german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IITA Transforming African Agriculture

CGIAR

Technology toolkit

Completing the integrated soil fertility management equation

Latest trends in research and scaling for organic and auxiliary inputs

Highlights

Contact

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Friedrich-Ebert-Allee 32 + 36
53113 Bonn,
Deutschland

T: +49 228 44 60 - 0
F: +49 228 44 60 - 17 66
E: info@giz.de
I: www.giz.de/en

Authors
Dries Roobroeck (IITA)
Bernard Vanlauwe (IITA)

Contributors
Steffen Schulz, GIZ
Hanna Weinsheimer, GIZ
David Kersting, GIZ
Wim van Nes, Netherlands Development Organisation (SNV)
Bernhard Freyer, University of Natural Resources and Life Science, Vienna (BOKU)

Disclaimer
This publication has been realized under the ProSoil program of GIZ financed by BMZ (project processing n° : 21.2005.3 002.00). The contents of this publication are the sole responsibility of the authors and do not necessarily represent the views of GIZ or BMZ.

Citation
Roobroeck D, Vanlauwe B, 2024. Technology Toolkit: Completing the Integrated Soil Fertility Management Equation – Latest Trends in Research and Scaling for Organic and Auxiliary Inputs. Highlights. IITA

©International Institute of Tropical Agriculture

Copyright
This work is published under a Creative Commons Attribution 4.0 International License. Use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited.

Design
ARGE EYES-OPEN K15 GmbH und weissbunt GbR

Snapshot of content in technology profiles as related to potential for sustainable intensification, enhanced profitability, emission reduction, and policy mechanisms to promote access and use.

Microbial inoculants to manage nutrients and pests

- Advanced legume integration in maize and wheat crop rotations / intercropping systems, and harnessing biological nitrogen fixation processes, can save up to 10% of synthetic fertilizer input.
- Biopesticides for protection of cotton achieve return rates of 0.9 to 1.7 but would be higher than chemical products if environmental costs are accounted.
- The energy demand for the manufacture of an inoculant/biopesticide is 1% of that for a synthetic product whereby emission footprints can be substantially reduced.
- Selling of biofertilizer together with improved seed through farmer networks has increased the distribution-to-production ratio by 12%, and the sales-to-distribution by 34%.
- Certification schemes through industry control bodies with independent testing and labeling of inoculant products can ease quality control.

Composting for nutrient recovery and value addition

- Food and green waste from households in urban centers from Sub Sahara Africa (SSA) countries has the potential to produce 50,000 to 500,000 tons of compost per year.
- Service delivery models and automation systems are needed to increase the volume of organic waste that is composted in rural and urban landscapes.
- Through replacement of synthetic fertilizer, liquid compost can save 5.3 kg CO_2 per ton, whereas solid and vermiculture compost save 17 kg CO_2 per ton.
- A radio show with tips on compost has increased adoption from 25% to more than 89 %, proven that extension is key.
- Savings in disposal fees at landfills can measure US $24 to $113 per ton of organic waste, which can be used as financial support to enterprise development and capacity building.

Liming products to counteract soil acidity

- In SSA, cereal crops suffer yield losses of 10 to 80% resulting from reduced phosphorus and micronutrient uptake, and aluminum toxicity in acid soils.
- The use of agricultural lime across SSA is very low; for example, in Kenya the expected demand would be 187,000 ton based on soil data, but sales are less than 50,000 ton.
- Applying lime at rates of 2 to 5 tons per hectare on wheat and barley in conjunction with ISFM provides net added value of US $1,320 to $1,420.
- Yield increases and higher fertilizer use efficiency due to use of lime are lowering the emissions per food quantity and compensate for emissions from the transport.
- The Ethiopian government is exploring the option of a revolving fund to achieve its target of treating 4 million hectares of land with lime without relying on taxes or foreign investment.

Biochar as structural organic amendment

- Realistic input rates of biochar at 1 to 10 tons ha-1 can increase the agronomic efficiency of an inorganic fertilizer application by 50 to 70%.
- Yield increase and soil health benefits last for more than 15 years, with 60% sequestration of carbon under intensive cultivation.
- Its high permanence, lower cost of production and ease of verification favor biochar for climate offsets, delivering 93% of all durable carbon removals in 2023.
- Purchase agreements for over 30,000 tons C credits have been issued using the Global Artisan Standard that is designated to on-farm production.
- Legislation for carbon credit trading and benefit sharing is fast emerging but standards for biochar as farm input have not been prescribed.

Biodigester slurry for nutrient inputs to crops

- A tank of five cubic meter with daily feeding of 50 kg can annually produce of 11 tons slurry that allows to fertilize 2 hectares of land.
- Based on livestock ownership, water availability, fuelwood scarcity, population density and climate technology are feasible for 18.5 million households in SSA.
- Farmers using bio-slurry, e.g., in Ethiopia, were found to save US $17 and $52 per year through substitution of mineral fertilizer inputs.
- Use of digestion and slurry can lower greenhouse gas emissions, terrestrial acidification, and freshwater eutrophication compared to direct field application of manure.
- Result-based financing mechanisms are ideally placed to leverage investments for the promotion of biodigester and slurry in communities.

Enhanced rock weathering as fertilizer and lime substitute

- As rocks react with water, they release phosphorus, potassium and micronutrients that stimulate plant growth and improve soil structure.
- Several 100 thousand cubic meters of quarry fines and overburden waste has accumulated near mines in SSA, and as exploration activities expand the disposal of rock debris is increasing.
- An application rate of 10 tons of basalt dust per hectare removes between 1.2 and 1.6 tons CO_2 per year, with carbon credits going for US $230 per ton.
- In Brazil, rock dust is applied on more than 3 million hectares of cropland, and 30 mines are certified to produce soil remineralizer products.
- Tiered pricing and subsidies proportionate to application rates and farm size can ensure different customer segments have equitable access.

Rate card

Ease of implementing organic and auxiliary inputs as related to specific value chain level and components scored on key indicators by expert judgement.

			Technology					
Level	Component	Metrics	Inoculants	Compost	Lime	Biochar	Slurry	Rock dust
Manufacture	Raw material	Availability labor preparation logistics	Very easy	Average	Easy	Easy	Average	Easy
	Production system	Skills equipment operation output	Average	Difficult	Difficult	Average	Average	Easy
	Business model	Demand competitive profitable	Easy	Average	Easy	Very easy	Average	Very easy
Distribution	Stock keeping	Infrastructure quality loss bulk volume	Average	Difficult	Easy	Easy	Difficult	Easy
	Supply chain	Logistics trading	Very easy	Average	Very difficult	Average	Average	Very difficult
Application	Input practice	Suitability labor frequency extension	Easy	Easy	Average	Easy	Easy	Average
	Agronomic benefit	Dosage responses legacy effect	Easy	Easy	Very easy	Very easy	Easy	Easy
Governance	Regulatory oversight	Standards procedures	Easy	Average	Easy	Average	Average	Easy
	Incentive structure	Feasibility leverage potential	Average	Easy	Easy	Average	Easy	Easy

Very difficult Difficult Average Easy Very easy

Contacts

International Institute of Tropical Agriculture
Dries Roobroeck,
d.roobroeck@cgiar.org

Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
David Kersting,
david.kersting@giz.de

Steffen Schulz,
steffen.schulz@giz.de

Hanna Weinsheimer,
hanna.weinsheimer@giz.de