syngenta foundation for sustainable agriculture

Risk reduction through soil health improvement

List of concepts for the Syngenta Foundation – February, 2019

1. Context

Unsustainable cropping practices, such as slash-and-burn agriculture, continuous mono-cropping and poor nutrient management have greatly decreased soil health and fertility in many parts of Africa, leading to reduced yields and a limited resilience of cropping systems. This is likely to aggravate in the context of climate change as degraded soils offer limited capacity to store moisture, whilst also more rapidly eroding during excessive rains. In recent years, a number of 'push' initiatives have been launched to improve soil fertility and health in developing countries. However, we believe that improving soil health needs clear and sustainable 'pull' incentives for farmers in order for them to be sustained and implemented at scale – both in a spatial and temporal context**. This needs tailored combinations of commercially viable, risk-reducing interventions with near-term return on investment for farmers and their business partners**. At the Syngenta Foundation for Sustainable Agriculture (SFSA), this creates an imperative for us to develop approaches that can lead to sustainable improvements of soil health for smallholders to raise the productivity and resilience of their cropping systems.

As a first area of intervention, we selected East Africa and in particular Kenya. The country offers a comparatively liberal and enabling policy framework (e.g. no rigid fertilizer subsidy schemes) and existing or developing private sector supply chains for inputs (such as nutrient blends and soil diagnostic tools). We will test different mechanisms for tailoring combinations of soil health promoting interventions to individual farmers in order **to identify flexible, effective, replicable models that can be widely adopted, enabling transformation of soil management among East African smallholders.**

A review of the available literature and discussions with number of public and private stakeholders led us to the identification of three different models of intervention. They are listed in Table 1 below and are currently being rolled out with selected partners.

Intervention Model	***Partners and Geography***
Soil-testing and nutrient management To integrate soil testing and training (e.g. optimizing chemical use and variety selection) into a large-scale smallholder-focused project to catalyze farmers' interest and capacity to access high-quality farm inputs (such as hybrid crop varieties), thereby expanding the market and solidifying the commercial basis for soil health enhancement.	The Nature Conservancy (part of the global TNC-SYT-SFSA partnership)
Market-led crop diversification To test diversification-promoting interventions for cereal cropping systems and quantify adoption rates, soil health improvements, yield, and farmer benefits (e.g. income, labor).	AgVenture Kenya, potentially involving The Nature Conservancy
Hub models To identify and test innovations and models for catalyzing aggregator hubs to form, paired with 'push' and 'pull' interventions relevant to improved soil health.	The One Acre Fund

Table 1: List of soil-health related interventions currently being rolled out in Kenya.

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2. Soil-testing and nutrient management

Expert opinion compiled by the SFSA (e.g. 2013 workshop) and recent analysis by IFDC provide a solid foundation for identifying specific soil-related challenges and potential interventions. A common theme is **improving soil fertility, plant nutrition, and productivity through comprehensive soil testing and improved access to soil amendments** (i.e. organic material, mineral nutrients, lime).

Kenya represents a promising opportunity given the progressive liberalization of the input sector in recent years and the entry of a number of new input providers into the market. They can translate improved data from soil diagnostics and mapping into appropriate input management advice and increases in productivity.

In this context, we have developed an intervention model in collaboration with The Nature Conservancy, which is currently being rolled-out as a part of the global TNC-SYT-SFSA partnership. This model has the aim **to link soil testing with extension and nutrient recommendation and supply channels**. We selected an area in central Kenya where unsustainable agricultural practices have led to high rates of soil erosion resulting in loss of soil fertility, low yields, and water quality impacts that affect downstream users. The farmers also face the challenge of limited access to effective extension services, high-quality farm inputs, soil diagnostic services, insufficient water to grow vegetable crops off-season, and effective marketing services. The overall aim of the work described in this model is **"to test the viability of sustainable intensification that builds on a foundation of good soil management and health and uses improved inputs, seed, and cropping practices to increase productivity, incomes, and reduce environmental impacts."** The benefits of improved soil fertility can be further enhanced through agronomic advice that seeks to promote alternative rotations, high-quality inputs, and Integrated Pest Management (IPM), among other best practices. The result will be farms that are more productive, profitable, can better withstand weather and climate volatility (ie are more resilient) and have reduced environmental impact.

3. Market-led crop diversification

In many parts of sub-Saharan Africa, agriculture is based on rotations of small-grained cereals (barley/wheat) or continuous corn farming. These monocultures have led to the build-up of a variety of challenges that have caused yields to stagnate or even decrease. These include the depletion of nutrients from soils and increased susceptibility to pests and disease. Rotation crops have the potential to break pest and disease cycles and – if legume or pulse crops are included in the rotation – can add atmospheric nitrogen to the soil to reduce subsequent fertilizer applications. Moreover, legume-cereal rotations can also increase overall water use efficiency and offer additional opportunities for weed management.

Major factors that have limited the uptake of rotation crops so far include the lack of suitable rotation crops and varieties, limited farmer awareness in how to grow non-cereal crops and missing linkages to output markets. To address these aforementioned challenges, we are partnering with AgVenture Ltd., a consortium of medium- and large-scale cereal farmers in Kenya (http://www.agvke.com/). In recent years, AgVenture farmers have observed decreasing yields as a result of continuous monocultures. They have since introduced canola as a rotation/breaker crop and established linkages to local oil processors to sell their harvest. They now intend to partner with smallholder communities to increase overall output volumes through providing inputs, extension and access to offtake markets. AgVenture also aims to further diversify their production by introducing additional rotation crops such as pulses and legumes.

The objective of our collaboration addresses two aspects, namely **introducing new rotation crops and improving their capacity to support smallholder farmers in crop diversification**. We will therefore help identifying, sourcing and trialing potential rotation crops and varieties. Successfully trialed varieties will then be channeled through the Syngenta Foundation's Seeds2B platform (https://www.syngentafoundation.org/seeds2b) to facilitate variety registration and local seed production. The latter is particularly important as most preferred rotation crops are open-pollinated species with

perishable seed. They therefore offer more challenging business cases compared to hybrid or GM crops and seed companies often need support in establishing functional and reliable seed supply channels.

Apart from not addressing the challenges of setting-up reliable seed supply channels, many previous initiatives to introduce rotation crops have often focused on agro-ecological aspects and soil benefits instead of also assessing the market potential of candidate rotations. This has led to a limited adoption of rotation practices as most smallholder farmers need seasonally reoccurring income sources. Our approach is therefore to **combine both agronomic and market aspects in the crop selection process**. We have therefore initiated a rating process and market study to assess rotation candidates that will then be taken to the field. First candidates and their ratings can be found in Table 2 below.

Rotation Crop	*Agronomy*	*Rotation Benefits*	*Market Potential*	*Total Score*
Field Peas (blue/ green, & white)	7	9	7	**23**
Soya	5	10	8	**22**
Oats	10	3	8	**21**
Green Grams	7	5	8	**20**
Quinoa	9	4	7	**20**

Table 2: Rating of potential rotation crops based on crop agronomy (e.g. compatibility with local equipment and production systems), rotation benefits (e.g. nitrogen fixation) and the local market potential.

Interestingly this model has recently raised interest from the Nature Conservancy and a second proposal from Kenya for the global TNC-SYT-SFSA partnership, with greater involvement from SYT, is being developed based SFSA's model. Moreover, given the prevalence of cereal cropping systems in many parts of sub-Saharan Africa, we aim to develop a scalable model to replicate this approach in other geographies.

4. Hub models

Some element of 'push' strategies are needed to disseminate proven approaches and technologies that improve soil health. However, **"push" strategies are not likely to be particularly effective without 'pull' strategies that send market signals to farmers that higher quality varieties and rotation crops can command prices and other economic benefits that make financial and other risks of adopting new management worthwhile.**

This aggregator function to serve both "push" and "pull" factors appears to be amongst the most limiting variable in East African smallholder agriculture systems. Local agro-dealers can partially offer such services, but are often limited to selling input products in a passive manner as guided by suppliers. Improvements are needed to drive systemic change, such as improved extension and training, stronger access to offtake markets (e.g. in the case of new rotations or certified products), financing, and risk management tools. Such interventions are likely to exceed both capacity and infrastructure of existing agro-dealer networks.

We are currently developing two interventions based on aggregator hub-models: The first intervention is based on a collaboration with the One Acre Fund (https://oneacrefund.org/), a large scale aggregator in East Africa to **de-risk the uptake of new technologies that promote soil health both for farmers and technology suppliers** (working with more than 1 million farmers, the One Acre Fund can offer a substantial aggregated market potential). Here we will look at technologies such as soil amendments (lime, organic fertilisers) and microbial growth enhances (such as Rhizobia). The second intervention is anticipated to be based around SFSA's expanding network of digitally supported one-stop shop delivery and market access hubs. We will use the hubs to **combine soil testing with nutrient management and potentially the use of legume rotation crops and combine improved agronomy with market linkages to sell the production**.