TECHNICAL BRIEF

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Soil health in Tanzania, with a focus on the Southern Highlands

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Let's recap what we know...

Soil health in many southern African ecosystems is in decline, with problems ranging from low nutrient levels to high levels of acidification, and more. Across the board, fertilisers are an essential input used by smallholder farmers to increase productivity given the highly weathered and nutrient-poor nature of many of the soils of southern Africa. Due to immediate results, inorganic fertilisers are the most commonly used type of fertiliser, and in many countries in Southern Africa these fertilisers are supplied to farmers through subsidy programmes. Although inorganic fertilisers have certain benefits, evidence points to the need to use them with other soil management tools and techniques. Lack of knowledge and guidance on appropriate fertiliser application, such as over-application of inorganic fertilisers, may lead to increase of the cost of production for farmers whilst not contributing to crop growth, and can even lead to decreasing soil health.

Soil health management practices, like the use of fertilisers, should not exist in a bubble but should be implemented through fertiliser combinations and alongside other sustainable farming practices (Tanzania FSD 2023-2030). Our discussion starter on payments for soil health services in Malawi outlines some similar challenges, and possible solutions in the context of Malawi, in more detail. Although Tanzania faces similar soil health challenges, creating space for cross-learning between the two countries, historical, political, and environmental factors differ, and should inform the approach to rethinking soil health in Tanzania. The focus for this paper, in Tanzania, is on the Southern Highlands, with their highly weathered nutrient-poor sandy soils that are prone to soil acidification.

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Agriculture in Tanzania

Tanzania places 90th out of 113 on the Global Food Security Index (Economist Impact, 2023), scoring lower on affordability, quality and safety and sustainability, but higher on food availability. In 2023, local agricultural production in Tanzania contributed to 124.5 percent of the food requirements and 26.5 percent of GDP (URT, 2024), highlighting its importance in the Tanzanian economy. Moreover, more than 65 percent of the population is employed in agriculture (URT, 2024), with women making up the majority, and comprising largely of small-scale farmers (Kinuthia, B. K., 2020). As part of their 2019 strategic plan, the Tanzania Agricultural Research Institute (TARI) identified that agricultural growth had stagnated below the desired growth rate of 6 percent (TARI, 2019). Over recent years, several policies and projects have been introduced to transform Tanzania's agricultural sector to address problems of food security and reduced agricultural productivity. The most important of these being agenda 10/30, aiming to increase the crop sub-sector GDP growth rate to 10% by 2030, up from 5.4% currently. (Ministry of Agriculture, 2024).

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Soil Health in Tanzania

Beyond its economic contribution, agriculture contributes largely to the food security of the overall population, and the livelihoods of rural communities in Tanzania. Therefore, ensuring production remains sufficient and sustainable can contribute positively to livelihood protection and the national economy. The 2013 National Agricultural Policy (URT, 2013) identifies natural disasters such as droughts, heavy rains, flooding, diseases and pests, and soil degradation as some environmental disasters that affect crop and livestock production. Across Tanzania's seven different agro-ecological zones, the combination of dry periods and heavy rainfalls, along with an inadequate land maintenance system, aggravates the land degradation process and makes the country's agricultural production highly vulnerable to weather related shocks (Enfors and Gordon, 2007). In 2022/2023, 48 district councils, 26 percent of all councils in 13 regions, identified as having crop production shortages for the upcoming year (IPC, 2023).

The most prominent environmental threats that have been identified since 2003 are varying and unpredictable levels of rainfall, pests and diseases, and shifting agro-climatic zones that lead to shifts in temperature and rainfall. Partially caused by these threats, as well as continuous cropping and low soil nutrient levels (Arce and Caballero, 2015), "soil fertility depletion and erosion are already threatening the sustainability of arable agriculture" (PMO, 2023). Soil erosion is a major problem in causing poor soil fertility in Tanzania, exacerbated by soil acidification, salinisation, leaching, and erosion and leading to a deficiency of nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulphur (S). Overall, this reduces the value of land, reduces crop yields, and ultimately creates food shortages (Mlingi et. al, 2023; Lasway et. al, 2020).

Policy development

Tanzanian national policy documents have mentioned soil fertility as a challenge as well as part of the solution in agricultural production and productivity. The 2013 agricultural policy (URT, 2013) lists soil fertility management as one of the strategic areas for intervention, with a focus on proper use of fertilisers. In recent agricultural policy, priority actions are identified around soil health management, introducing "soil conservation measures, reforestation and agro-forestry, appropriate conservation agriculture and sustainable pasture management methods" (PMO, 2023). The 10/30 agenda focuses its efforts on mechanisation, improved irrigation, enhanced extension services, market access, and improved use of modern inputs, such as seeds and fertilisers (Ministry of Agriculture, 2024). Several other policies aim to address soil health issues across the country using modern inputs, including fertilisers (Tanzania Fertiliser Sector Development Strategy 2023-2030), amongst other solutions.

Fertilisers can boost productivity directly, while addressing issues of acidity and low nutrient content. The promotion of fertiliser use has long been part of Tanzanian policy and agricultural incentivisation programmes. As early as the 1990s, fertiliser subsidies were in place through economic liberalisation policies. Between 2002, 2008, and 2013 severe droughts, a national food crisis, and sharp price increases, spurred government support measures and introduced various fertiliser subsidy programmes, starting with the National Agricultural Input Voucher Scheme (NAIVS) and continuously improving it for further iterations (Kinuthia, 2020). Subsidy schemes in Tanzania have been guided by regional policies and programmes, including Malawi's input voucher programmes of 2005 and 2008, the 2003 Maputo Declaration on increased expenditure in agriculture (AGRA, 2007) and the 2023 African Fertiliser and Soil Health Summit in Dakar, Senegal which emphasised Integrated Soil Fertility Management (ISFM).

Two phases of NAIVS, one starting in 2002 and the other in 2008, leveraged the private sector to reach farmers and sell them seed and fertiliser. The NAIVS subsidy was implemented in 11 agricultural regions, and more than 50% of the investment went to DAP and Urea fertilisers. According to Gajdosova et al. (2023), the regions of Iringa, Njombe, and Katavi have some of the highest soil acidity, with respectively 41%, 18% and 18% of agricultural lands affected by soil acidity. Although the subsidy programmes reached many farmers, they also had several limitations. Problems regarding malpractice, fraud, and limited capacity of agro-dealers in the earlier scheme were mostly addressed by moving from manual systems to a digital platform. However, some limitations persisted, including limited range of fertiliser types, and lack of awareness and knowledge amongst farmers on the subsidy platform and fertiliser usage (URT, 2014). These problems have persisted into the current fertiliser subsidy scheme, which aims to improve affordability and access to fertiliser, but does not address the ineffectiveness of inorganic fertiliser when not combined with other soil amendment practices (AfDB, 2020). "Many studies show that NAIVS programme influenced production but it did not lead to the expected green revolution – due to mistargeting and implementation issues" (Kinuthia, 2020).

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Inorganic fertiliser usage & identified problems

Inorganic fertilisers need to be specific to the needs in the farming system; blanket recommendations covering the entire country or even entire districts can be harmful for soil health and will not have the desired impact on crop production and productivity. Therefore, inorganic fertilisers need to be part of a package of soil health management practices. Soil quality measured through its nutrient contents in soil tests often lack translation from data to action, as technical reports and graphs of soil quality are not easily interpreted by farmers, nor are the same problems always directly observable. This creates

gaps in perception of soil quality and difficulty understanding what actions to take. This could lead to, for example, farmers using too much fertiliser, the wrong type of fertiliser or too little fertiliser, as in a World Bank project in 2021 (JPAL, 2023). It also means that fertilisers can easily be deemed ineffective if applied incorrectly and not providing the results that farmers are hoping for, sparking suspicion in fertiliser subsidies.

Fertiliser Subsidy

In Tanzania, fertiliser subsidy schemes have been the most common governmental measure to address the high cost of fertiliser to farmers. Various iterations of the fertiliser subsidy scheme have helped to reduce fertiliser costs to farmers and enhanced fertiliser use. For example, until 2007/2008, before direct fertiliser subsidies, Tanzania subsidised transport costs to the grain basket of Tanzania, (Iringa, Ruvuma, Mbeya, Rukwa).

The NAIVS was introduced in 2009 and operated until 2017, with the exception of the 2014/2015 season. Reasons for introducing a voucher subsidy scheme in place of the transport subsidy included delays in fertiliser delivery to farmers, inability of farmers to travel to distribution points, inadequate knowledge amongst fertiliser dealers and their limited capacity to finance adequate fertiliser stocks. The NAIVS provided input vouchers covering a maximum of one acre of cultivated land per farmer, reaching 2 million farmers in all regions in Tanzania training 3,850 fertiliser dealers. Limiting subsidy coverage to one acre of land had an impact on production and productivity, as farmers were asked to cover the costs of any additional seeds and fertilisers needed.

In 2014/2015, the NAIVS was replaced by subsidised interest on agricultural credit, allowing farmer groups, associations and cooperatives to buy fertilisers on credit from fertiliser companies. Purchasing fertiliser required a 20% deposit as collateral, and a matching 20% grant was provided by the government. The farmers were required to pay the remaining 60% of the fertiliser cost after harvest. This scheme was deemed ineffective and abandoned in the following season, when they reverted back to NAIVS.

Despite more efficient and effective functioning of the NAIVS, the government of Tanzania still faced several challenges within this scheme. This included the high costs, the support for a limited set of fertilisers (DAP and Urea), and inadequate targeting of beneficiaries. Moreover, inadequate supervision and unclear allocation mechanisms led to problems of false claims and diversion of subsidised fertiliser to neighbouring countries, indicating that subsidy vouchers and its related products were not always used as intended by the farmers who needed it.

In the Southern Highlands, using DAP and Urea fertilisers increases the acidity of already acidic soils. Overuse or misuse due to lack of knowledge can also lead to decreasing soil health. The use of fertilisers with the right nutrients, such as those rich in non-acidifying elements or use in combination with liming and organic matter additions, plus rotations and intercropping, can provide balanced nutrition and neutralise soil acidity. In addition, subsidy programmes should ideally be complemented by a strong and appropriate soil health advisory service for farmers.

In recent years, the Government of Tanzania introduced the fertiliser Bulk Procurement System (BPS), taking advantage of economies of scale and lowering the price of fertilisers. Additionally, the Government replaced the NAIVS with a new system, providing a 24% fertiliser subsidy through a digital management system, where farmers are registered at the village level. This digital management system has proven successful in resolving problems from the NAIVS, such as ease of access to the subsidy and fertiliser disbursement, clarity of allocation mechanisms, and misallocation of subsidies. The current system has reached more farmers, working through mobile phones and easily connecting farmers, businesses, and the government, and providing adequate support systems for ease of use. It has also helped the government monitor the purchasing and use of fertiliser across the country. The system still faces some challenges in reaching the last-mile suppliers, agro-dealers, and therefore farmers, as distribution contracts have moved from small-scale agro-dealers to large fertiliser companies, disrupting supply where agro-dealers don't have sufficient capital to procure fertilisers from these companies. Moreover, larger suppliers are directly distributing to farmers, with more limited reach than local agro-dealers. Lastly, the current subsidy scheme still lacks a focus on general soil health, and farmers are still paying a large share of the fertiliser price, as shown in table 1.

Table 1 Indicative fertiliser price as of November 2024

RETAIL INDICATIVE PRICES FOR DAP 50KG NOVEMBER, 2024								
WARD	**SALES POINT**	**DISTRICT**	**REGION**	**SELLING (TZS)**	**FARMER (TZS)**	**SUBSIDY (TZS)**	**SUB (%)**	**FARMER CONT (%)**
TUNGI	TUNGI	KIGAMBONI	DAR ES SALAAM	100,999	65,745	35,254	35%	65%
NYAMUNYUSI	NYAMUNYUSI	KASULU DC	KIGOMA	114,177	78,923	35,254	31%	69%
RETAIL INDICATIVE PRICES FOR UREA 50KG NOVEMBER, 2024								
WARD	**SALES POINT**	**DISTRICT**	**REGION**	**SELLING (TZS)**	**FARMER (TZS)**	**SUBSIDY (TZS)**	**SUB (%)**	**FARMER CONT (%)**
TUNGI	TUNGI	KIGAMBONI	DAR ES SALAAM	73,656	62,207	11,449	16%	84%
NYAMUNYUSI	NYAMUNYUSI	KASULU DC	KIGOMA	**85,372**	**73,923**	**11,449**	**13%**	**87%**

Source of Data: TFRA Nov, 2024

Possible solutions to soil health challenges

Consistent with the declarations of the 2023 the African Fertiliser and Soil Health Summit in Dakar, Senegal, soil health is more consistently being considered in agricultural policies, including fertiliser provision, and the idea of SMART fertiliser subsidies is being regionally pursued. Soil health solutions have far-ranging benefits, including increasing production, enhancing human nutrition and providing climate adaptation and mitigation practices.

The Government of Tanzania has undergone a substantial effort to make sure that farmers get the fertilisers at the right time and at an affordable price. These efforts include establishing the Tanzania Fertiliser Regulatory Authority (TFRA), introducing the Fertiliser BPS, and introducing and learning from various fertiliser subsidy schemes. All these efforts could benefit from complementary parallel support on other dimensions of soil health, systematically improving sustainable production and nutritional security. Improvement in soil health across the country will require targeted and tailored approaches and addressing nutritional security and livelihood protection will require a mix of the best technical solutions, training, and policy, as outlined in points 1-4 below.

1. Soil health solutions

In promoting the soil health solutions, the fertiliser subsidy needs to both reverse soil acidification as well as create balanced crop nutrition. It is estimated that about 4.7 million ha of cultivated land in Tanzania are acidic with pH levels below 5.6, which can have serious implications for crop productivity and fertiliser use efficiency. Acidic soils can reduce nutrient use by crops by up 50% (FSDS 2024). In the Southern Highlands, a shift is needed from acidifying fertilisers to those that reverse the acidification trend. This may include the use of lime as a soil amendment. Incentives to facilitate greater use of organic matter and organic fertilisers are also needed. Intercropping with nitrogen-fixing legumes also needs to be incentivised.

2. Awareness creation and soil testing

To ensure proper uptake and sustainability of the solutions for soil health and smart agricultural practices, knowledge dissemination and awareness creation across key stakeholders is crucial. A key part of this is expanded soil testing, so farmers become aware of the specific soil health issues they need to manage for. Soil testing and knowledge creation should ensure proper application of the correct fertilisers and other soil health practices, maximising the efficiency and effectiveness of a subsidy (JPAL, 2023). It is likely that the most effective knowledge systems will be based on digital platforms (Campbell et. al, 2023). Key stakeholders in the knowledge system include smallholder farmers as well as private sector actors and agro-dealers, and, most importantly, the extension services that can help in creating a supportive ecosystem for a fertiliser subsidy programme (JPAL, 2023).

3. Policy Reform

In most African countries, including Tanzania, fertiliser subsidies are expensive and seem unsustainable and are therefore often temporarily provided. For sustainable soil health management, the Government can review its policies and continue subsidising organic or semi-organic fertilisers enabling a large number of farmers to apply these fertilisers for restoring soil health in several areas, which is possible as Tanzania is currently producing large quantities of these fertilisers. The government can also reform its fiscal policy on agricultural lime (which is locally available) and soil testing facilities by introducing exemptions for various associated taxes and charges, resulting in reduced costs for soil management practices and attracting investments in soil testing and related soil health practices from the private sector.

4. Other Solutions

1. **Promote adoption** of integrated soil fertility management to reduce soil degradation
2. **Enhance the use of soil remedies** including the use of soil conditioners such as agricultural lime
3. **Promote the use of organic fertiliser** (about 20% of farmer to use organic fertilisers by 2030)
4. **Develop and distribute the guidelines** on risks associated with fertiliser mismanagement
5. **Develop and distribute the guidelines** for reducing fertiliser health related risks

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Next steps and Recommendations

There are significant ongoing efforts to rethink subsidy schemes, in Tanzania and elsewhere. These can be complemented by a far-reaching lesson learning programmes which can help shape future initiatives. Lessons learning can also be fostered across countries, as the nutrient poor sandy soils of Southern Africa stretch from Angola to Mozambique, and from Zimbabwe to Tanzania. Lessons learning can be driven by farmers organisations, getting bottom-up feedback about current initiatives, as well as by government officials who are grappling with productivity, soil health and national economic challenges.

Implementing best practice and lessons learnt from previous initiatives can inform new (subsidy) systems, where soil testing, strengthened advisory systems, greater flexibility in input choice, incentives for soil health practices and the uptake of digital systems could become the norm.

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