishment has resulted in nutrient depletion and mining of these essential nutrients, lowering of organic matter and making soils more acidic. Some of these deficiencies of potassium, sulphur, calcium, iron, copper and zinc in Kenyan soils are shown below.

(a) Potassium deficiency in maize
(b) Zinc deficiency in maize
(c) Sulphur deficiency in maize
(d) Iron deficiency in maize

Plate 1: Nutrient deficiencies in maize
The practice of liming acid soils is not common in Kenya due to farmers and other agricultural actor’s limited knowledge on lime effectiveness, unavailability and bulk nature of liming materials leading to high transportation cost. Soil acidity necessitates application of agricultural lime to maintain crop response to applied fertilizers.

As a result of high cost of inorganic fertilizers (e.g. 50kg bag of DAP currently costs 3500 KES) there has been a concerted efforts to develop more effective nutrient sources through research on organic materials. However the organic materials contain low amounts of the essential nutrients hence large quantities 5-10 t/ha are recommended which is bulky and almost impracticable for resource poor farmers to acquire and apply. Consequently, low organic materials are applied leading to soils poor in organic carbon and hence low nutrient holding capacity and accelerated climate change effect.

### TABLE I. EFFECTS OF LIMING ON MAIZE YIELD IN WESTERN KENYA

<table>
<thead>
<tr>
<th>No lime</th>
<th>Lime (2 MT/ha)</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>5.3</td>
<td>573</td>
</tr>
</tbody>
</table>

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The decline in agricultural production caused by poor soil health has attracted many players to soil fertility research. Soil health research in Kenya is undertaken by research institutions, universities and private sector institutions.

![Plate 3. Changes in soil color due to organic matter content](image.png)

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.
These institutions constitute the national agricultural research system (NARS). Other local and international institutions involved in ISFM research include MEA limited, Arthi River Mining Company, KEL chemicals, Crop Nutrition Laboratory Services Limited and international research organizations such as Tropical Soil Biology & Fertility (TSBF), International Center for Tropical Agriculture (CIAT) and World Agro-forestry Centre (ICRAF), Food & Agriculture Organization of the United Nations (FAO), International Center for Research in the Semi-Arid Tropics (ICRISAT), International Center for Insect Physiology & Ecology (ICIPE) and Potato International Center (CIP) among others. Unfortunately all these institutions work in isolation and use different soil sampling depths and soil nutrients testing methods thus generating variable ISFM technology recommendations that sometimes confuse end users. This has resulted in a series of fertilizer recommendations that are not effective for the varying agro-ecological zones in Kenya. There is need to mainstream ISFM into all research agenda affecting soil health, ecosystems services and harmonize recommendations.

Policy recommendations
From the foregoing analyses and discussions, this policy brief therefore recommends the following:

- Conduct research on the appropriate source, rate, placement and timing of agricultural lime in combination with inorganic and organic fertilizers on smallholder farms.
- Support blending of fertilizers for specific locations and crops following soil test recommendations.
- Research is required on management of organic materials.
Further reading


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