Influence of Environmental Knowledge on Small Scale Women Farmers Adoption of Conservation Agriculture Nakuru County, Kenya

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Authors' contributions

This work was carried out by the two authors in all the design work, statistical analysis and manuscript writing as well as literature searches and approved the final manuscript.

Short Research Article

ABSTRACT

Adoption of any technology especially in agricultural practices depends on environmental dynamics. This paper evaluated the influence of environmental knowledge on women small-scale farmers on adoption of conservation agriculture (CA) in Nakuru County. Kenya as one of the developing countries in Africa faced with numerous problems particularly food insecurity, hunger, poverty, diseases and biodiversity loss as a result of conventional agriculture practiced under poor backdrop of environmental knowledge. To alleviate all these problems mentioned above, the alternative method of agricultural practice should now aim at improving conservation agriculture which was discouraged long time ago. But environmental Knowledge to adopt conservation agriculture is needed as better option for maximum agricultural yields and protection of the environment. It is claimed that, CA adoption in Nakuru County by women small-scale farmers was low and there was inadequate research documentation regarding this claim. To establish the claim whether true or not,

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find out why CA adoption was low in the study area, the research sampled three sites; Naivasha, Rongai and Njoro selected purposefully for differences in ecological characteristics. The sample size of 360 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 knowledge of the environment influenced women small scale farmers' adoption of CA and that CA adoption uptake was low. Recommendations; Policy and decision makers use the results to develop land and agricultural policies, provide incentives to promote small-scale women farmers, use new emerging technologies to speed up knowledge on adoption of CA in order to boost food security and conservation of the environment in Nakuru County and Kenya.

1. INTRODUCTION

New innovations in developing countries face increasingly new complex challenges and cause problems to small-scale farmers from maximizing their food production particularly women cohorts [1]. Poverty, low food production, diseases and loss of biological resources are characterized as major problems facing those working institutions attaining global development today in developing countries. This calls for an urgent need to acquire mechanisms to foster the diffusion of innovation and to strengthen ways of disseminating information with a view to empowering smallholder farmers and other vulnerable groups facing food insecurity [2]. New studies show that conservation agriculture (CA) is becoming a better option in mitigating environmental degradation and significantly contribute towards increasing food production and protecting the environment. Conventional agricultural methods in comparison have fuelled environmental problems seen today [3].

Further research studies have established that environmental factors such as climate change, land use changes among others require well rounded environmental knowledge of CA adoption in Africa by farmers particularly women smallholders [4]. Level of environmental knowledge has the significant impact on agricultural production and biodiversity in the study area. This paper deals with small-scale women farmers' knowledge on the environment as significant contributor to CA adoption [4].

For any agricultural technology to be adopted, the knowledge of the environment on soil, water, climate, nature of land and methods used is very significant for its implementation stages and production results. Likewise, farmers' attitude, knowledge, perception, culture among others should be well understood and their applications have done appropriately. It is recommended that future studies aiming to understand the adoption process of conservation agriculture innovations and its adoption in Africa South of Sahara should take into account both sets of variables [5]. Women in Sub- Saharan Africa are mostly affected by environmental factors because they are the main producers of food. It has been observed that 80% of farmers practice small-scale production and out of this, over 70% of small-scale farmers are women [4]. Other studies found that knowledge on environmental functions for a farmer is vital [6]. A farmer who has the knowledge of the environment stands a better chance of succeeding in agricultural production and conservation of the natural resources which play an important role in controlling his/ her activities. Conservation agriculture requires farmers to, therefore, understand changes in their environments [7]. Conservation agriculture is more knowledge intensive than traditional low input systems. This is partly because it is new, but also because of the need for a farmer to understand the basis of the system so that CA can be adopted in particular conditions integrated with use of other methods applied in chemical weed control and good farm and crop management [5]. Smallholder farmers are often poorly linked to knowledge systems external to the community. Overcoming this barrier and increasing the knowledge base of the smallholder farmers in Africa is probably the biggest hurdle to overcome in achieving widespread adoption of conservation agriculture in the continent [8]. Success will not only depend

on enhancing the knowledge of conservation agriculture adoption among researchers but focusing more on the farmers. Extension agents are very important in the knowledge flow and the farmer is the target of change towards food production and environmental quality. It will also require the development of local innovation systems incorporating agents representing as many as possible of the principal components of the local agricultural value chains using their own comparative advantages and information networks to remove bottlenecks to farm productivity [7].

Other studies indicate that, women have learnt the importance of biodiversity and the farmers experiment with varieties of other plants in their farms [9]. It has also been found that farmer's knowledge of agro biodiversity management correlated with the involvement in integrated crop-livestock-tree and agro forestry systems [10].

With the dynamic environment, a farmer needs to have a deep understanding of rhythms of nature in order to remain productive. Farming with sound knowledge of the environment leads to better yield and management of other adverse factors that may affect farming input and output. [8]. In this objective, ten indicators were tested, analyzed and discussed. To realize this objective, specific aspect relating to environmental knowledge was rated against the adoption of CA by farmers before the overall effect was determined suing Likert scale. The items were weighted in terms of frequencies before cross-tabulation was carried out. The analysis was done on each question item and thereafter a combination of all the items was analysed to give the overall relationship [5].

In Nakuru County which was the study area, it was found that, a lot of land degradation due to deforestation, pollution, accumulated wastes, poor agricultural methods that pose a great threat to the sustainability of the environment. No available research in Nakuru County to establish to what extent women farmers are knowledgeable about environmental dynamics and the need to conserve nature and increase their food production [11]. Due to lack of information on the study area, the researcher felt there was a need to build a body of knowledge by filling the gaps on the study subject by finding out the extent of women farmers' environmental knowledge and influence on CA adoption. The information gathered would be helpful to the

women farmers improve their knowledge by avoiding practices leading to destruction of the environment and increasing food production. The government would also be informed to make policies on empowering farmers to adopt CA, which is claimed to be environmentally friendly through creating sustainable communities.

2. OBJECTIVE

The objective is to explain the influence of environmental knowledge on adoption of conservation agriculture, among women small-scale farmers in Nakuru County.

3. METHODOLOGY

The research study was carried out in Nakuru County, the study area and the study lasted for one year period. The influence of environmental knowledge on small-scale women farmers was conducted using descriptive survey design. The descriptive survey design was the best for this study as the study had a specific objective that it aimed to answer. The specificObjective formed the framework for the adoption of CA. The study described the variables as they are without manipulation [12]. Descriptive research is not only restricted to fact finding but may often result in the formulation of important principles. And also enables the analysis of different variables as well as giving room for the researcher to describe adoption of innovations and technologies in agricultural production and environmental management in Nakuru County Kenya.

The research was administered using structured questionnaires, interview schedules and focus group discussions and the researcher and his assistance were all involved in the administration of data collection.

The population of Nakuru County at the time of research was approximately 1.7 million people according to estimated statistics [13]. The population of each sub-county selected was; Njoro 195,253, Rongai 155,745 and Naivasha 269, 632. The target total estimates of women small scale farmers population were estimated at120, 000. Out of the target population, a sample size of 390 women farmers' was elected for interviews. The study used purposive sampling to pick on the 3 out of 11 sub counties 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 390 women farmers, 130 came from each sub-county by simple random selection. The 390 sampled from the target farmers population of 120,000 was proportionate and would take care of the sampling errors and provide a level of accuracy and confidence level of 95%. The respondents were picked from both churches and self-help groups present in the sub-counties. Nine churches and nine self -help groups were used to pick the small-scale women farmers using simple random selection. From this a certain number of respondents from each study station were determined.

Data collected was analyzed according to the main objective. 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 farmers (adopters, incomplete adopters and non-adopters) in Nakuru County.

The quantitative data collected was tabulated and analyzed according to their frequency, means 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 hypothesis. *Post hoc* tests were used to test if the mean differences really existed.

Qualitative data were analyzed by determination of patterns and trends from the open-ended test items and interviews with respondents. The analyzed data were then presented in tables, graphs.

4. RESULTS AND DISCUSSION

The research findings indicate that, out of 360 women small-scale farmers in the study, 54 farmers practiced CA, 204 practiced conventional farming and 387 practiced both CA and conventional farming. The decision by women farmers to adopt CA or not to adopt depended on environmental knowledge.

The results in Table 1 indicate that farmers who are knowledgeable about environmental issues are more likely to adopt CA practices. This is indicated by the high mean (3.47) among farmers practicing CA compared to the other two groups. However, to determine whether there was a significant difference in the means, ANOVA was carried out. The results are presented in Table 1.

The results in Table 2 showed that there was significant difference ($p < .05$) in the means of the three groups of farmers. Thus the null hypothesis which stated that there is no statistical significant difference between environmental knowledge and influence on farmers' adoption of CA was rejected. This implies that there is a relationship between the farmers' knowledge on environmental issues and their adoption of CA practices.

To determine where the differences existed, *post-hoc* analysis was carried out using Bonferroni test. The results are presented in Table 3.

In Table 3 the results have shown that, environmental knowledge to a great extent influence women farmers' adoption of CA. The null hypothesis which stated that there is no significant influence of knowledge of the environment on women farmers' adoption of CA has been rejected and environmental knowledge to a great extent influence women farmers adopt CA practices.

The Fig 1. Indicate that out of the indicators measured and tested minimum tillage crop rotation protection of wetlands wildlife scored the highest while manure benefits scored the lowest. The percentages responses to CA of all the indicators are above 50% meaning they all Influence women farmers adopt of CA.

The Fig. 1 shows that minimum tillage (95%) crop rotation (94%) and wildlife increase (92%) scored the highest while soil control measures (62%) and use of manure (50%) were least regarding women knowledge of the environment. CA practices focus on best ways of increasing food production and protecting the environment. It is imperative for farmers to have deep knowledge of ecosystem functions so that they are able to practice farming methods which add value to the environment. Women are known to have deep ethno indigenous knowledge on the environment and are good managers of the environment. If women are given training on CA technologies they would do better than men farmers.

5. DISCUSSION

The knowledge of the environment influence on CA adoption was analyzed. The study found that, farmers especially women were aware of environmental conservation and sustainability. 80% of the women farmers practice conservation of the environment. The role of field staff help farmers continuously on; soil conservation, riparian protection to maintain quality and quantity of flow of rivers for caring for aquatic life and human consumption, safe handling of pesticides, safe disposal of pesticide containers, HIV/Aids / STS, drug and substance abuse, lifestyle diseases, gender issues, soil fertility management, agroforestry. It was noted that whether farmers practice CA or not, but they have some moderate information.

The NGOS who help farmers in this study area are; Africa Conservation Tillage Network Sustain Net – mainly for CA, FAO – sponsor some CA projects, Seeds of Gold Egerton University, KALRO formerly KARI were found to be helpful in creating awareness to the women small scale farmers.

Women are known to have knowledge about environment. It is not clear if women's knowledge of the environment helps them in farming practice. For any innovation regarding farming techniques, women to women contacts provide a better extension method in CA adoption. Farmers who adopted CA fully were influenced by Knowledge of the environment. Focus group discussions also voiced that the women farmers were generally influenced by knowledge of the environment.

The analysis of results indicates that, the overall mean awareness of climate change was, CA adopters 3.47, non-adopters, 3.18 and incomplete adaptors 3.03 as seen in Table 1. This explains that the mean of CA was higher in CA adopters hence extension methods influence women farmers adoption of CA. There could be other reasons why non-adopters did not adopt CA; could be age, education level size, of farms, equipment costs among others. Knowledge of the environment is very vital in the understanding of environmental dynamics which affect farmers daily.

It was also noted that most of the women farmers are educated and younger hence have to some extent have environmental knowledge. They are aware of the importance of planting trees, use of manure to protect soil and increase fertility, mulching, to conserve water, crop rotation to maintain soil fertility, ripping to have little effect on soil structures and soil organism's which are helpful in soil fertility, growing of drought resistant crops to cope with climate change.

Wildlife conservation is a problem because, most farmers have small farms less than 3 acres
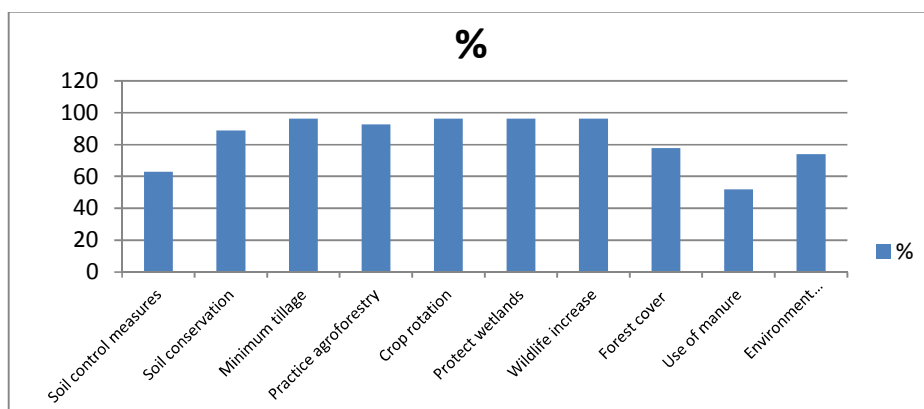

Fig. 1. Shows percentage results of women response to indicators of knowledge of the environment

Table 1. Overall mean effects of environmental knowledge on adoption of CA

N	N	Mean	STD deviation	STD Error
Conventional	204	3.1873	.23891	.01673
CA	27	3.4704	.15396	.2963
Both	129	3.057	.31888	.02808
Total	360	.3.1542	.28885	.01522

Table 2. ANOVA Test overall effect of environmental knowledge on adoption of CA

	Sum of squares	Df	Mean	Square F	Sig.
Between Groups	4.735 2	2	2.367	33.511	.000
Within Groups	25.219	357	.071		
Total	29.954	359			

Table 3. Bonferroni test differences in the means

(1)Type of farming	(J) Type of farming	Mean difference (1-J)	Std error	Sig.
Conventional	CA	-.28312(*)	.05443	.000
	Both	.15160(*)	.02990	.000
CA	Conventional	.28312(*)	.05443	.000
	Both	.43471(*)	.05625	.000
Both	Conventional	-.15160(*)	.02990	.000
	CA	-.43471(*)	.05625	.000

* The mean difference is significant at the .05 level.

6. CONCLUSION

The study established that to some extent the small-scale women farmers in the study area Nakuru County had knowledge of environment which significantly influenced their adoption of conservation agriculture. The null hypothesis presented which stated that environmental knowledge of small-scale women farmers had no influence on the adoption of CA was rejected at alpha value $p < 0.05$. Age, education level and size of farms also influenced farmers adopting CA. The low rate of adoption in Nakuru County by women farmers is therefore attributed to the degree of environmental knowledge. The study also provides an explanation that, women farmers who did not adopt CA may have been influenced by other factors other than the one under study. It was observed that generally the adoption of conservation agriculture was very low in Nakuru County. 15% of the farmers sampled fully adopted conservation agriculture and the rest did not adopt or tried both systems for their own security reasons. Through discussions and interview schedules, women farmers adopters embraced CA because; it maintains soil fertility for a long time, prevent and control pollution, use minimal pesticides and herbicides, safe from food diseases got from crops when chemicals are used a lot, costs less, mitigate climate change, increase biodiversity and conserve indigenous plants and animals that provide various ecosystem services.

7. RECOMMENDATIONS

1. The ministry of agriculture should develop agricultural programs towards conservation agriculture.

2. Establish agricultural policies to encourage women farmers adopt conservation agriculture which is proving to provide higher benefits and conserving the environment for sustainable farming production.
3. The NGOs targeting women farmers are doing a good job but there is disconnect when it comes to information sharing from their research. They need to share freely what affects women from adoption of CA.
4. Women small-scale farmers seminars and training should be held within close proximity so that farmers especially women could attend with little cost. This will minimize cost for travel, meals, hotel charges and time for women who are always busy.
5. Ministry of agriculture and agricultural expert groups should use religious services opportunities to sensitize farmers the need to shift from industrial farming to conservation farming.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ngwira A, Johnsen FH, Aune B, Mekuria M, Thierfelder C. Adoption and Extent of conservation agriculture practices among smallholder farmers in Malawi. Soil and Water Conservation Society. Journal of Soil and Water Conservation. 2014;69(2): 107-119.
    Available:www.swcs.org

2. Saya S. Climate change and women farmers in Burkina Faso. Impact and Adaptation Policies and Practices. Oxfam Research Report; 2017

3. Kassam AH, Friedrich T, Derpsch R. Reconciling poverty eradication and protection of the environment. Overview of the global spread of conservation agriculture. The Journal of Field action. 2012;Special Issue:6.

4. Kimani NJ, Macharia KN, Nicholas MS, Lentunyoi MK, John W, Ikonye N. Challenging conventional mindsets and disconnects in conservation: The emerging role of eco agriculture in Kenya's Landscape Mosaics; 2015.

5. Pelum. Barriers to trade for smallholder farmers in Tanzania. A review and analysis of agricultural related market policies in Tanzania. PELUM Tanzania and ESAFF; 2016.

6. Pelum. Barriers to Trade for Smallholder Farmers in Tanzania. A Review and Analysis of Agricultural Related Market Policies in Tanzania. PELUM Tanzania and ESAFF; 2013.
    [ISBN 978-9987-8956-2-5]

7. Wall PC, Thierfelder C, Ngwira A, Govaerts B, Nyagumbo, Baudron F..Conservation agriculture in Eastern and Southern Africa. In Jat RA, Sahrawat KL and Kassam AH Eds. Conservation Agriculture: Global Prospects and Challenges. CABI, UK. 2013;263-292.

8. Seline SM, Delia C, Oluyede C, Ajayi G, Sileshi W, Maarten N. The role of knowledge, attitudes and perceptions in the uptake of agricultural and agro forestry innovations among smallholder farmers in sub-Saharan Africa, International Journal of Agricultural Sustainability; 2014. DOI: 10.1080/14735903.2014.912493

9. United Nation Women Watch, (2016). Availanble:https://womenwatch.unwomen.org/special-tags/popular

10. Alcade CS, Enock GAD. Orou GG, Adam A. Farmer's knowledge and perception of diversified farming systems in sub-humid and semi-arid areas in Benin. Sustainability. 2015;7:65736592. DOI: 10.3390/su706653

11. NCR, Nakuru County Integrated Development Plan 2013- 2016.

12. Kerlinger FN. Foundation of behavioural science. New York: Holt, Renehard and Winston; 2005.

13. Kenya population analysis Report, Africa agriculture status report, climate change and smallholder agriculture in Sub Saharan Africa; 2014. Available: www.argra.org

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