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Research Paper

Improved Fallow Practices for Food Security Among Resource-Poor Farmers in Lower Nyakach, Kisumu County, Kenya.

Geography

KEYWORDS : Sustainability, Improved fallow practices, Resource-poor farmers, Kenya.

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ABSTRACT

Declining soil fertility due to nitrogen deficiency is recognized as one of the major limiting factors to sustainable food production in Sub-Saharan Africa. Soil fertility has been declining because of continuous crop cultivation with little or no nutrient inputs. Decreased productivity of agricultural land has further worsened food deficit in this region of the world. Improved fallow practices- short-duration tree fallows were introduced and tested under on-farm trials among small-scale, resource-poor farmers in Lower Nyakach, Kenya so as to replenish soil fertility. The objective of this study was to examine the influence of these practices on food security among these farmers. The results revealed that improved fallow practices increased the farmers' yield three-fold (300 percent increase) within four harvesting seasons (two years). The practice was feasible and profitable to farmers. The farmers' participation in on-farm trials and the potential of the practice to increase food production without applying chemical fertilizers excited the resource-poor farmers, who operate under low-input or no-input farming systems that are characterized by infertile soils, unreliable rainfall and low yields. The idea of food sovereignty should be adopted by the government of Kenya and other governments in the developing world, and therefore the resource-poor farmers in these countries. Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. While the objective of food security may sound good, the concept of Food Security has been mis-used to justify policies that prioritize only yield and the delivery of food to consumers by any means. It as become divorced fro any consideration of how that food is produced and by whom. It is mis-used to justify and encourage the industrialization of agriculture, food aid, the use of genetically modified seeds, the shifting of food production from diverse crops for local markets to monocultures for export, and the liberalization of markets where small scale producers are put out of business and production by subsidized imports. Policies based on this narrow understanding of Food Security have also failed to protect consumers and producers from soaring food prices. Thus, under Food Security practices prescribed by governments, business and FAO, world hunger is growing, faster even than population growth. Despite scientific hi-tech approaches, hunger is increasing. Food has increasingly become a commodity for maximizing profits for the few rather than actually feeding people. Real Food Security is impossible without first achieving food sovereignty.

INTRODUCTION

Food security is one of the main global concerns in many developing countries (FAO, 1996, World Bank, 1996). However, food insecurity is most acute in Sub-Saharan Africa (SSA) and a significant proportion of the rural population in Sub-Saharan Africa is food insecure and malnourished ((FAO 2010). The need to improve soil fertility management in Africa has become a very important issue in the development policy agenda due to the strong linkage between soil fertility and food insecurity on one hand and the implications on the economic well being of the population on the other (Ajayi et al., 2003). Thus, the attainment of food security is intrinsically linked with reversing agricultural stagnation and safeguarding the natural resource base (Cleaver and Schreiber, 1994, Thangata and Alavalapati, 2003 and Place et al., 2004).

Declining soil fertility and low macro-nutrient levels has been recognized as the major biophysical impediments to agricultural growth of African agriculture (Vanlauwe and Giller, 2006 and Jama and Pirazzo, 2008). The low soil fertility arises mainly due to the breakdown of the traditional natural fallow system (that used to be the means of replenishing soil fertility when human population was still low and land was in plenty) and continuous cultivation of crops without external fertilization due to the high costs of chemical fertilizers (Kwesiga and Coe, 1994, Kwesiga et al., 2002 and Matata et al., 2010). The continued threat to the world's natural resources is exacerbated by the need to reduce poverty and unsustainable farming practices.

Combined effects of continuous nutrients removal and inappropriate land-use practices cause decline in soil fertility and, hence, declining agricultural production in Kenya (Buresh and Tian, 1997, Jama and Pirazzo, 2008). Since Kenya relies on agricultural production as the backbone of its food production, such decline in agricultural production further worsens the bad situation of food insecurity in the country (Smaling et al, 2009). In order to avert food insecurity, therefore, sustainable agricultural practices must be encouraged among farmers. Schroth (1995) and Shepherd et al (2008) cite that soil compaction, depleted soil nutrients, sheet erosion, rill erosion, and gully erosion are some of the forms of soil degradation that are caused by inappropriate use of agricultural land in Kenya. These have resulted into reduced plant growth, loss of productive capacity of soil and low food production due to surface crusting, plough pans, excessive cultivation and stock trampling. These have eventually resulted into low agricultural production hence food insecurity in the country (Barrios et al., 1997, Braun, et al., 2007).

METHODOLOGY

Study Area/Location

Lower Nyakach is located in mid-western part of Kenya on the Kano Plain along the shores of Lake Victoria, the second largest fresh-water lake in the world, between latitude 0°00' (the equator) and 0°25' South and between longitude 34°45' and 35°21' East. It covers an area of 182.6km^2, which is a flat and flood-plain region. It has a total population of 69,974 (National census, 2012). It has a bimodal rainfall pattern with long rains falling between March and June, and short rains are less pronounced and unreliable, falling between September and November. The rains are of convectional type, with temperatures ranging from a mean minimum of 20°C to mean maximum of 35.0°C. Soils are 51 - 60% Black Cotton Clay (vertisols), with moderate to poor fertility, poor drainage and prone to flooding. Lower Nyakach lies on a lowland flat area within the agro-ecological zones 3 and 4, where traditional crop and animal farming is the dominating practice. The natural vegetation in the region consists of grasses, bushes and woodlands with mainly *Acacia* species and swampy vegetation in the swampy areas. Land tenure is individual and farmers have user rights to cultivate and use the land as they purpose. 98 percent of the population depends on agricultural production and over 90 percent of the regional economy is derived from agriculture, of which 80 percent is contributed by food crop cultivation. Farm holding size averages about 0.9 ha, most of which is cultivated. Rice (*Oryza sativa* L.) is the main cash crop among smallholder farmers; other crops grown for both food and cash include maize as the main staple crop, green grams, beans and sorghum (*Sorghum bicolor* L.). Over 85% of the farmers own livestock ranging from 1 to 20 in number.

Data Collection Technique

A total number of 90 farmers were selected for interview during the 2012 planting season, among which 20 were purposively chosen for on-farm trials on the basis of their acceptance to adopt improved fallows as a land-use practice on their farms. The villages chosen were the pilot sites where Vi- agro forestry research and dissemination activities were taking place. In each selected village, a random sampling technique was used to select farmers. Primary data was collected through a structured questionnaire that was administered to the farmers. The questionnaire had closed and open-ended questions that were to collect information on various socio-economic characteristics such as age, household demography, the farmers' knowledge of improved fallow technology and food security status of the farm families. Additional information was collected from farmers' focus group discussions in each village. A total of three Focus Group Discussions (FGDs) were held to collect general information about farmers' views regarding their food security status and improved fallows technology. Farmers were sampled as food secure, mildly food insecure, moderately food insecure and severely food insecure for purposes of analysis.

Improve Fallow practices

Choice of fallow species

The choice of the species for planted fallows depends on adaptation of the species to the biophysical and socio-economic conditions of a given site. For the purposes of this study, farmers who planted *Sesbania sesban, Tephrosia vogelii, Crotalaria grahamiana and Cajanus cajan* (Pigeon pea) were regarded as adopters of improved fallow technology. Sesbania is not new in the area, though, and is particularly popular with the farmers because of its soil fertility improving properties and for firewood. The other species were relay-sown in standing maize and millet during the long rains of May the year 2012, four (4) to five (5) weeks after sowing. Relay cropping minimizes negative effects of the trees on the crop and allows the trees to benefit from crop husbandry practices such as fertilizer application and weeding. It also permits tree growth to be extended for two seasons. When the crops were harvested at the end of the first season (July-August 2012), the trees were left to grow during the second season (six-month long) until they were cut in February or March 2013 and the cropping cycle repeated. The cycle is repeated as long as necessary to improve the fertility and productivity of the soil. Once the trees were cut, wood was removed and the leaf and small twigs were left on the field and incorporated into the soil during land preparation in February and March 2013. Depending on how much weed control was achieved during the fallow period, it was possible to plant the crop with no or minimum tillage when the fallow were cut.

RESULTS AND DISCUSSION

On-farm trials of Improved Fallow and Food Security

On-farm trials were conducted with the sample farmers in the three villages. The farmers have constructed trenches that are about 2.5 m deep and 7 metres long that they use to divert water from the Rivers Nyando and Awach for irrigation on their farms when rains fail. The farmers have established improved fallows of *Sesbania sesban, Gliricidia sepium, Crotalaria grahamiana and Tephrosia candida*. The biomass from the improved fallows is used for soil fertility replenishment on farms whose fertility has gone down in the past. Sesbania shrub is also useful in reduction of striga seed pools in the soil. Striga is known to be the worst menace in this area, and the weed competes for nutrients with crops such as maize, sorghum, beans and millet that are grown by these farmers. Sesbania helps rejuvenate the striga-infested farms back to productivity, and this has ensured improved food production for the farmers who have adopted the use of *Sesbania sesban.*

Overcoming soil fertility depletion is fundamental to increasing maize, which is the staple crop and other crops yield in the area. The Improved Fallow technology was explored and evaluated by this study as a practice that could restore soil fertility and improve soil productivity hence food production and security. These evaluations were conducted in two types of trials: **Type 1 trial** (researcher-designed and farmer-managed), **Type 2 trial** (farmer-designed and farmer-managed). From these trials, improved fallows/ planted fallows of fast-growing leguminous species emerged as a technology that can improve soil fertility and crop yields remarkably. Consequently, experimentation and adoption of this technology by farmers is on-going. While improved fallows can improve crop yields in Nitrogen-limited soil, its effects are little in Phosphorus-limited soils that cover a large area of the study area (Braun *et al.*, 1997).

Unlike Nitrogen, trees do not obtain Phosphorus from the air. For Phosphorus-limited soils, therefore, input of phosphorus is necessary to integrate with improved fallows practice to improve crop yields. The options for Phosphorus sources are either inorganic Phosphorus fertilizer or direct application of reactive phosphate rock (PR). Farmers in the area are classified as resource-poor and practice subsistence farming. Maize, which is the main staple food crop, is normally intercropped with sorghum, green gram or beans. These crops are planted with little or no use of organic fertilizers. Farm inputs are expensive and the resource-poor farmers of Lower Nyakach cannot afford the inorganic fertilizers and improved seeds. The number of animals that the small holdings are able to support limits the use of animal manure. Consequently, the annual nutrient deficits on such small holdings are estimated at 100 kg N ha-1 and 10 kg P ha-1 (Shepherd *et al.*, 1996).

In the on-farm of Researcher-designed, Farmer-Managed study (type 1 trial) at an NPK-deficient site, a six-month fallow of *Sesbania sesban, Tephrosia vogelii, Crotalaria grahamiana* and *Cajanus cajan* increased maize yield from 35% to 128% compared with continuous maize with no fertilizer application. This had good prospects for many farmers in the area with fewer other options for improving crop yields. Maize yield was highest after fallows of Tephrosia, 3.8 t ha-1, Sesbania 3.6 t ha-1 and similar for fallows of Crotalaria, Cajanus and natural fallow at 2.6 t ha-1. Maize yield was lowest for the continuous cropping systems, at 1.9 t ha-1, although it was higher than the typical yield of 1.0 t ha-1 or less for such a system (Swinkels et al., 1997). The fallows showed considerable residual effects on the subsequent crops, which were harvested in July-August 2013, which ranged from 36 percent for natural fallow to 48 percent with *Sesbania sesban.* This could have important implications on the economic evaluation of the practice, but this is recommended for another study.

The potential of short-duration improved fallows was also assessed on farm, under farmers' own designed and managed conditions (Type 2 trials). In a study on Nitrogen and Phosphorus-deficient sites, six-month fallows of Crotalaria and Tephrosia increased maize yields from 35 percent to 48 percent compared with continuous cropping without the addition of Nitrogen and Phosphorus. Maize yield from non- Phosphorus addition soil was similar for that from Crotalaria and Tephrosia fallows, which were 2.6 and 2.4 t ha-1 respectively, but higher than the farmers' no-input control fallow, which yielded 1.5 tonnes per hectare. With the addition of Phosphorus as Tripple superphosphate (TSP) at the rate of 20kg ha-1, maize yield of all systems increased considerably for Crotalaria at 1.0 t ha-1; for Tephrosia at 1.3 t ha-1 and for the control at 0.5 ha-1 compared to non- P addition.

The farmers' yields have improved by 300 percent between the years 2011 and 2013 after they were introduced to improved fallow practices. However, the number of farmers who have adopted such productivity improvement strategies is still less, because out of the 90 farmers interviewed, only 12 had accepted and adopted the improved fallow system, the remaining 78 farmers still continued with their traditional production systems. This is only 13.3% of the farmers having increased yields. On average, the market value of the yields from their maize farms in 2010 was Ksh. 4,600 per hectare, before they started practicing Improved Fallow System. At the time that this paper was being written in the year 2013, only two years after starting the use of improved fallow system (Four planting seasons), and the value of the yields per hectare had improved to Ksh.13, 900. This is a 300 percent increase in maize production, which increased the food security level of these households three-fold.

Economic benefits of improved fallows

Economic returns of short-duration planted fallows were attractive under both trials1 and 2 conditions. This was evident from the results of an on-station study that compared the effects of a six-month Sesbania fallow (direct seeded at the rate of 20,000 plants per hectare) with a one-year natural fallow and continuous maize. The plots were planted at the end of the fallow period and P was applied at the rate of 20 kg ha-1 to only the first of four maize crops after the fallow period. Net benefits, expressed in terms of returns to land or labour per day worked, of Sesbania were positive and higher than those of the other two systems, whether Sesbania firewood was valued or not. Net benefits of sesbania increased slightly with the application of P compared with non P addition, at Ksh. 32,000 ha-1 and Ksh. 29,840 ha-1 respectively. The small increase with Phosphorus was attributed to the low amount of Phosphorus added.

In a nearby locality with P deficient soils, researchers with ICRAF-a Non-Governmental Organization carrying out research in collaboration with the farmers, found application of high rates of P, at 200 kg ha-1 after an 18-month *Sesbania sesban* fallow increased considerably both maize yields and economic benefits. (Jama *et al.*, 1998). Because of the low value of 6-month Sesbania wood, its valuation did not affect much the net benefits. Economic assessment of improved fallows under twenty (20) farmer-designed and managed conditions in the study area also revealed positive results. They demonstrated that the break-even maize yield, that is, the yield increase required over continuous maize to cover the cost associated with planted fallows, for a one year long Sesbania fallow as 21% of 0.6 t ha-1, which is a typical yield for nutrient-depleted soils with no fertilizer inputs. Improved fallow effects are usually more than 21%. The main reasons for positive economic returns of improved fallows are increased crop yields, labour cost and other crop inputs saved during the fallow period, residual effects of fallows extending beyond the first crop after and; firewood from fallow which is limiting in many areas of Lower Nyakach.

CONCLUSION

Flat terrain and poor farming practices in Lower Nyakach ecosystem have led to soil erosion that has resulted into loss of iodine in the soil, consequently making it absent in plants and food. The study area is composed mainly of Sodic soils, with very high Sodium content at the depths of between 50cm to 1metre. This Sodium content makes the soils hard to manage due to hard pans and crop production here is low. The use of farm residues instead of recycling nutrients to improve soil structure and act as mulch is very common in the study area. With reducing farm sizes and increasing numbers of dependants, people are forced to resort to unsustainable practices, further enhancing decline in soil fertility. Soils become exposed to erosion with subsequent decline in fertility thus leading to reduction in agricultural outputs. This in turn affects the quantity of food available leading to reduction in food security and income generated from agro-based activities.

Leaving land fallow under natural vegetation is common in Lower Nyakach. This improves soil fertility and crop yields hence food security, to a little extent. This survey shows that on average, 48 percent of the farmers leave their land under natural fallow for at least one cropping season, mainly during the short rainy season, which has become unreliable. The extent of fallowing is about 10 percent to 50 percent of the total land holding. . The reasons that the farmers have for natural fallowing include improving soil fertility and lack of labour. This high percentage of land under fallow in such a densely populated area could be avoided if the farmers had the alternative ways of sustaining their production throughout the year, and this can be done successfully through improved fallow technology.

Improved fallows represent a technically effective and financially profitable technology that is attractive to poor households with little cash available for investment. They are being used and adopted by a significant proportion of households in areas of western Kenya where they had been disseminated in the late 1990s, and this can be extended to farmers that are not aware of these practices. On the other hand, farm sizes are small and the ability of farmers to set aside land, even for a season is limited. Hence, the average size improved fallow is small among adopting farmers.

Improved fallow technology has a positive influence on soil fertility improvement, conservation, productivity hence food security. However, there is need for phosphorus inputs. Phosphorus deficiency is widespread in the study area. 86 percent of the farms are severely deficient in phosphorus. High yields require large P applications of at least over 100 kg per hectare. Phosphorus input is, therefore, a must in order to improve yields meaningfully. The options of P inputs are phosphorus fertilizers and phosphate rock (PR).Due to cost effectiveness, the latter is the more recommended for the resource-poor farmers of the study area.

POLICY IMPLICATIONS

It is important for policy makers and implementers to identify and eliminate perverse policies and subsidies, for example, for agrochemicals; Significantly increase the share and effectiveness of public expenditure for agricultural development in general and for sustainable agriculture in particular; Train farmers in sustainable agriculture practices and improve related extension systems; Provide incentives and platforms for farmers, other actors in the value chain and policymakers to share knowledge and experiences with sustainable agriculture; Support farmers in creating groups for knowledge sharing, production planning, joint marketing and problem-solving; Reward farmers practicing sustainable agriculture with access to local and other markets, and improving physical infra-structure for transport, communication and marketing and Government and other procurement programmes; Minimize post harvest losses through improved storage, roads and electrification, and by bringing processing closer to the harvest area; Combine sustainable agriculture production with renewable energy; Recognize stability in land management and tenure systems as important policy issues related to enhanced soil fertility; encourage land reform, including strengthening of women's land rights; and put in place, national support measures for sustainable agriculture supplemented by reformed international trade policies that truly support sustainable agriculture. This should include more policy space for developing countries to use effective instruments to promote food

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security, farmers' livelihoods and rural development.

The idea of food sovereignty should be adopted by the government of Kenya and other governments in the developing world, and therefore the resource-poor farmers in these countries. Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers. Food sovereignty prioritizes local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal fishing, pastoral-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability. The essential characteristics of the food sovereignty concept are that: villages, counties, countries have control of their food production and supply; food availability in sufficient quantities and quality; food that is culturally appropriate; production systems that are environmentally sustainable; production systems that recognize the rights-genetic resources, seeds, water, gender, land; the right to choose; and the protection of bio-diversity and local knowledge systems.

While the objective of food security may sound good, the concept of Food Security has been mis-used to justify policies that prioritize only yield and the delivery of food to consumers by any means. It as become divorced fro any consideration of how that food is produced and by whom. It is mis-used to justify and encourage the industrialization of agriculture, food aid, the use of genetically modified seeds, the shifting of food production from diverse crops for local markets to monocultures for export, and the liberalization of markets where small scale producers are put out of business and production by subsidized imports. Policies based on this narrow understanding of Food Security have also failed to protect consumers and producers from soaring food prices. Thus, under Food Security practices prescribed by governments, business and FAO, world hunger is growing, faster even than population growth. Despite scientific hi-tech approaches, hunger is increasing. Food has increasingly become a commodity for maximizing profits for the few rather than actually feeding people.

The idea of Food Sovereignty developed as a response to the crises facing the world's farmers and food systems. The concept evolved through the experience and analysis of the people on which the world's food supply still depends- the small scale resource-poor food producers. It is therefore not based on abstract theories about profit growth and Gross Domestic Product. It is a more holistic system than Food Security. It recognizes that control over the food system needs to remain in the hands of farmers, for whom farming is both a way of life and a means of producing food. It is clear that the globalized and industrialized food system, is failing to meet neither the needs of the world's people nor sustain the ecosystems on which food production depends. Real Food Security is impossible without first achieving food sovereignty.

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