PALGO JOURNAL OF AGRICULTURE

ISSN 2476-8359
Volume 4 Issue 2,April 2017.Page 225-229
http://www.palgojournals.org/PJA/Index.htm
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IMPROVING LIVELIHOODS OF SMALLHOLDER FARMERS THROUGH SUSTAINABLE AGRICULTURE: A CASE OF SIAYA COUNTY, KENYA

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Accepted 04 April, 2017

Rapid population growth, high poverty levels, climate change, environmental degradation and food insecurity are key challenges to sustainable livelihoods and development in many parts of Kenya. Majority of people in Siaya County depend on agriculture as the main source of livelihood, yet the impacts of climate change, environmental degradation and unsustainable agricultural practices on small available farms has meant unreliable crop yields. To enhance sustainable development and livelihoods it may be necessary to promote sustainable agriculture, environmental conservation, enhance community resilience to climate change impacts and eradicate poverty. This current paper is a case study testing the effectiveness of conservation agriculture practices in Siaya County in improving agricultural production systems. The goal of this project was to improve the livelihoods of vulnerable communities in Siaya County through conservation agriculture practices. Specifically the project was to train local vulnerable communities on maintaining sustainable agricultural systems, through conservation agriculture practices. The project involved collaboration between Ministry of Agriculture, Kenya Forest Service, Research team and communities. Surveys were done to establish socio-economic status of farmers inorder to inform planning for farmer trainings and other project activities. Capacity building was done through trainings, workshops, Farmer Field Schools and Farmer to Farmer exchange visits. Field trials in experimental plots to compare yields when conservation agricultural practices were employed and when farmers used conventional agricultural practices were carried out. Results show that there has been wide adoption of conservation agriculture practices by many farmers, contributing to improved food security, economic incomes and poverty alleviation. This is a reflection of enhanced ecological resilience of agricultural production systems. It is concluded that this approach is easily adopted by vulnerable communities and should be upscaled in other parts of the country to enhance food security and stability of local economies whilst maintaining integrity of ecosystems for sustained development.

Key words: Climate change,food security, communities, livelihoods, ecosystem resilience

INTRODUCTION

Land degradation is increasingly a key factor affecting agricultural productivity in Sub Saharan Africa (SSA) in general and East Africa in particular (FAO, 2006). Despite general global advancements in farming technologies, much of SSA's farming systems have recorded at best stagnation in agricultural productivity and agricultural growth (FAO, 2006). Improving the resilience of agricultural systems is essential for climate change adaptation (Conant 2009; Parry *et al*. 2007; Adger *et al*. 2003). And, improvements in agricultural production systems offer the potential to provide a significant source of mitigation by increasing carbon stocks in terrestrial systems, as well as emissions reductions through increased efficiency (FAO 2009; Paustian *et al.* 2009; Smith *et al*. 2008). Strengthening agricultural production systems is a fundamental means of improving incomes and food security for the largest group of food insecure in the world (World Bank 2007; Ravallion and Chen 2007).

Key challenges to sustainable development in Siaya County in Kenya include rapid population growth, high poverty levels, climate change, environmental degradation and food insecurity (GoK, 2013). Improving smallholder agricultural systems is a key response to these challenges. The majority of people in Siaya County have their livelihoods depending directly or indirectly on agriculture. It is important to move agricultural systems in this region to more productive and

sustainable levels, while addressing climate change, hence increase food security and adaptive capacity of the food production system. Additionally, developing sustainable agriculture and forestry practices is essential to ensure availability of the ecosystem services necessary to maintain conditions for life on Earth.

This project was designed and implemented to get better, higher and sustainable farm productivity especially in three districts targeting smallholder-subsistence farming communities. Main new idea in this project is sustainable agriculture for improved livelihoods of smallholder farmers as an approach to adaptation to climate change. Strengthening conservation agriculture to improve agricultural production systems through crop rotations, reduced tillage, and soil cover is a fundamental means of improving incomes and food security for the food insecure communities in the county and in Kenya (FAO, 2006).

This research project was to contribute to improving livelihoods of smallholder farmers through sustainable conservation agriculture (CA) by the rural communities. When agricultural productions are enhanced the food security of households becomes increased and this makes families to be economically stable and enhances local economies. The project was implemented within three divisions in Siaya County of Kenya for two years from 2012 to 2014. It has resulted in increased food security in households as a result of many farmers adopting conservation agriculture practices.

OBJECTIVES

The general objective was to improve food security and rural livelihoods and build a foundation for the expansion of conservation agriculture (CA) to contribute to sustainable agriculture/development.

Specifically these included: To train local communities on maintaining sustainable agricultural systems; To promote agro-forestry and conservation agriculture practices; To enhance income generation/reduce poverty through improved yields; and generate information to help county government in making informed decisions in implementing its integrated development plan.

METHODS AND ACTIVITIES

This project was conducted in three divisions in Siaya County in Kenya. Siaya County is found on the Western part of Kenya, in the former Nyanza province. The region is generally characterized by low and unreliable rainfall patterns, which come twice a year as short rains between September and November and long rains between March and June.

Purposive selection of the three divisions was done based on areas with highest environmental degradation and poverty indices. A total of 50 households were randomly selected for inclusion in the research project and women or household heads taken as respondents. Household surveys were conducted using interviews through Participatory Rural Appraisal (PRA) and Focus Group Discussions to determine the socio-economic status and level of awareness and practice of agro-forestry and Conservation Agriculture practices. Observational study was used to confirm information obtained through interviews. Data was analysed using Statistical Package for Social Science (SPSS) and Microsoft Excel software to determine frequencies, comparisons, percentages, mean values, standard deviations and correlations.

Capacity building for the selected households on concepts of Conservation Agriculture, Agro-forestry and environmental management was conducted through trainings, workshops, Farmer Field Schools and Farmer to Farmer exchange visits. This was done in collaboration with Ministry of Agriculture, Kenya Forest Services, local Non-Governmental Organizations (NGOs) and Community Based Organizations (CBOs). All Conservation Agriculture-Farmer Field School (CA-FFS) groups had a learning day – on average once in a week. Each CA-FFS group managed a group plot, which was normally demarcated into smaller plots, for information exchange and demonstration on CA and equipments. Knowledge and experiences sharing was done through Farmer-to-farmer visits and interactions with the private sector. Extended and elaborate farmer-to-farmer exchange visits and field-day competitions were conducted as one of the effective tools in helping learning from fellow farmers and by seeing. The farmer-to-farmer visits were to help farmers, both the visiting and the visited, enhance their confidence in themselves and their practices. They gave them opportunity to test out what they knew among their peers.

Experimental research design was used to investigate efficiency of conservation agriculture and agro-forestry on enhancing ecological resilience of farmlands and crop yield production. Three demonstration farms were established in each division and used for trainings. Seedlings, seeds and other inputs were supplied to target farmers. Field trials were conducted in the demonstration farms. Experimental plots were established and using a Complete Randomized Design (CRD), treatments were done on the plots based on Conservation Agricultural practices and conventional agricultural practices. The yields were measured and the means of the various parameters in the experimental plots compared. The means were subjected to Analysis of Variance (ANOVA) to establish whether any significant differences exist in the various treatments. The farmers were trained on laying out the experimental designs, data collection and entry into

prescribed data sheets. The activities conducted on the farms included agro-forestry using high value and fast-growing tree species with multiple benefits for food, fodder, fuel, shade and reducing soil erosion such as *sesbania sesbans* and *gravillea*.

For soil and water conservation mulching and incorporation of residues and crop rotation for reducing wind and soil erosion, increasing water retention, and improving soil structure and aeration was done. Cover crops like potatoes, cowpea, pigeon pea and beans were introduced on the farms. Maize crops were intercropped with legumes such as cowpeas, peas, and climbing beans introduced as a more productive bean variety.

RESULTS AND DISCUSSION

This project has resulted in increased scientific knowledge and awareness on CA and Agro-forestry among local communities as displayed in the changes in agricultural practices among the people (Table 1); Establishment of knowledge networks; Increased crop yields hence food security (Table 2).

Table 1: Conservation agriculture practices by communities

Conservation Agriculture Practice	No. of households (%)			
	Initial Practices		Practices during project period	
	Practice (done)	No practice (not done)	Practice (done)	No practice (not done)
Agroforestry	15	85	65	35
Mulching	0	100	55	45
Cover crops	2	98	55	45
Climbing beans	0	100	50	50
Miniponds	0	100	40	60

Table 2: Crop yields experienced

Crop Type	Average crop yield per household (No. of 90kg sack per hectare)	
	Without CA	With CA
Beans	2	7
Maize	5	20

Agro-forestry using high value trees give multiple benefits such as food, fodder, fuel, shade and reducing soil erosion. Trees and bushes may also yield products that can either be used for food consumption (fruits), fodder, fuel, building materials, firewood, or sold for cash, leading to greater average household income, and contributing to household risk management via reduced income variability (Ajayi *et al.* 2009; Franzel *et al*. 2004). Planting trees and bushes also increases carbon sequestered both above and below ground, thereby contributing to GHG mitigation (Verchot *et al*. 2007). Conservation agriculture (CA) incorporates a wide range of practices aimed at minimizing soil disturbance, and minimizing bare, uncovered soils (Blanco and Lal 2008). The Food and Agriculture Organization of the United Nations (FAO) includes crop rotation as an essential component of conservation agriculture. Reduced or zero tillage plus incorporation of residues or other mulches reduces wind and soil erosion, increases water retention, and improves soil structure and aeration (Blanco and Lal 2008). Thus, conservation tillage practices can increase farm system resilience and improve the capacity of farmers to adapt to climate change. At the same time, such practices may reduce carbon losses that occur with ploughing, and also further sequester carbon via residue incorporation and reduced erosion (Lal 1987). Cover crops and rotation patterns can also alleviate potential weed problems where herbicides are not available or accessible to poor smallholders. Alley cropping between cover crops ; continuous cover between main crops can reduce erosion, build soil organic matter, and improve the water balance, leading to higher and more stable yields on the alleys sown to main crops (Blanco and Lal, 2008). Cover crops or improved fallows ensure that the soil is not left bare after harvest. Leaving residues on the field is one method of covering the soil. Improved fallows generally mean the deliberate planting of fast-growing species – usually legumes – that produce easily decomposable biomass and replenish soil fertility (Matata *et al*. 2010; Sanchez 1999). The point is both to keep cropland covered during the entire year, and in the case of improved fallows, to increase soil fertility. An additional benefit from continuous crop cover is reduction in weeding and pest control, at least after some period; In terms of soil sequestration, cover crops and improved fallows can increase soil carbon particularly when there is zero or minimum tillage (Govaerts et al. 2009; Bot and Bonites 2001; FAO 2001). An additional benefit from continuous crop cover is reduction in weeding and pest control, at least after some period; In terms of soil sequestration, cover crops and improved fallows can increase soil carbon particularly when there is zero or minimum tillage (FAO 2009). In terms of adaptation, such practices can reduce erosion and enhance water retention, both of which should enhance resilience to drought (Conant 2009; Peterson and Westfall 2004). Cover crops and improved fallow crops that have had at least partial success in many African contexts

include leguminous cover crops such as cowpea, pigeon pea, *lablab purpureus*, and *mucuna pruriens* (velvet bean) as well as improved fallows seeded with fast-growing tree species such as *sesbania sesbans* and *gliricidia sepium*.

OUTCOMES

Wide dissemination of scientific knowledge on CA; Empowerment of communities to adaptation to climate change through CA; Adoption of CA and agro-forestry practices in the county (Table 1); Improved livelihoods of communities and Reduced poverty in the county; Enhanced ecological resilience of agricultural and forest ecosystems (improved environmental sustainability); Enhanced adaptation capacity of communities to climate change; Development of informed sound policies on environmental conservation.

CONCLUSION

The project has stimulated and facilitated intensive farmer-to-farmer sharing in supporting the self-learning process and farmer interaction with private sector. This has added much to the wealth of knowledge and true experience of the CA/FFS farmers. It has led to improved food security and farm incomes which have attracted attention to CA within the context of food security and poverty alleviation. The project findings are thus important in informing policy and advocate for the implementation of Siaya County integrated development and management plans aimed at maintaining ecosystem resilience and integrity.

ACKNOWLEDGEMENTS

The authors express their gratitude to all stakeholders/partners who participated in this project. We appreciate the contributions of government ministries (MoA, KFS), NGOs and CBOs. We are grateful to the farmers for their cooperation throughout the project period.

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