
Full Length Research Paper

Assessment of influence of land use changes on women farmers adoption of conservation agriculture, Nakuru County, Kenya

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This paper examines the effects of land use changes on women small-scale farmers on adoption of conservation agriculture in Nakuru County. Developing countries are faced with two major problems, food insecurity and biodiversity loss which occur as a result of conventional agricultural methods. Conservation agriculture (CA) based on minimum tillage, crop residue retention and crop rotation has been proposed as a better option for it results in maximum yields and protection of the environment. But CA adoption in Nakuru County by women small scale farmers is low and the reasons for CA adoption in the study area are many some of which are land use changes and climate change among others. Land use changes from arable land to other economic land uses are claimed to influence adoption of CA by women smallholder farmers. There is inadequate research documentation regarding this claim. To find out why CA adoption was low in the study area, the research sampled three sites; Naivasha, Rongai and Njoro selected purposefully due to different ecological characteristics. Three hundred and sixty women farmers were randomly selected from a target population of 120, 000 women farmers of which, 120 were selected from each of three Sub Counties. Descriptive survey design using structured questionnaires; interview schedule, personal observation and focus group discussion were used to collect data. Statistical package for social sciences (SPSS version 20) was used in the data processing and analysis. Descriptive statistics; frequency distributions, means, proportions, percentages and inferential statistics; Chi-square, ANOVA, Bonferroni test at alpha value ($p < 0.05$) level were employed to test the hypothesis. The findings concluded that land use changes significantly influenced women farmers' adoption of CA and that CA adoption uptake was low. The following are recommendations; Policy and decision makers use the results to develop land and agricultural policies, provide incentives to promote women small-scale farmers, use new emerging technologies to speed up adoption of CA in order to realize food security and conservation of the environment in Nakuru County and Kenya.

Key words: Conservation agriculture, adoption, land use change, small-scale farmers.

INTRODUCTION

The global environmental degradation is a result of numerous human activities, some of which are inappropriate technological advances such as conventional agricultural practices. These unsustainable practices have resulted in climate change, soil erosion, deforestation, loss of biodiversity, waste disposal,

pollution among others (Kahimba et al., 2014). Research study found that, conventional agriculture contribute 30% of the environmental damage although it leads in world food production and economy (Theodor et al., 2014). New innovations in developing countries face new and increasingly complex challenges hindering farmers from maximizing their food production (Ngwira et al., 2014). Poverty, low food production and loss of biological resources are major problems facing global development practitioners' today especially in developing countries.

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Population increase and the establishment of infrastructures and urbanization are taking big toll in arable land which is significantly reducing area for food production (Saya, 2011).

Several studies have observed that, conservation agriculture (CA) is becoming a better option in mitigating environmental degradation and contributing significantly in increasing food production and protection of the environment in areas where significant land use has occurred and arable land has been replaced with other economic uses (Caroline et al., 2016). The study indicated that, in South America, Zambia, Burkina Faso, Malawi and parts of Kenya, conservation agriculture (CA) seem to be a better option for mitigating environmental problems and land use changes towards increasing food production and protection of environment (Kassam et al., 2012). Conservation agriculture provides a set of principles of implementing sustainable agriculture while minimizing environmental degradation because the practice relies on three basic principles: 1) minimum soil disturbance or if possible, no tillage at all; 2) soil cover—permanent, if possible; and 3) crop rotation (Caroline et al., 2016).

In Africa only about 3% is under CA and the rate of adoption of CA is very slow. The diffusion of CA across Africa South of Sahara is affected by several factors; institutional, economic, social, historical, environmental and political (Kassam et al., 2010). One factor impeding extensive adoption of CA is that the practice is generally knowledge intensive, presupposing farmer understanding of soil nutrient cycles, causal affects between erosion and soil fertility, and the role of cover crops or residues in evapo-transpiration (McNair, 2012). Improving conservation agricultural techniques by scientific research and practice and the dissemination of results and experiences are therefore crucial and an important challenge for specialists engaged in sustainable land use around the world (Katelyn, 2016).

Land use/cover statistics revealed that substantial land use/cover changes have taken place and that the built-up areas have expanded by about 47 km² over the study period (1976 till present). Forests have decreased substantially while agricultural lands have been on the increase. Rapid economic developments together with the increasing population were noted to be the major factors influencing rapid land use/cover changes (Thuo, 2014). Urban expansion has replaced agricultural farmlands and other natural vegetation, thereby affecting habitat quality and leading to serious environmental degradation. The random, unplanned growths of environmentally degraded squatter settlements were noted to be emerging in the rural fringes. In another study, it was found that, Nairobi urban periphery arable land is being eaten up by high rise buildings and Nairobi's development will require reliable information about land use/cover changes and factors influencing such changes (Thuo, 2014).

Major changes in vegetation and land use over the last 30 years across 60,000 km² of the agricultural areas of Kenya have been quantified by high-resolution aerial photography (Mubea and Menz, 2014). Cultivation has become both more extensive (50% increase in area) and more intensive (from 42% to 63% median cover), but at the expense of the herbaceous rather than the woody component of the natural vegetation. Evidence for unsustainable intensification is lacking (Mubea and Menz, 2014). A range of biophysical and socio-economic drivers has been studied to observe and understand changes in cropping patterns (Mike, 2015). Management of natural resources on Government land, primarily in forests and other reserves, remains an unmitigated disaster with significant encroachment of cultivation. Signals in land use change trajectories associated with the observed changes in climate over the study period are proving difficult to detect (Mike, 2015). The rising rural population densities, declining land sizes and unsustainable forms of agricultural intensification are eminent in the study area. The question asked? Are most farms becoming, or have many already become, "too small" to generate meaningful production surpluses and participate in broad-based inclusive agricultural growth processes given existing on-shelf production (Muyanga and Jayne, 2015).

Since smallholders also constitute the majority of farms in Africa, it is generally accepted that a smallholder-led strategy also holds the best prospects for economic development in Africa. The following are some of the smallholder-led growth strategy indicators in Africa; mounting population pressure and shrinking farm sizes; signs of unsustainable forms of agricultural intensification; changing farm structure; rising proportion of land among medium-scale farms; youth bulge and limited non-farm (Muyanga and Jayne, 2015). The growing urbanization and shift from farm to off-farm employment are evident in developing worlds. Growing land pressures and declining land sizes are contributing to unsustainable forms of agricultural intensification (Muyanga and Jayne, 2015). Are increasing population densities inducing innovations aimed at intensifying the use of land? Mounting population pressure is resulting in unsustainable forms of agricultural intensification in some counties and reduced fallow periods, soil mining, depleted soil organic matter, increasing soil acidity (Nyangah, 2012).

Food insecurity and loss of biodiversity are current serious challenges facing fast changing world especially the developing countries (Kahimba et al., 2014). Most widespread anthropogenic changes affecting the planet earth is forest conversion for alternative human use, resulting in environmental degradation.

Land use has generally been considered a local environmental issue, but it is now becoming a force of global importance. Worldwide changes to forest farmlands, waterways and air are being driven by the need to provide food, water and shelter to more than six

billion people. The world croplands, pastures urban areas and plantations have expanded in recent times, accompanied by large increase in energy, water and fertilizer consumption, along with considerable losses of biodiversity (Meridith et al., 2016). Such changes in land use have enabled humans to appropriate an increasing share of the planets resources, but they also potentially undermine the capacity of ecosystems to sustain food production, maintain freshwater and forest resources, regulate climate and air quality and reduce infectious diseases (Museletu, 2013). How land is managed by any society is important and land use changes and cover changes are actions that can lead to serious food shortage that requires intelligent attention in order to solve global problems.

Agricultural land denotes the land suitable for agricultural production, both crops and livestock. It is one of the main resources in agriculture (Museletu, 2013). The process of urbanization is one of the most important dimensions of economic, social and physical changes on the planet earth and the future is an urban one. The largest and fastest growing cities are in developing countries. Approximately 25 percent of Africa's population lived in towns and cities in 1975 and by 2015 the proportion is expected to increase to 47% by 2015 and double by 2025, Kenya is not exception (Thuo, 2014). The conversion of agricultural land to residential uses is leading to the rapid transformations in the agricultural production, spatial structure, social structure, land ownership and land market in these areas (Mubea and Menz, 2014). Land conversions in the Nairobi rural-urban fringe is eating into agricultural land and thus leading to the reduction in the quantity and quality of land for farming. As already indicated, the case study area was formerly a coffee growing zone, and for economically viable coffee growing, one needs a relatively large portion of land. Since most of the land has been sub-divided either due to *in situ* increasing population or immigration leading to land demand for residential purposes, most families have been left with small portions of land for cultivation. Therefore growing such crops as coffee is becoming economically unviable and thus farmers are switching to demand driven farm produce (Thuo, 2013). In areas with high population densities, smallholder farmers usually cultivate less than one hectare of land, which may increase up to 10 ha or more in sparsely populated semi-arid areas, sometimes in combination with livestock of up to 10 animals (Salami et al, 2010).

Agriculture can be an important engine of growth and poverty reduction. But the sector is underperforming in many countries in part because women, who are often a crucial resource in agriculture and the rural economy, face constraints that reduce their productivity. The potential reasons why women farmers have not adopted improved maize technologies and discuss the implications for agricultural research. Women farmers are often constrained by their lack of access to labor, land,

and inputs. In addition, women may prefer different outputs than men. Finally, the dynamics of household decision-making affects technology adoption; roles and responsibilities within the household are often renegotiated when new technologies are adopted, and women may be reluctant to provide labor if they do not receive some of the benefits (Tanglacagan et al., 2014)

Land use changes in Nakuru County

Research study conducted in Njoro indicate that, land degradation in the form of decline in soil fertility due to erosion and crop harvesting has led to continuous decline in crop production to an alarmingly low level. This is attributed to land subdivision, intensive cultivation and urbanization which have resulted in the conversion of large-scale farms into small-scale farms and the gradual diminishment of plantation forests. The high population growth rate and the accompanying land fragmentation have strained land resources resulting in massive soil erosion and other forms of land degradation. While aspects of land degradation have been successfully tackled, most research done to address these problems has fallen short of solving the problems of land degradation especially under smallholder production systems (Mainuri and Owino, 2014). This increasing influence of land use change to pose a threat to the conservation of soils in the watershed. From the cited findings and the magnitude of land use changes occurring in the study area, it was important to find out the influence of land use changes on small scale women farmers in Nakuru County.

METHODOLOGY

The population of Nakuru County at the time of research was approximately 1.7 million peoples according to estimated statistics (NCR, 2014).The study used purposive sampling to pick on the 3 sub counties out of 11 namely; Naivasha, Rongai and Njoro. The sub counties exhibit different ecological characteristics and are highly vulnerable to land degradation particularly, soil erosion, climate change, human settlements, industrial pollution, deforestation and land use changes. Of the 360 women farmers, 120 came from each sub county by simple random selection. The respondents were picked from 9 churches and 9 self-help groups present by simple random sampling. The 360 farmers were sampled from the target farmers' population of 120,000 in Nakuru County.

Data was collected by use of custom made structured questionnaires, interview schedules and personal observation guides. The questionnaires were used to collect data from the key respondents. Personal observation technique was used to confirm ideas that the

Table 1. Shows the age of respondents.

	Frequency	Percent	Valid Percent	Cumulative Percent
18-25	52	14.4	14.4	14.4
26-35	50	13.9	13.9	28.3
36-45	53	14.7	14.7	43.1
46-55	182	50.6	50.6	93.6
56 and above	23	6.4	6.4	100.0
Total	360	100.0	100.0	

Table 2. Show the level of education of respondents.

	Frequency	Percent	Valid Percent
std 1-5	54	15.0	15.0
std 6-8	78	21.7	21.7
some secondary	153	42.5	42.5
Tertiary	75	20.8	20.8
Total	360	100.0	100.0

respondents had given in the questionnaires and for the researcher to get first-hand information on the type of agricultural practices being undertaken in the study area. It also supplemented the information gathered from the respondents. Interview guides included structured (close ended) and unstructured (open ended). This was essential since it allowed for face to face interactions between the researcher and the respondent in the course of oral discussions. The questions had the following features: several response options hence respondents were able to identify with the preferred response accordingly. Focused Group Discussions (FGDs) views were used to confirm or cross check the information obtained through other data collection methods.

The instrument was subjected to the right questions in terms of accuracy and meaningfulness based on research results (Mugenda and Mugenda, 2003). Piloting was used in this study to measure the reliability of the instrument employing split half method. This method was used because it has a major advantage of eliminating chance error caused due to differing test conditions. Cronbach's alpha Coefficient of 0.80 was used to estimate the reliability of the instrument.

Data collected was analyzed according to the objective of the study. The collected data was coded, cleaned and finally entered in a computer system using Statistical Package for Social Sciences (SPSS version 20). The target population units analyzed in this study were women small scale farmers.

The quantitative data collected was tabulated and analyzed according to their frequency and percentages. Qualitative analysis involved measure of central tendency (Cross tabulations, proportions, means and percentages). Chi-Square was used because the data were categorical and showing if there would be any relationships between the variables. ANOVA model was used to determine the statistical significance of the means at $p < 0.05$ level and

whether to reject or accept null hypotheses. Post hoc tests were used to test if the mean differences really existed. Qualitative data was analyzed by determination of patterns and trends from the open ended test items and interviews from respondents. The analyzed data were then presented in tables, graphs and charts.

RESULTS AND DISCUSSIONS

Findings

This paper examined the influence of land use changes on the adoption of conservation agriculture by small - scale women farmers. In order to capture complete information regarding the land use changes and its influence on CA adoption, socio economic characteristics of women farmers were important for the understanding of the study.

The results of Table 1 indicate that majority of women farmers (93 %) were middle and younger in age. 6.4% were older farmers. Age of famers determine whether they would take up any new innovations. Older famers are more rigid and would not be influenced by any change. Younger farmers are more flexible. CA adoption depends on the age of farmers.

In Table 2 majority of farmers (63.1%) had education level above secondary level. It can be concluded that, the famers were moderately educated this was an advantage to them in adopting new methods in farming. Educated farmers can participate in training, use of ICT, attend seminars and are easily trained. Education is significant in adoption of CA.

In Table 3 majority (57%) of famers had smaller farms and 43% had farms above 3 ha. The size of farms influences the nature or agricultural methods employed by the farmers. Farmers with small farms would generally practice mixed farming, crop rotation; use organic farming

Table 3. Shows the size of farms.

Size of farm (ha)	Frequency	Percent
< 1.0	79	21.9
1.0-2.5	179	49.7
2.6- 3.5	26	7.2
>3.6	76	21.1
Total	360	100.0

Table 4. Shows ownership of farms.

		Frequency	Percent	Valid percent
Valid	Own	204	57	57
	Rent		27	27
	Borrowed		16	16

Table 5. Women farmers' response to indicators of land use changes.

	Indicators	Non-adopters	Adopters	adopters + Non adopters	Level of significance
1	Policy on forest cover	12.7	96.3	58.9	0.048
2	Land for road construction	37.7	70.4	20.9	0.021
3	Urban growth	35.3	95	58	0.049
4	Farm size reduction	25.5	92.6	38	0.002
5	Grazing land reduction	25.4	88.9	58	0.048
6	Industrial growth	36	74.1	20.9	0.021
7	Mining sites	35.3	79.6	50	0.049
8	Settlements	37.3	81.5	40.3	0.042
9	Mixed farming	33	92.6	54	0.000

to maximize the farm areas which are part of CA practice.

Table 4 indicates that majority of farmers (57%) own land the rest 43% either rented or borrowed. CA practices are suitable in farms owned by farmers. A farmer who rents a farm may not be allowed by the land owner to practice agro forestry which is one of the CA practices.

The results emerged that, there were three types of farmers; the adopters of CA fully, the incomplete adopters (practiced both conventional and CA) and non-adopters of CA.

The results in Table 5 shows that, land policy on forest cover indicator scored 96.3% the highest for adopters. This means that, to great extent women farmers who adopted CA were knowledgeable and practiced CA by planting more trees in their farms, 12.7 % non-adopters and 58.9% incomplete adopters hence land policies on forest cover are important in CA adoption. For urban growth, 96.3% of CA adopters were aware that urban area was encroaching into their farms decreasing the size of farms hence practiced CA to maximize their food production such as intercropping, mixed farming, zero grazing, 12.7% non-adopters and 20.9% incomplete adopters were aware that more farm land has been replaced with urban expansion leading to small farms that can be productive under CA practices.

The results in Figure 1 indicate that, policy on forest cover, mixed farming urban growth are leading influential indicators affecting women farmers. The study has eluded that, land use changes have influenced women farmers to adopt CA. Mixed farming is a practice that can maximize, farm yields when farms are small and forest trees are important in conservation and protection of soil. The findings agree with other findings (Thou, 2014)

In the second part of the analysis, out of the nine-land use changes indicators analyzed, the results showed that all of them influenced women farmers to adopt CA practices.

In Table 6, the mean for CA was higher than conventional practice meaning that, land use change influenced adoption of CA.

In Table 7, ANOVA test confirmed that the differences between the groups of farming type were statistically significant. It can be concluded that Land use change significantly influence CA adoption by farmers.

Table 8 indicate that mean differences existed in all the farming types and were all statistically significant. Land use changes influence CA adoption.

Table 9 explains percentage changes that have occurred regarding the land use. 46.06% of cropland has been converted, 39.81% of natural forest has been

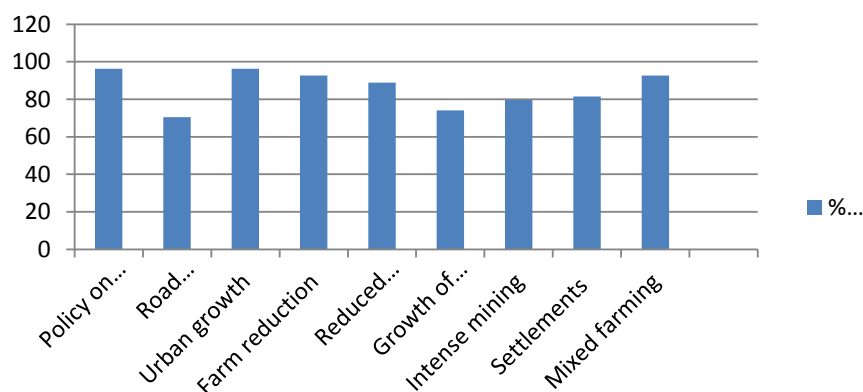


Figure 1. Drawn from the data in table 5 shows the most and least influential land use change indicators.

Table 6. Shows the overall mean of the ten indicators of land use changes.

	N	Mean	Std. Deviation	Std. Error
Conventional	204	3.3230	0.31089	0.02177
CA	27	3.8519	0.19245	0.03704
Both	129	3.4522	0.39313	0.03461
Total	360	3.4090	0.36340	0.01915

Table 7. Shows the ANOVA test.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.045	2	3.523	31.155	0.000
Within Groups	40.365	357	.113		
Total	47.411	359			

Table 8. Shows Bonferroni test.

(I) type of farming	(J) type of farming	Mean Difference (I-J)	Std. Error	Sig.
Conventional	CA	-0.52887(*)	0.06886	0.000
	Both	-0.12921(*)	0.03783	0.002
CA	Conventional	0.52887(*)	0.06886	0.000
	Both	0.39966(*)	0.07116	0.000
both	Conventional	0.12921(*)	0.03783	0.002
	CA	-0.39966(*)	0.07116	0.000

replaced, and grassland 9.91% changed to other uses. The results in table 2 indicate that land use /cover changes have occurred over the years between 1990 and 2014 with the highest percentage change in between 2010 and 2014. Grasslands and plantation forests have reduced. Croplands have changed significantly. Population expansion and other economic uses have caused the land use changes.

The three study sites Njoro, Rongai and Naivasha

Three study sites were selected from Nakuru County and Focus group discussions held. The results are presented in Table 10. The number of farmers in each self-help groups in each site was 13 in Njoro, 11 in Rongai and 12 in Naivasha. The responses from the three groups interviewed were recorded. The responses were voted and the mean responses were determined. The mean

Table 9. Land use changes in hectares and percentage change year 1990, 2000, 2010 and 2014.

Land use Variables change	Njor		Ron		Naiv	
	Yes	No	Yes	No	Yes	No
Free grazing land conversion to settlements- Rate is high	8	5	7	5	10	1
Grazing land converted to flower farms. more flowers grown	6	7	7	5	8	3
Settlements encroaching productive farm lands	9	4	9	3	8	3
Forests areas replaced by cultivated fields	7	6	7	4	7	4
Some farms introducing planted forests to replace natural once	6	7	6	6	7	4
Mining and quarry taking up some productive farm lands	5	8	6	6	8	3
High rate of greenhouse flower farms increasing	8	5	7	5	9	2
Construction roads reducing farm lands	7	6	7	5	5	6
Large ADC farms sub dived and sold to private and developed to urban	10	3	9	2	5	6
Single cropping like wheat/ maize /pyrethrum replaced with subsistence crops such as potatoes, vegetables, maize,	11	2	8	4	7	4
Large farm reduced to small farms	9	4	9	2	6	5
Extensive livestock farming to intensive small scale	8	5	7	5	6	5
Single cropping to mixed farming	9	4	8	4	9	2
Coffee and Tea farms replaced by subsistence farming	8	5	4	8	3	8
Pyrethrum plants uprooted and horticulture and zero grazing done	11	2	8	4	2	9
Mean responses for Land use changes	8.13	1.87	7.26	2.74	6.00	3.00

Table 10. Land cover/use area (Ha) % change area (Ha) % change area (Ha) % change Area (Ha) % change.

Cropland	5779	8.77	26297	39.89	33548	50.89	30363	46.06
Grassland	31226	47.37	29503	44.76	6845	10.38	6535	9.91
Natural Forest	3324	5.04	2067	3.14	22923	34.77	26244	39.81

Source: Mubea and Menz (2014) Classified Images of Land and land use changes from 1990 -2014.

response for YES in Njoro was 8.13, in Rongai it was 7.26 and in Naivasha was 6.66. This means that the land use changes were more in Njoro than Rongai and Naivasha. There are more farmers in Njoro than the rest of the two sites. Njoro is a farming area and is cooler with high rainfall and fertile soils. Naivasha on the other hand and is dryer in comparison. Rongai study site weather conditions are between Njoro and Naivasha. Naivasha Sub County was more of wildlife grazing land but since then, the grazing land has been changed greatly to flower farms, settlements and urbanization.

Njoro study site

Several interview schedules were held with key informants; agricultural officers at Njoro Sub County office with field officers, NGOs representative and key community leaders. Environment and Land Development

Officer Njoro led the team. The interviews were held to determine environmental factors influencing women small-scale farmers' adoption of conservation agriculture (CA). In Njoro study area, there are 35, 012 households with 28,791 farm families. Female farmers are approximately 16,590 and male farmers are 12,201. The number of extension agricultural officers (Field staff) in the whole sub county was 27 and out of this, 4 are more of CA experts and the rest are conventional agriculture experts. Donors who directly deal with field staff mainly manage CA in this area.

The CA uptake in Njoro was very low and it was noted that there are reasons for its slow uptake; CA takes time to realize its benefits because the natural processes taking place can be realized over time. Njoro in the past 30 years has experienced rapid land use changes particularly in the last 20 years from extensive large scale farming to intensive small-scale farming and other economic activities, which have dominated the whole

landscape. Former large ADC farms have been converted into settlements, cash crop to subsistence. Large dairy farms to small scale zero grazing units except a few areas with large-scale farming. From single cropping to multi or diversified cropping systems. The population expansion has put great pressure on land from large arable farms to small plots of farm that can no longer support agriculture and solve food scarcity in the area. From 1970s to mid-1980s, the land was under wheat and dairy keeping. From 1980s to 1990s major sub-division of farmlands into small farms for settlements, urban expansion, industries and road constructions as dominating economic activities. Cash crop replaced by subsistence crops, large scale to small scale. Increase in women involvement in subsistence farming. Forest encroachment and deforestation led to clearing land for settlements and cultivation.

Naivasha study site

The study found that, 65% of small-scale farmers are women, out of which 16% practice conservation agriculture. It was reported that, to a great extent, women were aware of climate change and the effects of reduction in land size and the conversion of land into other uses. The farmers experience the harsh ecological environment, which affects them greatly, and therefore many of the farmers adopt a mixture of CA and conventional methods. To the south of Naivasha on the higher ground along the Naivasha Nairobi highway, the farms have been subdivided into very small parcels with more of vegetable and maize farming. A round the Longonot region to Mai Mahihu, the land is less cultivated. Along the southern part of the lake, the farms have been converted into large tracks of flower farms. 25% of the women farmers have abandoned farming practice for employment in the farms, which they believe, is better than dry farming. A lot of quarry industry at the west region of the study area, are impacting negatively on farmers by making the soil exposed to erosion or leaving the quarry sites infertile for farming. Between Naivasha and Kinungi, the free wildlife and livestock-grazing zone has now been converted by 60% into peri urban development. Real estate, industries and business complex has since replaced the rangeland. This rapid change of land use has affected women farmers and wildlife presence. At Karagita, the farmlands and grazing area is now under pressure of subdivisions with surging human population for settlements and business parks. The farmers at Karagita particularly women have found farming is becoming unprofitable and challenging hence taken other income generating activities such as working in the flower farms.

In promoting, CA, one farmer said, Naivasha is dry and farmers here have adopted new farming techniques that will not only guarantee them improved harvests but also

transform the environment in a good way. The land use changes /cover have had adverse effect on farming particularly women small scale farmers.

Rongai study site

The interview results indicate that, there are 33, 434 women farmers and 50% of them practice conventional farming, 15% CA and 35% practice both CA and conventional. Most farmers have heard about CA as one of the promising practices to overcome climate change hazards but are reluctant to embrace it fully therefore this explains why CA uptake in Rongai is low. The reasons could be several; attitude to change to a new technology. Farmers are used to their traditional methods and are not convinced if CA works and its benefits; two, lack of specialized equipment. CA requires special equipment which they do not have; three, conflicts between livestock keeping and growing of crops. Farmers would like to practice livestock and crop farming, four decisions making in the family. Most women farmers would want CA adoption but they are hindered by their husbands who believe in conventional practice as a way of getting income. The fifth one is ownership. Most women do not own land, which affects them not to practice CA. For CA practice, land tenure is important.

It was observed that land use changes have occurred since 1970s and most rapidly in the early

DISCUSSIONS OF RESULTS

Land use changes in the study area influence women small scale farmers in of CA. From interview schedule, nearly 50% of agricultural land in the study area has been hiked out for settlements, construction, mining, flower farming and several urban satellites. Results from the interviews and focus group discussions provided in depth information on the effects of land use change and its influence on women farmers in adopting CA. This finding confirms what was found by other researchers elsewhere that land use changes affect famers (Nyangah, 2012). Over 73% respondents interviewed indicated that before 1990, the study area was under extensive agricultural production.

Although, land use changes influence adoption of CA, there are strong evidences showing that age of the farmer, education level and household size influence women adoption of CA. Most women who adopted CA were young in age, moderately educated and small households while the farmers who did not adopt were old, low education level. Income level could also consider influencing adoption of CA. When more land is converted to other uses, the arable land becomes too small for any conservation of agriculture is practiced.

Several factors have been also used to explain land use

decisions including soil quality, farm size, farm labour, level of household education, farming experience, land tenure security, distance to market, farm age, off-farm income, participation, initial wealth status of households, access to credit, and technical knowledge (Ebanyat et al., 2013).

Integration of Landsat and ALOS PALSAR that gives good results on land use changes that have taken place in Nakuru County since 1970s. In Nakuru town periphery, 19.70 km² of land changed to urban land-use from arable land between the years 2000 to 2010 indicating rapid urban growth (Thujo, 2014). Land-use information is useful for the comprehensive land-use planning and an integrated management of resources to ensure sustainability of land and to achieve social equity, economic efficiency and environmental sustainability (sourced from the Ministry of planning, Nakuru County 2014). Urban expansion due to population increase as more people prefer to live in towns has taken over peri urban farming. This growth of urban has pushed women farmers to adopt CA practices in order to maximize their production function (Mubea and Menz, 2014).

A similar study in Kisii County Keumbu study site by Ogechi and Hunja (2014) found that Kisii County is experiencing a high rate of land use / cover changes which in turn affects food production significantly. The agricultural land fragmentations, high population increase and urbanization has led to decrease of agricultural land, food production and also impacted negatively on biodiversity. This phenomenon has left the rural livelihood food insecure. Construction of houses and other non-food uses of agricultural lands have reduced food supply as the area under food crops reduced. The world grain stock has dwindled to dangerously low levels, highlighting the fragility of food supplies in a world where the population is expected to rise (Saya, 2011)

There is very high level of rural agricultural land being converted to urban settlements, industries and commercial activities. In Limuru, productive land for coffee and tea is being converted to real estate development. This rapid of land utilization of nonagricultural activities is the cause for farmers shifting and embracing innovations and changing their cropping style to engage in food production requiring small land and under intensive agricultural practice such as zero grazing, poultry keeping and horticultural crops (Thujo, 2013). As change in farming system is happening the need for large tracts of land for crop production is becoming unnecessary (Ogechi and Hunja, 2014).

Land use changes have taken toll on arable land and hence influence conservation agriculture. The low adoption of conservation agriculture by women farmers is that the land size and establishment of other uses of land such as increased human settlements, urbanization, and infrastructures have made conservation of agriculture not practical.

Conclusions

The overall mean scores for the ten items on land use changes showed that they all influence women farmers to adopt conservation agriculture. Land policy on forest cover and growth of urban scored 96.3% being the highest followed by farm size reduction and mixed farming practice 92.6% for adopters. Road construction and growth of industries scored lowest, 74% and 70.4% respectively. Farmers who adopted CA fully were influenced by land use changes. From Focus group discussions, Njoro, the study site the women farmers were generally influenced by land use changes in Nakuru County. All the study sites indicated that land use change is very significant and has affected the arable land which subsequently has led to low food production and loss of biodiversity. Land use change has significantly affected women farmers in their way to increase food production through CA practices. CA adopters are quite knowledgeable of land use changes and find alternative in maximizing their yields through CA.

Recommendations

- i.) The government to address the usage of land with the view of resettling the human population and towards conservation of land for various uses
- ii.) Arable land should be preservative of agricultural production and the unproductive land be used for other economic activities.
- iii.) Land tenure policy to give women opportunities to own land. This will encourage women to own land and use it without any restriction for the agricultural production.
- iv.) More land should be allocated to forests to increase forest cover hence avert climate change.
- v.) There is need to develop discourage land fragmentation and instead integration of land or land consolidation to increase farm land sizes.
- vi.) Creating awareness on the importance of land and its productivity to women farmers. Changes in agricultural policies will encourage women farmers to adopt CA.

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REFERENCES

Ebanyat P, N. de Ridder, A.de Jager, R. J. Delve (2010). Drivers of land

- use change and Household determinants of sustainability in smallholder farming systems of Eastern Uganda. *Population and Environment, Population. Environ.* 2010 Jul; 31(6): 474–506.
- Caroline Brock, Jessica D. Ulrich-Schad, and Linda Stalker Prokopy (2016). Bridging the Divide: Agricultural and Conservation Support for Plain Producers. The Amish and Agriculture. <http://www.etown.edu/centers/young-center/amish-conference2016-fri-abstracts.aspx>.
- Kahimba FC, Mutabazi KD, Tumbo SD., Masuki KF, Mbungu WB. (2014) Adoption and Scaling-Up of Conservation Agriculture in Tanzania: Case of Arusha and Dodoma Regions Natural Resources, 5: 161-176. <http://dx.doi.org/10.4236/nr.2014.54016>.
- Kassam AH, Friedrich T, Derpsch R (2010). Conservation Agriculture in the 21st century: Aparadigm of sustainable agriculture, Proceedings of the European Congress on Conservation Agriculture, Madrid, Spain, October 2010.
- Kassam AH, Friedrich T, Derpsch R (2012). Reconciling Poverty Eradication and Protection of the Environment. Overview of the Global Spread of ConservationAgriculture. *The J. of Field action. Special Issue 6/ 2012.*
- McNair WE (2012). Assessing the Influence of Conservation Agriculture on Household Wellbeing and Maize Marketing in Tete and Manica Mozambique. University of Tennessee, Knoxville Trace: Tennessee Research and Creative Exchange
- Mainuri ZG, Owino J (2014). Linking landforms and land use to land degradation in the Middle River Njoro Watershed. *Int. Soil and water Conserv. Res.*, 2(2): 1–10.
- Mike Norton-Griffiths (2015). Agricultural Land-use Dynamics in Kenya: Institutional, Biophysical, and Socio-Economic Drivers. Oxford Centre for Tropical Forests. <http://www.tropicalforests.ox.ac.uk/www.tropicalforests.ox.ac.uk/events/383.html>
- Muyanga M, Jayne TS. Tegemeo National Policy Conference 2015. Kenya School of Monetary Studies, Nairobi, Kenya. November 10, 2015.
- Mubea K, Menz G (2014). Spatial Effects of Varying Model Coefficients in Urban Growth Modelingin Nairobi, Kenya. *Journal of Geographic Information System*, 6, 636-652. <http://dx.doi.org/10.4236/jgis.2014.66053>.
- Mugenda O, Mugenda A (2003). *Research Methods, Quantitative and Qualitative Approaches*, Nairobi: Acts Press
- Museletu EK (2013). An Investigation into Causes and Effects of Agricultural Land use Conversions in The Urban Fringes: A Case Study of Nairobi-Kiambu Interface.
- NCR (2014). Nakuru County Integrated Development Plan 2013-2017.
- Ngwira FH, Johnsen JB, Aune MM, Thierfelder (2014). Adoption and extent of conservation agriculture practices among smallholder farmers in Malawi. *Soil and Water Conservation Society. J. of Soil and Water Conservation* 69(2):107-119. www.swcs.org.
- Ogechi BA, Waitthaka EH (2014). Land Use Land Cover Changes and Implications for Food Production: A Case Study of Keumbu Region Kisii County, Kenya." *International Journal of Science and Research* 3.10 (2014): 752-58. [Web.http://elearning.jkuat.ac.ke/journals/ojs/index.php/jscp/article/viewFile/1152/954](http://elearning.jkuat.ac.ke/journals/ojs/index.php/jscp/article/viewFile/1152/954)
- Salami A, Kamara AB, Brixiova Z (2010), *Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities*, Working Papers Series N° 105 African Development Bank, Tunis, Tunisia.
- Saya S (2011). *Climate change and Women Farmers in Burkina Faso. Impact and Adaptation Policies and Practices*. Oxfam Research report July 2011.
- Tangcalagan C, Kent E, Chiong-Javier, Manuel R.R (2014). *Gendered Benefits and Challenges of Conservation Agriculture: Implications for Smallholder Adoption in Developing Countries*. De La Salle University, Manila Philippines.
- Theodor F, Josef K, Amir K (2014). *Conservation Agriculture in Developing Countries: The Role of Mechanization 1. Food and Agricultural Organizations of United Nations*. Research Gates Publishers.
- Thuo A, Daniel M (2013). Impacts of Urbanization on Land Use Planning, Livelihood and Environment in the Nairobi Rural-Urban Fringe, Kenya. *Int. J. of Sci. & Technol. Res.*, 2(7): 12-16.
- Thuo AD (2014). Community and social responses to land use transformations in the Nairobi rural-urban fringe, Kenya. *Journal of Field Actions Science Reports. Urban Agriculture, Special Issue 1, 2010.*
- United Nations Environment Programme (2002) *Integrated Approach to the Planning and Management of Land Resources*, Nairobi, Kenya.