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Soil Testing Strategies for Soil Health and Fertility

Neil Rowe Miller, Agriculture and Livelihoods Technical Advisor, Eastern Africa

Background

Soil infertility is a key constraint to crop production for small farmers. Soils throughout Sub-Saharan Africa are degraded and deficient in nutrients and organic matter. As a result, there is a growing demand for soil testing services from farmers and NGO staff who want guidance on which inputs are best, and how much they should apply to restore soil health and fertility.

Given the wide range of soil testing options which are available, it is important to identify which tests are most useful. Some tests are helpful in developing recommendations for how farmers manage crops. Other tests may not help make crop management decisions, but they are useful in training farmers to think about soil health. Still others are appropriate in monitoring and evaluation of the effects of a project on soil nutrients and soil health.



Church of Uganda, Nebbi, staff sample a farmer's field for rapid pH testing.

Soil Testing Recommendations for Crop Management Decisions

Some soil tests provide information that farmers can use to increase their productivity or sustainability. Projects should focus on such testing when deciding how to advise farmers. The following guidelines summarize these issues:

- **Soil pH** affects the availability of many of the nutrients which are needed for good plant health. In addition, farmers can improve the pH of acid soils by using lime and/or wood ash. Soil pH testing using pH strips costs less than \$0.15 per sample (contact us for more details), and thus individual small-scale farmers can afford to have their fields tested.
- **Complete soil nutrient tests should include pH, phosphorus (P), and potassium (K)** - Additional soil tests for calcium, magnesium, and cation exchange capacity are sometimes included at no additional cost, but are less helpful since they aren't generally as limiting. **Complete soil nutrient tests are generally too expensive (e.g. \$25-50 per sample) for individual small-scale farmers to afford.** However, testing a range of soils in an area can help project staff develop general recommendations on which fertilizers are most important in the area, and what rates of fertilizer, compost and/or manure farmers should be using.

- **Soil Organic Matter (SOM) testing** – Since SOM provides many benefits for soil health and fertility, our goal for tropical soils is generally to maximize SOM. Thus, testing for SOM doesn't help in making management decisions (farmers should always apply more if they can!)
- **Nitrogen testing** is often expensive and the nitrogen content of the soil changes rapidly, especially with wet conditions. *For this reason, nitrogen testing is not generally helpful in developing fertility recommendations.*
- **Micronutrient testing** is also expensive and the availability of most micronutrients is strongly influenced by soil pH. Furthermore, micronutrient fertilizers are rarely available for small scale farmers. *For these reasons, it is generally better to focus on good soil pH management rather than to spend time and money on micronutrient testing.*

Soil Testing Methods for Farmer Education Purposes

- **Crop growth and yield**, including signs of nutrient deficiency on crops, are generally the most convincing evidence of soil health recognized by farmers. Such observations should be encouraged and taught widely.
- **Increasing soil organic matter** content is the single most important strategy for improving soil health and crop production, and should be central in any educational effort for small farmers. Because soil color and organic matter content are closely related, this is an easy measurement for farmers to discuss and monitor. Documenting rising SOM levels, or higher SOM in project fields than in traditional fields, can motivate farmers to manage their soils well.
- **Soil infiltration and erosion demonstrations** using small plots or containers are very effective ways of demonstrating the impact of good soil management and/or the differences between healthy and depleted soils (see Module 3 in our [CA Facilitators Guidebook](#)).
- **Soil health assessment tests**, as developed by the [USDA](#) or [Cornell University](#), provide additional ideas for encouraging farmers to think about improving their soils.

Soil Testing Recommendations for Project Monitoring and Evaluation

- **Complete soil nutrient analyses** are useful to provide a baseline, and to measure changes due to improved management practices. 30-40 fields should be randomly selected at the beginning of the project. Essential tests for a baseline include: pH, buffer pH, P, K, and organic matter. Nitrogen, sulfur and boron are not appropriate indicators in a baseline because they are too mobile to be consistent over time.
- **Soil health assessment tests**, including soil color, structure, biological activity, etc., are also good parameters to monitor as part of an M&E strategy.
- **Soil texture** is *not* an appropriate measure as it is not affected by management practices.
- **Follow-up sampling for monitoring purposes** should be taken in the same fields as the baseline, *at the same time of year*. A dry-season sample will be difficult to compare with a baseline sample taken during the wet season. It is even more helpful to compare project fields with an adjacent field which has not been managed with recommended methods.
- **Detailed records should be kept** on soil and crop management practices for these M&E fields. This may reveal information that will guide the project's future recommendations.

Challenges in soil testing with small farmers:

- Good plant nutrient recommendations require good crop-response data. However, in many environments, and for many crops, such research has never been done, especially in countries where small-scale farmers reside.
- Even when accurate soil tests and response data are available, small-farmers often have access to only a limited number of fertilizers or soil amendments so acting on the recommendations generated through soil testing can be difficult.
- Cheaper forms of soil testing, such as near-infrared spectroscopy used by some commercial laboratories, need even more calibration than traditional laboratory methods, and in many cases, the data for adequate calibration is not available.

The Role of Marketing: What Makes a Successful Project?

Loren Hostetter, Marketing Consultant, CFGB Scaling Up CA Project

Many CFGB-supported projects have begun to include value chains and marketing as part of their food security strategy. It seems so logical: if farmers market well, they will earn more profits and their families will have the resources to thrive. However, marketing efforts have had mixed success bringing benefits to small scale farmers. What makes marketing interventions successful?

Staff capacity - Staff of most humanitarian organizations are accustomed to serving the needs of marginalized individuals, and have developed skills in compassion and rapid response. Marketing skills are quite different; focused on hard analyses of what is profitable, and turning away people who cost more than they can contribute. It is not easy to convert humanitarian staff into business decision makers. Thus, NGOs which are most successful at marketing often recruit skilled private sector specialists.

Integrating marketing from the start - Many projects add marketing components to larger projects, and often marketing is the last component to be implemented. Their reasoning is "We'll begin marketing after we increase production and have a surplus." However, effective marketing begins by researching what the market wants before you produce, planting varieties which are marketable, and ensuring the volume, quality and packaging that traders want. Marketing must be integrated into projects from the start.

Selection of Participants - This is often a controversial issue for humanitarian organizations. Resource-poor farmers are not generally the best candidates for starting aggregation groups. A smarter roll-out approach is to begin with clusters of small-scale, but commercial-

oriented farmers who have the assets and skills to reliably produce the volume and quality demanded by buyers. These dependable producers can open market connections, establish storage facilities, and “get the trucks rolling.” Once aggregation groups are successfully established, poorer, risk-averse farmers can add their surplus to the group.

Local ownership - In successful marketing projects, farmers take full ownership of everything from decision making to risk. If an NGO arranges buyers for their groups, what will happen when the project ends? Subsidizing marketing services inevitably creates dependency. In contrast, participatory marketing exercises teach practical marketing skills, such as record keeping and market analysis, without creating dependency. As farmers develop such skills, and accept risk, they become empowered to attain their goals.



Participatory learning promotes local ownership

Single-purpose marketing groups - Successful marketing occurs when aggregation groups form for one purpose: to market a product. When more diverse self-help groups try to mix marketing activities with broader objectives, many members will not be motivated to market.

Timing is crucial - The single most effective marketing decision is delaying sales until market prices increase. A price calendar exercise helps farmers reflect on when they *normally* sell (and at what price) and when they would *like* to sell (and at what expected price). Participants then discuss the reasons they don't sell when they would like to. This exercise helps the group to make concrete actions to bulk, store, and delay sales by using other income, such as savings and diversifying income, during the low-price months. Aggregation groups often put a great deal of effort into finding “better buyers.” However, buyers seldom vary in price by more than 5-10 %. Good market timing, on the other hand, can increase gross margins by more than 100 per cent!

Attention to profitability (gross margins) - After subtracting costs of meeting buyers, transportation, labor, storage, etc., is aggregation more profitable than selling individually to traders at the farmgate? The increased price earned by aggregating small amounts of product is often not enough to cover these added expenses. One aggregation group, after calculating their gross margins, realized that they were losing money aggregating maize, and decided to focus on aggregating a larger quantity of beans to market. Most members continued growing maize for their own consumption, though one woman decided she would produce only beans, since with her profits, she could buy maize cheaper than growing it!

Profit it is not the only goal - While a good marketing project must focus on gross margins, most farmers have other goals which they must consider when making decisions. Furthermore, long-term profitability is dependent on improving productivity and sustainability. The CFGB Scaling Up Conservation Agriculture (SUCA) project employs a scorecard exercise when helping groups consider different crops. Farmers and project staff determine critical factors in addition to profitability, then score each crop accordingly before deciding on which one to produce and aggregate.

Marketing and conservation agriculture (CA) activities support each other - SUCA projects have also used gross margin analysis to compare the profitability of CA and conventional farming. One group found that, by increasing yield and reducing costs, CA would increase profits by 300 per cent. Since CA also increases the reliability of production in dry years, it is a particularly good complement to marketing projects.

ADS-w	Maize	Beans
land rent	(3000)	(2000)
land prep	2000	1500
Seed	2500	1000
labor planting	2000	1000
fert	5500	0
herbicide	0	0
pesticide	1000	0
labor weeding	2000	1000
labor harvest	2000	1000
cleaning/drying	4000	1000
Purchase Bags	4500	2250
fumigation	900	1125
storage		200
transport to market	350	50
labor loading		
Total Costs	24900	8850
yield	9 bags	2 bags
cost per bag	2767/bag	4425/bag
Revenue	2700	9000
Profit/bag	-67	+4575
Profit	-603	9150

A Gross Margin analysis of maize and beans in Kenya

Partner Profile: Terepeza Development Association, Ethiopia

Neil Rowe Miller, Agriculture and Livelihoods Technical Advisor, Eastern Africa

Terepeza Development Association (TDA) is the development branch of the Wolayta Kale Hiwot Church (WKHC), located in southern Ethiopia. TDA has implemented programs on soil and water conservation, education, HIV and health, child sponsorship, food security, integrated rural programs, emergency relief programs and Self Help Group (SHG) development.

TDA first began promoting conservation agriculture (CA) with their Offa-Kindo Koysha Food Security and Livelihood Development Program, which began in 2012 with the support of Tearfund Canada/CFGB, Tearfund UK, and Tearfund Netherlands. Their initial CA project grew from 40 CA farmers in the first year to over a thousand in year four.

In 2015, TDA expanded to Humbo and Damot Woydie Districts as part of the East Africa Scaling Up CA (SUCA) project. After four years, TDA had helped 7,625 farmers adopt CA (including 2,055 women) and their five-year goal was increased to 8,500! TDA has expanded the number of cover crops (lablab, cowpea, desmodium, jackbean, velvet bean) used, and more than 50% of the CA farmers they work with now plant cover crops. Last year, the project CA fields yielded an average of 4,900 kg/ha of maize compared to the district average of 2,300 kg/ha. CA farmers are also producing papaya and moringa as cash crops. TDA has trained 54 village and district level government extension workers who now also provide CA technical support to farmers.



A female farmer uses oxen to rip lines for CA planting (photo: TDA).

Last year, TDA facilitated the formation of 40 marketing aggregation groups (938 farmers). After a price analysis, the groups prioritized maize, pigeon peas, lablab, common beans, and hot peppers as their main crops for aggregation, and their first sales included 38.7 metric tons of pigeon pea. Traders award CA farmers a premium price due to the quality of their grain. Last year, for example, CA wheat sold at a 37% higher price through aggregation.

TDA employs a gender officer to strengthen gender awareness among the staff and community members. Workshops for male and female farmer groups use practical exercises that engage women, and their participation in CA and SHGs is continuously increasing. Challenges like women's lack of decision-making authority and control of resources are being addressed in these trainings. The project staff include gender topics in CA and SHG training, and promote a family-based approach, where women, men, and children work together on the farm. On field days last year, 70% of the top CA farmers were women.



A taro field (arrow root) grown with CA (photo: TDA).

ALTA Travel Schedules

JEAN TWILINGIYUMUKIZA

15-28 September 2019

London, UK
Tearfund Orientation

14-18 October 2019

Ouagadougou, Burkina Faso
ODE and Tearfund Project visits

11-15 November 2019

Bugesera and Kayonza, Rwanda
PDN Project visits

26-28 November 2019

Kigali, Rwanda
ECHO Highlands Symposium

NEIL ROWE MILLER

16-20 September 2019

Addis Ababa, Ethiopia
CA Curriculum Writeshop

22-25 September 2019

Lalibela, Ethiopia
LWF Project Visit

9-13 October 2019

Soroti & Moroto, Uganda
KIDO and KIDEP Project visits

14-18 October 2019

Amuria, Uganda
Country-Level Workshop

11-15 November 2019

TBD, Tanzania
Tearfund and SUCA project visits



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