Factors influencing the adoption of conservation agriculture as an adaptation strategy to climate change - A case study of Ngata Division, Nakuru County

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Abstract

Soil degradation as a result of poor ploughing methods is one of the major challenges in agricultural production in many parts of the world, especially in developing nations like Kenya. Data was collected from selected smallholder farmers using a proportionate stratified random sampling. In the first stage, the Locations were stratified into five strata based on the degree of conservation agricultural extension efforts. A total of 120 household heads were selected randomly using probability proportional to size of the location. Data were collected from sampled households using structured interview schedule. The structured interview schedule was pre-tested, revised and then administered by well-trained enumerators recruited from the study area.

Descriptive statistics such as mean, standard deviations and frequencies were used to summarize the data while t test and chi square was used to test the hypotheses.

The results indicate that age, education, farm size, frequency of contact with extension agent and frequency of participation in field days had positive and significant influence on adoption of conservation agriculture while family size, sex, farm experience did not affect adoption. Based on these key findings, there is need for more extension effort in extension service so as to encourage farmers to adopt conservation agriculture. Improving smallholder farmers’ access to farm credit through government interventions will also help smallholder farmers ensure food security at household level.

Key words: adoption, conservation agriculture, socio-economic factors, institutional factors.

Introduction

Majority of people in sub-Saharan Africa live and work in the rural areas, where they depend directly or indirectly on agriculture as a source of livelihoods. Agriculture employs these rural population and continues to be a fundamental instrument for sustainable development, poverty reduction and enhanced food security in developing countries. It is a vital development tool for achieving the Millennium Development Goals (MDG), one of which is to halve by 2015 the share of people suffering from extreme poverty and hunger (World Bank, 2008).

Currently, agricultural productivity growth in sub-Saharan Africa (SSA) lags behind that of other regions in the world, and is well below that required to achieve food security and poverty goals. Small-scale farming in Africa faces a double challenge: to increase production and preserve natural resources simultaneously. This is not an easy challenge, but one which many people think is key to the development of the African continent, playing a vital role in fighting hunger and poverty.

In an attempt to increase agricultural productivity and improve food security, efforts have been taken to generate and disseminate improved agricultural technologies among smallholder farmers. Conservation Agriculture is one of the technologies promoted for enhancing sustainable agriculture and includes several practices such as no or minimum tilling, soil cover and crop rotations.

Despite the governments effort to systematically disseminate CA, very few empirical evidence has been presented as to what factors affect the adoption of conservation agriculture technology. Only a few studies (Natalie et al., 2009; ) have reported on the status and effects of CA in the country.
The objective of the current study was to determine the factors which influence the use of Conservation Agriculture by smallholder farmers in Ngata Division of Nakuru county.

**Materials and methods**

Data was collected from selected smallholder farmers using a proportionate stratified random sampling. In the first stage, the Locations were stratified into five stratas based on the degree of conservation Agriculture extension efforts. Finally, a total of 120 household heads were selected randomly using probability proportional to size of the Location. Quantitative data were collected from sampled households using structured interview schedule. The structured interview schedule was pre-tested, revised and then administered by well-trained enumerators recruited from the study area. Descriptive statistics such as mean, standard deviations and frequencies were used to summarize the data while t test and chi square was used to test the hypotheses.

**Results and discussions**

Age: Age is one of the factors which is useful in describing households and age structure of a sample and indeed the entire population. In most adoption studies age is taken to affect adoption positively due to farming experience old farmers have which make them easily adopt new technologies. Based on this fact, age was hypothesized to have positive relationship with adoption of conservation agriculture. The mean age of household head for adopters and non-adopters is 38.9 and 43.6 years, respectively. An independent t-test was conducted to test if there was significant difference in the mean age of adopters and non-adopters. The t-value (t=2.262) showed statistically significant difference in the mean age of adopters and non-adopters .The non adopters mean age was greater than that for the adopters and is significant at P<0.010 and the result is provided in Table 1. This clearly indicates that as the farmers grow older, they become reluctant to embrace technologies that they are not used to. The result agrees with the findings of Green and Ng’ong’Ola (1993) who in their study on adoption of fertilizer technological package in Malawi, found that age had a negative influence on adoption but contradicts the findings of Adesina and Baidu-Forson (1995) who reported a positive influence of age on adoption of sorghum in Burkina Faso.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adopters</th>
<th>Non adopters</th>
<th>T test</th>
<th>Significance level (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>38.9</td>
<td>43.6</td>
<td>2.621***</td>
<td>0.010</td>
</tr>
<tr>
<td>Farming experience</td>
<td>10.45</td>
<td>9.75</td>
<td>5.05</td>
<td>0.43ns</td>
</tr>
<tr>
<td>Family size</td>
<td>6.59</td>
<td>5.94</td>
<td>1.57</td>
<td>.630ns</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td>1.490***</td>
<td>.000</td>
</tr>
</tbody>
</table>

Family size

Family size in the study is considered as the number of individuals who reside in the respondent’s household. Large family size assumed as an indicator of labour availability in the family. Based on this fact this variable was hypothesized to have positive and significant relationship with adoption of conservation agriculture.

The respondents mean family size is 6.9 and 5.9 for adopters and non-adopters, respectively. It ranges from two to eleven members of the family. The finding on the mean difference of both categories is provided in Table 1. The result shows that the mean family sizes of adopters are greater than non adopters. The results show that there is no significance mean difference among the adopter categories.

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(t= 0.483, p=0.630). This is because of the fact that most farmers have experienced shared labour to overcome labour shortage.

**Farm experience**

Farm experience is one of the factors which influence adoption. For this particular study, farm experience did not affect adoption. There is no statistically significant mean difference between adopters and non-adopters. The mean year of experience for the adopters is 10.45 years while for non-adopters its 9.75 years Table 1. From this we can conclude that having experience alone cannot make a farmer adopt conservation agriculture. The result agree with the work of Chilot *et al.*, (1996) who indicated that farming experience does not matter in the adoption of improved wheat and coffee technologies. However it disagrees with Tesfaye’s (2004) who in his study on adoption of inorganic fertilizer on maize in Amhara, Oromia, and southern regions, explained that farm experience significantly influencing adoption of chemical fertilizer

**Education**

Education is very important for the farmers to understand and interpret the agricultural information coming to them from any direction. A better educated farmer can easily understand and interpret the information transferred to them by a development agent.

From Table 2, the total number of farmers who had secondary school level of education and above was 76% for adopters’ and 21.5% for non adopters. Education was found to be significant (p<0.01), implying that farmers who have education are more likely to accept technologies than those who lack education. This shows that the education level of adopters of conservation agriculture is higher than non-adopters of the technology, implying the influence of the variable in making adoption decisions. This provides support for the hypothesis that better education levels are associated with greater information on conservation measures and in turn results in a greater adoption.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adopters</th>
<th>%</th>
<th>Non adopters</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>21.4</td>
</tr>
<tr>
<td>Primary</td>
<td>9</td>
<td>18</td>
<td>40</td>
<td>57.1</td>
</tr>
<tr>
<td>Secondary</td>
<td>22</td>
<td>44</td>
<td>12</td>
<td>17.1</td>
</tr>
<tr>
<td>Tertiary</td>
<td>14</td>
<td>28</td>
<td>2</td>
<td>3.0</td>
</tr>
<tr>
<td>University</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

$T$-test $= 1.49\ P = 0.010$

High level of education enhances the understanding of instructions given and should also improve the farmers level participation in agricultural activities. This is so because education enables one to access information needed to make a decision to use an innovation and practice a new technology. Education increases managerial competence and therefore enhances ability to diagnose, assess, comprehend, and respond to financial and production problems.

The findings of this study are in agreement with the studies of Tom (2006), Chitere and Dourve (2000) who found that education is a significant factor in facilitating awareness and adoption of agricultural technologies. However, the findings disagree with the study of by Tesfaye (2003), on soil and water conservation practices in Wello, Wolaita and Konso areas of Ethiopia revealed that there is no variation between literacy and illiteracy rates in terms of soil and water conservation.
Economic variables
Economic factors can play important role in determining the adoption of Conservation agriculture. The main and significant economic factors considered in this study are the area of farm size, labor availability and off farm activities of the household.

Farm size
Table 3 clearly indicates that, the average farm size for non-adopter group was 6 ha with (SD 4.96) while adopters were 13.9 ha and 10.6 standard deviation. Farm size affects adoption negatively. The results of independent sample t-test (with value of t=-2.609) shows a statistically significant mean difference between adopters and non-adopters at 1% significant level. This study is in agreement with the study of Taha 2007. In his study, he illustrates clearly that small land area may provide an incentive to adopt a technology especially in the case of an input-intensive innovation. In that study, the availability of land for agricultural production was low, consequently most agricultural farms were small. Hence, adoption of land-saving technologies seemed to be the only alternative to increased agricultural production.

Labour
Availability of labour did not influence adoption of conservation Agriculture. The average labour availability in terms of man equivalent for sample household was 3.07 with standard deviation of 1.5 for adopters and 2.5 and 1.3 for non adopters Table 3. The analysis (t= 1.396 and P = 0.247) shows the absence of significant mean difference between adoption categories, the result of this study confirms the findings of Pandey and Mishra (2004) who found no association between adoption of zero tillage and the family’s ability to access labor and disagrees with the findings by Baudron et al., (2007) who argued that due to the paucity of family labor, more farmers will likely turn to technologies that save labor like reduced tillage systems if they are accessible and affordable.

Table 3: Association between economic variables with adoption (n=120)

<table>
<thead>
<tr>
<th>Variablen</th>
<th>MeaSDn</th>
<th>T-test</th>
<th>Significance level (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm size</td>
<td>13.9 10.6</td>
<td>6.0 4.9</td>
<td>-2.609 0.10**</td>
</tr>
<tr>
<td>Labor</td>
<td>3.07 1.5</td>
<td>2.5 1.3</td>
<td>1.396 0.247</td>
</tr>
</tbody>
</table>

Off farm activities
From this study, there is no significant relationship between adoption and participation in off farm activities. The fact that one does not participate does not make them adopt this technologies. The finding of this study agrees with the studies carried out by but disagrees with the studies of Mulugeta et al. (2001) who indicated positive relationship between off farm activities and adoption and Techane (2002) who in his study on determinants of fertilizer adoption in Ethiopia reported the negative influence of participation in off-farm income on farmers’ adoption of chemical fertilizer.

Table 4: Association between off farm activities and adoption (n=120)

<table>
<thead>
<tr>
<th>Off farm activities</th>
<th>Adopters N</th>
<th>Adopters %</th>
<th>Non adopters N</th>
<th>Non adopters %</th>
<th>X2</th>
<th>P</th>
</tr>
</thead>
</table>

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Institutional factors
Contact with extension agents. Extension plays a great role in promoting conservation agriculture. During the interview, it was clear that farmers in the area had directly got assistance from the extension officers in the district. As shown in (Table 5.6), 68% of the adopters contacted with extension agent. The contact of these farmers with the extension officers helps them to know more about the technology and helps them to practice conservation agriculture more effectively. The chi-square result ($\chi^2=7.651$ and $P=0.053$) shows there was statistically significant difference between adopters and non-adopters with respect to farmers’ contact with extension agent. This shows that the farmers who frequently visit extension agent get more acquaintance with technology and tends to decide adoption of the technology than those who don’t. This agrees with the study carried out by Kidane (2001).

Field day participation
Field day is one of the most popular methods of transfer of technology. Conducting field days on farmers’ field is a good way of convincing other farmers to adopt new technology. In field day neighboring farmers will get an opportunity to observe how the new technology is put in to practice in the field. This situation may facilitate the adoption process. Table 6 indicates that few farmers attended the field days compared to those who never attended. To determine the relationship between field days with the adoption of conservation agriculture chi-square analysis was conducted.

The chi-square analysis showed ($\chi^2=18.837$, $p=0.027$) that there existed a significant relationship between them at 5% probability level (Table 6). This study is in agreement with the earlier works of makokha 1999 who observed that farmers characteristics such as Participation in field days had significant influence on perception and hence adoption decision of farmers.

Access to credit
Access to credit facilities is an important component as far as agricultural production is concerned. It is thus believed that a lack of adequate access to credit may have significant negative consequences on various aggregate and household level incomes, including technology adoption, agricultural productivity, food security, nutrition, health and overall household welfare.

From this study, there is a significant relationship between adoption and access of credit. \((\chi^2 = 12.674, P = 0.005)\) as shown in Table 7. This can also be confirmed in distribution of percentage of respondents where only 25 of non adopters have access to credit while the percentage difference between adopters is not as high as the one between non adopters.

### Table 7: Association between access of credit and adoption (n=120)

<table>
<thead>
<tr>
<th>Response of farmers</th>
<th>Adopters</th>
<th>Non adopters</th>
<th>X2</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>30</td>
<td>12</td>
<td>12.674</td>
<td>0.005</td>
</tr>
<tr>
<td>No</td>
<td>41</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>49</td>
<td></td>
<td></td>
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</tbody>
</table>

**Information sources**

The study also looked at ways through which farmers in the area get informed about conservation agriculture. In this particular study we looked at sources of extension services and teaching methods.

Sources of agricultural extension services. As revealed in Table 8, all interviewed farmers reported government extension workers as main providers of extension services followed by non-governmental extension staff (63%). Fellow farmers (50%) and farmer-based organizations (8%) were also cited as sources of extension services. From this results, farmer based organisations had the least percentage. This is so because farmer based organisation which can carry out extension services are still few.

### Table 8: Respondent-farmers’ sources of agricultural extension services in the study area

<table>
<thead>
<tr>
<th>Source of extension service</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government extension staff</td>
<td>120</td>
<td>100</td>
</tr>
<tr>
<td>NGOs</td>
<td>75</td>
<td>62.5</td>
</tr>
<tr>
<td>Research institutions</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>Farmer based organizations</td>
<td>10</td>
<td>8.33</td>
</tr>
<tr>
<td>Fellow farmers</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>N=120</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These results shows clearly the important role that government extension workers play in the dissemination of agricultural technologies and hence the need for government to build more capacity for them to effectively carry out extension work.

Extension teaching methods experienced by farmers. In this study, farmers were also asked to identify the extension teaching methods used by extension workers in the dissemination of conservation agriculture. The findings in Table 9 show the distribution of extension teaching methods identified by farmers. All the farmers (100%) identified method training as an extension teaching method used by extension workers followed by field day (83%) as another common extension teaching method used in the area. Other extension teaching methods were result demonstration (50%), leaflets (25%), posters (18%), and radio (12%). Farm magazine was the least mentioned extension teaching method.
constituting 5.8% probably because of the language used. Most of farmer magazines are written in English. Most of the farmer are semi literate and this makes them get difficulties in reading this magazines.

<table>
<thead>
<tr>
<th>Table 9. Respondent-farmers’ extension methods in the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension method</td>
</tr>
<tr>
<td>Field days</td>
</tr>
<tr>
<td>Demonstrations</td>
</tr>
<tr>
<td>Leaflets</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Radio</td>
</tr>
<tr>
<td>Posters</td>
</tr>
<tr>
<td>Farmer magazines</td>
</tr>
</tbody>
</table>

Training was ranked the highest as a method through which farmers get informed. This is due to the fact that several farmer field schools were set up in the area in order to teach farmers on conservation agriculture.

It is thus very important that appropriate extension teaching methods be used to pass across appropriate technologies given the nature of the technology to disseminate

**Conclusion**

Education levels of households head were found to be positively and significantly influencing adoption decision of Conservation Agriculture. The educated farmers easily understand the basic land management practices and they also know the advantage that is obtained from conservation Agriculture as compared to conventional tillage. Hence, it is appropriate for research, agricultural extension and NGOs to target them during on-farm research and CA promotion as they can easily understand about the technology which, in turn, helps them convince others to adopt the technology. The research can also identify and document the existing Indigenous Technical Knowledge of farmers to integrate valuable ITK into conservation agriculture.

From this study, frequency of contact with extension agents has positively and significantly influenced adoption of conservation agriculture which clearly suggests the need for more targeted and continued extension services. Thus, there is need to strengthen the extension system operating in the areas and elsewhere so as to increase the flow of information for rural development. Clear messages on conservation agriculture should be included in the normal extension packages and training of both extension workers and farmers should be emphasized so as to improve their understanding and skills.

It was found that credit is strongly influencing adoption of conservation Agriculture. Non adopters were not using the existing credit in the area due to high interest rates. The government, research, extension, NGOs, and Private Sectors can look for ways of providing credit to these farmers at reduced interest rates.

**Recommendations**

Appropriate Education policies will be good to stimulate and increase the adoption of conservation Agriculture since it affected the probability of Adoption of conservation Agriculture Extension services should be strengthened to help overcome the problem of lack of information since it is evident that they provide technical information to farmer’s hence increasing the probability of adoption of conservation Agriculture. However these should go hand in hand with financial support to enable farmer’s get capital for purchasing farm inputs. This would also address the problem of lack of credit which was a major constraint facing farmers.
Acknowledgement

The author thanks the director KARI for granting me study leave to pursue my studies. I am grateful to my supervisors for their support and encouragement and special thanks goes to the division agricultural officer, Ngata and farmers who availed information needed for this study.

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