SUBA FARMERS REPORT 2009

BIOCHAR COMMUNITY PROJECT

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1 INTRODUCTION

Declining soil fertility due to poor nutrient management is a major constraint to crop production in the Suba District, extending to other parts of the lake region of Western Kenya. Cover crops, mulches, compost or manure additions have been used successfully by few farmers, supplying nutrients to crops to support rapid nutrient cycling via microbial biomass. However, such benefits of soil amendments are short-lived to the small farmer (Jeckinson and Ayanaba 1977); and organic soil amendments must be applied annually to sustain soil productivity (Bol. Et al, 2000). The Suba District has not had defined soil management policies, as such, the Suba Farmers have taken the initiative via the *Farmers Participatory Research Approach* (FPRA) to research and trial Biochar farming practices. This helps the small farmers to understand farming methods, identify farming constraints, analyze soil fertility management options and evaluate Biochar technology in soil management. Over time, the goal is to identify the best options to address local limitations in soil management, and expand knowledge of additional local farming opportunities.

If FPRA can be easy adopted, it can be a gateway for greater involvement of small farmers in the Biochar technology evaluation and dissemination program. In turn, farmers will be easily empowered to overcome socio-economic constrains at the farm level, which currently limits the adoption of major soil management technologies. Fundamental goals of FPRA include: farmer evaluation to diagnose crop threats; respect for the capability of the individual farmer; produce and analyze knowledge; commitment by researchers to involve the community, and the recognition that research is an educational process for researchers and the community. FPRA also empowers or expands the farmers' indigenous technical knowledge and capacity to learn, improving collaborative research and delivery of results.

The Biochar trial began by challenging local farmers to solve the rapidly declining soil fertility in their own capacity, and help address the hunger disaster in the region; because the decline is largely caused by continuously using the traditional farming system in every planting season. More pressure for soil fertility decline is further generated by increased human population, global climate change and increasing costs of organic fertilizers.

It is encouraging that farmers have taken a step and are actively involved in the Biochar trials, evaluating the Biochar impacts in soil management and crop productivity. This has encouraged a holistic review of constraints in Biochar applications in soil management by including farmers' opinions. In this regard, farmers are directly involved in soil management practices by monitoring and evaluating Biochar farm trials, scoring and ranking the performance of Biochar using their own criteria.

2 BACKGROUND

Biochar is a black porous solid, composed of carbon which is highly resistant to decomposition; it is produced via pyrolysis of plant and waste feed stocks. As a soil amendment, Biochar creates a recalcitrant soil carbon pool that is carbon negative, serving as a net withdrawal of atmospheric carbon dioxide stored in a highly recalcitrant soil carbon stocks. From research done by a number of scientists on Biochar in other parts of the world, char amended soils have shown significant reduction in fertilizer requirements in every planting season; reductions in nitrous oxide emissions from soils; reduced run off of phosphorus into surface waters; and reduced leaching of nitrogen into ground water. Previous research has also shown Biochar significantly increases the efficiency of commercial fertilizers, enhancing crop yields; and at the same time, also reduces the need for commercial fertilizers. Biochar offers promise for its soil productivity and carbon sequestration (Glaser et al, 2002).

In this first phase (year one) of the Biochar Community Project, the technology approach of Farmers Participatory Research has given quick adoption though with diffused study/result on the adoption. This has been attributed to; limited power to create awareness of the technology, income constrains, correct ratio of charcoal to manure application on farms and the famine disaster experienced in the community this year of 2009. However, the project has remained focused to scale up the technology and reach more small farmers in the community in order to enhance food security and alleviate poverty among the population.

The Biochar Community Project in Suba District has considered drawbacks in past planting seasons as a yardstick, to improve and continue to develop and implement more innovative and low cost technologies. This has been reflected in the project report, where the focus on the growth and harvest of a target crop of maize has been documented. This synthesis report highlights the most likely promising research findings of Biochar soil management success in developing countries with an aim of identifying gaps for future research. Also the success will be providing useful insights to the way forward of Biochar projects through Farmer Participatory Research.

3 STUDY AREA : SINDO

The project base is in Sindo, Suba District, western Kenya region. The area is a depression of land that stretches up to 20km along the shores of Lake Victoria and up to 10km to the foot of the hills. To its Northern boarder lies Rang'wa, Gembe and Gwassi Hills. The soils in Sindo are generally deficient and marginal. The use of cover crops, mulches, compost or manure additions alone have shown no improvement to correct and balance soil nutrients and sustain crop yields. Moreover, its general application to the farms is time consuming, labor costing, short lived and has to be applied in every planting season. Biochar soil nutrient management can maximize the benefits of organic nutrient applications, offering much promise to enhance low cost crop productivity on small scale farms in the region.

Sindo is divided into two zones; Eastern and Western. The Eastern zone is characterized with black sandy soils and the Western zone with red soil. Biochar performance has been evaluated based on these soil zones. Annually, one or two crops have always been grown in each zone; there have been no specific evaluations for various crops cultivated in the past in Sindo to compare Biochar adaptability and acceptability. Through the government of Kenya, few farmers received maize seeds (variety H513), which is a medium maturing breed of maize. Despite this, the region is still in a precarious position, lacking food security. Rainfall has been inconsistent this year; sufficient during planting months of March through to May, then no rains re-surfaced to support the crops from growth to maturity, resulting in poor crop performance or poor yields. If this pattern is experienced in the near future then it will be difficult to overcome hunger among populations in the region.

Based on what is being experienced now, weather experts have encouraged farmers to re-plant their farms as short rains are expected to occur later in the year through to January 2010.

4 METHODOLOGY

The Suba Farmers Participatory Research trial enlisted 28 farmers, whom received the hybrid H513 maize seed. Farmers from Eastern zone characterized with black sandy soil and those from the Western zone characterized with red soil, each had fourteen Biochar trial farms. With the fourteen, seven were treated and the other seven served as controls respectively.

The farms uniformly applied a mixture of charcoal and manure in the ratio of (1:2), measured as 1 wheelbarrow of charcoal to 2 wheelbarrows of manure, at 35-40 wheel barrows per hectare. This was applied on the surface of the cultivated land prior to planting. In the control fields, no soil additives were applied. Each selected farm trial measured one hectare. Planting of the selected farms was done in the same week. Weeding in the farms was done once just as it is normally done in every planting season.

Fig X: Mixing char with manure before field application

To estimate the effects of the mixture of char and manure, 150 maize plants were sampled from every Biochar trial farms (both treated and controls) in each of the soil zones. The sampling was done at maturity stage of the maize or at harvesting time in which weights of ears/pods (with and without) and heights of the sampled maize plants were measured.

5 RESULTS

The application of manure in combination with char resulted in increased yields in the black sandy soils of the Eastern Zone compared to untreated farms; and in the red soils of the Western Zone, compared to untreated farms.

Table 1: Results of charcoal and manure, in the ratio (1:2), added to soils growing maize; harvested after 119 days.

Zone	Height (units)	Weight (with Ears) (units)	Weight (less Ears) (units)	Yield Ears (units)
Eastern Zone: black sandy soils.	304	7.252	6.783	0.469
Western Zone: red soils.	283	6.334	5.901	0.433

Table 2: Results of charcoal only, added to soils growing maize; harvested after 119 days.

Zone	Height (units)	Weight (with Ears) (units)	Weight (less Ears) (units)	Yield Ears (units)
Eastern Zone: black sandy soils.	205	6.008	5.609	0.399
Western Zone: red soils.	197	5.212	4.282	0.930

Fig 2: Maize growth with charcoal and manure added to the soil

Fig 3: Maize growth with no charcoal or manure added to the soil; the struggling crop became infested with Striga weed.

6 DISCUSSION

1. Enhancement of Farmer Participatory Research Approach to benefit small farmers through active participation in Biochar technology application process. In the long run, farmers would have learnt the techniques from problem diagnosis to research implementation and eventual technology transfer.
2. Some parts of Sindo are steep with undulating hills thus highly exposed to soil erosions. Also experienced is soil degradation and nutrient depletion due to continuous cultivation, removal or burning of crop residue, loss of nutrients through erosion, over grazing between cropping seasons and inadequate use of inorganic manure leading to decline in food production. Though judicious application of organic

manure is recognized as the most effective amendment in overcoming decline in soil fertility or in alleviating nutrient deficiencies, it is however costly in terms of labor force and is unprofitable to the small farmer. Initiating a Biochar soil management project is likely to increase and sustain the declining soil fertility and farmers will together develop it for sustainability.

3. Awareness, workshops and training to small farmers with an aim to develop a concept on ways farmers can sustainably use cooking stove that produces more charcoal (i.e. Folke Gurthe's cooking stove) than ashes as a means to curb deforestation in the region.

4. Establish correct ratio (grained charcoal to manure) of Biochar application on farms to enhance better yields due to improved Biochar soil management techniques

5. Ensuring that the coverage of Biochar soil management research is widely disseminated to be easily adopted, and is effective enough to impact poverty alleviation and increase income.

6 Develop strategies that empower farmers to rapidly diagnose existing soil fertility problems in their farms and seek custom solutions to suit the local resources available to farmers. Also establish ways that can link the community to other relevant agencies that could lead to financial support as well to invention and embracing of other new ideas of soil management.

7 CONCLUSION

The addition of charcoal and manure to the soil increased yield in must have resulted in increased levels of exchangeable bases such as calcium, phosphorous and potassium, which have essential amending effects to improve the structural, biological and chemical properties of soil. Even though, the inorganic carbon of manure on the Biochar farms is yet to be established.

Biochar integrated nutrient management has maximized the complimentary effects of organic nutrient sources resulting in increased crop productivity on the Biochar trial farms in the Sindo region. The application of manure in combination with porous char showed improvement in survival of maize in low rainfall, and eventual increased yields when compared with control fields. Farmers embraced treated Biochar farms as a low cost technology and thus a probable alternative to the expensive and sometimes inaccessible and un-heard of organic fertilizer usage.

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