CASA

Commercial Agriculture for Smallholders and Agribusiness

Scalable alternatives to Inorganic fertiliser in Kenya

April 2023 – Final Report

Foreign, Commonwealth & Development Office

TechnoServe
Business Solutions to Poverty ®

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Agenda

Executive Summary

A confluence of short-term and long-term factors highlights the need to transform the $0.5B Kenyan fertiliser market – the fertiliser price crisis has significantly affected food security, and the over-reliance on inorganic fertiliser accelerates soil degradation and carbon emissions.

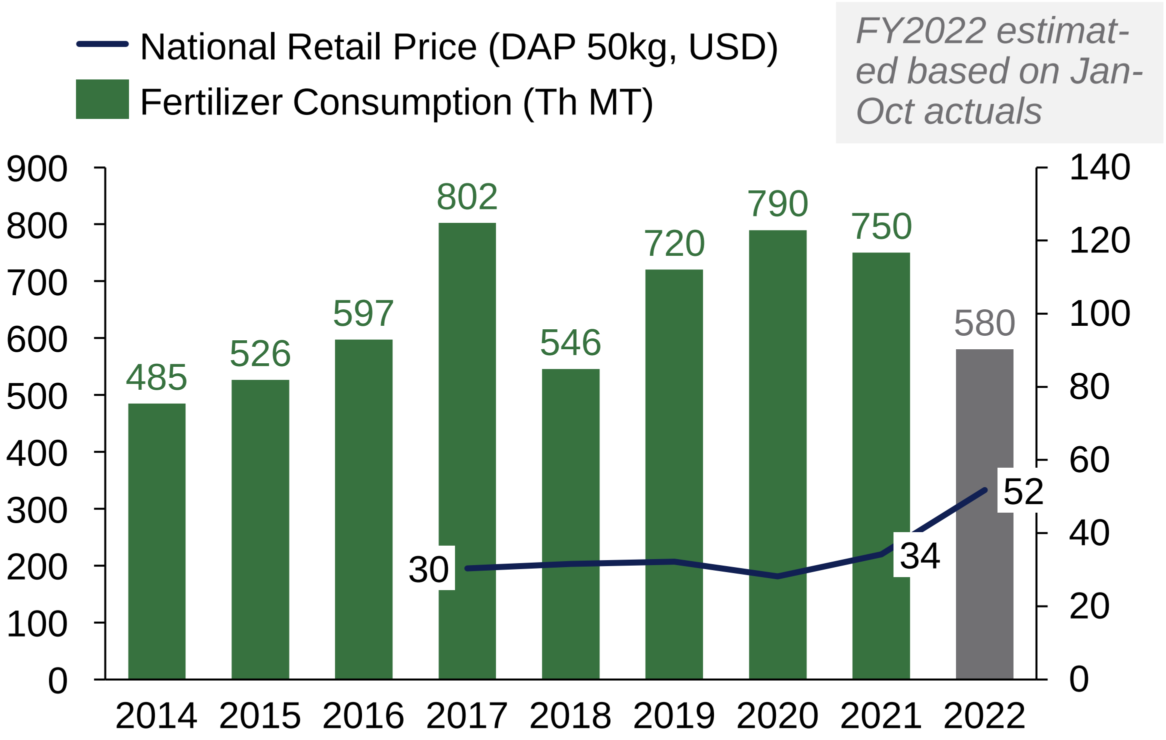
Organic fertility solutions can be effective to tackle these challenges as part of an integrated soil fertility management strategy. This market should represent $45-75M in Kenya in 2030 vs. $3M in 2022 and can help boost yields, lower carbon footprints, create economic opportunities and increase resilience.

Kenya's role as an organic fertiliser hub in East Africa is accelerating but the sector faces many difficulties: complex biomass supply chain, operating model trade-offs, costly R&D, insufficient scientific evidence, lack of capacity across the value chain, and lack of effective distribution channels.

The immediate priority is to build a strong evidence base on product efficacy before scaling supply and boosting demand. We defined a mix of policy, investment, and broader sector development recommendations to address these priorities and effectively support sector growth.

Fertiliser, a $0.5B Kenyan market critical for food security, is being heavily disrupted

Yearly fertiliser consumption and average price 2014-2022
Thousand MT, USD



FY2022 estimated based on Jan-Oct actuals

Estimated total retail value in million USD	488	344	464	444	513	**601**

Source: AfricaFertilizer / IFDC (2022), World Bank (2020)

- **Kenya uses 60-65kg/ha** (~50% nitrogen, ~45% phosphorus), up from 30kg/ha 10 years ago
- **Kenya ranks 3rd in Sub-Saharan Africa** (SSA) behind Ghana (107kg/ha) and Zambia (80kg/ha)
- **SSA** avg. is **22kg/ha, World** avg. is **145kg/ha**

- **Commodity DAP** (diammonium phosphate), **CAN** (calcium ammonium nitrate), **urea**, and **NPKs** (NPK 26-5-5 and NPK 17-17-17) represent nearly **90% of consumption**
- **Limited penetration of product innovations** over time, **commercial organic products only represent around 1%** of total consumption in 2022

- **High year-on-year variation of subsidies** over last 10 years, covering **36%** of total import value in 2014-2015, down **to 6%** in 2018-2019; **DAP and CAN representing 60 to 100%** of total
- Government announced **500kMT of subsidized fertiliser in 2023**, **totalling to ~230M$** together with **publicly financed maize production** (20kMT) to face recent disruptions

Recent inorganic fertiliser supply and price disruptions have highlighted the need to look at domestic alternatives, including organic solutions

Effects of over-reliance on inorganic fertiliser	Role of organics to restore the soils
x **Lack of supply chain resilience**: Since 99% of fertiliser is imported, there is a **significant exposure to shocks** as proven by recent **price crises** and **variations in availability**, largely driven by changing subsidy policies	✓ **Strengthened value chain**: Locally produced fertiliser **reduces dependencies on imports** while soil organic matter also helps **improve water holding capacity**, improving resilience to droughts and making semi arid areas more productive
x **Land degradation**: A significant proportion of soils in the heavily cropped SW region have **pH below 5.5** (a 4.5 pH-level leads to 70% of nutrient waste), and **organic matter and primary nutrients are below target levels** in the vast majority of cases	✓ **Restored soils**: Organics **improve soil pH and increase cation exchange capacity**, thus reducing nutrient leaching and enhancing soil microbial activity, improving overall soil health
x **Carbon emissions**: Inorganic fertilisers are responsible for **1% Kenyan GHG emissions** but imports cause **more than 5x the amount of emissions upstream** in its value chain through production and transportation	✓ **Carbon sequestration**: Organic fertiliser and other climate-smart agricultural practices **boost soil organic matter** (SOM), which means soil can **capture up to more than 30x of CO_2 vs. today**

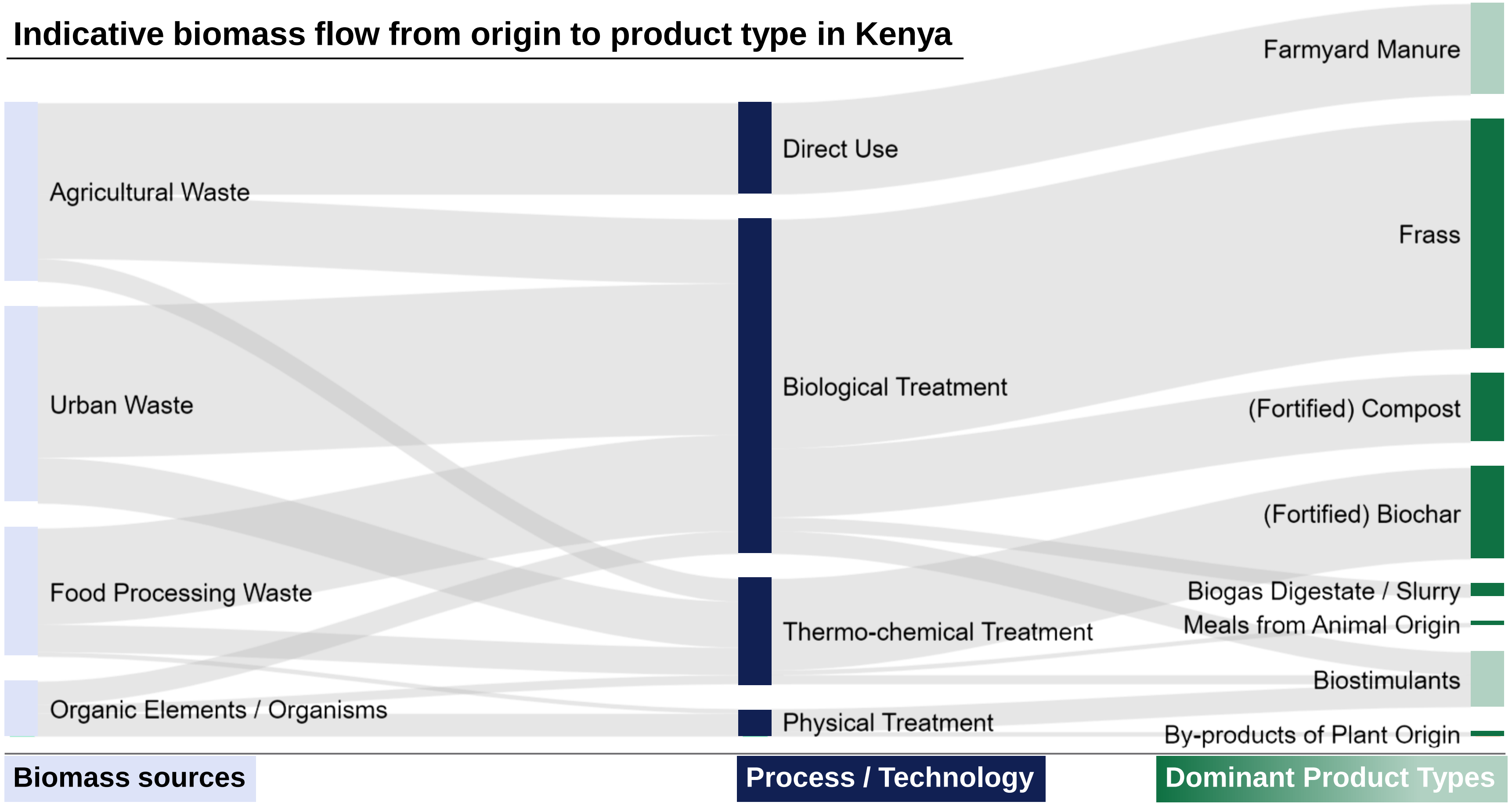
Reduced risk on food security and smallholder livelihood

Improved climate and agricultural resilience

Source: TechnoServe analysis, CropNuts (2022), CropNuts (unk.), NAAIAP (2014), Kabiri (2020)

Organic fertilisers and soil amendments repurpose nutrients in available biomass; Waste availability is unlikely to constrain product development

Indicative biomass flow from origin to product type in Kenya



🟩 **Organic fertiliser**

min. 3,5% NPK level[2,3]

Any substance or material of plant or animal origin that is added to the soil-plant system in its original form or naturally decomposed form to supply plant nutrients

🟩 **Soil amendment**

max. 3,5% NPK level[2]

Product stimulating plant nutrition process and enhancing abiotic stress tolerance and/or crop quality traits and soil conditions, regardless of its nutrients content. Includes seaweed, other naturally occurring stimulants, biofertiliser, i.e. any bacterial or fungal inoculant applied to plants

Around **1.4 million tons of** organic urban and industrial **waste is estimated economically viable to access today**[1] – 2.0 million tons in 2030

10 to 50% biomass conversion depending on biomass and process types; likely average today is around 20%

Maximum production level today is >140k MT using most conservative assumptions, and estimated around 500MT in 2030 (assuming overall conversion improvement to 25%)

Source: TechnoServe analysis | Note: 1. According to Sanergy’s estimation, 2. According to KEBS, 3. For EU standards, min. 4% NPK level for solid and 3% NPK level for liquid organic fertiliser

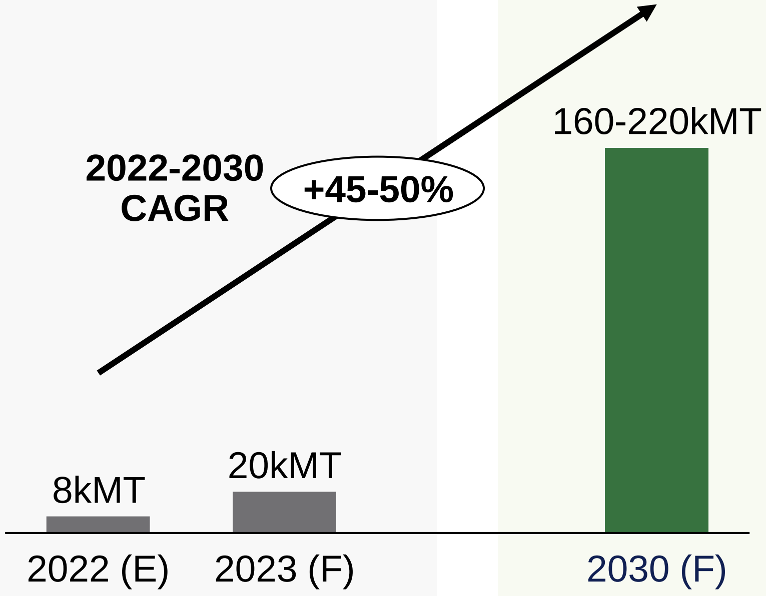
Kenya's role as a bio-fertiliser hub is accelerating, output is likely to increase 2.5x in 2023

Dynamic supply and regional innovation hub

Domestic organic fertiliser / bio-stimulants production in Kenya
Supply base (left), yearly production (MT) and market value ($M) (right)

Number of companies	Clusters	Share of total production
3	**Pioneers – 2010-2015** Leaders in waste management and organic fertiliser with large-scale ops regen organics, Safi Organics, TAKA TAKA SOLUTIONS	80%
5-10	**Early Followers – 2014-2018** Businesses with stabilized operations and products looking to scale	10%
25-50	**"Gold Rush" Phase – 2019-2022** Small scale production further developing and testing their technology	10%

\+ Foreign specialized actors mostly from India and Europe importing into Kenya



	2022 (E)	2023 (F)	2030 (F)
Avg. Price	350$/MT	350$/MT	280-350$/MT
Mkt. Value	$3M	$7M	$45-75M

Strong demand potential to be stimulated

Forecasted demand for organic fertiliser / bio-stimulants production in Kenya in MT and $M

Our conservative assumption is based on historical growth of entire fertiliser market (4.7% CAGR) and benchmarking against other markets (12.5-17.5% organic fertiliser penetration in leading markets)

Other estimates suggest market size of **$200M**+ by 2030. This may be possible in an optimal scenario

Source: TechnoServe analysis and survey data (30 companies identified and surveyed – 12 respondents)

Catalysing investment in the sector is complicated by its complexities

Operations

- **Feedstock collection is complex** due to inconsistent and fragmented sources
- **Manufacturers face operating model trade-offs** which significantly impact capital requirements and scalability

Product

- **Dominance of BSF frass is explained** by greater sub-sector coordination and linkage to research
- **Still sector suffers from costly R&D** preventing the development of large scale scientific evidence

Go-To-Market

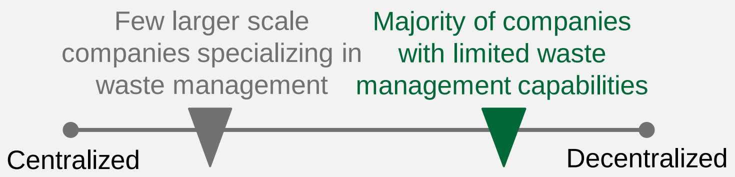
- **Distribution and competitive pricing remains a bottleneck** despite technological innovation, as it does for inorganic fertiliser
- **Farmers and agro-vets**, among others, **suffer from lack of awareness and capacity** making go-to-market more complex

Waste/Feedstock Management

#1	Urban and commercial waste: market, kitchen
#2	Agri-processing waste: rice, avocado, bagasse…
#3	Farm level: manure, plant residues (maize)

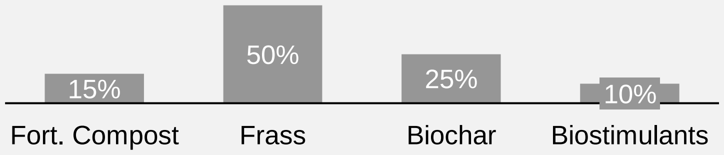
Dominant feedstock sources (qualitative)

Production



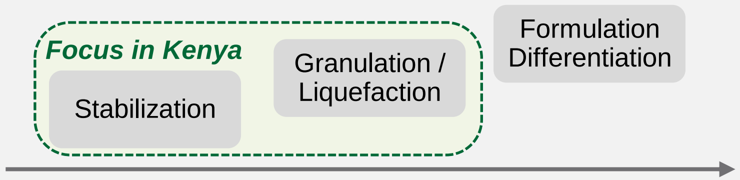
Level of operations centralization

Technology



Indicative market share (in value) by technology

Product Development

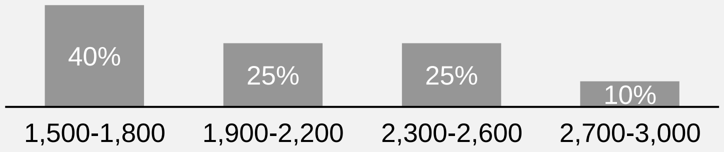


R&D focus depending on company maturity

Distribution

Dominant distribution models

Value Proposition



Ind. share of companies by price range (KES per 50kg bag)

Source: TechnoServe analysis and survey data (30 companies identified and surveyed – 12 respondents)

Based on our assessment of the sector we defined four key trends which should structure its growth over the next 5-10 years

Further specialization and intermediation along the value chain	• **Companies will further specialize** in either waste management or in fertiliser production • **Fertiliser producers will diversify supplies**, buying from others to reduce complexity and invest resources in product development and distribution • **Primary feedstock sources will remain commercial and industrial**; Immediate and growing opportunities for small-scale entrepreneurs to create farm-level nutrient-recycling services
Sector growth driven by large players with centralized operations	• **Larger companies will scale more rapidly** their capital-intensive operations and dominate the market in volume of product sold • **Decentralized operations will be more numerous** but will remain localized serving specific value chains • **Growth will be boosted by investments from large inorganic/industrial players** which will also stimulate research and advocacy
Higher share of products combining existing technology	• **Market will be dominated by tech with more investment in research** and higher knowledge available and sector-wide coordination – **BSF has already made strong progress** • **Innovation will come from combining existing technology** – e.g., BSF for biocontrol features, biochar for carbon sequestration, bio-stimulants for plant resilience – enabled by greater cross-sector collaboration allowing manufacturers to better understand and address customer needs
Sales driven through channels with clear market linkage	• **Sales and distribution will primarily develop through integrated operations with direct market access**, e.g., offtakers / cooperatives / outgrowers • **Increasing recognition of integrated soil fertility management** will drive greater harmonisation of extension services, but **improved coordination will take time and subsidies on organic fertiliser will likely remain limited** given weight of established inorganic players

Source: TechnoServe analysis

The immediate focus should be to develop a strong evidence base before ensuring scalable supply and boosting demand

Priority **1** **Strong Evidence Base**

- **Build capacity and harmonize knowledge** amongst decision-makers, donors and investors
- **Drive cross-sector collaboration to build strong evidence base** on organic fertiliser efficacy and soil impact
- **Reinforce quality standards** accordingly and ensure compliance

+

- **Improve resilience to shocks in the short-term** through farm-level solution development initiatives

Priority **2a** **Scalable Business Models**

- **Enable manufacturers to adopt best practices and scale** through targeted investments and technical assistance
- **Improve the business case for organic fertiliser** by reducing cost of doing business and creating market incentives

Priority **2b** **Broad Farmer Adoption**

- **Increase farmer awareness and drive behaviour change** towards integrated soil fertility management practices
- **Evolve routes to farmers to increase reach**: more holistic productivity support policy, pluralistic extension services, risk-sharing model with input providers

Source: TechnoServe analysis

Our recommendations require coordinated efforts from Private Sector, National and County governments, Research Institutes, Farmer Associations and Development Practitioners

Relative importance to address priority High | Medium | Low

		Private Sector	Public Sector / Research	Farmers / Dvpt. Practitioners
1 Strong Evidence Base	1.1 **Capacity building** across the entire market system	Medium	Medium	High
	1.2 **Cross-sector research** on product efficacy	Medium	High	Medium
	1.3 **Standards and compliance** to guarantee product quality	Low	High	Low
	1.4 **Soil data access** for all relevant stakeholders	Medium	High	Medium
	1.5 **Short-term resilience** programs to develop farm-level solutions	Low	Low	High
2a Scalable Business Models	2.1 **Ease of doing business** for manufacturers to reduce their costs	Low	High	Low
	2.2 **Investment and TA** to strengthen business models and value prop.	High	Low	Low
	2.3 **Business model development** to better align farmer/market incentives	High	Low	Medium
2b Broad Farmer Adoption	3.1 **Farmer behaviour change** to drive adoption of desirable practices	Low	Medium	High
	3.2 **Productivity support policy** to incentivise positive practices	Low	High	Low
	3.3 **Pluralistic extension** for improved reach and coordination	Low	Medium	High
	3.4 **Private sector partnerships** to increase product availability	High	Low	High

Source: TechnoServe analysis

Agenda

The scope of the study was to assess the fertiliser sector in Kenya and design a potential pathway to scale uptake of organic fertiliser and bio-stimulants

Background

- There is today a confluence of short-term and long-term factors that highlight the need to shift from an over-reliance on inorganic fertiliser in Kenya:
  - The current fertiliser price crisis leads to lower adoption (reduced yield or reduced hectarage) which is significantly affecting food security.
  - Over 12 million people reside in areas with degraded lands in Kenya, highlighting the imperative to shift towards soil nutrition strategies that better address soil needs.
  - Inorganic fertiliser usage is a contributor to carbon emissions within the agricultural sector.
- Today, a number of compelling Kenyan start-ups are using innovative approaches for fertiliser alternatives. However, these sectors are sub-scale and high cost. There is potential for Kenya to grow these sectors, but the lack of consensus on which alternatives offer the most promise is creating complexity and confusion.

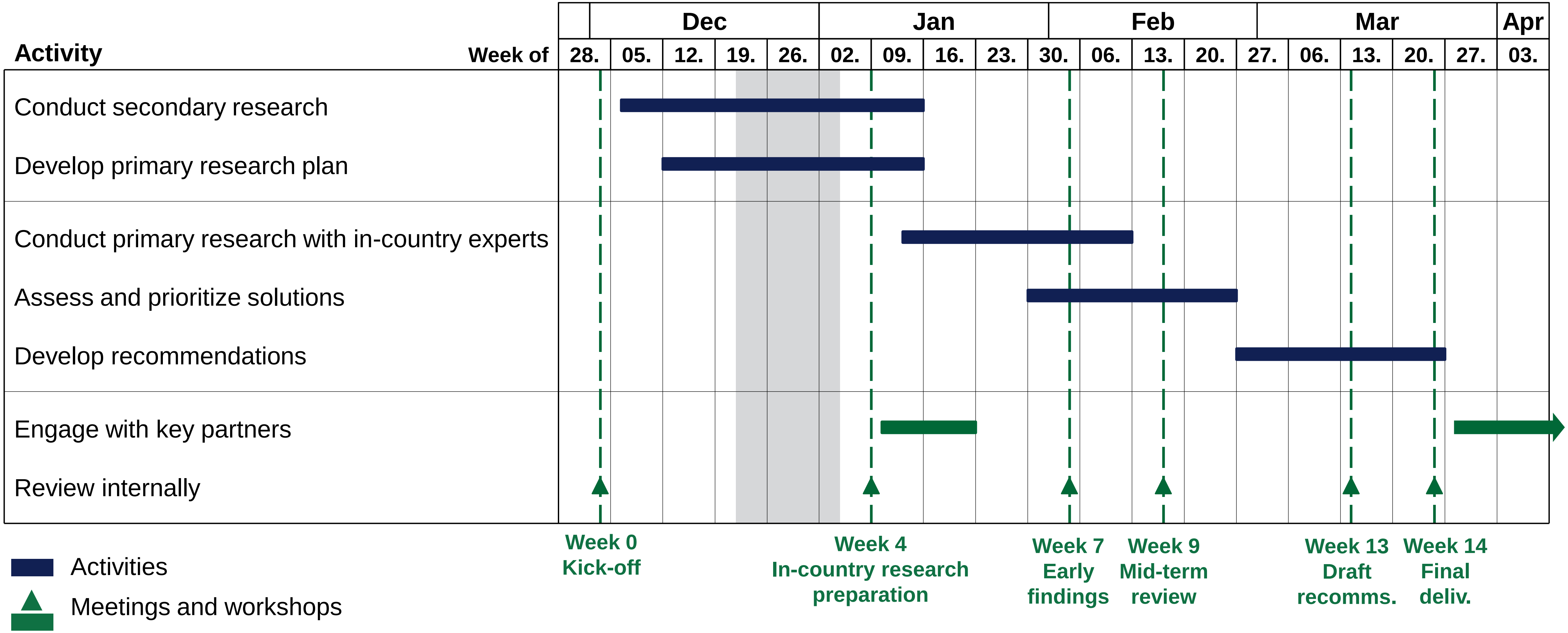
Objectives

- Identify and assess the highest growth potential alternatives to inorganic fertiliser in Kenya and define the pathway to scale for prioritized options with critical insights that are relevant for private, public, and donor actors in Kenya

Approach

- Establish background context of the fertiliser value chain in Kenya and implications of current fertiliser usage, on food security, soil health and carbon emissions
- Define the potential for organic fertilisers and bio-stimulants in Kenya based on their ability to increase yield
- Characterise existing alternatives to inorganic fertilisers, focusing on companies operating in the various segments to understand production models, operational cost and effectiveness and current adoption level
- Identify barriers to scale and formulate recommendations to government, private sectors, investors, donors and other potential partners to unlock growth

This study was conducted over the course of 14 weeks from December 2022 to March 2023, through a mix of in-country research and desk research and analysis



We conducted around 60 interviews across all relevant stakeholders in the fertiliser sector and reviewed more than 30 market reports, academic reports and other key data/documents

Fertiliser manufacturers	**Intermediaries**	**Enabling environment**	**Reports & datasets**
Inorganic fertiliser manufacturers Organic fertiliser manufacturers Importers	Farmer networks and associations Outgrowers / Offtakers / Processors Suppliers and input dealers Service providers	Government Research Financial institutions NGOs Development donors and investors	IFDC datasets Academic research papers Market reports
10+ Interviews	15+ Interviews	30+ Interviews	30+ Studies

Terminology: Fertiliser sector is complex requiring clear and harmonized definitions as baseline; Differentiating organic agriculture from organic inputs is also critical

Key terminology Inorganic Organic **Basis:** Living animal Multiple Other Focus of this report

	Crop nutrition products		**Crop protection products**
EU standards: Min. 4% and 3% NPK level for solid and liquid org. fertiliser, respectively	**Fertiliser** (min. 3,5% NPK level[2]) Adds plant nutrients necessary for enhancing plant growth and development	**Soil amendments**[1] (max. 3,5% NPK level[2]) Stimulates natural processes without bringing additional nutrients	**Pest control** Application of pesticides on crops or soils for the control of any pests
Inorganic	**Inorganic fertiliser**: A synthesized substance/material added into the soil to add plant nutrients necessary for enhancing growth and development Generic (DAP, CAN, Urea, NPK) Crop-specific blends Microbiome activation	**Inorganic soil amendment / conditioner / improver** Nitrification inhibitors Liming material	**Chemical pesticide**
	Organo-mineral fertilisers: Emerging group of fertilisers and soil amendments obtained from a mixture of organic substances and mineral fertiliser, consisting of both chemical and organic raw materials (e.g., animal manure) enriched with sulphur, zinc, phosphorus, potassium, nitrogen and organic nutrients		
Organic	**Organic fertiliser:** Any substance or material of plant or animal origin that is added to the soil-plant system in its original form or naturally decomposed form to supply plant nutrients. Products include fortified (vermi-)compost, biochar, frass, farmyard manure, human and industrial waste	**Bio stimulants:** Product stimulating plant nutrition process and enhancing abiotic stress tolerance and/or crop quality traits and soil conditions, regardless of its nutrients content. Includes seaweed, other naturally occurring stimulants, **biofertiliser**, i.e. any bacterial or fungal inoculant applied to plants	**Biocontrol:** Biocontrol agents used in plant productions are living organisms protecting plants against their enemies, i.e., reducing the population of pests or diseases to acceptable levels

Existing overlaps and inconsistencies of definitions

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Organic agriculture

A holistic agricultural system that uses organic fertilisers (e.g., compost, animal manure) and places emphasis on techniques such as crop rotation and companion planting

Source: TechnoServe analysis, Wageningen University & Research (2023), Government of Kenya (2020)

1. Also known as soil conditioner or soil improver 2. According to KEBS

Agenda

- Executive summary
- Introduction
- **Overview of existing fertiliser value chain**
- Case for organic fertiliser
- Characterisation of organic fertiliser sector
- Pathway to scale
- Appendix

Recent events affecting the $0.5B / 750K MT Kenyan fertiliser market have highlighted the need to look at domestic alternatives

Fertiliser Consumption

Highest intensity market in region consuming 750K MT nutrients and dominated by generic products

- Import price of generic products doubled over last two years which significantly affected consumption (minus 25-30% over the same period)
- Cereals – especially maize – drive around 60% of consumption, cash food crops represent 30% of consumption
- About 90% of products consumed are generics (DAP, Urea, CAN, NPK): nitrogen is ~50% and phosphate is 40-55% of nutrients consumed
- Commercial organic products (around 1% of consumption as of 2022 from farmers with traditionally higher fertiliser usage) and other innovations suffer from reluctance to change from dealers and end-users
- Fertiliser use is highly concentrated in high potential/western regions; political economy, agrovets density and on-time availability, education and extended support are factors largely affecting fertiliser consumption (both organic and inorganic)

Market System Description

Import market with growing local mechanical blending capabilities and shift back to centralization of subsidized fertiliser distribution

- Imports 95% of all fertiliser; fertiliser enters through Mombasa ports in the South mostly in bulk, bagged and transported upcountry via truck; clearance fees, transport costs and mark-ups represent 30% of consumer price
- Local production is limited: Only KEL manufactures and processes locally whereas a few large players (Yara, ETG, MEA, etc.) have only blending plants; for 2025, the government announced a proposal for a new green ammonia plant
- 30-50 major distributors (large wholesalers) sell to hundreds of wholesalers who in turn distribute to thousands of stockists who provide last mile sales to farmers
- In 2019, the centralized national subsidy programs evolved to address inefficiencies and further boost adoption through the use of e-vouchers; However, in 2022 the new government went back to bulk purchases procured through the Kenya National Trading Company (KNTC) and distributed across the country through NCPB depots
- Kenya’s regulatory framework is evolving to address soil, plant protection and other challenges but passing on binding legislation and respective implementation tools on fertiliser have been delayed

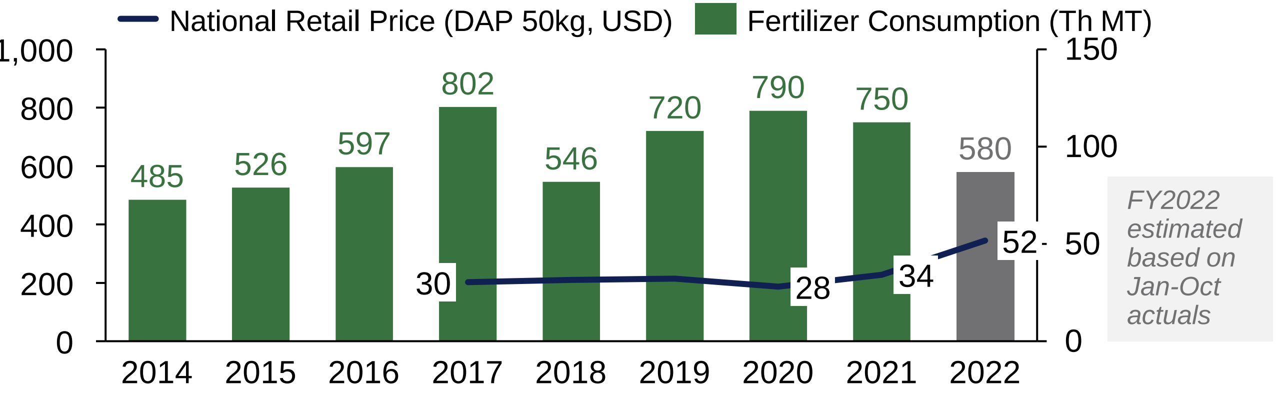
Implications on inclusive and sustainable development

A number of short- and long-term factors highlight the need to look at alternatives/additions to inorganic fertiliser use

- Despite increased use of fertiliser since the nineties, maize productivity has remained constant in Kenya
- Recent high prices have further degraded the situation and severely impacted smallholder income and food security risks - estimated 22% decline of maize production in 2022 compared to average production between 2016-2020
- Extensive use of inorganic fertilisers have led to largely acid soils and depleted nutrients, and is responsible for 1% Kenyan GHG emissions while imports cause >5x of emissions upstream in its supply chain

Kenya consumes 750k MT of fertiliser nutrients today – consumption is driven principally by staple food crops with maize accounting for 50%

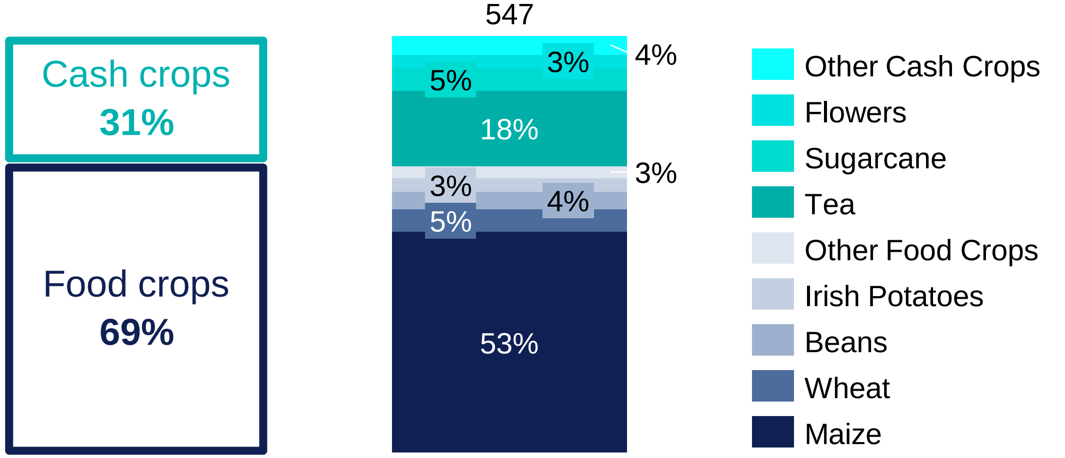
Yearly fertiliser consumption and average price 2014-2022
Thousand MT, USD



FY2022 estimated based on Jan-Oct actuals

	2017	2018	2019	2020	2021	2022
Estimated total retail value in million USD	488	344	464	444	513	**601**

Fertiliser consumption by crop, 2016, MT



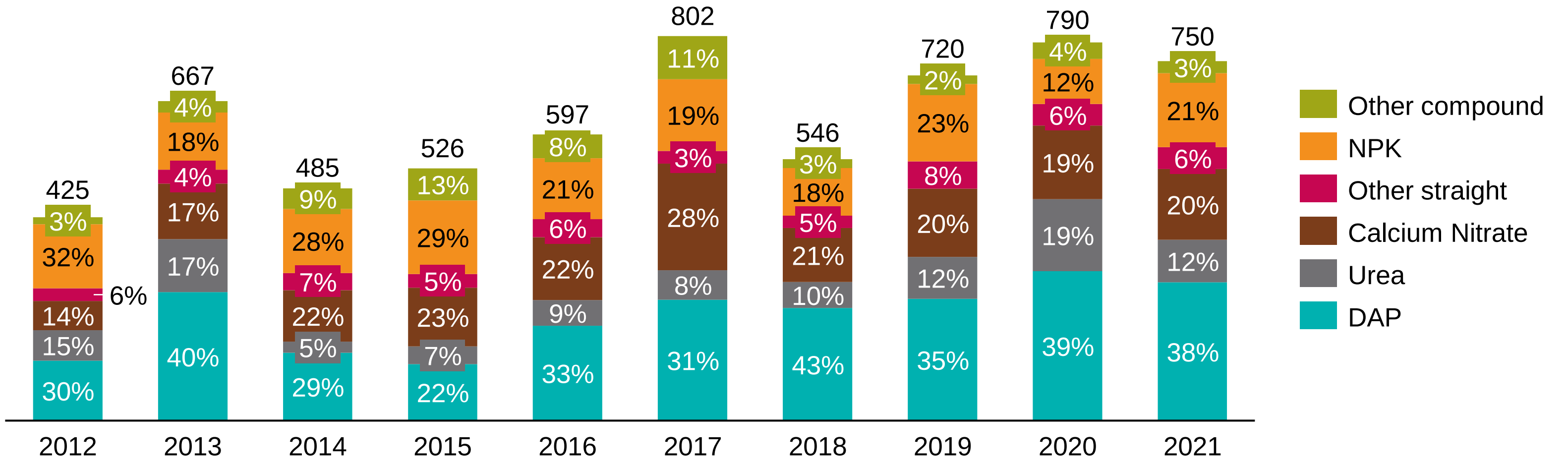
- **Fertiliser consumption grew steadily until 2020** at 4.7% CAGR largely driven by government subsidy programs
- **The 2017-2018 period did not follow the same pattern** due to political campaign period typically leading to higher import figures and subsequent carryover stocks year-over-year
- **Consumption significantly dropped in 2021-2022** due to substantial increase in fertiliser prices

- **Kenya uses 60-65kg/ha** up from 30kg/ha 10 years ago and now **ranks 3rd in sub-Saharan Africa** (22kg/ha avg. in the region) behind Ghana (107kg/ha) and Zambia (80kg/ha), world avg. is 145kg/ha
- For **Cash crops**, average use is greater than **200kg/ha**, largely driven by better access to fertilisers and more optimal practices, **mostly commercial players** with focus on exports
- For **Food crops**, average use is around **50kg/ha**; More than 95% of the country's **smallholder farmers** are engaged in maize production, accounting for an estimated 85% of total maize produced

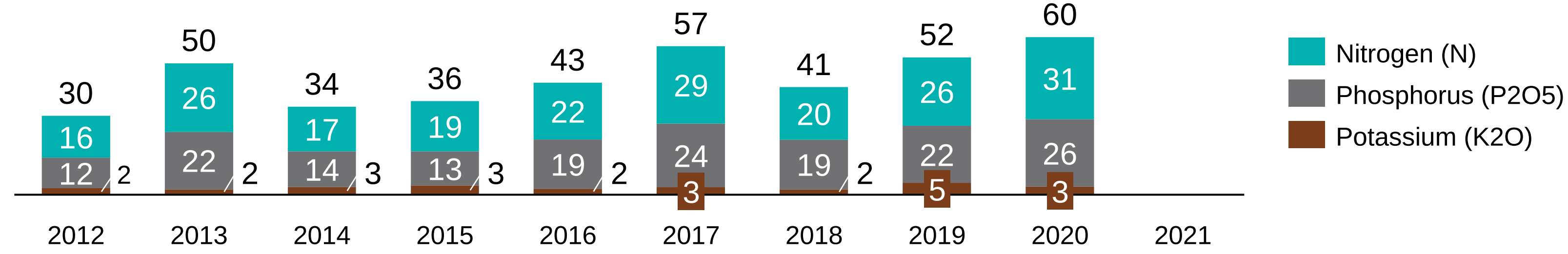
Source: AfricaFertilizer / IFDC (2016), AfricaFertilizer / IFDC (2022), KALRO (2021)

Major products consumed are generics: nitrogen is ~50% and phosphate is 40-55% of nutrients consumed

Yearly fertiliser consumption by fertiliser type 2012-2021
Thousand MT



Average fertiliser consumption 2012-2021
Kg/ha



- **Commodity products represent nearly 90% of consumption**
  - Diammonium phosphate (DAP), and NPKs (NPK 26-5-5 and NPK 17-17-17) mostly used as basal fertilisers
  - Calcium ammonium nitrate (CAN) and Urea mostly used as top/dressing fertilisers
- **Fairly stable proportions illustrate reluctance of farmers to change**
  - **Limited penetration of blend-/crop-specific NPKs** despite strong push
  - **Commercial organic products represent around 1%** of total consumption in 2022**,** mainly from farmers with traditionally higher fertiliser usage (larger farming systems, more educated smallholders)

- **Share of nutrient has been stable** over the last 10 years
- **Nitrogen is ~50%** and phosphate is 40-55% of nutrients consumed

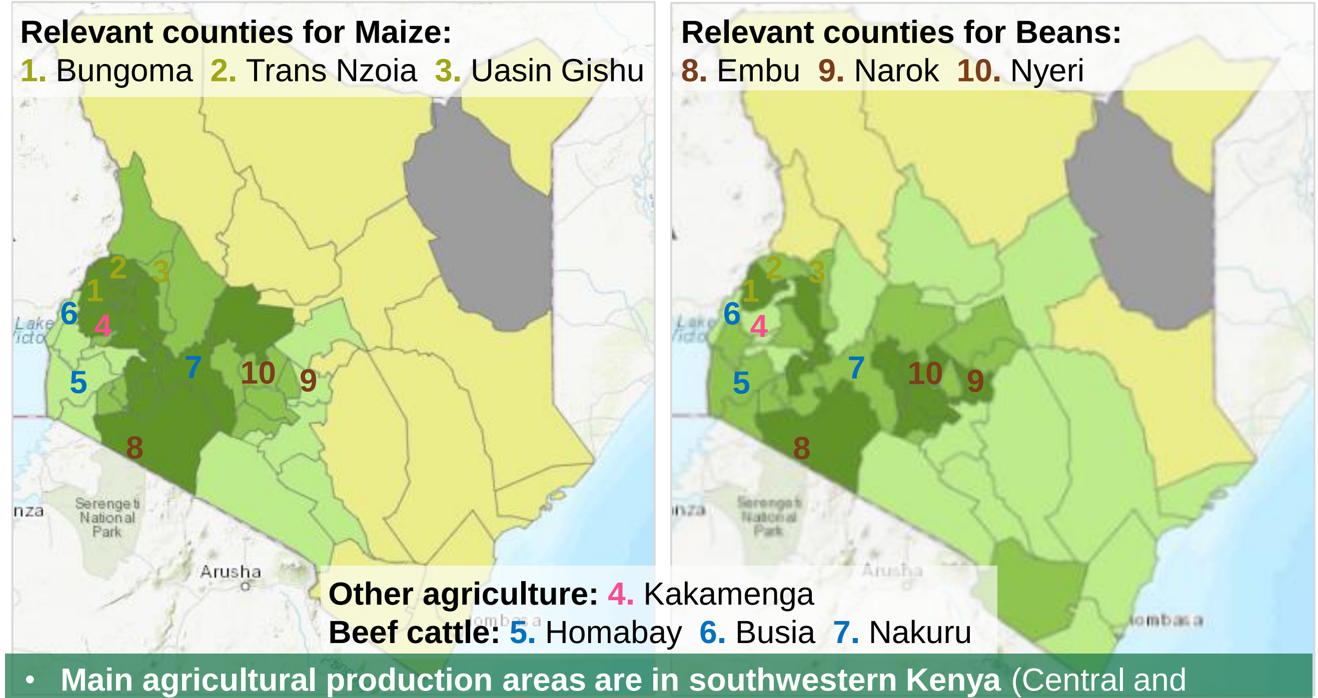
Source: AfricaFertilizer / IFDC (2020), AfricaFertilizer / IFDC (2022)

Fertiliser consumption vary widely by region and crop: For maize, farmers use fertilisers >200kg/ha in the Western Highlands, compared to Northern and Eastern region with ~30kg/ha

Fertiliser use for maize (left) and beans (right) by county (2016) in kg/ha

Maize: ● No data ● 30,35-54,18 ● 54,18-99,92 ● 99,92-139,34 ● 139,34-208,62

Beans: ● No data ● 0,49 - 6,06 ● 6,06 - 15,15 ● 15,15 - 24,75 ● 24,75 - 36,36



Relevant counties for Maize:
1. Bungoma 2. Trans Nzoia 3. Uasin Gishu

Relevant counties for Beans:
8. Embu 9. Narok 10. Nyeri

Other agriculture: 4. Kakamenga
Beef cattle: 5. Homabay 6. Busia 7. Nakuru

- **Main agricultural production areas are in southwestern Kenya** (Central and Western Highlands), with Uasin Gishu, Kakamega, and Trans Nzoia have the highest aggregate area of agricultural holdings, and Rift Valley
- **Main beef cattle distribution in around Lake Victoria and Rift valley**, namely in Homabay, Busia, and Nakuru with >250 beef cattle per km^2 (heads)

- **Fertiliser consumption varies per geography and its conditions, and dependent on the crop;** Top 3 counties with highest fertiliser for Maize and Beans:
  - Maize: Bungoma, Trans Nzoia, and Uasin Gishu, each with more than 200 kg/ha
  - Beans: Embu (36kg/ha), Narok and Nyeri (32kg/ha)

- **Multiple drivers impact fertiliser consumption across geographies within a given value chain:**
  - **Agrovets density**: Limited access to agrovets, e.g., due to long travel, hinders buying and transportation of fertiliser
  - **Education**: Lack of well-functioning extension systems hinders information-sharing regarding use, benefits, and recommended rates
  - **Sector development:** Comparably unstructured maize sector (vs. tea and coffee sector) leads to more economic uncertainty and less longer-term investment decisions
  - **Economic situation**: Unavailability of liquid capital to finance fertiliser, e.g., due to lack of credit/crop insurance greatly impacts fertiliser consumption of risk averse smallholders
  - **Biomass control**: Lack of livestock, rice husks, or sugarcane prevents efficient fertiliser production, as well as lack of data and knowledge on the value of biomass and its purpose as fertiliser

Source: TechnoServe analysis, AfricaFertilizer / IFDC (2016), FAO (2017), Egerton University (2009)

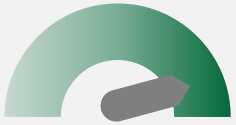
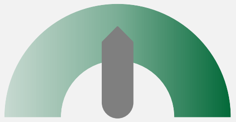
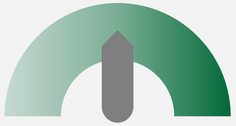
Affordability and (timely) availability are key barriers to fertiliser adoption; for organic, awareness has recently improved but many challenges around accessibility and quality remain

		Inorganic fertiliser		Organic fertiliser	
Farmer Decision		**Criticality of barrier**	**Description**	**Criticality of barrier**	**Description**
Quality and Efficacy	*Does this product work?*	**Minor**	• Long established efficacy for commodity products; new blends typically come with large scale field trials	**Major**	• Variability in product quality inherent to biomass and process used to produce fertiliser • Efficacy is not supported by large scale field trials
Affordability	*Is it economically viable for my farm?*	**Major**	• Gov't subsidies have fixed farmer's perception of fair price at a cut rate level • Even though farmers can afford, they buy less full price to avoid 'overpaying'	**Major**	• Lower price than inorganic per kg but more volume is required if used as standalone • Lack of strong evidence on yield benefits makes the business case unclear for farmers
Availability in location	*Is this product available near me?*	**Minor**	• Strong agro-dealer and retail network throughout Kenya carrying inorganic fertiliser	**Major**	• Products are typically not distributed too far away from production unit which limits availability • Product is more risky to stock given impact on cash and profitability
Availability in time	*Is this product available when I need it?*	**Moderate**	• Depending on political economy and broader international context, preferred products are not always available on time • Farmers consume less while waiting for subsidies on preferred products	**Major**	• Low stocking at agro-dealers and retail stores due to apparent low turnover and packaging • Dependency on availability of biomass which does not necessarily fit with crop schedules
Accessibility	*Can I use this product?*	**Minor**	• Long standing familiarization to product usability, e.g., through development of tools for application or packaging for transportation	**Moderate**	• Packaging and size (e.g., bulkiness), colouring, consistency (e.g., granularity), product application recommendations are less accessible
Awareness	*What are the these products and why should I use them?*	**Minor**	• Almost 99+% awareness due to decade-long reliance on inorganic fertiliser	**Moderate**	• Lack of knowledge, e.g., due to missing large-scale scientific evidence • Strong resistance to change and ability to take risk

Source: TechnoServe analysis

Increased fertiliser prices reduced fertiliser consumption resulting in reduced food productivity, and food insecurity

Frequency: ● High ● Medium ● Low

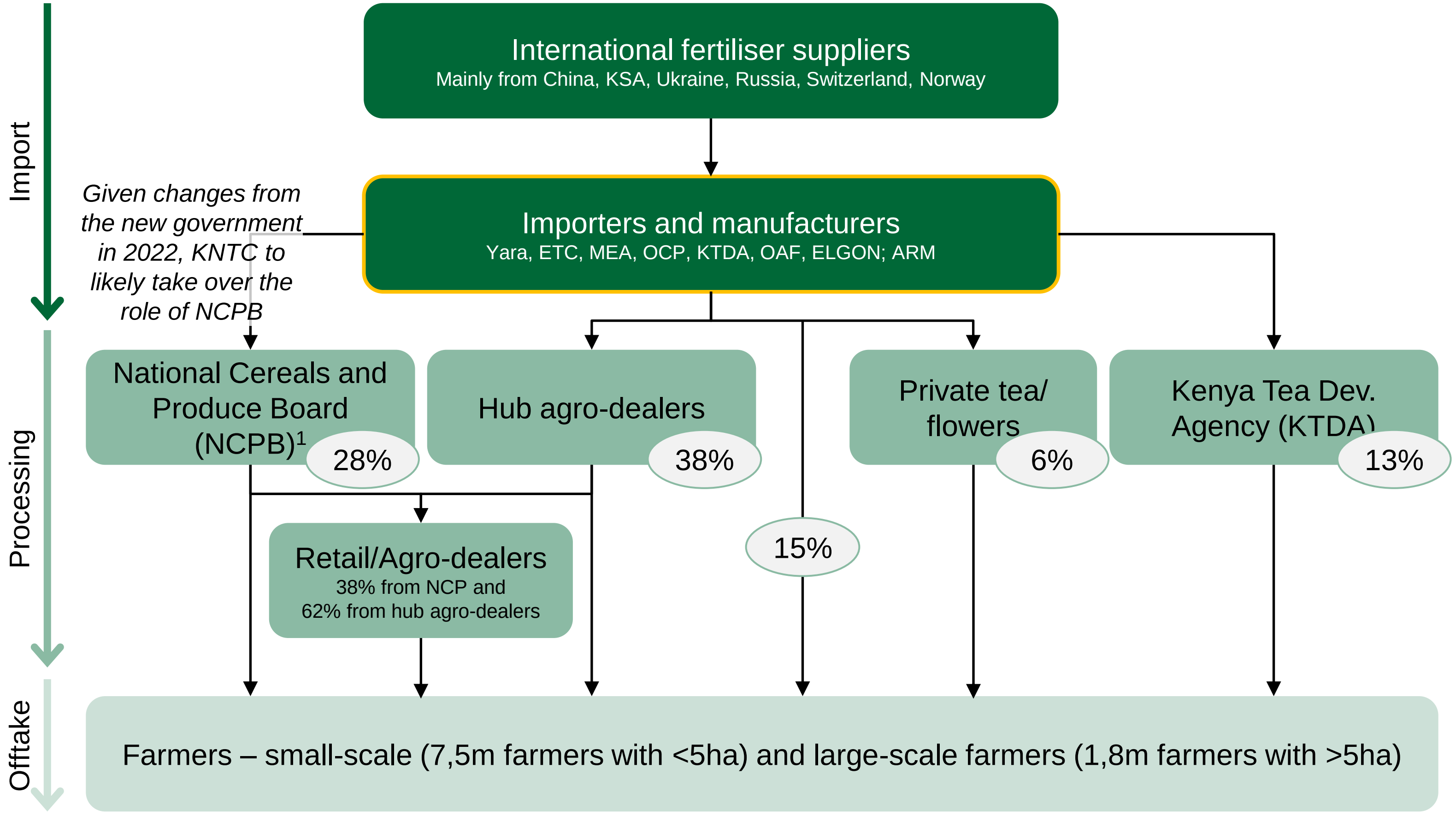
Mitigation actions	Description	Frequency of respondents	Consequences
Changing consumption patterns	• Reduction of overall fertiliser application per ha • Buying of smaller fertiliser bags, e.g., from 50kg down to 20kg • Uptake in both locally-produced and commercial organic fertilisers		• Reduced productivity (quantity and quality of food produced) • Food insecurity (hunger, malnutrition) • Increased levels of poverty
Reduction of farming area	• Reduction of area under crop cultivation since farmers could not afford the expenses of cultivating bigger land area		
Leaving farming sector	• Moving into livestock and poultry farming, e.g., as seen through increased number of pig farms		
Sourcing alternative supplies	• Application of cheaper or even contraband products		• Land degradation • Reduced productivity
Changing crops produced	• Shift towards into higher value or short-cycle crops, e.g., kale • Production of crops that can be sold in nearby towns		• Increased risk of production (market access, agronomical support, experience)

Source: TechnoServe analysis (~10 interviews with service providers and agribusinesses working directly working with smallholders)

There is an extensive network of agro-dealers bringing products from large importers and blenders to farmers

☐ Deep-dive follows

Kenyan fertiliser distribution and share of volume 2018
%



Import

Processing

Offtake

International fertiliser suppliers
Mainly from China, KSA, Ukraine, Russia, Switzerland, Norway

Importers and manufacturers
Yara, ETC, MEA, OCP, KTDA, OAF, ELGON; ARM

Given changes from the new government in 2022, KNTC to likely take over the role of NCPB

National Cereals and Produce Board (NCPB)[1] 28%

Hub agro-dealers 38%

15%

Private tea/ flowers 6%

Kenya Tea Dev. Agency (KTDA) 13%

Retail/Agro-dealers
38% from NCP and
62% from hub agro-dealers

Farmers – small-scale (7,5m farmers with <5ha) and large-scale farmers (1,8m farmers with >5ha)

Almost all inorganic fertiliser is imported by a handful of international players

- Possess either blending/granulation capacity
- Investments also focus on facilitating product movement, especially around Mombasa

Marketing power lies with approximately 150 hub dealers, and 8,000 agro-dealers

- Given cash constraints, intermediaries are inclined to stock products that sell fast and with strong brand awareness vs. products unfamiliar to farmers (e.g., organic)
- Well positioned to promote “novel” products and offer extension services to farmers in return of commissions and other (credit) terms from input manufacturers

Farmers typically adopt a “seeing is believing – on my own farm” stand

- Long-standing affinity towards CAN and DAP, especially due to historical push and subsidies (40-70% of market price)
- Often reluctant to change and even sceptical of new products

Source: TechnoServe analysis, AGRA (2018), AfricaFertilizer / IFDC (2022)

Note: 1. Until 2022, part of NCPB’s share of volume most likely distributed to retail and (hub) agro-dealers, given the termination of the National Fertiliser Subsidy Program (2009-19) in 2019

Most fertiliser imports come from OCP, MEA, ETG and Yara – further companies have set up processing plants in Kenya

Activity type: I = Importing **M** = Manufacturing (including chemical reaction to produce fertiliser) **P** = Processing (blending and steam granulation)

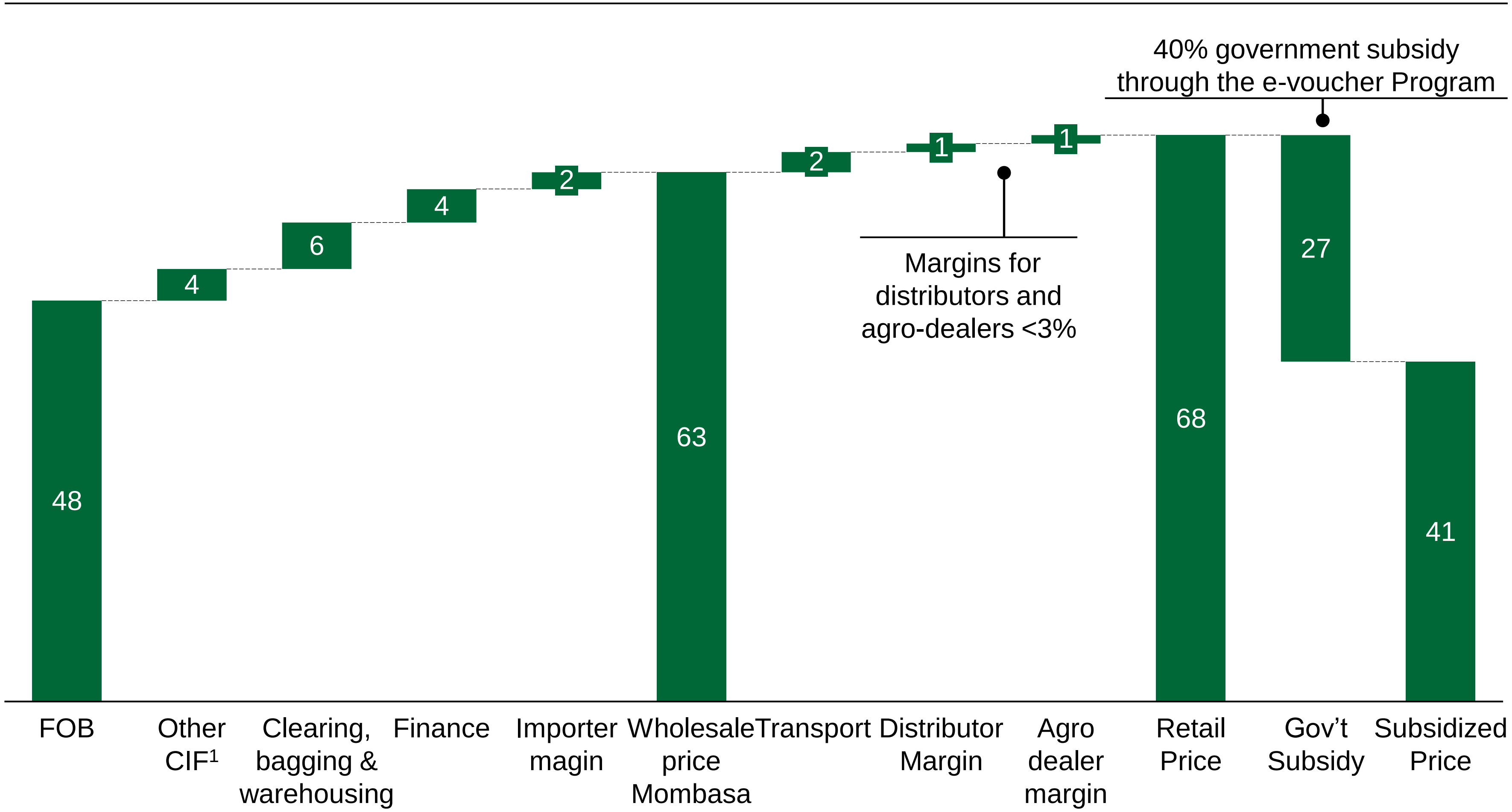
Company	Plant founded	Plant location	Activity type			Plant capacity	Key facts
			I	M	P		
OCP	-	-	✓	✗	✗	-	• Given war in Ukraine, Moroccan-based OCP became one of the largest importers
MEA	1977	Nakuru	✓	✗	✓	50 mtph	• Privately owned Kenyan firm • Hit hard by subsidies, moving into NPK blending to maintain/grow volumes
ETG	2017	Mombasa	✓	✗	✓	50 mtph	• Regional commodity trader. Owns Falcon brand, • Sells to other smaller importer/distributors to maintain volume
Yara	2021	Nairobi	✓	✗	✓	30 mtph	• Used to own 70% of the market, declined in share in the last 10 years • Built brand name in the East via demo plots and field days, well known for quality
CFAO Agri Ltd[1]	2016	Eldoret	✓	✗	✓	50 mtph	• In 2022, TIMAC agro acquired 51% of CFAO Agri to further develop CFAO’s Baraka Fertiliser brand by adding more advanced solutions for soils and crops
Fertiplant East Africa	2021	Nakuru	✗	✗	✓	15 mtph	• Fertiplant is a subsidiary of MEA and received $10m loan by IFC to set up plant (2017) and boost local fertiliser production (100,000 MT annually)
Elgon	2022	Nairobi	✗	✗	✓	30 mtph	• Thabiti as main fertiliser brand for NPK, CAN, UREA, and DAP
Maisha Minerals & Fertilisers	2004	Athi River	✗	✗	✓	35 mtph	• Devki Group of Companies acquired plant (300,000 MT of fertiliser annually) as buyout from ARM Cement; Mavuno Fertilisers as main brand for fertiliser blends
Kel Chemicals	1970 (M) 2020 (P)	Thika	✗	✓	✓	12k mtpy (M) 35k mtpy (P)	• Only phosphate manufacturing facilities in Kenya with production of phosphate rock and phosphate-based fertiliser compounds

Source: TechnoServe analysis, AGRA (2018), AfricaFertilizer / IFDC (2023), CFAO Group (2022), Business Daily Africa (2021)

Note: 1. Formerly Toyota Tshusho Fertiliser; Activity type: I = Import, M = Manufacturing, P = Processing

Clearing fees and transport are the major cost drivers with high competition leading to thin margins for distributor and agro-dealer

Average monthly cost build-up of DAP bulk from Morocco, 2022
USD/50 kg bag

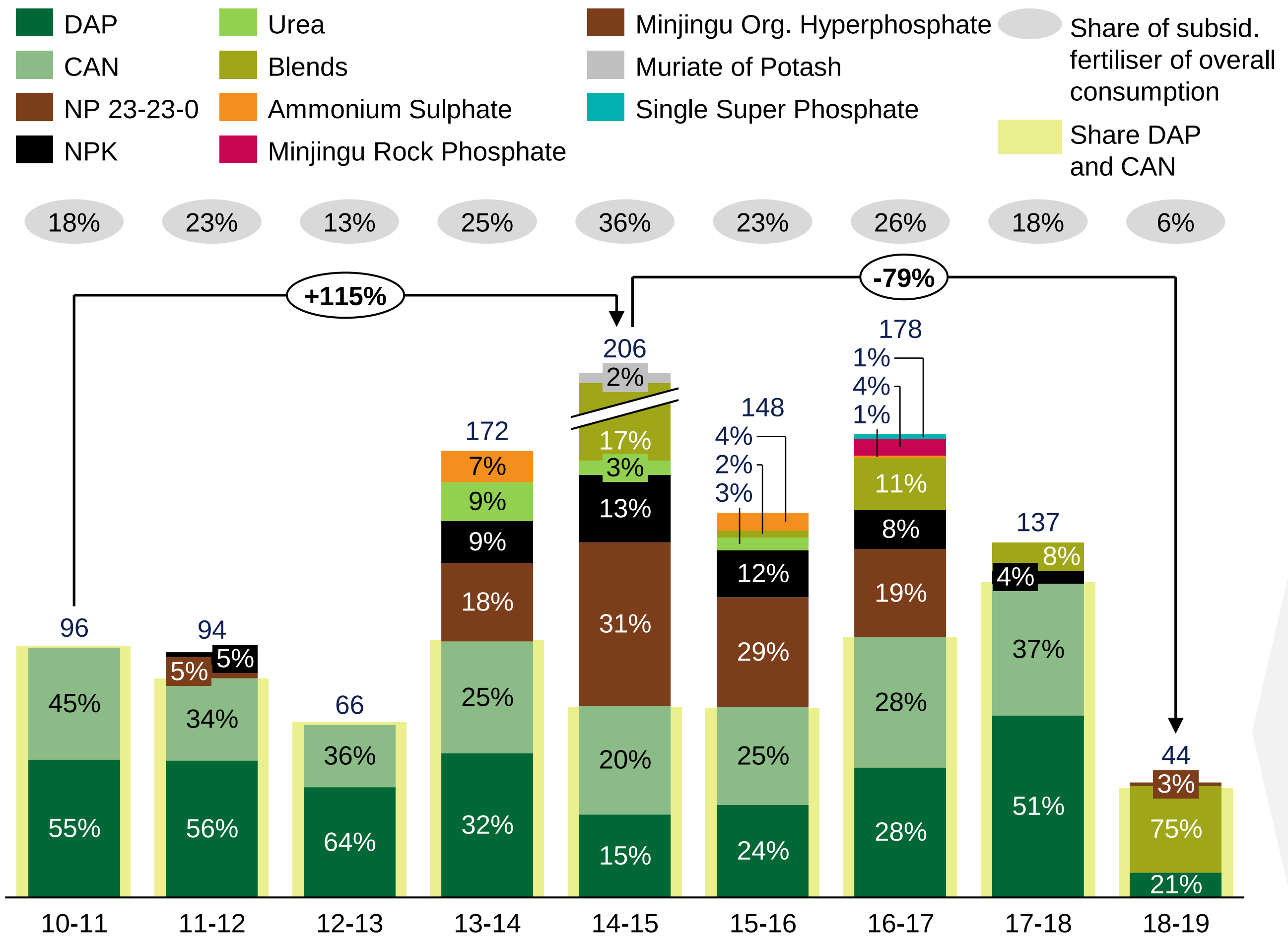


Source: TechnoServe analysis, AfricaFertilizer / IFDC (2022)
Note: 1. Includes freight costs and marine insurance

- **Retail price contains a 40-50% mark-up on Free on Board (FOB) price**
  - Difference is mainly driven by clearing, bagging, warehousing and transportation cost
  - 40% government subsidy is granted registered farmers through the e-voucher program
- **Components tends to be stable over time, however, two exceptions exist:**
  - FOB has increased by 100% since the outbreak of the war in Ukraine, limiting the supply and thus increasing prices
  - Transportation cost to agro-dealers and retailers depend on the distance between the port in Mombasa to the town as well as the weight

Subsidies play a major role in fertiliser adoption and are largely supply-driven, and recent instability has affected their effectiveness – in 2018/19, only 6% of fertiliser consumed was subsidized

Annual subsidized fertiliser FY 2010-2019
k MT



Background on major subsidy programs:

National Fertiliser Subsidy Program (2009-19):

- Farmers access the subsidized fertiliser at NCPB depots
- Estimated 40% of product in the subsidy leaked to agro-dealers, across borders, and to farmers not targeted for subsidies (e.g., due to long distance to the depots, tedious processes of accessing the subsidized fertiliser)

E-voucher Program (since 2019-2022)

- Roll-out in 12 counties across 4 value chains with subsidized access to fertilisers, lime, agrochemicals, insurance, and seeds
- Payment split between farmer (60%) and gov. (40%)
- With the new government in 2022, the subsidy program changed back to national fertiliser program with distribution through NCPB

- **Subsidies are not defined based on soil needs but rather on quantity and price** – from 2010-2018, **DAP and CAN made up ≥ 50%** of all subsidized fertiliser (except for 2014-15)
- **High volatility of overall subsidy budget** (-79% from 2014-18) and specific products (DAP: +120% from 2014-17, -86% from 2017-18) prohibit long-term planning of farmers
- Recent developments (2023):
  – **Declared intention by the gov. to make 500k MT of subsidized fertiliser** available to drive ongoing farmer registration
  – **DAP supply cut** in a bid to stem soil acidity
  – **Limited support for bio-inputs** (included in the E-voucher prog.)

Source: AfricaFertilizer / IFDC (2019), AfricaFertilizer / IFDC (2022), Business Daily Africa (2023), Kilimo News (2023), Ministry of Agriculture (2023)

Kenya has developed a regulatory framework, but organic fertiliser manufacturers have observed numerous challenges with governmental stakeholders that inhibit support and growth of the sector

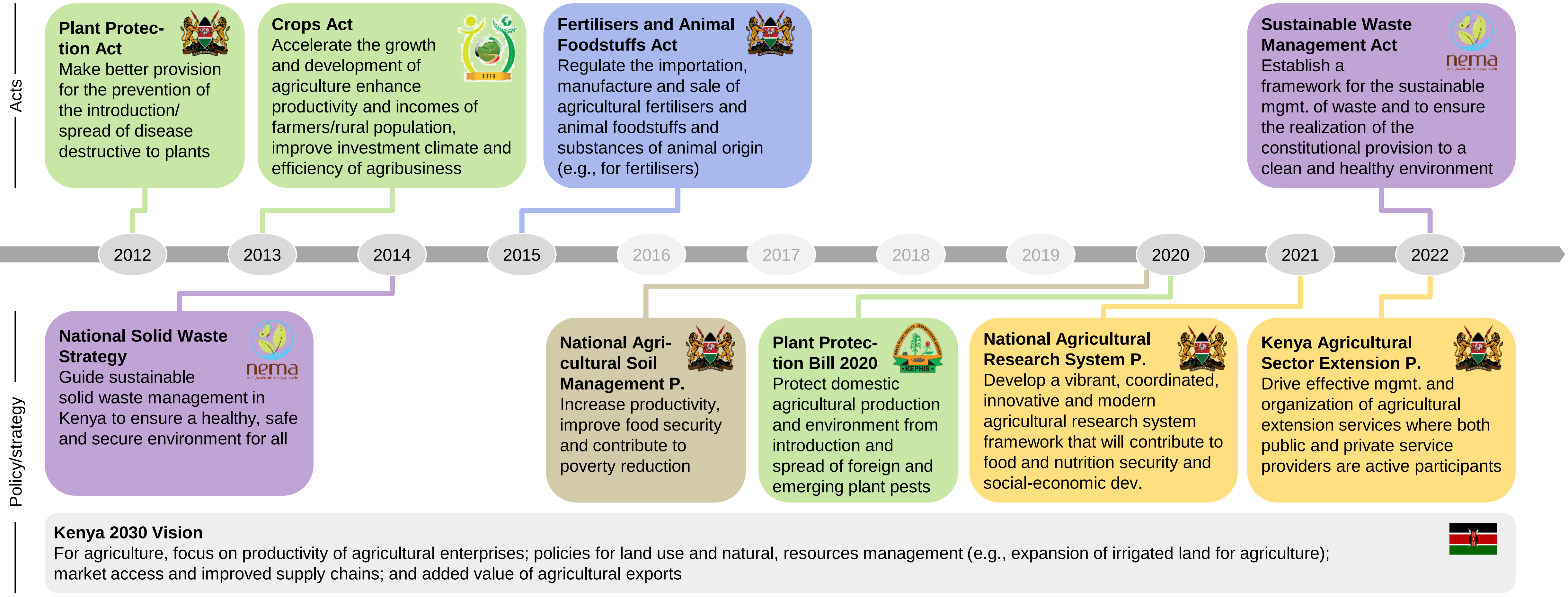
Organization	Objective	Role regarding (organic) fertiliser and regulation	Observed challenges regarding support of fertiliser manufacturers
Ministry of Agriculture & Livestock Development	• Formulates, implements and monitors agricultural legislations, regulations and policies	• Drafts bills regarding (organic) fertiliser • Provides implementation framework	*"We need to make some noise to get attention for organic fertiliser – for that, the MoA is lagging behind to create standards and push regulations"* – research association
Ministry of Industrialization, Trade and Enterprise Development	• Creates an enabling environment for a globally competitive, sustainable industrial, enterprise and co-operative sector through appropriate policy, legal and regulatory framework	• Can enforce trade restrictions and import bans on organic products, e.g., to drive local production	*"Just like limiting steel imports, the MoI needs to act now, and support and incentivize local fertiliser production"* – organic fertiliser manufacturer
Kenya Plant Health Inspectorate Service (KEPHIS)	• Assures the quality of agricultural inputs and produce to prevent adverse impact on the economy, the environment and human health	• Provides quality assurance and offers testing of soil as well as organic products • Provides training and capacity building of extension officers	*"Working with KEPHIS has been proven difficult and expensive to us, eventually slowing down our launch"* – organic fertiliser manufacturer
Kenya Bureau Of Standards (KEBS)	• Provides standards development, metrology, conformity assessment, training and certification services	• Provides testing, inspection and quality certification • Enforces standards for new organic products, e.g., KS 2290:2018 (organic fertiliser) and KS 2356:2016 (bio-fertilizer)	*"It took us 18 months to get a KEBS license, because no one was there to help"* – organic fertiliser manufacturer
Kenya Agricultural and Livestock Research Organization (KALRO)	• Coordinates research and regulation, technology and innovation development; and catalyzes transfer and utilization of agricultural research outputs	• Provides recommendations and conducts studies about soil and organic products, e.g., soil mapping study (~30 years ago), organic systems study (due in 2026) • Provide first-level of extension training (ToT)	*"Widespread adoption of organic fertiliser and understanding of our soil requires new knowledge that needs to be disseminated top-down – KALRO has not really been helpful with that"* – organic fertiliser manufacturer
National Environment Management Authority of Kenya (NEMA)	• Supervises and coordinates all environmental activities and serves as the main national body to implement environmental policies in all sectors	• Implements on behalf of the government, e.g., Green Point program (extension program in >15 counties) • Coordinates agendas between agencies, e.g., for Green Point participation • Manages waste streams (urban and industrial) that form raw materials for organic fertiliser manufacturers	*"We have a few good policies, for example to prevent waste dumping; what we need now is implementation of these for us to thrive"* – organic fertiliser manufacturer

Source: TechnoServe analysis, Government of Kenya (2023), stakeholder interviews

Despite recent progress, passing on binding legislation and respective implementation tools on fertiliser have been delayed

Key focus areas: 🟩 Plant protection 🟦 Inputs 🟪 Waste 🟫 Soil 🟨 Capacity building ⬜ Overarching

Selection



Plant Protection Act
Make better provision for the prevention of the introduction/ spread of disease destructive to plants

Crops Act
Accelerate the growth and development of agriculture enhance productivity and incomes of farmers/rural population, improve investment climate and efficiency of agribusiness

Fertilisers and Animal Foodstuffs Act
Regulate the importation, manufacture and sale of agricultural fertilisers and animal foodstuffs and substances of animal origin (e.g., for fertilisers)

Sustainable Waste Management Act
Establish a framework for the sustainable mgmt. of waste and to ensure the realization of the constitutional provision to a clean and healthy environment

National Solid Waste Strategy
Guide sustainable solid waste management in Kenya to ensure a healthy, safe and secure environment for all

National Agricultural Soil Management P.
Increase productivity, improve food security and contribute to poverty reduction

Plant Protection Bill 2020
Protect domestic agricultural production and environment from introduction and spread of foreign and emerging plant pests

National Agricultural Research System P.
Develop a vibrant, coordinated, innovative and modern agricultural research system framework that will contribute to food and nutrition security and social-economic dev.

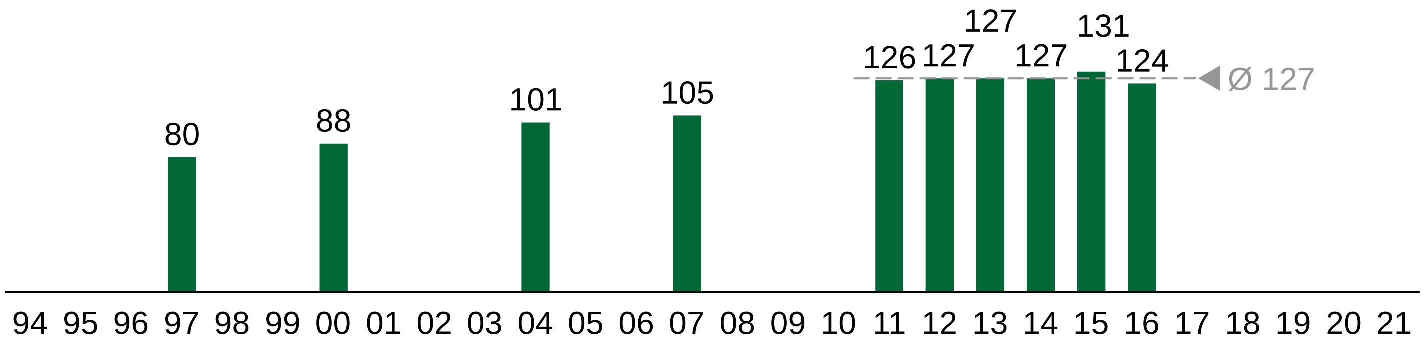
Kenya Agricultural Sector Extension P.
Drive effective mgmt. and organization of agricultural extension services where both public and private service providers are active participants

Kenya 2030 Vision
For agriculture, focus on productivity of agricultural enterprises; policies for land use and natural, resources management (e.g., expansion of irrigated land for agriculture); market access and improved supply chains; and added value of agricultural exports

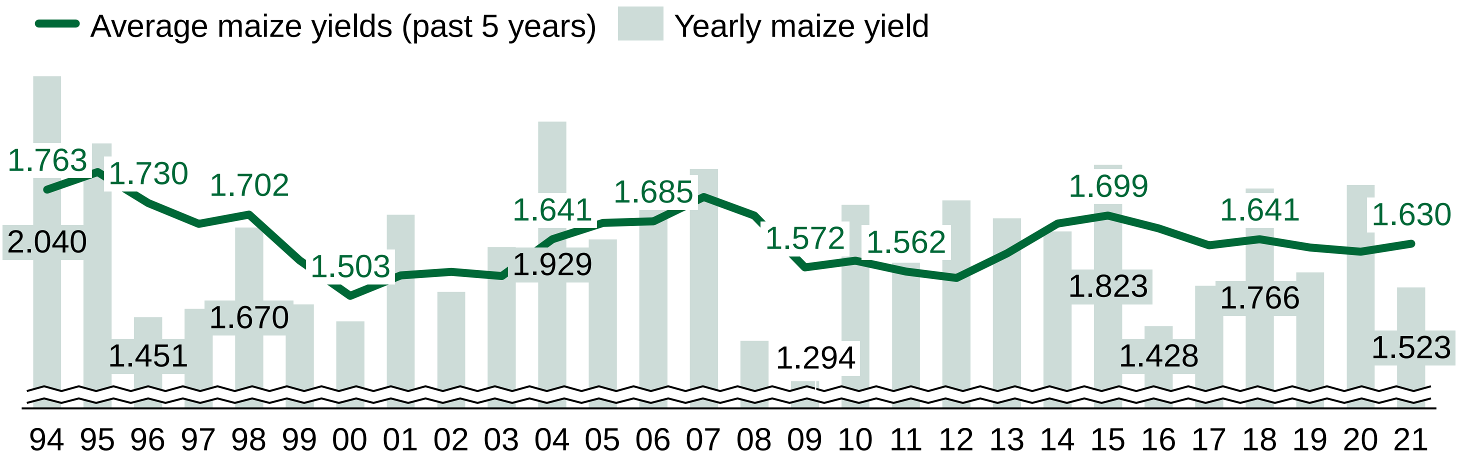
Source: TechnoServe analysis, Government of Kenya (2012, 2013, 2014, 2015, 2020, 2021, 2022, 2023)

Despite increased use of fertiliser since the nineties, productivity has remained constant in Kenya; recent high prices (2022 onwards) have further degraded the situation

Yearly maize fertiliser application rates in Kenya, 1994-2021
kg/ha



Maize yields in Kenya, 1994-2021
kg/ha

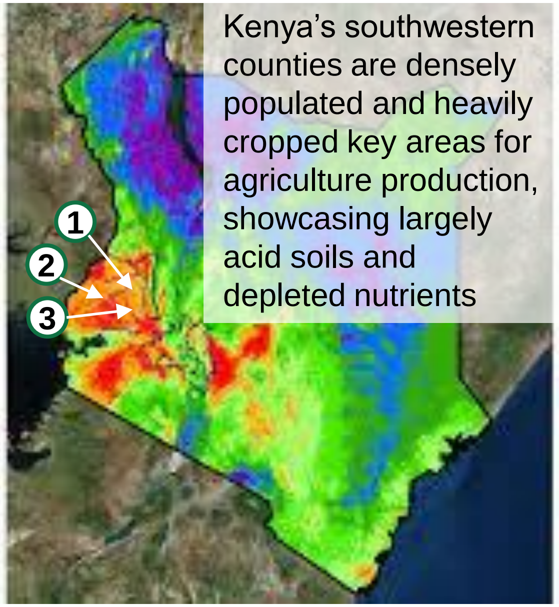


- **Maize production consumes >50% of total fertiliser volume, application rate has increased by 50% in 20 years and now stabilized**
  - It increased from 80kg/ha in the late nineties and plateaued at 127 kg/ha over 2011-16
- **Maize productivity is lower than in the nineties and remains low vs. other countries**
  - It currently varies between 1.6 and 1.7 tons per hectare vs. 4.2 MT/ha in Ethiopia (+200%)
- **Increased fertiliser usage has not led to increased productivity and several factors can explain it**
  - Inefficient fertiliser usage: Fertiliser has been used sub optimally by farmers given lack of capacity-building
  - Soil degradation: Farmlands have lost their ability to absorb nutrients and thus lower yields
  - Farmland expansion: From 1994-2021, harvested maize area has increased by 45%, potentially driven by improved availability of fertiliser through subsidies that led to farm expansion vs. higher application rates of existing cropland

Source: TechnoServe analysis, AfricaFertilizer / IFDC (2016), FAO (2021), Center of Evaluation for Global Action (2009)

Extensive use of inorganic fertilisers have led to undesired acidification of soils and depleted nutrients, especially in counties in the heavily cropped SW region

Soil acidity in Kenya 2018
pH H_2O level



Kenya's southwestern counties are densely populated and heavily cropped key areas for agriculture production, showcasing largely acid soils and depleted nutrients

🟥	Strongly acid	<5,5	🟩	Very slightly alkaline	7-7,5
🟧	Medium acid	5,5-6	🟦	Slightly alkaline	7,5-8
🟩	Slightly acid	6-6,5	🟪	Medium alkaline	8-8,5
🟩	Very slightly acid	6,5-7	🟪	Strongly alkaline	>8,5

% of farms below target level on selected soil parameters in the three counties with the highest aggregate area of agricultural holdings

	Soil pH	SOM	Available N	Available P
Target Level	5,5 pH level	2,7%	0,2%	30ppm
① **Uasin Gishu county (n=143)**	80-93%	90%	43-87%	90%
② **Kakamega county (n=210)**	99%[1]	100%	68-100%	68-100%[2]
③ **Trans Nzoia county (n=114)**	20-67%	90%	25-95%	13-97%

- **>13% of Kenya's total land area is occupied by soils with largely poor pH levels, mostly in agricultural areas**
  - The extensive use of acidic fertility products (e.g., DAP) combined with a lack of understanding of soil's chemical properties are causing this deterioration
- **Acid soils significantly reduce fertiliser efficiency and land productivity:**
  - For soils with a 7.0 pH level, 0% of NPK fertiliser is wasted: crops can absorb 100% of the fertiliser
  - For soils with a 4.5 pH level, over 70% of NPK fertiliser is wasted: Low pH level is recognized as the main driver of massive soil nitrogen losses through reduced mineralization with lower microbial activity
- **Farmers are consequently incentivized to use higher rates of fertiliser further contributing to acid soils**
  - The vicious circle leads to an increase in production cost without increasing productivity

Source: CropNuts (unk.), NAAIAP (2014), AfricaFertilizer / IFDC (2018), KALRO (2002), The Standard (2022)

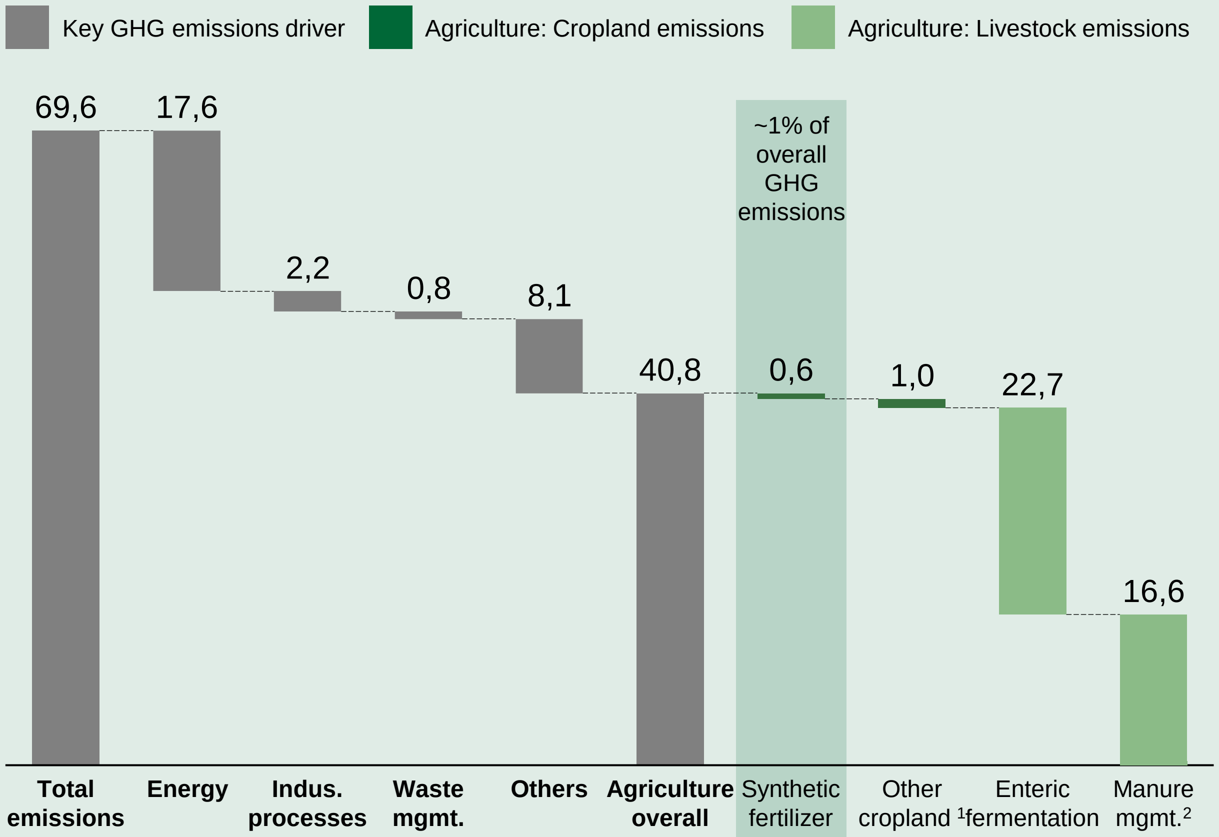
Note: n = Number of sampled farmers in NAAIAP study, SOM = soil organic matter/total organic carbon | 1. Excluding Butere Sub County (48%) and Lugari Sub County (47%) 2. Excluding Matungu Sub County (52%)

(1) Extensive use of inorganic fertilisers in Kenya is responsible for 1% Kenyan GHG emissions but (2) fertiliser imports cause >5x of emissions upstream in its value chain through importing countries

Sources of GHG emissions of inorganic fertiliser…	**…and their major key drivers**
① In Kenya: Synthetic fertiliser made up **0,6 Mt** (1%) of overall emissions Overall, Kenya emitted **69,6 Mt of CO_2 equivalents** Thereof, **agriculture has been the largest polluting sector** (~60%), of which livestock accounts to ~96,2%	**50% of applied nitrogen fertiliser** is not taken up by crops due to inadequate knowledge on crop and soil characteristics, eventually releasing GHG
	Carbon is not able to be **stored in the soil as soil organic carbon (SOC)** yet released into the atmosphere due to bad agricultural practices
② Outside of Kenya: Through N imports, fertiliser consumption caused another **3,4 Mt of GHG emissions** (of that ~50% from China and KSA)	**Production of industrial N fertiliser** as contained in synthetic fertiliser is one of the leading polluters (79% of all fertilisers imported)
	Freight transportation as key driver alone needs to reduce its CO2 emissions by 70 to 80% below 2015 levels to meet the targets set in the Paris Agreement

Kenyan GHG emissions 2015

Mt CO_2 equivalent



Source: CropNuts (2022), CropNuts (unk.), Kabiri (2020), World Bank (2015), MIT Climate Portal (2021) | 1. Includes emissions from burning savannah, crop residues, burning of crop residues, cultivation of organic soils and rice cultivation 2. Including manure left on pastures and emissions from manure applied to soils

Agenda

- Executive summary
- Introduction
- Overview of existing fertiliser value chain
- **Case for organic fertiliser**
- Characterisation of organic fertiliser sector
- Pathway to scale
- Appendix

Addressing soil fertility is the most effective way to tackle short- and long-term challenges caused by the over-reliance on inorganic fertiliser and unlock significant benefits for smallholders

***This study focuses on soil fertility products** and does not cover other inputs (seeds) or practices (irrigation, no tillage, mulching, etc.) influencing soil fertility*

☐ Deep-dive follows

Environmental benefits

- **Improved soils** with more nutrients and more conducive pH levels
- Reduced **GHG emissions** through carbon sequestration and localised fertiliser production
- Supported a diverse and active **biotic community**
- **Cleaner soils & waterways** due to reduced leaching[1]
- Increased **climate resilience**, e.g., reduced erosion, improved water holding capacity, mitigated forest degradation

Economic and social benefits

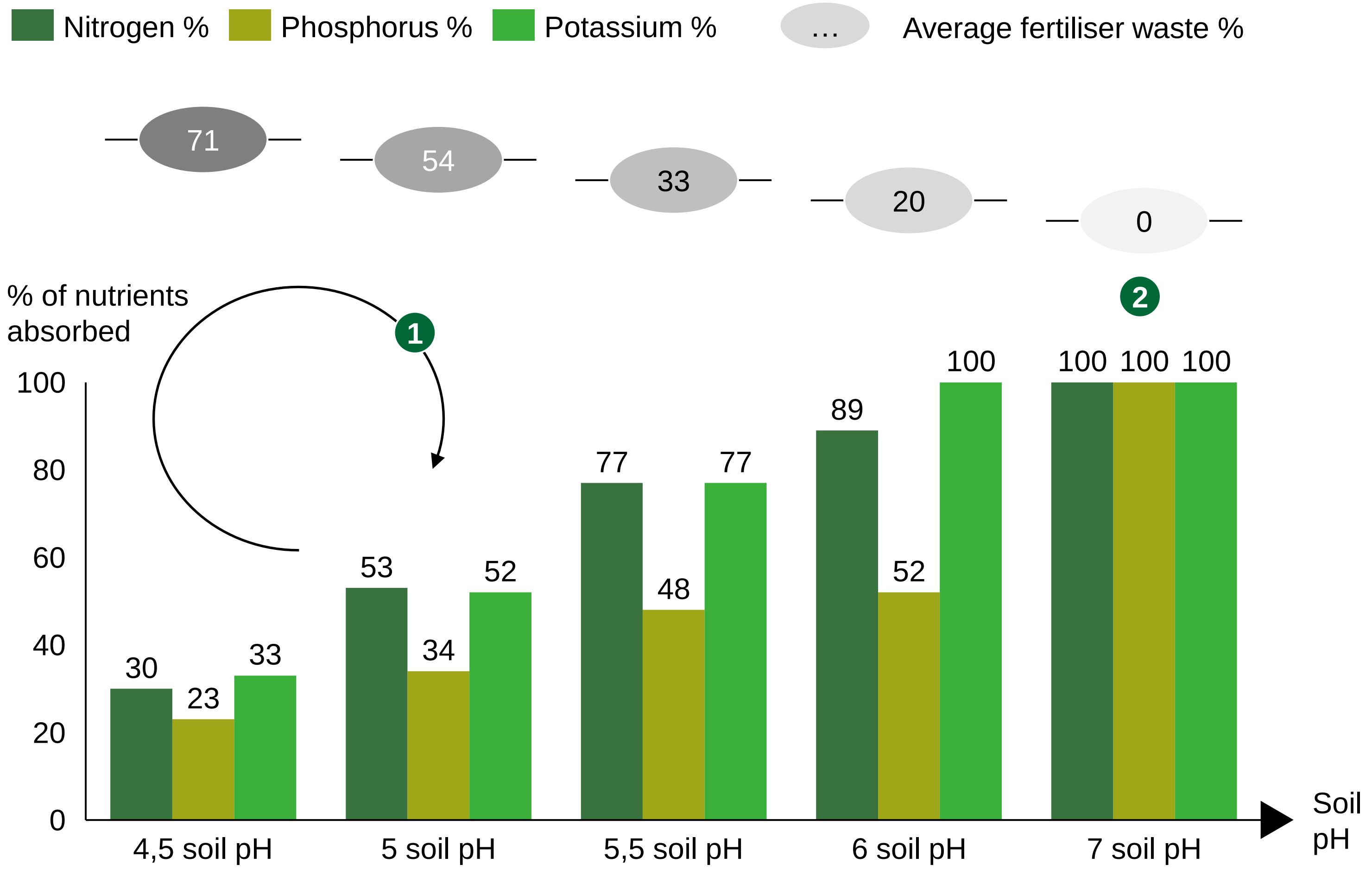
- Increased **farm productivity** over long period of time
- Improved quality of **farm outputs**
- Improved **food security**

Notes: 1. Farmyard manure and slurry can also leach nutrients into the wider environment

Source: TechnoServe analysis

Low soil pH levels observed across heavily-cropped areas in Kenya inhibit further absorption of nutrients

Correlation between soil pH level and fertiliser efficiency
%, kg/ha



Source: CropNuts (2022)

① Inorganic fertiliser caused a vicious cycle through overconsumption, leading to fertiliser inefficiency

- Soils have become depleted and strongly acidic (<5,5 pH level), largely due to the longstanding extensive usage of inorganic fertiliser
- Low soil pH levels inhibit further absorption of nutrients
- To compensate (and without the correct understanding of soil characteristics), this led to even more usage of fertiliser, wasting up to 71% of its consumption

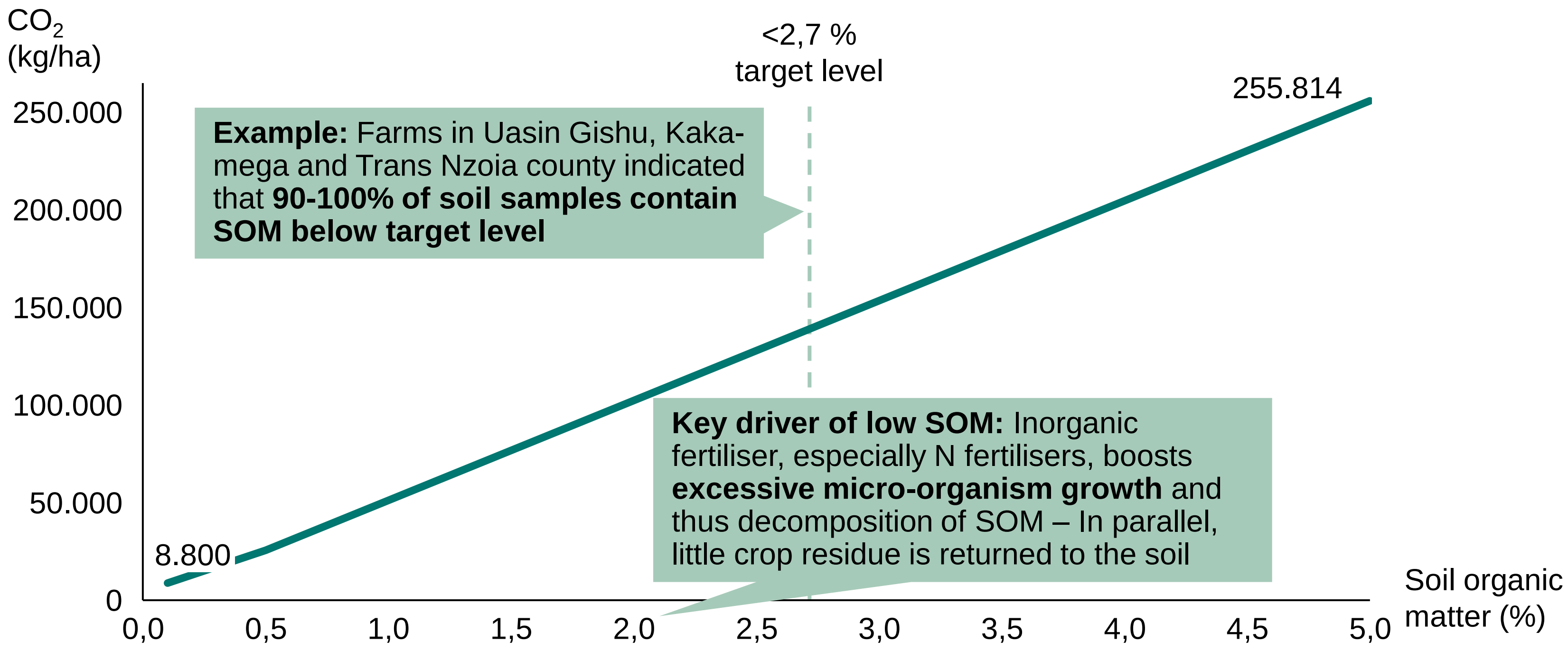
② However, there is an opportunity to move the challenge into virtuous cycle

- Soil amendments like liming can effectively increase soil pH
- Organic materials can also improve the soil's cation exchange capacity (CEC) to unlock and hold nutrients in a form that plants can readily absorb
- Combined, these solutions can drive soil restoration to reduce unleashes fertiliser waste down to a minimal number, and improve farmer economics

More resilient soils have a higher share of soil organic matter (SOM) and thus can capture more than 30x of CO_2

Correlation between soil organic matter and CO_2 capture
%, kg/ha

Ideally, **soil** contains four major ingredients: 45% mineral particles, 25% water, 25% air, and at least **5% organic matter – the latter** one is made up of around 10% plant roots, 10% living organisms, and 80% humus. SOM serves as a “revolving nutrient fund” and improves soil structure, maintains tilth and minimizes erosion.



Example: Farms in Uasin Gishu, Kakamega and Trans Nzoia county indicated that **90-100% of soil samples contain SOM below target level**

Key driver of low SOM: Inorganic fertiliser, especially N fertilisers, boosts **excessive micro-organism growth** and thus decomposition of SOM – In parallel, little crop residue is returned to the soil

- **Organic fertiliser increases soil organic matter** by:
  - Balancing nutrient supply and increasing microbial activity
  - Improving nutrient holding capacity, by stimulating activities to increase root extension for extensive nutrient availability to crops
  - Increasing water holding capacity
  - Improving soil texture and structure
- **Climate-smart agricultural practices also positively impact SOM**, including:
  - Rotations with high-residue crops and deep- or dense-rooting crops
  - Cover crops, e.g., by adding plant material to the soil for organic matter replenishment
  - Zero or reduced tillage to avoid degrading the soil structure and its potential to hold moisture

Source: CropNuts (unk.), NAAIAP (2014), FAO (unk.), Brempong et al. (2022)

Scientific consensus has emerged regarding Integrated Soil Fertility Mgmt. (ISFM), taking biological & physical soil characteristics into account and promoting the joint use of inorganic & organic fertiliser

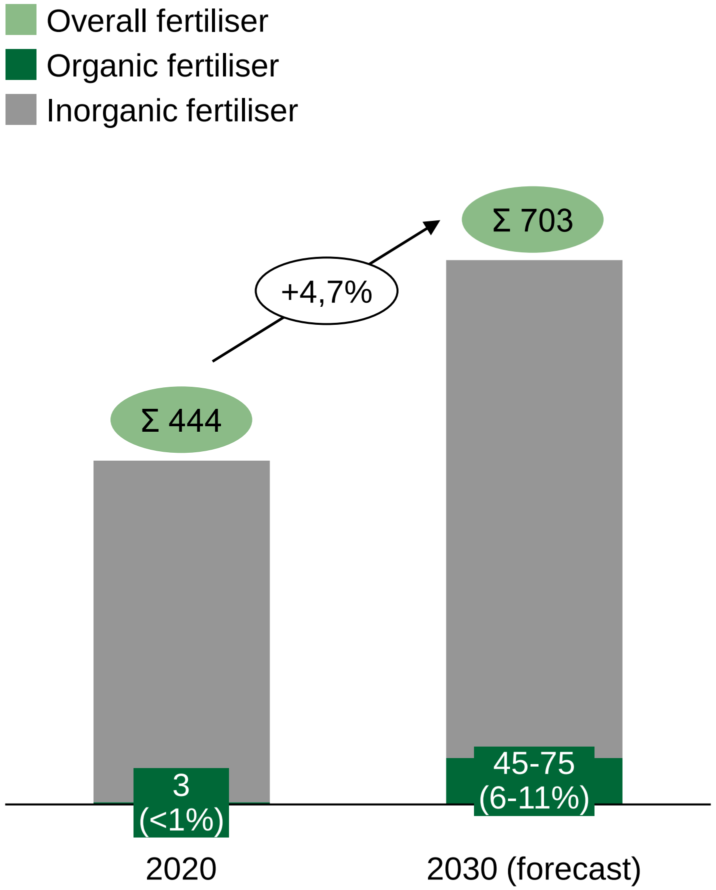
Soil characteristics: ▩ Biological ▨ Physical □ Chemical **Direct Influence:** 🟢 Very positive ◉ Positive ◌ Limited ⚪ Neutral 🟡 Negative 🟠 Very negative

Key parameter	Description	Influence on parameters		
		IF	OF	BS
▩ **Beneficial soil microbes**	• Bacteria, fungi, and protozoa are major players in soil microbial processes, performing a variety of functions beneficial to soil and the plants growing in that soil, e.g., recycle and regulate carbon, nitrogen and phosphorous • Fungi such as Trichoderma and other biological interventions are introduced to the soils mostly by large scale farmers • Most smallholders know about intercropping maize and beans but limited understanding of science	🟡	🟢	🟢
▨ **Soil Organic Matter (SOM)**	• SOM is any material produced originally by living organisms (plant or animal) that is returned to the soil and goes through the decomposition process – most soil organic matter originates from plant tissue • Most farmers are taught to add animal manure to their farms with effects of this being most dominant in dairy farming regions – access for smallholder farmers is still limited	🟡	🟢	⚪
▨ **Cation Exchange Capacity (CEC)**	• CEC indicates the capacity of the soil to retain positively-charged nutrients (e.g., K^+, NH_4^+, Ca^{2+}) and can influence soil structure stability, nutrient availability, soil pH and the soil's reaction to fertilisers and other ameliorants • Farmers are limited in their understanding of this key soil parameter and how it helps decision-making, e.g., soils may not need addition of K for example but rather something to unlock the K in the soils	🟡	🟢	🟢
□ **Soil pH**	• Soil pH measures the acidity or basicity of a soil – in Kenya, long-term use of DAP has left many parts of the country with acidic soils • There are cases where nutrients are locked in the soil and just improving pH can unlock the nutrients without adding other nutrients • Lime was heavily promoted but limited use and effect by smallholders given the volumes needed and additional application costs	🟠 *New blends* ⚪	◉	◌
□ **Primary elements:** Nitrogen, Phosphorus, Potassium	• Primary macronutrients (N, P, K) are required in large quantities, and essential for plant growth and a good overall state of the plant • N supports plant development, P drives root growth, K is involved in the regulation of water • For inorganic fertiliser, elements are often mined from the earth: NPK, DAP (N and P only), CAN and Urea (N only), Potash (K only)	🟢	◌	⚪
□ **Secondary elements:** Calcium, Magnesium, Sulphur	• Secondary macronutrients (Ca, Mg, S) are consumed in smaller quantities than N, P, and K • Ca stabilizes the cell wall, Mg is essential for photosynthesis, S participates in the formation of chlorophyll • Mainly from inorganic sources, e.g., CAN, Yara and ETG Blends	◌ *New blends* ◉	◉	⚪
□ **Micro elements:** Iron, Boron, Copper, Zinc, Chlorine, Manganese, Molybdenum	• Micro elements are essential nutrients that are found in trace amounts in tissue, but play an imperative role in plant growth and dev. • A few basal products in the market are starting to include B and some Zn, additionally there are various foliar products but focused on horticultural crops • Lack of understanding for these elements, and lack of comprehensive soil tests leave SHFs blind to deficiencies regarding these element	⚪ *New blends* ◉	◉	⚪

Source: TechnoServe analysis, FAO (2006), FAO (2022) | Note: IF = Inorganic fertiliser, OF = Organic fertiliser, BS = Biostimulants

Assuming adoption at scale of integrated soil fertility management, organic fertiliser could grow into a $44M industry (6% of overall fertiliser market, the rest being synthetic)

Fertiliser market size 2020, 2030 (forecast)
M$



Source: AfricaFertilizer / IFDC (2022)

2020 perspective

- In 2020, **overall fertiliser market was 444M$**
- Total fertiliser consumption was at **789k MT** – almost **exclusively including inorganic products (99%)**, with DAP ~40%, followed by Urea with ~20%
- On average, **price for DAP was at 562 USD/MT**

- In 2022, **organic fertiliser made up <1% (3M$)** of the overall fertiliser market
- Volumes in 2022 are estimated at ~8k MT (likely an increase vs. 2020) and prices at ~330 USD/MT (weighted average, likely similar to 2020)

2030 perspective

- In 2030, the **overall fertiliser market** is expected to **exceed 700M$**
- Growth is driven by volume which is expected to reach 1.2m MT, assuming that the **CAGR of 4,7%** observed over the last decade will maintain
- **Overall market prices are assumed to stay constant** at 562 USD/MT

- In 2030, **organic fertiliser market** is expected to grow to **between 45M$ and 75M$** (45-50% CAGR from 2022)
- Main assumptions are:
  - **12.5-17.5% volume share** of organic in the overall fertiliser market – similar range than Mali, a leader in organic fertiliser consumption in sub-Saharan Africa
  - **Price between 280 and 350 USD/MT** although some stakeholders (Kenyan research institute, organic fertiliser manufacturers) suggest price could go as low as 240 USD/MT

However, sector growth faces immediate challenges

Lack of scientific evidence

- **Research institutes** have developed and tested technologies largely in isolation from the private sector which means that best practices are not necessarily reflected in commercial products
- **Organic fertiliser manufacturers** sell products of varying quality and have not performed large scale field trials to be able to articulate impact on yields and generate standard recommendations similar to what exist for inorganic products
- **Farmers** currently need to rely on costly soil testing and lengthy field trials to prove the value (about 2-3 seasons to at least see the benefits of organic)

Lack of awareness and understanding

- **Farmers** have been using the same inorganic products for decades and do not necessarily have the incentives or the knowledge to understand why organic fertility products could be beneficial for them
- **Agro-dealers** have limited understanding of product specifications and general risk aversion to take on “novel” products given potential impact on cash and profitability
- **Extension workers** have not yet harmonized knowledge amongst themselves and are typically reluctant to adopt products whose efficacy is not widely recognised

Source: TechnoServe analysis

Agenda

Organic fertiliser and soil amendment products typically leverage existing biomass across the value chain to repurpose available nutrients with circular processes

▨ **Limited/Informal Commercialization** in Kenya 🟩 **Dominant Commercial Production** in Kenya ⬜ **Limited Commercial Production** in Kenya

	Organic fertiliser (typically >5% nutrient content)					**Soil amendment** (typically <5% nutrient content)		
Dominant Organic Fertiliser and Soil Amend. Product Types	🟩 **(Fortified) Compost** *Decomposed organic matter, composting can be accelerated by earthworms and/or fungi and enriched with minerals and microorganisms*	🟩 **Frass** *Insect larvae faeces or dejections, their feeding substrate and parts of farmed insects*	⬜ **By-products of plant origin** *By-products particularly from agricultural value chains and processing e.g., oilseed cake meal*	⬜ **Meals from animal origin** *Meals from animal blood, hoof, horn, bone, meat, feather, hair, skin, or from fish by-products*	🟩 **(Fortified) Biochar** *Carbon-rich material that emerges from the pyrolysis of biomass such as agricultural or forestry wastes or residues*	▨ **Farmyard Manure** *Mixture of animal excrements and vegetable matter (animal bedding and feed material)*	⬜ **Biogas Digestate / Slurry** *End product of anaerobically fermented organic materials from animal and plant origin*	🟩 **Biostimulants (incl. Biofertiliser)** *Bacterial, fungal inoculants and/or inert materials stimulating plant nutrition processes independently of the product's nutrient content*
Process / Technology	**Biological treatment**	**Biological treatment**	**Physical treatment**	**Thermo-chemical treatment**	**Thermo-chemical treatment**	**Direct use**	**Biological treatment**	**Multiple**
	Composting / Vermi-composting	Black Soldier Fly treatment	Mechanical processing / Extraction	Thermo-chemical treatment	Pyrolysis	Direct land application	Anaerobic digestion	
Biomass sources								
1 Agricultural waste	✓	✓	✗	✗	✓	✓	✓	✗
2a Plant–based municipal waste	✓	✓	✗	✗	✓	✗	✓	✗
2b Human excreta / sewage sludge	✓	✓	✗	✗	✓	✗	✓	✗
2c Food processing waste	✓	✓	✓	✓	✓	✗	✓	✗
3 Organic elements / organisms	✓	✗	✗	✗	✗	✗	✗	✓

Source: TechnoServe analysis

We estimate available aggregated biomass to be approx. 3.9MT today in Kenya although competing use cases also need to be considered by economic actors, e.g., animal feed and bio-energy

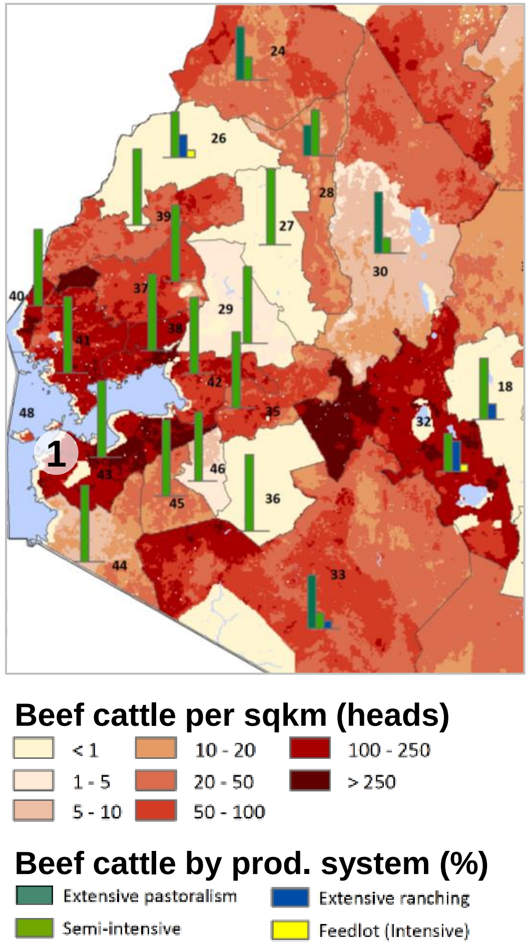
		Circular			Non-Circular
		1 Agricultural waste (including livestock)	**2a 2b 2c Organic waste from municipalities and industries**		**3 Naturally occurring elements**
Description		- Livestock and poultry manure - Crop residues	- Commercial agri-processing waste - Plant-based waste from households, retail, markets, restaurants, caterers, parks - Sanitation waste (Human excreta and sewage sludge)		- Seaweed - Fungi - Minerals
Estimated quantity in Kenya	**2020**	*Not estimated*	3,869,055 MT	*57% of total waste is estimated to be organic, excludes sanitation waste* *Only 1.4 million MT is currently estimated economically viable to access by Sanergy*	*Not estimated*
	2030		5,798,612 MT		
	2050		10,848,854 MT		
Collection process and challenges		- Traditionally disposed through direct use, often not the most efficient (lack of understanding of economic trade-offs, suboptimal transformation processes) - Large farming systems who have optimized their profitability would typically re-use for their own operations	- Urban waste only partially collected (~50% in Nairobi), - Uncollected waste in dumped and only 10% is currently recycled (challenging as not segregated) - ~200 small actors and 2 larger ones (Citifresh, TakaTaka) involved in collection and segregation - Some industrials re-use waste for their own needs		- Mined/cultivated specifically for selected use cases - Fungi and microbes require advanced technical skills - Minerals typically requires more transportation from point of collection to production and consumption
Applications		- Crop production - Animal feed - Bio-energy (transport/domestic)	- Crop production - Animal feed - Bio-energy (transport/domestic)		- Crop production and protection - Human food - Cosmetics - Other industrial applications
Waste promotion benefits		- Reinsertion of nutrients in the value chain - Reduced environmental pollution form waste - Better farm land valuation	- Reinsertion of nutrients in the value chain - Reduced environmental pollution from waste - Reduced contamination from waste (soil, water)		*N/A – not circular*

Source: World Bank (2018), DBFZ German Biomass Research Center (2022), Sanergy (2023)

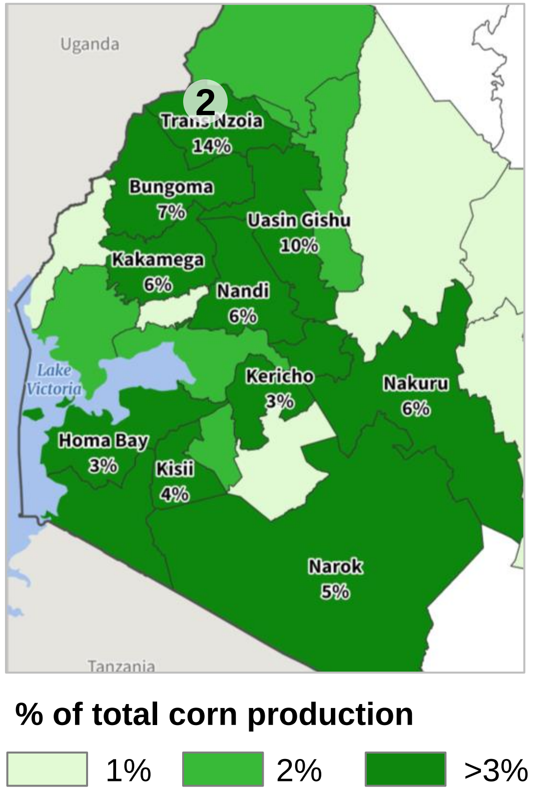
Biomass is not consistently available across the country, meaning that some areas can largely depend on farm-level biomass while other areas will need to rely on commercial organic fertiliser products

We selected corn to illustrate fertiliser needs, and manure and urban centers to illustrate availability of main waste streams

Beef cattle distribution 2017

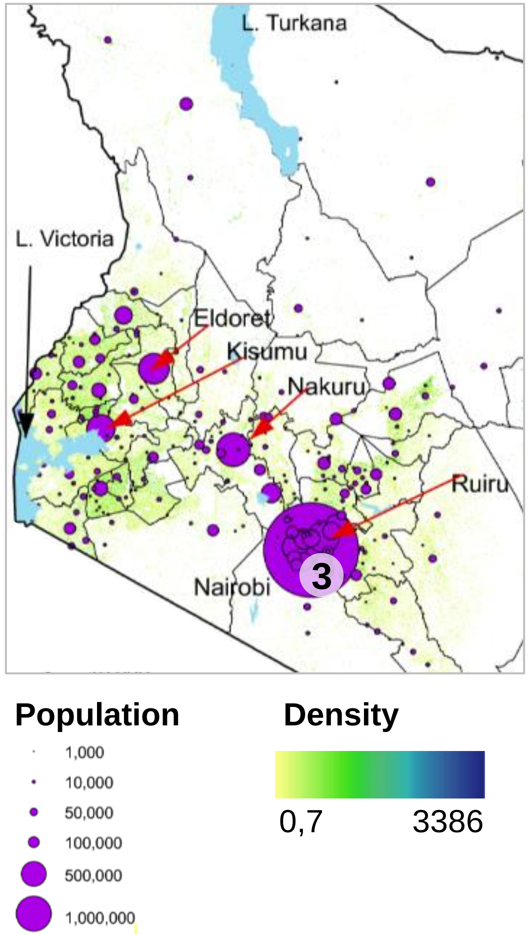


Corn production 2018



New large-scale corn production to be developed in the coastal region (Kilifi/Tana River counties) through the government's Galana Kulalu Food Project (overall 1m ac)

Population size & density 2019



1 Homa Bay

- High concentration of **beef cattle production** leading to increased availability of animal manure to create biomass

2 Trans-Nzoia

- High availability of **farm-level residues** through maize production, and urban and industrial waste through urban centers (Kitale)
- However, little to no concentration of farm-level manure
- Additionally, availability of farm-level residues due to extended geographical overlap with **sugar production**

3 Nairobi

- High concentration of **urban and industrial waste** through densely populated urban areas offers biomass sources for organic fertiliser
- Limited availability of farm-level manure or crop residues
- Most organic fertiliser producer are situated in this region (Nairobi/Nakuru) due to the availability of waste

Source: FAO (2017), Macharia et al. (2021), USDA FAS (2018), Government of Kenya (2023), TechCabal (2023), Business Daily Africa (2023), Confederation of Danish Industry (2020)

Kenya's role as a fertiliser / bio-stimulant innovation hub is accelerating with 50+ companies operating in this space; output is likely to increase 2.5x in 2023

Dynamic supply and regional innovation hub

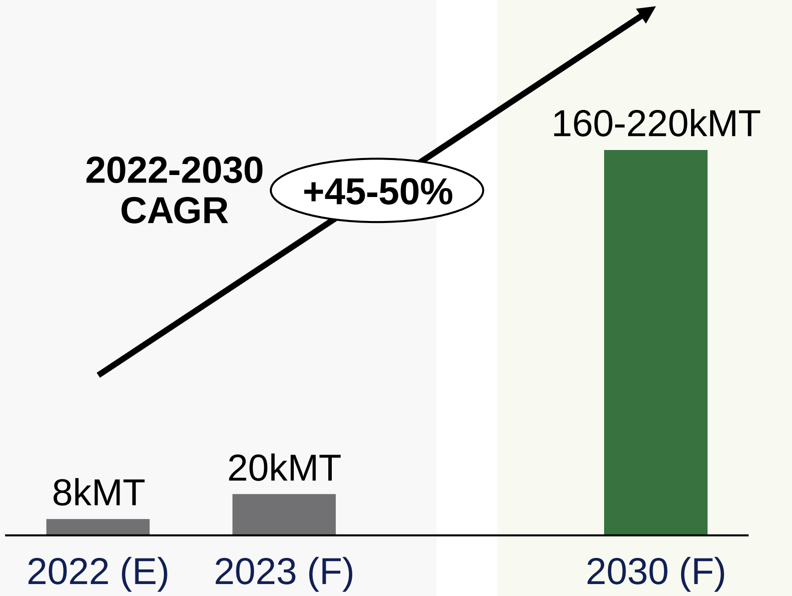
Domestic organic fertiliser / bio-stimulants production in Kenya
Supply base (left), yearly production (MT) and market value ($M) (right)

Number of companies	Clusters	Share of total production
3	**Pioneers – 2010-2015** Leaders in waste management and organic fertiliser with large-scale ops regen organics, SafiOrganics, TAHA TAHA SOLUTIONS	80%
5-10	**Early Followers – 2014-2018** Businesses with stabilized operations and products looking to scale	10%
25-50	**"Gold Rush" Phase – 2019-2022** Small scale production further developing and testing their technology	10%

\+ Foreign specialized actors mostly from India and Europe importing into Kenya

Strong demand potential to be stimulated

Forecasted demand for organic fertiliser / bio-stimulants production in Kenya in MT and $M



	2022 (E)	2023 (F)	2030 (F)
Avg. Price	350$/MT	350$/MT	280-350$/MT
Mkt. Value	$3M	$7M	$45-75M

Our conservative assumption is market growing to **$45-75M** by 2030 based on historical growth of entire fertiliser market (4.7% CAGR) and benchmarking against other African markets (12.5-17.5% organic fertiliser penetration)

Other estimates suggest market size of **$200M**+ by 2030. This may be possible in an optimal scenario

Source: TechnoServe analysis and survey data (30 companies identified and surveyed – 12 respondents)

Companies target large aggregated waste sources but level of operations centralization vary; BSF is the dominant technology; Maturity is lower on product development and go-to-market

Operations

- **Large aggregated feedstock sources** are targeted in priority: urban and industrial
- **Small-scale companies adopt decentralized operations** directly connected to waste sources to limit cost

Product

- **Frass from BSF dominates the market**, explained by investments in awareness, education and research
- **Leaders focus R&D on granulation and/or liquefaction**, smaller companies mainly focus on product stabilization

Go-To-Market

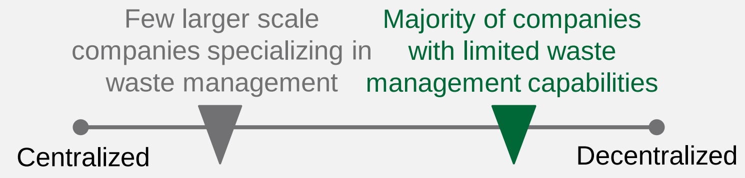
- **Distribution shifting towards large agro-dealers and aggregators** given cost and complexity associated with B2C
- **High range of prices**, observed price for BSF slightly lower than for others (enabled by multiple revenue streams)

Waste/Feedstock Management

#1	Urban and commercial waste: market, kitchen
#2	Agri-processing waste: rice, avocado, bagasse…
#3	Farm level: manure, plant residues (maize)

Dominant feedstock sources (qualitative)

Production

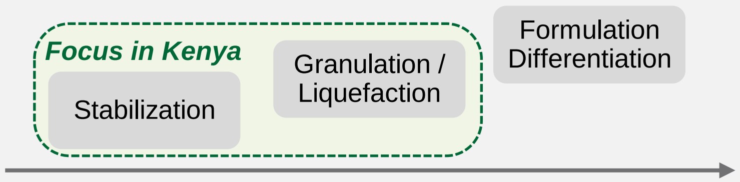


Level of operations centralization

Technology

Indicative market share (in value) by technology

Product Development

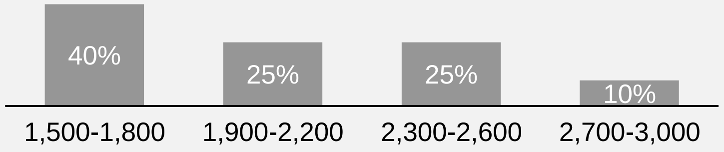


R&D focus depending on company maturity

Distribution

Dominant distribution models

Value Proposition



Ind. share of companies by price range (KES per 50kg bag)

Source: TechnoServe analysis and survey data (30 companies identified and surveyed – 12 respondents)

We observed different models regarding input collection and output creation amongst the companies we interviewed

Operations

1. Waste management model (inputs)

Collection of waste

2. Production models (output)

Production of organic fertiliser

	Own operations Manage waste collection and segregation with own equipment and operations	**Economic interest groups** Train local groups to manage waste and meet predefined requirements to buy from them	**Buy from others** Buy raw organic waste or compost from third party who specialize in those activities
Fully centralized Large product unit located close to large waste source, serving customers nationally	TAKA TAKA SOLUTIONS regen organics		regen organics
Hybrid Small local pre-processing units feeding central ops serving customers nationally	SafiOrganics	SafiOrganics	
Fully Decentralized Small production units sourcing waste and serving customers locally	INSECT PRO		INSECT PRO

Businesses producing organic fertiliser need to choose the right operating model depending on their capabilities and ability to handle risk and complexity

Operations

Waste Management Model (input)

	Own operations	Economic interest groups	Buy from others
Description	Manage waste collection and segregation with own equipment and operations	Train local groups to manage waste and meet predefined requirements to buy from them	Buy raw organic waste or compost from third party who specialize in those activities
Typically adopted by…	Large companies specialized in waste management	Companies adopting waste preprocessing next to source	Scaling companies needing consistent waste supply
Cost	◑	◕	●
Complexity	●	◕	◔
Risk on Input Quality	◑	●	◕
Risk on Input Availability	◑	◕	●
Reasons / prerequisites to adopt	• Strong waste management ops • Capital availability • Ability to establish relationships with waste sources	• Ability to attract and train local entrepreneurs • Local economic impact • Cost predictability	• Complexity reduction / focus on core capabilities • Diversification of supply

Production Model (output)

	Fully Centralized	Hybrid	Fully Decentralized
Description	Large product unit located close to large waste source, serving customers nationally	Small local pre-processing units feeding central ops serving customers nationally	Small production units sourcing waste and serving customers locally
Typically adopted by…	Large companies specialized in waste management	Scaling companies needing consistent waste supply	Scaling companies needing consistent waste supply
Cost	◑	◕	◑
Complexity	◑	◕	●
Risk on Out-put Quality	◑	◕	●
Risk on Out-put Availab.	●	◕	◑
Drivers	• Economies of scale and reduced prod. complexity • Increased transportation costs	• Close linkage to local communities for offtake • Increased cost of transportation and complexity	• Steady supply due to close collab. • Increased stakeholder complexity and overhead costs

Source: TechnoServe analysis | ● = high, ○= low

The choice of product technology has implications on operations: biochar is shorter to produce, frass is typically also produced with animal feed and bioenergy…

Operations

Quality of evidence: High Medium Low

	(Fortified) Compost	Frass	Biochar	Biostimulants (incl. Biofertiliser)	Comments
H **Dominant feedstock type / raw material in Kenya**	• **Urban and industrial waste** • **Farm waste** including maize stalks and manure • **Enriched** with locally-sourced minerals, molasse • Biogas slurry remains underutilized despite growing digester installations • Very limited use of bio-organisms (complex and costly)	• **Typically mixed** as it improves quality: **Urban waste, Mango, Avocado** • **BSF cannot process all types of waste** which means that segregation of organic waste is required	• **Rice husks, Coconut husks, Bagasse** • Especially relevant for organic waste **not suitable for compost** and/or for insects and waste with elements not suitable for consumption	• **Locally sourced minerals** • **Beneficial bacteria (Rhizobium)** • **Kelp/Seaweed extracts**	• **Aggregated sources are targeted** (either urban or industrial) • **Companies are getting closer and closer to industrials** with interesting waste streams • **Biochar is complementary** to compost and frass
H **Waste to output ratio**	• **15-25%**	• **20-30%**	• **10-50%** - 50% with rice husks; 40% with bagasse; 10% for maize	• n/a	• **Frass and Biochar typically have higher yields**
H **Time to produce**	• **16-24 weeks** • Lengthy process which can be accelerated with external agents – requires advanced technical knowledge to get to consistent quality	• **4-5 weeks**	• **3-4 weeks** including fermentation time to enrich biochar • Using biochar as a standalone amendment is not cost effective	• Varies depending on underlying technologies	• **Frass and Biochar are faster to produce**, even when compost is accelerated with external agents

Source: TechnoServe analysis

We observe a lack of scientific evidence and a wide range of product characteristics from private sector actors across all product technology

Quality of evidence: High | Medium | Low

	(Fortified) Compost	Frass	Biochar	Biostimulants (incl. Biofertiliser)	Comments
M **Observed NPK**	• N(**0.5-4**) • P(**1.5-8**) • K(**0.5-3**) Varies widely with waste source and fortification method	• N(**1-5**) • P(**1-2**) • K(**1-2.5**) Higher range matches ICIPE recommendations	• N(**1.5-5**) • P(**3-8**) • K(**2-5**) Varies widely with waste source and fortification method	• n/a – does not contain nutrient intended to be delivered to the plant but **rather help the plants absorb nutrients available in the soil** (even with very low pH)	• **Product info is often given as a range; Ranges can be wide depending on tech. maturity, biomass, etc.** • **Products with nutrient content >10% are typically enriched with minerals**
M **Other Nutrients available in quantity matching crop needs**	• C/N Ratio: **10 to 20** • Secondary: **Calcium, Magnesium, Sulphur** • Micro: **Boron, Iron, Copper, Zinc, Manganese**	• C/N Ratio: **10 to 20** • Secondary: **Calcium** • Micro: **Iron, Copper, Zinc, Manganese**	• C/N Ratio: **10 to 500 (50 avg.)** • Secondary: **Calcium** • Micro: **Iron, Copper, Zinc, Manganese**		• **Secondary nutrients are similar across technology** • **Higher C/N ratio typically leads to more significant improvement of the soil physical and chemical properties**
L **Other Impact / Benefits (soil/carbon)**	• Carbon storage, water holding capacity, pH correction, soil microbial activity	• **Pesticide** properties (nematodes, soil borne pathogens) • Carbon storage, water holding capacity, pH correction, soil microbial activity	• **Carbon storage**, 1.7 ton of CO2 for every ton of biochar (Safi estimate) • Water holding capacity	• **Resistance to stress** (temperature, water availability, salinity, etc.)	• **The various technologies have added benefits on top of standard ones which highlight potential for combination** • **Better scientific knowledge is required to innovate and maximize product impact**

Limited information on relative pH correction and water holding capacity benefits

Source: TechnoServe analysis, , Kätterer et al. (2019), Omulo (2020), Beesigamukama et al. (2020), Tanga et al. (2021), Anyega et al. (2021), Kätterer et al. (2022)

Product guidelines remain generic (50% inorganic – 50% organic) and wide price ranges observed are not well understood by market

Go-To-Market

Quality of evidence: High | Medium | Low

	(Fortified) Compost	Frass	Biochar	Biostimulants (incl. Biofertiliser)	Comments
M **Quantity Recommendation**	• **Manufacturers: >200kg/ha** (50% inorganic, 50% organic) to maintain yields • **Research: 5MT/ha** (if compost not enriched)	• **Manufacturers: 250 to 500kg/ha** (50% inorganic, 50% organic) to maintain yields • **Research: 2.5MT/ha**	• **Manufacturers: 300kg/ha** (50% inorganic, 50% organic) to maintain yields • **Research: 5MT/ha** (if pure biochar)	• **Manufacturers:** varies widely based on product, examples include 100g of seeds inoculant per hectare or 500 ml/ha for liquid solutions	• Manufacturer **guidelines are generic** and largely harmonized, derived from **farmer economics rather than scientific evidence** • **Observed yield benefits remain anecdotal** as none of the companies have performed large scale trials
L **Observed avg. yield benefits**	• Varies widely depending on level of enrichment	• **~30% improv.** (maize) with 250kg/ha and inorganic	• **~15% improv.** with 300kg/ha and inorganic (up to 40% avg. benefit with selected prod.)	• Varies depending on underlying technology	
H **Cost (50kg)**	• **Average: KES 2,100** • **Minimum: KES 1,500** • **Maximum: KES 3,000**	• **Average: KES 2,000** • **Minimum: KES 1,500** (target price according to research) • **Maximum: KES 2,500**	• **Average: KES 2,250** • **Minimum: KES 2,000** (target price according to research) • **Maximum: KES 2,500**	• WonderGro: KES2,500 • Calcimax: KES1,300/l • More accessible to larger farm systems using a variety of fertility products	• **Cheaper than subsidised inorganic products** • Equivalent to USD300-400/MT • Compared to 200-250/MT in more mature markets and to USD40-80/MT for local organic manure
M **Main cost drivers**	• Waste collection • Composting facility due to lengthy processing time	• Waste collection • Maintenance cost (high risk of colony collapsing if not enough capacity) • Complementary revenues from insect larvae and oil help to keep fertiliser price lower	• Waste collection • Labor intensive process with basic equipment, high capital required with more advanced equipment	• High sourcing and production costs • Greater in-house R&D capabilities • Higher storage cost for biofertilisers with restricted shelf life	• **Less advanced techniques will rather rely on OpEx** than CapEx but are less scalable • Organic fertiliser is typically more capital intensive than biostimulants

Source: Nematian et al. (2021), Ye et al. (2019)

Based on our assessment of the sector we defined four key trends which should structure its growth over the next 5-10 years

Further specialization and intermediation along the value chain	• **Companies will further specialize** in either waste management or in fertiliser production • **Fertiliser producers will diversify supplies**, buying from others to reduce complexity and invest resources in product development and distribution • **Primary feedstock sources will remain commercial and industrial**; Immediate and growing opportunities for small-scale entrepreneurs to create farm-level nutrient-recycling services
Sector growth driven by large players with centralized operations	• **Larger companies will scale more rapidly** their capital-intensive operations and dominate the market in volume of product sold • **Decentralized operations will be more numerous** but will remain localized serving specific value chains • **Growth will be boosted by investments from large inorganic/industrial players** which will also stimulate research and advocacy
Higher share of products combining existing technology	• **Market will be dominated by tech with more investment in research** and higher knowledge available and sector-wide coordination – **BSF has already made strong progress** • **Innovation will come from combining existing technology** – e.g., BSF for biocontrol features, biochar for carbon sequestration, bio-stimulants for plant resilience – enabled by greater cross-sector collaboration allowing manufacturers to better understand and address customer needs
Sales driven through channels with clear market linkage	• **Sales and distribution will primarily develop through integrated operations with direct market access**, e.g., offtakers / cooperatives / outgrowers • **Increasing recognition of integrated soil fertility management** will drive greater hamornisation of extension services, but **improved coordination will take time and subsidies on organic fertiliser will likely remain limited** given weight of established inorganic players

Source: TechnoServe analysis

Funding and technical assistance needs vary with the business maturity and the production model

		Start-ups Companies with small scale production further developing and testing their technology	**Smaller companies** Revenue generating businesses with stabilized operations and products to scale	**Scaling companies** Leaders in waste management and organic fertiliser with large-scale ops
Capital needs		**100-300k USD** Conduct rigorous testing and scientific studies to stabilize product and ensure efficacy	**0.5-1M USD** Build steady production capacity and product supply, and drive marketing to acquire customer	**1-10M USD** Reach economies of scale, e.g., optimized waste collection, increased production capacity
Technical assistance	**Operations**	Define model for feedstock collection including sourcing and production	Improve feedstock collection and production processes to bring down costs	Expand feedstock collection and production processes to increase scale
	Product	Closely collaborate with research institute to continuously test and improve product	Refine product (e.g., formulations) to develop crop-specific guidelines	Differentiate product offering (e.g., planting, top-dresser, foliar)
	Go-to-market	Test product in selected areas to better understand farmer needs and improve value proposition	Establish collaboration (e.g., with agrovets and aggregators) to increase reach	Build large-scale partnerships (e.g., aggregators) to increase product reach

Key takeaway

- Higher capital needs for waste management focused models
- Evolving core focus from R&D (efficacy) to operations (scalability) to go-to-market (reach and penetration)

Source: TechnoServe analysis

To be successful in the growing market, companies will need to develop of set of core capabilities

Operations	Product	Go-To-Market
1 Resilient Waste Supply Chain	**3 Collaborative R&D**	**5 Partnerships for Reach**
a. **Diversify feedstock sources** to reduce the risk in supply availability, formalising relationship with large providers	a. **Build the scientific evidence through large-scale scientific trials** working with leading research to build trust	a. **Adopt lightweight distribution model** to minimize overheads, partnering with orgs that can significantly increase reach
b. **Adopt most cost-effective operating model**: own operations vs. economic interest groups vs. buy from others	b. **Collaborate with other private sector actors** to reduce R&D cost and influence quality standards and regulation	b. **Provide capacity-building to partners** who can efficiently cascade it down to farmers, incl. aggregators, NGOs, etc.
2 Cost-effective Production	**4 Demand-driven Innovation**	**6 Tailored Value Proposition**
a. **Optimize operational network** balancing reduction of transportation cost and economies of scale in production	a. **Optimize the product technology** to address farmers' affordability and accessibility constraints	a. **Define crop-specific guidelines** with price and volume adapted to farmer's P&L in each value chain
b. **Standardize procedures and quality control** to reduce operational variability and increase output quality	b. **Differentiate product offering** to address differentiated segment needs, developing and testing formulations on the ground	b. **Stimulate demand through targeted communications** to farmers, end-consumers, retailers and policy-makers

Source: TechnoServe analysis

Selected business examples illustrate challenges and opportunities faced by Kenyan companies in this nascent sector compared with best-in-class example

		regen organics	SafiOrganics	éléphant vert
Company Information	Country	**Kenya**	**Kenya**	**Mali[1]**
	Production (2022 or latest available)	**3,600MT**	**2,000MT**	**30,000-40,000MT**
	Market Share of company within country	**~50%**	**~25%**	**~60-70%**
	Dominant Tech	**Black Soldier Fly**	**Biochar**	**Fortified Compost**
Maturity Level *Exploring = Aware of best practices but not adopting* *Developing = Partially adopting best practices* *Leading = Adopting all or most best practices*	1. Waste Management	**Leading**	**Developing**	**Leading**
	2. Production	**Developing**	**Leading**	**Leading**
	4. Research	**Developing**	**Developing**	**Leading**
	3. Product Development	**Developing**	**Exploring**	**Leading**
	5. Distribution	**Developing**	**Exploring**	**Developing**
	6. Value Proposition	**Exploring**	**Exploring**	**Leading**

Source: TechnoServe analysis, AfricaFertilizer / IFDC (2021) | Note: 1. Mali has an average fertiliser consumption of more than 650,000 tons in five years – with that, it is the second largest fertiliser consuming country in the sub-region behind Nigeria. Additionally, Mali has one of the largest organic fertiliser consumption figures (average over five years: 10% of total consumption)

Case study: Regen Organics is the pioneer in the organic fertiliser production space in Kenya and market leader with more than 50% market share in 2022

regen organics

Company Info

- Year Founded: **2010** (part of Sanergy)
- Staff: **201-500**
- Location: **Nairobi** (3 production units)
- Development Stage: **Scaling**

Sales

- **2022** Est. Quantity: **3,600MT**
- **2023** Proj. Quantity: **12,000MT**

Main Product

- **Evergrow** from 1.5-3%N, 1%P, 1%K and 20:1 carbon nitrogen ratio
- Current price: **KES2,200/bag** (50kg)
- Dominant technology: **thermophilic composting** + **Black Soldier Fly**

Operations

Waste / Feed Stock Collection

- Supply chain of feed stock collection is the main competitive advantage, but is costly as they absorb collection and sorting costs
  - no support from public sector apart from county government linking them to markets
- 8,000 tons/month of waste collected, no more than 50km away from production site:
  - Market, commercial agri-processing and sanitation waste in Nairobi; Bagasse from sugar processors in Western Kenya (exception to 50km-rule, higher transportation cost)

Production

- 10 acre production space for fertiliser
- Mix of feedstock going through BSFs and going directly into fertilizer (not suited for BSF) – also exploring biochar products
- Extensive quality control to guarantee safety and consistency, key to build trust
- Equipment is largely imported (no tax relief)

Product Development

Assortment

- Evergrow products are KEBS-standard compliant, Evergrow Gold meets EcoCert export standards
- Products in powder/loose form for manual application
- Focus on packaging as a way to strengthen quality perception and legitimacy

R&D

- Development of different recipes that respond to the variation in waste availability has been the key focus
- Now developing crop-specific formulations for high-value crops (tea, coffee)
- Limited scientific evidence to date limits adoption; Focus of 2023 is to build it over 260 treatment groups
- Ongoing investment in granulation capabilities to address strong market need

Go-To-Market

Customers / Distribution

- Selling to 1,000+ agro-vets across 40 counties who serve 8,000+ farmers with Regen's products (planning to add 10k more in 2023), including a majority of smallholders and 300-500 mid-size farms (5-100ha)
- Selling directly to large commercial farms but penetration is limited as Regen do not sell granulated product

Marketing / Value Proposition

- Positioned as a complement to inorganic: maintain yield by replacing up to 50% of synthetic fertiliser with EverGrow
  - 2-4 bags/acre at planting
- Agro-vets run products demos and events, Regen works with largest stockists offering credit terms and competitive margins

Requirements to Scale

- Ability to get sorted waste at low price / free
- Ability to scale industrial operations
- Government incentives and low-interest-rate financing to access best equipment

- Product segmentation through formulation development/improvement
- Development of widely accepted recommendation rates through testing

- Customer segmentation and price differentiation (by crop)
- Continued training of new farmers
- Partnerships with relevant orgs.

Source: Stakeholder interviews

Case study: Safi Organics is scaling a decentralized production model, minimizing transportation costs and creating rural economic opportunities

SafiOrganics

Company Info

- Year Founded: **2015**
- Staff: **11-50**
- Location: **Mwea, Kisumu** (2 production units)
- Development Stage: **Scaling**

Sales

- **2022** Est. Quantity: **2,000MT**
- **2023** Proj. Quantity: **4,000MT**

Main Product

- **Safi Sarvi Plus** (Planting) 3-5-3 NPK
- Current price: **KES2,500/bag** (50kg)
- Dominant technology: **Biochar**

Operations

Waste / Feed Stock Collection

- Mainly collect rice husks (50% waste to biochar ratio) and bagasse (40% ratio)
  - High competition for risk husks from cement industry and bagasse from competitors
- Coffee husks also works well but availability is a challenge, corn is 15-20% so not suitable

Production

- Two production facilities in Mwea (90% of prod., 7-10MT/day capacity) and Kisumu
- Decentralized carbonation following a batch process (150kg/day) requiring lots of space, not cost effective if done centrally
  - Start with their own operations before transitioning to youth groups (challenge in Kisumu to attract local youth)
  - Provide young entrepreneurs with training, giving them financial capacity, paying them at delivery based on quality
- Enrichment to build nutrient through fermentation (3-4weeks) – raw biochar has <0.5% in primary nutrients

Product Development

Assortment

- Safi Sarvi Planting (3-5-3) and Safi Sarvi Topper (5-3-3) in powder format
- Safi Liquid Foliar Fertiliser
- Safi Biochar Acidic Soil Amender

R&D

- R&D efforts focused to date on biochar enrichment optimization, granulation (abrasiveness challenge) and quality of carbonation process
  - Different enrichment formulation to get to stable output regardless of waste input variations
  - Currently investing in continuous carbonation equipment (USD20k / machine) for cooperatives to multiply daily capacity by 20x
- Future efforts will focus on the development of more concentrated products (limitation with the amount of N you can load in biochar), need to investigate the use of bio-organisms

Go-To-Market

Customers / Distribution

- Agro-dealers and cooperatives as main route, initially tried B2C but time-consuming and costly
- Target larger horticulture farms (profit optimization) and smallholders (cost reduction)
- Stay close to production unit

Marketing / Value Proposition

- Sometimes used as standalone by smallholders but typically recommend 300kg/ha (6 bags) – see yield increase of up to 35%, still lot of potential to be optimized
- Trials and demos with farmers to drive adoption and mass media focusing on smallholder
- Currently in talks with large inorganic player for go-to-market collaboration (gave up joint product development)

Requirements to Scale

- Ability to engage community in new areas to replicate model (e.g., Kisumu)
- Government incentives and low-interest-rate financing to access best equipment

- Product tailoring based on local needs
- Private sector coalition for standards, quality regulation, etc.

- Partnership to deliver farmer trainings, capacity building to raise awareness
- Development of market incentives

Source: Stakeholder interviews

Case study: Elephant Vert has led the way in Mali to develop a USD 10+ million industry

elephant vert

Company Info

- Year Founded: **2014** (subsidiary of Elephant Vert Group founded in 2012)
- Staff: **51-100**, 501-1000 worldwide
- Location: **Segou (Mali)**
- Development Stage: **Maturity**

Sales

- **2022** Est. Quantity: **30,000-40,000MT; 60-70% market share**

Main Product

- **Fertinova**
- Current price: **KES750-900/bag** (50kg) depending on subsidy level
- Dominant technology: **Fortified Compost**

Operations

Waste / Feed Stock Collection

- Urban waste with evolving collection model over time:
  - Started buying waste from intermediaries managing collection and segregation but prices increased significantly over time
  - Developed EIG with clear requirements, providing equipment
  - Bought raw compost from other players to enrich it (only portion of overall waste)
  - Worked with city of Segou to implement sorting of bio-waste
- Slaughter houses

Production

- Central production unit in Segou (ISO9001 certified for quality management) with localised pre-composting (drying) platforms to minimize transportation cost
- Leveraging know-how of Elephant Vert group in Europe and Africa producing ~200,000MT of organic fertiliser / year

Product Development

Assortment

- Organova compost
- Fertinova (1-1-1 or 2-3-2), enriched with locally available minerals
- Biostimulants (microorganism, fungus)

R&D

- Plant Clinic as a separate BU, initially focusing on trials comparing organic, conventional and hybrid
- Evolved into crop-specific formulations and guidelines
  - Mapping of crops and review of P&L by value chain
  - Development of recommendations that maximize profitability for SHFs within each value chain
  - Joint work between R&D, Commercial and Operations to develop crop-specific products, continuous testing via collaboration with interprofessions and networks

Go-To-Market

Customers / Distribution

- Country-wide customer base
- Initially relied on local warehouses to distribute but stopped due to high overheads
- Developed partnerships with extension service providers, associations of small agro-vets (116 distributors, 1,100 points of sale), financial institutions to increase reach

Marketing / Value Proposition

- Differentiated prices and value proposition by agric. value chain
- Mass radio communications for farmer (soil science) and end-consumer (food quality and conservation)
- Extensive lobbying (in coalition with competitors) towards policy-makers and private sector networks which has enabled shares of subsidies allocated to organic to grow from 3% in 2017 to 12% in 2021

Requirements to Scale

Requirements to Scale	Operations	Product Development	Go-To-Market
	• Development of micro-composting platforms locally, optimizing location based on waste availability and fertiliser need	• Collaboration with leading research centres to incorporate innovations (e.g., micro-organisms)	• Further development of partnerships, including with inorganic manufacturers

Source: Stakeholder interviews

Agenda

The immediate focus should be to build strong evidence base to understand the impact of organic fertiliser and develop usage guidelines

Short-term

What is the impact of each product and how / when / where to use them?

Efficacy and awareness barriers:

- Limited **understanding of the problem** and the role of organic fertiliser across the value chain
- Limited **cross-sector collaboration** and information/knowledge sharing
- Lack of **scientific evidence** on efficacy and **crop-specific usage guidelines**
- Lack of **quality standards** and compliance
- Limited availability of **soil information**

Priority **1** **Strong Evidence Base**

Mid- to long-term

What are the most effective business models?

Affordability and quality barriers:

- High **cost of waste management** given lack of upstream segregation incentives
- High cost of **R&D and equipment,** limited **access to capital** for companies
- **Suboptimal operations** – lack of process standardisation, product quality optimisation
- **Product characteristics** limiting adoption (handling, bulkiness, appearance, shelf-life, etc.)

Priority **2a** **Scalable Business Models**

How do we encourage farmers to adopt available products?

Availability and accessibility barriers:

- Deeply rooted **farmer behaviour,** high **cost and risk level** associated with integrated soil fertility management practices
- Inadequate resources for **extension**, limited collaboration and harmonization
- Insufficient and inconsistent **product availability** for farmers
- Limited **adoption from agro-dealers** and other intermediaries given risk

Priority **2b** **Broad Farmer Adoption**

Source: TechnoServe analysis

We developed recommendations to address priorities and support sector growth

Priority 1 **Strong Evidence Base**

- ▶ **Build capacity and harmonize knowledge** amongst decision-makers, donors and investors
- ▶ **Drive cross-sector collaboration to build strong evidence base** on organic fertiliser efficacy and soil impact
- ▶ **Reinforce quality standards** accordingly and ensure compliance

+

- ▶ **Improve resilience to shocks in the short-term** through farm-level solution development initiatives

Priority 2a **Scalable Business Models**

- ▶ **Enable manufacturers to adopt best practices and scale** through targeted investments and technical assistance
- ▶ **Improve the business case for organic fertiliser** by reducing cost of doing business and creating market incentives

Priority 2b **Broad Farmer Adoption**

- ▶ **Increase farmer awareness and drive behaviour change** towards integrated soil fertility management practices
- ▶ **Evolve routes to farmers to increase reach**: more holistic productivity support policy, pluralistic extension services, risk-sharing model with input providers

Source: TechnoServe analysis

Our recommendations require coordinated efforts from Private Sector, National and County governments, Research Institutes, Farmer Associations and Development Practitioners (1/2)

Relative importance to address priority High Medium Low

	Private Sector *Fertiliser manufacturers* *Intermediaries and Distributors* *Investors*	**Public Sector and Research** *National government* *County government* *(Inter)national research institutes*	**Farmers and Dvpt. Practitioners** *Donors and DFIs* *Dvpt. NGOs* *Farmer associations*
1 Strong Evidence Base	Capacity Building	Research Coordination and Dissemination Standards and Compliance Capacity Building	Research Financing and On-the-ground Execution Capacity Building
2a Scalable Business Models	Business Models Financial and Technical Support Private Sector Collaboration	Ease of Doing Business	Business Model Development Technical Assistance
2b Broad Farmer Adoption	Private Sector Partnerships and Distribution Models	Extension Service Coordination Productivity Support Policy	Extension Service Delivery Farmer Behaviour Change

Source: TechnoServe analysis

Our recommendations require coordinated efforts from Private Sector, National and County governments, Research Institutes, Farmer Associations and Development Practitioners (2/2)

Relative importance to address priority High | Medium | Low

		Private Sector	Public Sector / Research	Farmers / Dvpt. Practitioners
1 **Strong Evidence Base**	1.1 **Capacity building** across the entire market system	Medium	Medium	High
	1.2 **Cross-sector research** on product efficacy	Medium	High	Medium
	1.3 **Standards and compliance** to guarantee product quality	Low	High	Low
	1.4 **Soil data access** for all relevant stakeholders	Medium	High	Medium
	1.5 **Short-term resilience** programs to develop farm-level solutions	Low	Low	High
2a **Scalable Business Models**	2.1 **Ease of doing business** for manufacturers to reduce their costs	Low	High	Low
	2.2 **Investment and TA** to strengthen business models and value prop.	High	Low	Low
	2.3 **Business model development** to better align farmer/market incentives	High	Low	Medium
2b **Broad Farmer Adoption**	3.1 **Farmer behaviour change** to drive adoption of desirable practices	Low	Medium	High
	3.2 **Productivity support policy** to incentivise positive practices	Low	High	Low
	3.3 **Pluralistic extension** for improved reach and coordination	Low	Medium	High
	3.4 **Private sector partnerships** to increase product availability	High	Low	High

Source: TechnoServe analysis

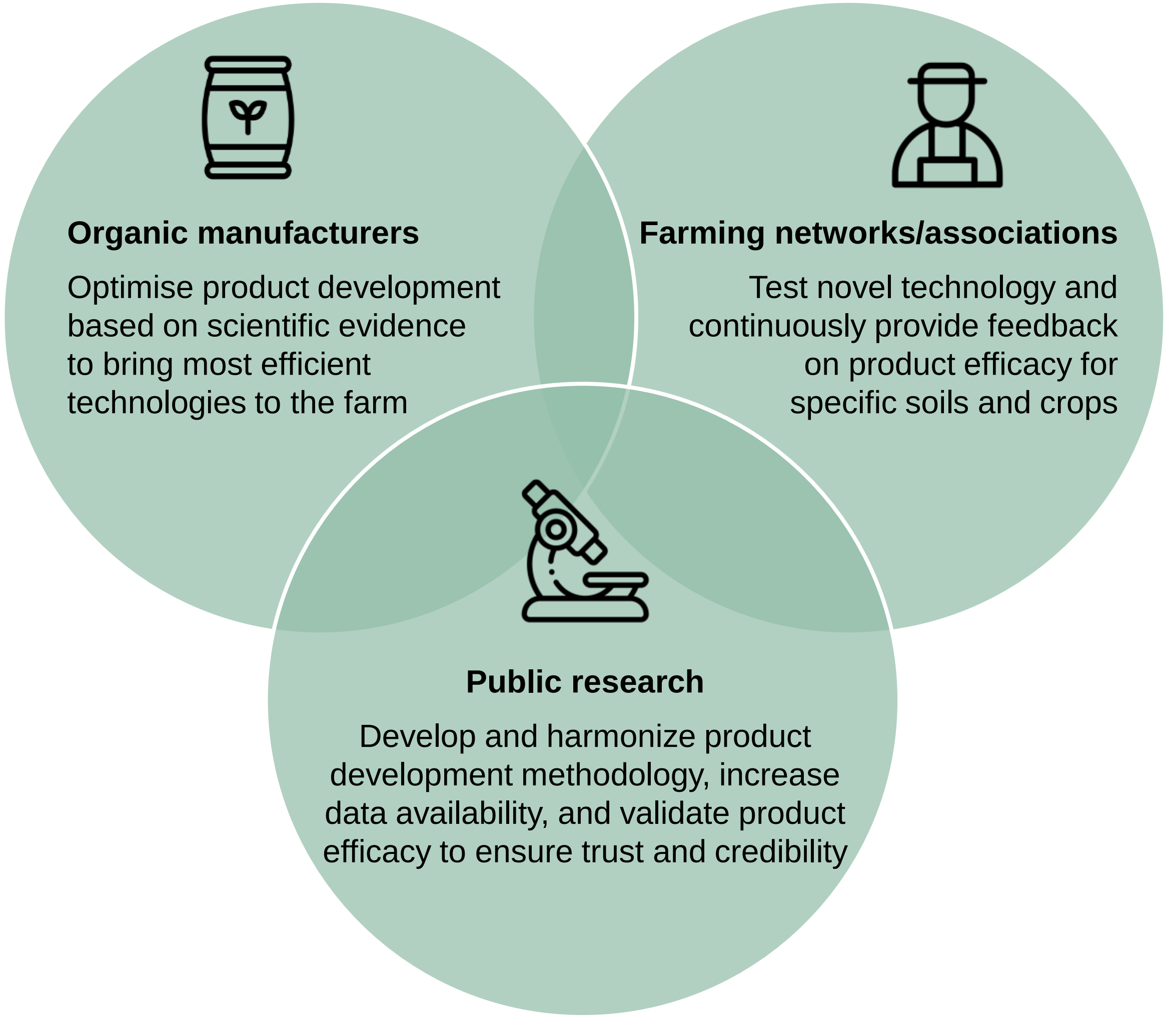
1 Immediate priority is to build capacity and a strong evidence base on product efficacy and soil health

Recommendation		Description	Key Stakeholders			Impact on adoption	Feasibility of implem.
			Govt.	Manuf./Invest.	Enabling Env.		
1.1	**Capacity building across the entire market system**	• Use this study to stimulate knowledge-sharing and collaboration amongst actors, identifying the right champions to advance integrated soil fertility mgmt.	• All	• All	• All	◑	●
1.2	**Cross-sector research on product efficacy**	• Develop research-led cross-sector collaboration to create consensus on ISFM and the need for organic fertiliser, determine product efficacy through large scale trials, ensure adherence of manufacturers to scientifically-defined best practices and develop crop-specific formulations and guidelines that will maximize farmers' profitability	• KALRO • Other (inter)national research org.	• Organic fertiliser manuf.	• Dvpt. donors • Fertiliser and farming associations / networks	●	◕
1.3	**Standards and compliance to guarantee product quality**	• Reinforce product standards based on inputs from research, ensuring product labelling displays actual formulation and guidelines on best practices • Effectively disseminate standards and define testing governance and methodology	• KEBS • KEPHIS • County govt. • KALRO			●	◕
1.4	**Soil data for all relevant stakeholders**	• Develop a regulatory framework for soil, including standards for soil analysis and soil data mgmt. practices • Develop collaborations between relevant organizations to increase data availability, quality and lower cost of soil tests	• Ministry of Agriculture • County govt. • KALRO • KEPHIS	• Private companies performing large scale tests	• Major soil testing labs • Dvpt. donors	●	◑
1.5	**Short-term resilience programs to develop farm-level solutions**	• Review existing programming to identify opportunities to further develop farm-level organic fertiliser production • Examples include farm-level energy solutions to free up biomass for fertiliser production, or local waste mgmt. as a mean to create economic opportunities for youth and women			• Dvpt. Partner Group	◕	●

Source: TechnoServe analysis

1 A collaborative research platform is required to build a strong evidence base

Cross sector collaboration removes silos and drives innovation by bringing manufacturers closer to farmers



Organic manufacturers

Optimise product development based on scientific evidence to bring most efficient technologies to the farm

Farming networks/associations

Test novel technology and continuously provide feedback on product efficacy for specific soils and crops

Public research

Develop and harmonize product development methodology, increase data availability, and validate product efficacy to ensure trust and credibility

Investors and DFIs

Provide funding, and coordinate knowledge-sharing, advocacy and linkage with international actors

Government agencies

Ensure output of research is embedded into laws and standards to build transparency and ensure compliance

Other stakeholders (consumer, NGOs, …)

Continuously advocate for development and growth of the organic fertiliser sector and stay informed

Source: TechnoServe analysis

1 Example: INSEFF is a collaborative research platform that drives adoption of insect-based animal feed and frass-based fertilisers

icipe

Example: icipe's cross-sector collaboration

- **The International Centre of Insect Physiology and Ecology (icipe) is a leading international scientific research institute**
  - icipe is a Nairobi-based non-profit organization whose mission is to ensure food security and improve the overall health of communities in Africa
- **INSEFF (Insects for Food and Feed) is one of icipe's research platforms**
  - INSEFF drives adoption of insect-based animal feed and frass-based fertilisers
- **icipe partners with various research and donor stakeholders**
  - icipe currently has a staff of >400 and collaborates with >200 national systems, research institutes and universities such as:

The Rockefeller Foundation, DANIDA Danish International Development Agency, KEBS, regen organics, Foreign, Commonwealth & Development Office, University of Copenhagen, FSC Food Security Center, KALRO Kenya Agricultural & Livestock Research Organization

Key activities of INSEFF

- **Develop technologies for enhancing availability and sustainable access to edible insects in Africa & beyond**
  - Promote adoption of low-tech options developed by INSEFF for mass rearing and trapping of edible insects (e.g., grasshopper, mealworm, dung beetles, BSF) among smallholders and entrepreneurs
- **Support innovative utility for organic fertilisers from insect farming**
  - Optimize and deploy technologies for the generation and utilization of novel nutrient-rich high-quality organic fertilisers from insect production systems in farmer fields
- **Facilitate the creation of enabling policies for scaling insect-based technologies**
  - Engage with regulatory and policy organizations to facilitate the creation of standards using evidence-based data that has allowed the use of insects in both the food and feed sector

Key learnings for effective collaboration

- **Put a strong focus on research trials to produce scientific evidence**
  - Close collaboration between national and international research institutes and on-the-ground manufacturers
- **Drive cross-sector collaboration to achieve buy-in and spread awareness, e.g.:**
  - Research institutes to create scientific evidence by conducting large-scale trials
  - Investors and DFIs to provide funding, link to international community, and provide expertise
  - Government agencies to anchor insights and potential new policies on national or county level
  - Manufacturers to put research insights into action
- **Participate in renowned competitions to spread awareness on research goals and to receive additional funding**
  - icipe won the 2020 Curt Bergfors Food Planet Prize with the mission to accelerate the transition to sustainable food systems

Source: TechnoServe analysis, icipe (2023), icipe (unk.), Food Planet Prize (2020)

2a

The private sector needs to seek targeted investments and technical assistance to adopt best practices and scale while the enabling environment needs to help improve the business case for organic fertiliser

			Key Stakeholders			Impact on	Feasibility
	Recommendation	**Description**	Govt.	Manuf./Invest.	Enabling Env.	**adoption**	**of implem.**
2.1	**Ease of doing business for manufacturers to reduce their costs**	• Implement tools to enforce waste segregation at source and gate fees to benefit both formal and informal waste mgmt. • Establish tax incentives for manufacturers importing equipment from abroad • Improve transparency and reduce cost of efficacy trials for SMEs • Ease financing for circular agri-economy sector	• NEMA • KEPHIS • KRA		• Financial institutions	◑	◑
2.2	**Investment and TA to strengthen business models and value prop.**	• Adopt the right operating model depending on resources and capabilities, drive process standardization, support partnerships to reduce cost and/or complexity (e.g., waste sourcing), improve access to equipment / infrastructure • Enable access to relevant agronomy, regenerative ag., biological/chemical experts to develop innovations that fit farmers' needs and assess trade-offs (e.g., granulation vs. new ways to efficiently apply powder fertiliser)		• Organic fertiliser manuf. • Relevant investors active in the Kenyan agri-sector		◕	◕
2.3	**Business model development to better align farmer/market incentives**	• Identify opportunities to stimulate commercial systems aligning market and farmer incentives through targeted investments and collaborations, including: - Integrated farming systems with direct market access (e.g., cooperative, outgrower, offtaker) - Retailer-led traceable value chain enabling higher grade products to be sold at higher prices to end consumers - Foreign importers setting requirements related to climate-smart practices		• Relevant private companies • DFIs	• Development Partner Group • Selected retailers	●	◕

Source: TechnoServe analysis

2a

Production in Mali, Uganda, and India is driven by larger centralized operations with strong partnerships for waste and go-to-market, enabling environment is key for research and efficacy

Country	Situation	Selected examples	Key observations		
			Operations	Product development	Go-to-market
Mali	**Relatively small fertiliser market with large organic penetration** (10-15% volume share over the last five years, ~60k MT produced annually)	• Elephant vert: Part of the international Elephant Vert group producing fortified compost (2022 est. quantity: 30-40k MT; 60-70% market share	**Centralized production to rapidly reach scale**, lowering cost, and producing higher volume consistently **Diversification of supply** to find the right trade-off between cost, risk and complexity	**In-house plant clinic to drive R&D efforts** enabling large-scale trials to create scientific evidence and later development of crop-specific formulations	**Diversified partnerships** with extension service providers, associations of small agro-vets and financial institutions to increase reach **Close collaboration with farmer networks and associations** to meet their needs and build trust
India	**Very large fertiliser market with growing focus on organic fertiliser** (200-300k MT produced annually)	• KCDC: Processes 300t of MSW per day to produce organic fertiliser • A2Z Infrastructure: Processes 8000t of MSW per day & operates 21 resource recovery facilities to produce compost and renewable energy • Terra Firma: Processes 1,400t of MSW per day to produce organic fertiliser and biogas	**Partnerships with local government entities and private enterprises** to reduce risk associated with high capital investments	**Strict compliance on product regulations and standards** with zero-tolerance policy on product quality	**Partnerships with existing retail distribution networks** to increase reach of sales and marketing efforts **Sustained interactions with farmers** through product demonstration (e.g., proof of concept farm fields)
Uganda	**Fast growing organic fertiliser sector** in SSA	• Mbale Compost Plant[1]: Processes 60t of municipal solid waste (MSW) per day to produce organic compost	**Partnership with local government** for efficient and no-cost supply of biomass **Fully centralized operations** to rapidly reach scale **Financial incentives for waste collectors** to sell plastic and metal waste to recycling companies	**Close collaboration with universities and laboratories** to ensure product quality and technical support	

[1] As of early 2023, the plant has discontinued operations due to lack of funding; operators are considering plans to resume operations given observed benefits on local farms.

Source: TechnoServe analysis, Stakeholder interviews, GIZ (2021), Otoo et al. (2018)

2a Case Study: Different business models can provide financial incentives for farmers to adopt organic fertiliser

- *Founded in 2021, now 300 employees*
- *3 farms and 1200 outgrowers*
- *2000t of fresh produce harvested & sold*

	FarmWorks	Leading Supermarket in Kenya	Foreign importers
Description	**"Outgrower model" – an integrated agricultural ecosystem including:** • Commercial mid-sized farms • Strong outgrower community with 1500 farmers • Guaranteed off-take with direct linkage to local and global markets • Research institute with technical assistance	**"Retailer-led model" – a dedicated and traceable value chain that includes:** • Food safety department at supermarket level leading the audit and co-ordination • Prequalified farmers or network of farmers • Agreed specifications and quality parameters to be adhered to by all actors • Traceability and audit mechanisms to allow for food safety guarantees to their consumers	**"Market-led model" – foreign importers that stimulate demand with:** • Well defined requirements, e.g., minimum residue limit (MRL) requirements • Enforced standards and regularly inspected products to meet guarantees • Network of producers (and/or county) who can meet standards and export
Expected benefits	• **Close collaboration and a community-based approach** drives trust building and fosters organic fertiliser adoption • **Technical support and evidence-based research** through own institute and demo farms strengthens value propositions • **Integrated model** incl. guaranteed off-take addresses risk-aversion of farmers	• **Determined list of inputs and farming techniques** accepted by farmers in the value chain and thus influence • **Traceability and audit activities** will influence consistency of practices and products used • **Establish aggregation** of demand for products and services that can be linked to input suppliers	• **Accelerated production and adoption organic fertiliser** through demand-driven incentive • **Existing and established market** to buy guaranteed off-take from producers • **"Ripple effect"** to other industries and value chain
Challenges to consider	• **Initial complexity to set up integrated large-scale ecosystem** including financial risk to guarantee off-take and provide scientific evidence	• **The time it takes to change behaviour** and practices at farm level with risk-averse and change-averse farmers	• **Time and capital** to upgrade existing production and processes to meet new demands

Source: TechnoServe analysis

2b

The broader enabling environment should work on driving farmer behaviour change while evolving all major routes to market to increase organic fertiliser availability

	Recommendation	Description	Key Stakeholders			Impact on adoption	Feasibility of implem.
			Govt.	Manuf./Invest.	Enabling Env.		
3.1	**Farmer behaviour change to drive adoption of desirable practices**	• Improve understanding of underlying behaviour preventing change in practices from farmers / land owners, agro-vets end-consumers • Prototype and pilot solutions using HCD targeting different populations and partnering with trusted public organization such as KEPHIS to maximise solutions' reach and impact	• Ministry of Agriculture • KEPHIS		• Development partner group	◕	●
3.2	**Productivity support policy to incentivise positive practices**	• Evolve agriculture productivity support policy to adapt to current and future context, defining higher-level goals such as nutrition, value creation, climate impact, … • Evolve existing instruments to also include subsidies for organic fertiliser, support for soil testing, capacity building, switch to beneficial crops/practices, etc.	• Ministry of Agriculture • County governments			●	◑
3.3	**Pluralistic extension for improved reach and coordination**	• Define extension's governance and operating model at county level starting with pilot county - County government defines the soil management strategy, and is responsible for lasting capacity-building harmonization and quality assurance - Private extension service providers are responsible for execution under county's supervision	• County governments		• Extension service providers	◕	◑
3.4	**Private sector partnerships to increase product availability**	• Support private companies to develop new partnerships and collaboration models to increase product availability - Develop innovative risk-sharing commercial models with large-scale agro-dealer and/or other actors providing inputs to farmers (e.g., cooperatives, aggregators) - Catalyse collaboration between inorganic and organic manufacturers, e.g., joint go-to-market with bundles		• Inorganic and organic manuf. • Relevant investors active in the Kenyan agri-sector	• Selected intermediaries	◕	◕

Source: TechnoServe analysis

2b

There are three main routes to boost availability and equip farmers with organic fertiliser with varied short- and long-term impact

	Subsidy programs	Extension services	Private sector partnerships
Impact	+ **Lowered product cost and policy campaigns** increase affordability and awareness, and drive product availability	+ **Longer-term (technical) support and hands-on guidance** drive awareness and long-lasting adoption	+ **Products sold by trusted and/or branded sources** support awareness, increase availability and potentially lower prices
	- **Lack of technical support and unstable political economy** hinder long-lasting adoption	- **Limited geographical expansion** inhibits both wide-spread adoption and availability of products	- **Limited technical support and guidance** on product application hinders long-lasting adoption
Strategy	• **Expand existing governmental subsidy programs** to include organic fertiliser and other related services, e.g., support for soil testing, capacity building, switch to beneficial crops/practices	• **Anchor private extension service providers** at county level to drive harmonized best-practice-sharing and information dissemination on organic fertiliser application	• **Develop partnerships**: a) suitable risk-sharing models with **distributors and outgrowers** to include organic fertiliser products or b) **inorganic-organic collaboration** with joint GTM
Key barriers	• Time-consuming **change of government policy**	• **Inadequate capabilities and resources** of current extension services • **Limited collaboration and harmonization** hinder capacity-building and quality assurance	• **Risk-aversion (cash and profitability)** to include organic fertiliser, e.g., inadequate appearance and handling, low shelf-life, low adoption

Source: TechnoServe analysis

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MALABO MONTPELLIER FORUM

Agenda

We engaged with 10 of larger producers and importers, and identified another 25 active in this space

10 companies engaged
Larger local producers (Pioneers and Early Followers) and importers
Typically engaged with cofounders, heads of ops / product dev

regen organics
TAKA TAKA SOLUTIONS
WonderGro
BBEAL Bharat Bio East Africa Ltd.
Safi Organics
dudutech Environmentally intelligent farming
ecodudu
WANDA ORGANIC
INSECT PRO
SISTEMA.bio CREATING VALUE FROM WASTE

~25 companies identified
From research, interviews, incubator/network listings

Select logos only

EcoFix(k) GREAT FOR YOU
KENYA BIOLOGICS Green, safe, and cost-effective crop protection
MAZAO FERTILIZER
Mzuri ORGANICS
realIPM
ESSENTIA KANAN ORGANIC FERTILIZER & COMPOSTING
dudumasters
Agri-Flora Organics
griincom
Rutuba Organic
Zh
HYGROW ORGANIC FERTILIZER

Other companies with limited visibility
Not included in our analysis

Source: TechnoServe analysis

List of interviewed and/or surveyed companies

Manufacturer: 🟨 Fertiliser 🟩 Biostimulants **Maturity:** **L** = Mature/Scaling **M** = SME **S** = Early-stage

	Company	**Head-quarter**	**Year founded**	**# of em-ployees**	**Est. production (in MT)**		**Technology**	**Relevant products**	**Funding**[1]
					2022	2023			
L	RegenOrganics	Nairobi	2010	201-500	3600	12000	BSF	Evergrow, Evergrow Gold	> 2,5m USD
L	SafiOrganics	Wang'uru	2015	11-50	2000	4000	Biochar	Safi Sarvi Planting, Safi Sarvi Topper, Safi Foliar Fertiliser, Safi Biochar (Acidic Soil Amender)	
L	Ecodudu	Nairobi	2017				BSF		> 0,5m USD
L	Takataka Solutions	Nairobi	2011	501-1000	900	1000	Compost	Bioplus	> 0,2m USD
L	Bharat Bio East Africa	Nairobi					Biogas	Green Gold, Bharat Prom	
L	Dudutech	Naivasha	2001					Ezyflow Calbud, Ezyflow Dolomite, Ezyflow Gypsum	
M	Insectipro	Limuru	2018	51-100	125	1000	BSF		
M	Sistema.bio	Nairobi	2010	>200			Biogas		> 15m USD
M	Wanda Organic	Nairobi	2011	>20	80	240	Hybrid (compost, biochar, microbes)	Plantmate Bio-organic Fertilizer	
M	AgRevive Africa Ltd.	Nairobi			900			WonderGrow	
S	Cityhub Counsulting Services	n/a	2018	4	3	5	Composting, biogas	Mazingira, Mazingira Foliar	
S	Kibuye Market Waste Management CBO	Kisumu	2014	16	6	11	Compost	Farmformula	
S	Gare Holdings Ltd	Kakamega	2021	4	1,16	13	Hybrid ((Vermi-)composting, BSF, fermentation of plant residue)	Mzuri NPK ActivePlus (solid), NPK Plus (liquid-foliar), Urea Plus (liquid-foliar/fertigant), NPK Chitosan Booster	
S	Camlpo Limited	Nakuru	2021	1 perm. 5 casual	13,8	60	Hybrid (hot Composting, BSF, biochar)	Nawiri Organic fertiliser, Nawiri Foliar Fertiliser	
S	Vermitech Consultants Ltd	Kisumu	2018	6 perm. 20 casual	20	50	Hybrid (vermicompost, biochar, biogas)	Boom Max Solid, Boom Max Foliar	

Source: Stakeholder interviews, TechnoServe survey, TechnoServe analysis | 1. Publicly available information; excluding grants

List of selected fertiliser and biostimulant manufacturers and importers in Kenya

Manufacturer: 🟨 Fertiliser 🟩 Biostimulants **Maturity:** **L** = Mature/Scaling **M** = SME **S** = Early-stage

	Company	HQ	Technology	Relevant products
Domestic production:				
🟩 L	MEA	Nairobi		Biofix
🟨 L	Kenya Forestry Research Institute	Nairobi		Kefrifix
🟨 L	Osho Chemical	Nairobi		Halt Neo, Nimbecidine
🟨 M	Minjingu	Nairobi	Rock Phosphate	Golden Leaf, Chai, Pamba
🟩 S	Kenya Biologics	Runyenjes	Seaweed	Algaliv, Bioradicante, Ecormon
🟨 S	Essentia Kanan	Ongata Rongai	Fortified compost	Lisha
🟨 S	Dudu Masters	n/a	Fortified compost, BSF	Kijanni Vermicompost
🟨 S	Phytomedia International Ltd.	Limuru	Fortified compost	Phymix
🟨 S	Rutuba Organic	Kitale		
🟨 S	Zihanga Limited	Kabete	Insect frass	
🟩 S	Percmacks Co	Nakuru		
🟨 S	Organic fields	Ruiru	Fortified compost	Hygrow
🟨 S	Dojibu Limited	n/a	BSF	
🟨 S	Griincom	Nakuru	Fortified compost	Griincom
🟨 S	Knight Profarm	Nairobi	BSF	
🟨 S	Mazao Organic Fertiliser	Kianjai	Fortified compost	Mazao Flourish
🟨 S	Comfort Worms And Insects	Gatwamba	Vermicompost / BSF	
🟨 S	Kijani Smile Ltd. Company	Nairobi	BSF	
🟨 S	Dorcas Poultry Farm Company	Nairobi	Poultry-based	
🟨 S	EcoFix	Nanyuki	Biochar	Crovit, Eco planting mix, Eco top dress
🟨 S	Leorganic Africa Ltd	JuJa Town		LEOrganic Folia
Imported products:				
🟩 L	Koppert	Nairobi		Capsanem, Citripar, Ercal
🟩 L	Fertinagro			Organia Biofuerza
🟩 -	Biosciences Llp			Vitazyme
🟩 L	AECI			Calcimax, Zincmax
🟩 L	Mahafeed Fertilizer			Multiphos 1.25.0/1.35.0
🟨 M	Biosorra	Nairobi	Biochar	

Source: TechnoServe analysis

KEBS has defined standards for organic fertilizer (KS 2290:2018) and bio-fertilizer (KS 2356:2016)

	Organic fertilizer specification: KS 2290:2018	Bio-fertilizer specification: KS 2356:2016
Goal	Promote safe use of organic fertilizers and bio-fertilizer, promote fair trade practices and ensure safety of consumers	
Key definitions	• **Organic matter:** Biomass of animals and plants. For this reason, only products that are solely derived from organic matter may be identified or described as "organic". • **Organic based product:** A product that contains at least 70% of organic materials • **Fertilizer:** Any material of natural or synthetic origin that is applied to soils or plants to supply one or more plant nutrients. Substance that increases soil fertility by supplying plant nutrients or by conditioning the soil with organic matter. • **Organic fertilizer:** A fertilizer that is either in solid or liquid form, naturally occurring in nature, which originates from organic material and those derived from natural mineral deposits. Organic fertilizers are substances that increases soil fertility by supplying plant nutrients or by conditioning the soil. • **Natural mineral fertilizer:** Materials that are directly mined from mineral deposits and only subjected to physical processes such as crushing/drying	• **Bio-fertilizer:** These are products containing living microorganisms which colonize the rhizosphere or the interior of the plant and promote growth by increasing the supply or availability of primary nutrients and/or growth stimulus to the target crop, when applied to see, plant surfaces, or soil. They may be formulated in different types of inorganic and organic carriers • **Bio-inoculant:** These are preparations containing beneficial micro-organism in a viable state, intended for seed, seedling, soil or other growing media application, designed for plant growth promoting benefits • **Bio-fertilizer carrier materials:** These are substances which support and present the organism, have potential to maintain viability of organisms and have no adverse effect to the environment
Require-ments	• **Smell:** Organic fertilizer shall be practically free from foul smell. • **Specific sources:** Dog and cat manures as well as untreated human waste shall not be used as fertilizers. • **Contents:** The fertilizer shall be free from foreign matter such as plastics, aluminum, wrappers, stones, weed, seeds etc. • **Specific quality requirements** – pH: 5.5 – 8.5 – Carbon Nitrogen ratio: ≤ 20:1 – Nitrogen: > 1 % – Organic matter content: ≥ 70 % – Total primary nutrients (NPK), % by weight: ≥ 3.5	For Rhizobia (selection): • **Carrier base/form:** most/dry powder, granules or liquid • **pH:** 6,5-7,5 for most/dry powder and granulated carrier based, and 5.0-7.5 for liquid based • **Moisture percent by weight**: 40-50% • **Shelf life:** – Liquid-based inoculants: 6 weeks (under refrigeration) – Solid based carriers: 6 months (under room temperature) and up to 23 months under refrigeration should have 5 months
Other	Packaging, environmental factors, labelling	

Source: KEBS (2018), KEBS (2016)