Socioeconomic Characteristics on Livelihood Outcomes of Conservation Agriculture Farmers in Makueni and Machakos Counties

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Abstract

It is estimated that a majority of the population in Sub-Saharan Africa (SSA) reside in rural areas where agriculture is the main source of livelihood. There is therefore the need to promote agricultural development to improve livelihoods and reduce poverty levels. The current study sought to assess conservation agriculture practices and their impact on livelihood outcomes focusing on Makueni and Machakos Counties. Specifically, the study investigated the effect of socioeconomic characteristics on livelihood outcomes of conservation agriculture farmers in Makueni and Machakos Counties. The study adopted sustainable livelihoods approach. The study employed cross-sectional survey as a research design. The sampling frame provided by the organization involved in the project indicates that there are 5091 Conservation Agriculture farmers. The Cochran formula was used with a 5% level of significance to obtain sample size of 384 respondents. The study relied on stratified random sampling to achieve a high degree of representation from groups with the desired characteristics. Sample size for each stratum was determined proportionately and individual elements selected through systematic sampling whereby the nth item was obtained by dividing the population in each stratum by the sample size. Qualitative data was be subjected to content analysis while quantitative data was analyzed using both descriptive and inferential statistics. Findings show that skills on CA and access to income positively influences CA farmers livelihood outcomes. On the other hand, non-farm activities have a negative effect on livelihood outcomes of smallholder farmers in Makueni and Machakos counties. The study recommends that the government at national and county levels should take responsibly in creating awareness on CA practices across the country and provide any necessary support for the farmers to embrace this noble practice.

Keywords: Livelihood Outcomes, Conservation Agriculture, Socioeconomic Characteristics, Ca Skills, Non-Farm Activities, Income

Introduction
Background to the Study

It is estimated that 70% of the population in Sub-Saharan Africa (SSA) reside in rural areas where agriculture is the main source of livelihood (Barasa et al., 2019). Continuous cropping

and application of inappropriate farming methodologies in many counties within the SSA has adversely affected the environment which has led to decline in soil fertility and erosion, and therefore, low production and food insecurity (IFAD, 2005; FAO, 2007; Guto et al., 2011). These challenges are particularly prominent in low income countries such as Kenya where at least 80% of the farmers are small-scale and who rely entirely on simple traditional farming techniques. These problems are further exacerbated by limited farm land due to increasing population, poor agricultural policies and management strategies.

Several researchers have argued that CA attempts to restore soil fertility, and mitigate against the effects of soil degradation and therefore, increase crop yields (Guto et al., 2011; Chikonye et al., 2006; Govaerts et al., 2009). The conservation agriculture principles of minimum tillage, maintenance of soil cover and crop rotation enables farmers to reduce on crop production costs hence higher returns resulting into more spending on various aspects which promote a quality life.

Conservation agriculture evolved as a response to concerns of sustainability of agriculture globally, has steadily increased worldwide to cover about 8% of the world arable land (124.8 M ha) (FAO, 2012). Conservation Agriculture aims to increase crop yields while reducing production costs (e.g. labour and inputs), improving and maintaining soil fertility (e.g. plant nutrients, organic matter, micro-organisms and structure) and water holding capacities and preventing soil erosion and land degradation. Conservation Agriculture comprises a package of crop production technologies and practices that can achieve sustainable agriculture and improve livelihoods (i.e. food security, nutrition and income generation) for vulnerable farming populations. Conservation agriculture can be applied to any crop whether cereal, pulse, fruit or vegetable. The practice is based on three core principals which are minimal tillage or soil disturbance, maintenance of soil cover and crop rotation (Fao, 2018).

CA seeks to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources enhancing environmental conservation as well as sustained agricultural production. In addition, CA has been shown to reduce crop vulnerability to extreme climate events. For instance, in drought conditions, it reduces crop water requirements by 30% making better use of soil water and facilitating deeper rooting of crops. In extremely wet conditions, CA facilitates rainwater infiltration, reduces the risk of soil erosion and downstream flooding (Mrabet, 2011).

A study conducted in Bangladesh indicated that adoption of conservation agriculture practice led to a decrease in poverty in terms of deprivation of health, education and living standards. There was also an improvement in overall livelihood circumstances (Uddin & Dhar, 2016). A similar study in Paraguay exploring farmers who have practiced CA for 7 to 10 years compared conventional farmers with their initial situation before adopting CA and it was reported that farms recorded an increase in crop output on adopting CA due to the fast-improving soil fertility. Consequently, there was a rise in farm income and decreased production costs which resulted in a significant higher net income (Friedrich and Kienzle, 2007).

Statement of the Problem
An estimated 80% of Kenyans live in rural areas where farming is their main source of livelihood. Continuous cropping as well as use of inappropriate farming techniques is practiced in many Sub-Saharan Africa (SSA) regions resulting to immense negative environmental impacts which are characterized by a decline in erosion and soil fertility. Other effects include degradation of arable land leading to less yields, food insecurity and perennial starvation (Guto et al., 2011). These challenges which are associated with conventional

farming prevent small scale farmers from improving their quality of lives since they end up becoming food insecure and unable to produce enough for the markets resulting in less returns.

Participation in CA is slowly gathering momentum in Kenya. There is estimated to be 17,170 farmers who practice CA countrywide as a result of various initiatives by non-governmental organization such as FAO, CA-SARD, Christian Impact Mission (FAO, 2018; Canadian Food grains Bank, 2018). For instance, FAO's FFS projects comprise of integrated soil management, water and other agricultural resources with the aim of mitigating against the effects of droughts on agricultural production while at the same time conserving soil. Similar initiatives are promoted in Machakos and Makueni counties by Christian impact mission and Kenya Small Scale Farmers Forum (KSSFF) respectively. Rotational cropping, water harvesting, soil conservation as well us intercropping are the most notable CA practices in these counties. Even though evaluation of these projects indicates that participation in CA has improved livelihood outcomes of the people, proper documentation of these findings based on robust scientific analysis is needed.

Studies have shown that conservation agriculture practices improve livelihoods of farmers (FAO, 2008; Yeray, 2012; Masika, 2020). Nevertheless, these studies have paid little attention on human development dimensions notably health and education in regards to CA farmers. The studies have mainly focused on economic and environmental aspects to show a change in livelihoods of CA farmers. Furthermore, it is not clear how socioeconomic characteristics of farmers practicing conservation agriculture affect their livelihood outcomes. Therefore, this current study sought tio investigate the effect of socioeconomic characteristics on livelihood outcomes of conservation agriculture farmers in Makueni and Machakos Counties.

Research Objective
The study sought to assess the effect of socioeconomic characteristics on livelihood outcomes of conservation agriculture farmers in Makueni and Machakos Counties.

Research Hypothesis
HO_1: There is no significant effect of socioeconomic characteristics on livelihood outcomes in Makueni and Machakos Counties, Kenya.

Literature Review
Conservation agriculture practices have essentially targeted vulnerable farmers. Different household characteristics influence technology adoption. Conservation agriculture is a new form of technology and its adoption by farmers relies heavily on the socio-economic characteristics of farmers. Some of these characteristics include; level of education, health status, age, land ownership and levels of income. The socio-economic characteristics will also contribute to the different levels CA adoption by the farmers.

The CA adoption gravitates towards the wealthier farmers since the enthusiasm to invest in appropriate technology is normally an accomplishment for the rich. There is a likelihood for richer households with more asset endowments to practice CA than their counterparts who are resourced poorly (Giller et al., 2009). According to Nkala et al (2011) land scarcity and tools to work are negative factors which prevent farmers from practicing conservation agriculture. Waweru et al (2013) further argue that land ownership has influence on the CA adoption with more adoption by the farmers who own their land compared to the people renting. A similar study by Feder et al (1985) found that smallholder farmers may fail to adopt

new technologies requiring initial capital or input investments due to the lack of loan or credit access. According to Ding (2018); Harper et al (2018), additional assistance may be required for poorer farmers who are less likely to adopt CA due to the initial investment required with establishment and the risk associated with decreased yields early in the adoption process. Young farmers are inclined to be more informed and knowledgeable about new technologies making it easier for them to be more open to adopt current practices compared to older farmers (Adesina and Zinnah, 1993). However, Langyintuo and Mekuria (2000) revealed that older farmers may have amassed more capital over the years and may get more trust from credit agencies thus provide them comparative advantage with regards to accessing loans. According to Aryal (2019) the likelihood to adopt CA increases with the increase in the share of off-farm income in the total household income. Uddin & Dhar (2016) observed that farmers adopting conservation agriculture practice could save more time and money to invest in other income generating activities compared to who are not adopting which ultimately resulted in more money income in case of focal farmers in comparison with proximal and control farmers.

Theoretical Framework
The study was guided by Sustainable Livelihood Approach.

Conceptual Framework
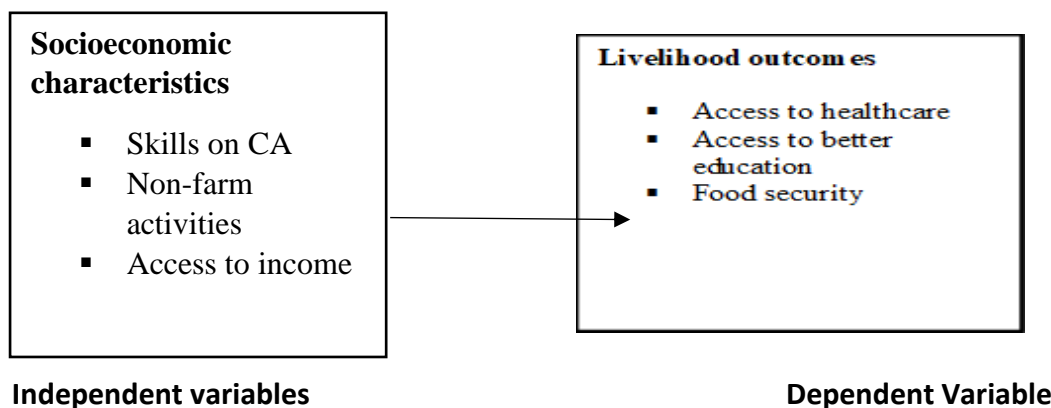
Independent variables   **Dependent Variable**
Figure 1: Conceptual Framework

Research Methodology
The research design adopted for this study was cross-sectional survey design. The target population for this study was 5091 CA farmers Makueni and Machakos Counties out of which a sample of 384 CA farmers were selected based on the Cochran (1963) formula. Key informants were also selected and they included 55 group leaders of farmer group. Stratified sampling was employed to identify the CA farmers by dividing the population into strata or homogenous subgroups and then using systematic sampling to select the nth item by dividing the population in each strata by the sample size. Primary data was collected using face to face questionnaire survey. Piloting of the research instruments was conducted in Machakos county and this was not sampled for the main study. All Likert scale items were reliable since they had coefficients of at least 0.6. Data was analyzed using descriptive and inferential statistics with the help of Statistical Package for Social Sciences.
The study employed descriptive statistics to measure the effects of the socioeconomic characteristics associated with conservation agriculture. In this regard, the study measured

the mean for skills on conservation agriculture, non-farm activities and the access to income of the targeted farmers. This study relied on multi regression analysis to examine the effect of independent variables on the dependent variable.

Results and Discussion

The questionnaire achieved a response rate of 70.29 percent which was considered more than sufficient for data analysis and making inferences regarding the effect of input costs on livelihood outcomes of conservation agriculture farmers in Makueni and Machakos counties. Other participants could not be reached for the entire period of the field work. In addition to questionnaire, 34 out 55 targeted leaders of the groups were interviewed.

Livelihood Outcomes
Food Security

The researcher sought to understand various livelihood outcomes from the CA farmers using food insecurity experience scale. Firstly, Figure 1 below presents summary statistics on food insecurity using FAO scale.
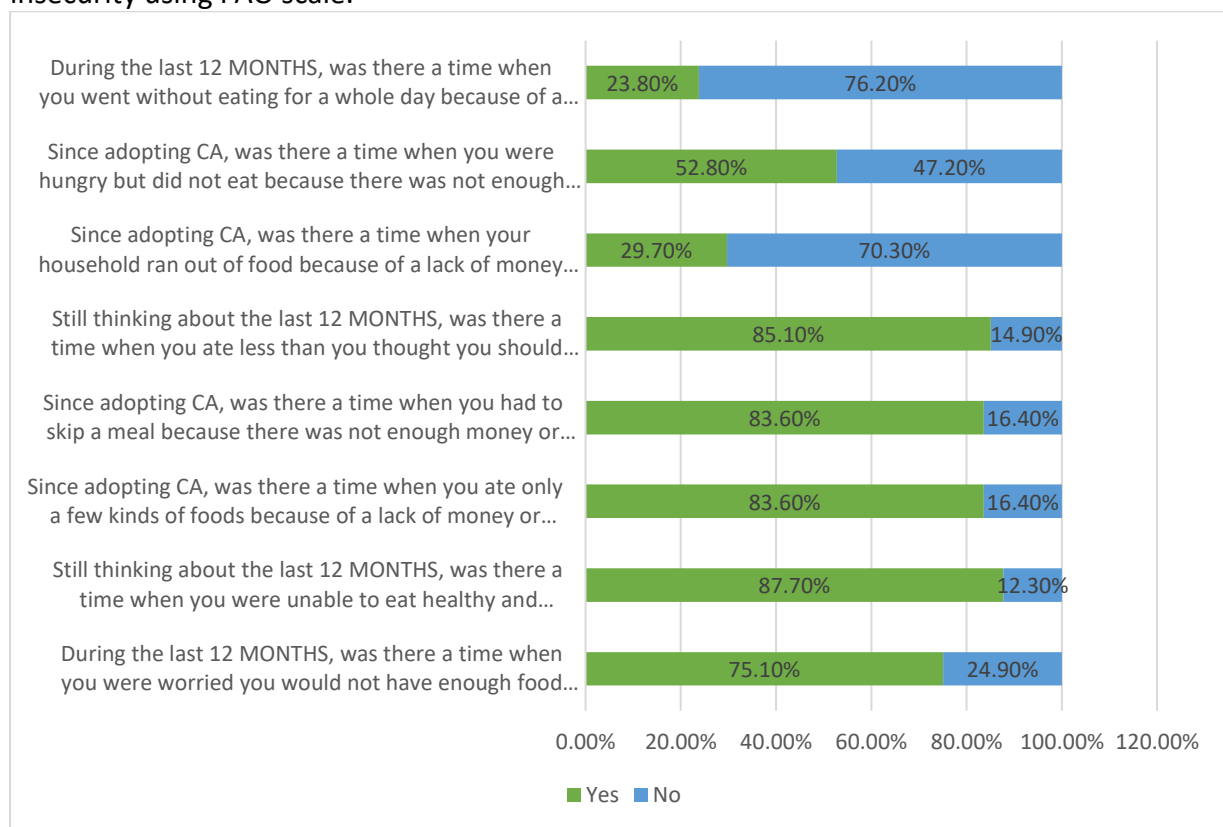
Figure 1: Food insecurity scale
Source: Author (2021)

Findings on food security show that majority of the households had access to food for the last 12 months. In addition, most farmers argued that since they embraced CA practices, there was no time where the household ran out of food. However, majority of the farmers indicated that since embracing CA practices, there was a time they were hungry, were worried of not having enough food and were unable to eat healthy and nutritious food due to lack of money or other resources. From these findings, it can be deduced that there are mixed feelings among the farmers on the effect of CA on their food security.

Rasch Model Analysis

The study also computed food severity index using Rasch model approach. This approach models item severity as the probability of an individual responding to a given item in each way. The model assumes that if a participant responds as "yes" to a question, it implies food severity or food insecurity. Table 1 below presents food insecurity rate based on the respondents' number of affirmative answers from the study. There are four categories: food secure (mildly food insecure, moderately food insecure, and severely food insecure.

Table 1

Food Insecurity Scale

Dimensions of food security	Food insecurity rate
WORRIED You were worried you would not have enough food to eat	75.1
HEALTHY You were unable to eat healthy and nutritious food	87.7
FEWFOOD You ate only a few kinds of foods	83.6
SKIPPED You had to skip a meal	82.2
ATELESS You ate less than you thought you should	85.1
RUNOUT Your household ran out of food	29.7
HUNGRY You were hungry but did not eat	52.8
WHOLEDAY You went without eating for a whole day	23.8
Overall rate	65.0

Key:0-25: Food Secure, 26-50: Mildly food insecure, 51-75: Moderately food insecure and 76=100: Severely food insecure

Findings of the Rasch model analysis indicate that items such as HEALTHY, FEWFOODS, SKIPPED and ATELESS reported severe food insecurity. Nevertheless, the overall Rasch model value of 65.0 shows that 65% of the study participants have moderate food insecurity. Mango et al (2017) found that adoption of CA can lead to a direct and positive influence on household Food Consumption Scores.

Furthermore, the farmers were asked to indicate the extent to which they agreed or disagreed with various statements on livelihoods on a scale of 1-5. Descriptive statistics are presented in Table 2 below.

Factor Analysis for Livelihood Outcomes

The study conducted factor analysis of the Likert scale variables with the aim of reducing these variables into a few which retains observed variations from the many variables. In factor analysis, variables with the same characteristics congregate. The reduced variables are used as inputs in the regression and hypothesis analysis. Table 2 below indicates the number of components extracted from a total of four statements. In addition, the table contains eigenvalues, percentage of variance attributable to each component and the total variance of the extracted components.

Table 2

Total Variance Explained on Livelihood Outcomes

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.220	69.027	69.027	3.220	69.027	69.027
2	1.032	11.471	85.600	1.032	11.471	85.600
3	.613	.053	99.953			
4	.713	.047	100.000			

Extraction Method: Principal Component Analysis.
Source: Author (2021)

The Principal Component Analysis (PCA) extracted only 2 components where the first component explains 69.03% variance while the second component explains 11.47% of the variance. This brings the total variance explained to 85.6%. The remaining percentage (14.4%) is explained by other variables outside the study. Components 3-4 have eigenvalues of less than 1 meaning that insignificant and hence, discarded in the process.

Table 3 below presents a component (Factor) Matrix which indicates that all the first two statements associated with food availability are substantially loaded to component 1 while the last two variables related to catering for medical costs and school fees are loaded on the second component.

Table 3

Component Matrix on Livelihood Outcomes

Variables	Component	
	Availability of food	Catering for education and healthcare
Since adopting CA, I have experienced increased food availability	**.988**	.393
Since adopting CA, I have experienced more food varieties	**.988**	.070
Since adopting CA, I have been able to cater for school fees for my children	.052	**.988**
Since adopting CA, I have been able to cater for medical costs for family members	.123	**.539**

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization.

Source: Author (2021)

Table 4 below presents the mean of the extracted component on livelihood outcomes. The findings indicate a mean of 1.221 for availability of food with a standard deviation of 0.30 and 1.30 for catering for social services (such as education and healthcare) with a standard deviation of 0.5. In addition, the statistics on Cronbach Alpha shows that the two extracted components meet the reliability threshold since all the coefficients are 0.7 and above.

Table 4

Descriptive Statistics on Livelihood Outcomes

Component	Mean	Std. Deviation	Cronbach Alpha
Availability of food	1.22	.30	0.70
Catering for education and healthcare	1.30	0.50	0.90

Mean: Strongly Agreed=1.00-1.80, Agreed=1.81-2.60, Neither Agree nor Disagree=2.61-3.40, Disagree=3.41.4-20, Strongly Disagree=4.21-5.00

Source: Author (2021)

The mean responses of the extracted factors show that study participants strongly agreed to the arguments that CA practices enhances availability of food to farmers as well as catering for social services. These imply that farmers who practice conservation agriculture are likely to reap more from their farms and hence, improve their livelihood outcomes in terms of availability of food and catering for social services like healthcare and education. This is consistent with several other studies. For instance, Uddin and Dhar (2016) conducted a study on CA farmer's livelihood status in Bangladesh and found that adoption of CA led to a decrease in poverty in terms of deprivation of health, education and living standards. Similarly, Mango et al (2017) reports that household Food Consumption Scores can be improved indirectly by CA through purchase of other essential food stuffs from income obtained after selling surplus crop outputs.

The findings are also supported by qualitative data as confirmed by an in-depth interview with CA group leaders. 28 leaders out of the 34 who were interviewed argued that farmers who embraced conservation agriculture were more food secure than those who have not. For instance, one participant argued that;

> *The practice of conservation agriculture has improved food production for some of us. This has in turn ensured that we have more food for our families and can also have surplus to sell to others. (L07)*

Socio-economic Characteristics and Livelihood Outcomes
In this sub-subsection, the study analyses both descriptive and inferential statistics related to socioeconomic characteristics and farmer's livelihoods. To begin with, the study sought to find out the highest level of education of the farmers. Table 5 below presents summary results. Majority of the farmers possess primary school certificate as their highest level of education followed by those with secondary level of education.

Table 5
Highest level of Farmer's Education

Education	Frequency	Percent
Informal	41	15.2
Primary	103	38.3
Secondary	90	33.5
Diploma	32	11.9
Degree	1	0.4
Masters	2	0.7
Total	269	100.0

Source: Author (2021)

The respondents were asked if they had other occupations apart from farming. Table 6 below presents findings of the study. The results show that most of the farmers, 39.8% are not engaged in any other occupations apart from farming. This was followed closely by those offering their labour for casual jobs. The findings imply that farming is the main source of livelihood for majority of the Machakos and Makueni residents.

Table 6
Other Occupations

Variable	Frequency	Percent
Casual labour	90	33.5
Teaching	16	5.9
Business venture	56	20.8
None	107	39.8
Others	0.0	0.00
Total	269	100.0

Source: Author (2021)

Still on socioeconomic characteristics, the farmers were asked to indicate the total acreage of land they owned and the type of ownership. Summary statistics are presented in Table 7 below. Most of the surveyed households have less than five (5) acres of land followed closely with those with 5-10 acres.

Table 7
Land Size and Ownership type

Variable	Frequency	Percent
Land size in acres		
Below 5 acres	137	50.9
5-10 acres	57	21.2
11-15 acres	19	7.1
16-20 acres	30	11.2
Above 20 acres	26	9.7
Total	269	100.0
Ownership type		
Title deed	60	22.3
Allotment letter	112	41.6
Leasehold	97	36.1
Total	269	100.0

Source: Author (2021)

These results implies that majority of the residents of Machakos and Makueni have smaller pieces of land. This imply that most farmers in Makueni and Machakos counties practice small scale farming. This could be attributed to sub-division of land into smaller units and limited CA skills and resources. This argument is supported by Nkala et al (2011) who found CA farming in central Mozambique, was on small scale. When it comes to land ownership, the study has established that only 22.3 percent of the interview farmers have title deeds for their land. The rest have an allotment letter or are on a leasehold.

Furthermore, research participants were asked to rate the extent to which they agreed or disagreed on the arguments related to socioeconomic characteristics and CA practices on a scale of 1-5. Descriptive statistics are shown in Table 8 below.

Table 8

Descriptive Statistics on Level on Socio-economic Characteristics (269)

Variable	SA	A	N	D	SD	Mean	Std.
	%	%	%	%	%		Deviation
I have been able to understand the principles of conservation agriculture;	59.5	40.5	0.00	0.00	0.00	1.41	0.49
I have been able to apply CA technologies	49.1	43.9	0.7	2.6	3.7	1.68	0.92
I have been able to comprehend the various CA benefits	75.5	23.0	1.50	0.00	0.00	1.26	0.47
The income gained from the other occupation, enables me to purchase farm equipment for CA;	61.0	39.0	0.00	0.00	0.00	1.39	0.49
The income gained from the other occupation, enables me to hire extra farm labour;	26.4	61.3	0.00	1.5	10.8	2.09	1.14
The other occupation supplements CA farming.	59.5	40.5	1.50	0.00	0.00	1.41	0.49
Since embracing CA, my poverty status has gone down;	55.4	32.3	12.3	0.00	0.00	1.59	0.70
Since embracing CA, I have been able to afford basic commodities with ease;	59.9	38.7	1.5	0.00	0.00	1.42	0.52
Since embracing CA, I have been able to increase my income streams.	64.3	35.7	1.50	0.00	0.00	1.35	0.49

Mean: Strongly Agreed=1.00-1.80, Agreed=1.81-2.60, Neither Agree nor Disagree=2.61-3.40, Disagree=3.41.4-20, Strongly Disagree=4.21-5.00
Source: Author (2021)

The mean responses show that farmers either strongly agreed or agreed to the arguments of socioeconomic characteristics of the study participants. These means that socioeconomic characteristics have implications on the relationship between CA practices and livelihood outcomes. In particular, the results means that non-farming activities enhanced their CA by providing money for buying inputs.

Factor Analysis
The study conducted factor analysis for the socioeconomic characteristics. Table 9 below presents results for variance explained which shows that three components were extracted from the process which had a total of 9 statements. The first component accounts for 18.96 % of the total variance while the second component accounts for 17.20 % of the variance. The third component accounted for 25.05%. Thus, the three extracted components explain 61.87 % of the variance in the observed variables. The remaining components were found not significant and hence, discarded in the process. This is because, their total eigenvalues is less than 1.

Table 9
Total Variance Explained for Socioeconomic Characteristics

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.725	19.163	19.163	1.725	19.163	19.163	1.707	18.964	18.964
2	1.662	18.462	37.625	1.662	18.462	37.625	1.548	17.198	36.161
3	1.152	12.804	61.870	1.152	12.804	61.870	1.264	25.048	61.870
4	.030	11.440	61.870						
5	.971	10.783	72.653						
6	.881	9.789	82.442						
7	.641	7.121	89.563						
8	.554	6.151	95.714						
9	.386	4.286	100.000						

Extraction Method: Principal Component Analysis.

Table 10 below presents rotated component matrix where the first three variables associated with the skills on CA are loaded on the first component, the next three variables related to non-farm activities are loaded on the third component while the last three variables associated with access to income are substantially loaded to the second component.

Table 10
Rotated Component Matrix for Socioeconomic Characteristics

Variables	Component		
	Skills on CA	Access to income	Non-farm activities
I have been able to understand the principles of conservation agriculture	**.777**	.141	.286
I have been able to apply CA technologies	**.624**	.088	.077
I have been able to comprehend the various CA benefits	**.827**	.144	.048
The income gained from the other occupation, enables me to purchase farm equipment for CA	.079	.251	**.823**
The income gained from the other occupation, enables me to hire extra farm labour	.167	.175	**.701**
The other occupation supplements CA farming	.193	.281	**.666**
Since embracing CA, my poverty status has gone down	.040	**.779**	.154
Since embracing CA, I have been able to afford basic commodities with ease	.060	**.818**	.035
Since embracing CA, I have been able to increase my income streams	.043	**.613**	.129

Table 11 below presents descriptive statistics for socioeconomic characteristics components. The mean response rate shows that study participants strongly agreed that farmers have well-grounded CA skills given a value of 1.12. In addition, the statistics show that farmers strongly agreed on the arguments of non-farm activities and access to income with reference to the implementation of CA practice.

Table 11

Descriptive Statistics for Socioeconomic Characteristics Components

Component	Mean	Std. Deviation	Cronbach Alpha
Skills on CA	1.12	0.11	0.87
Non-farm activities	1.34	0.20	0.78
Access to income	1.61	0.43	0.70

Mean: Strongly Agreed=1.00-1.80, Agreed=1.81-2.60, Neither Agree nor Disagree=2.61-3.40, Disagree=3.41.4-20, Strongly Disagree=4.21-5.00
Source: Author (2021)

Indeed, to practice conservation agriculture, skills and access to resource are very critical. These findings are affirmed by Tambo and Mockshell (2018) who argue that significant income gains from full adoption of CA across nine SSA countries. Similarly, Uddin & Dhar (2016) argued that there was an increase in annual income for farmers practicing conservation agriculture in Bangladesh. The results showed that while before practicing conservation agriculture farmers earned Tk. 100 money income, focal, proximal and control farmers earned about Tk. 110, Tk. 107 and Tk. 106 money income, respectively after practicing conservation agriculture. According to Aryal et al (2019), the likelihood to adopt CA increases with the increase in the share of off-farm income in the total household income.

An in-depth interview with CA farmer's leaders reveals that income generated from other occupations enhance their farming. This argument was advanced with 25 out of 34 group leaders who were interviewed. Most participants (28 leaders) argued that income from off-farming activities is used for purchasing farm inputs and hiring of labour force. In general, the findings indicate that the practice of CA has the potential of economic empowerment and hence, poverty alleviation. For instance, one leader argued that;

> *Other economic activities apart from farming helps farmers acquire inputs such as hiring of labour and purchase of fertilizer. This also supplements farmers income (LO14).*

Regression on Socio-economic Characteristics and Livelihood Outcomes

The study conducted a regression analysis between socioeconomic characteristics (Skills on CA, non-farm activities and access to income) and livelihood outcomes. Summary findings are presented in Table 12 below.

Table 12

Regression Results on the Effect of Socioeconomic Characteristics on Livelihoods

Independent	Model 1					Model 2				
	B	Std. Error	Beta	T	Sig.	B	Std. Error	Beta	T	Sig.
(Constant)	-.815	.318		-2.566	.011	-2.265	.265		-8.541	.000
Skills on CA	.183	.116	.078	1.582	.115	.291	.128	.123	2.279	.023
Non-farm activities	-.691	.104	-.327	-6.616	.000	-1.274	.134	-.497	-9.507	.000
Access to income	1.157	.127	.451	9.111	.000	.138	.054	.138	2.560	.011
Dependent	Availability of food					Catering for education and healthcare				
R – squared	0.366					0.279				
Adj. R squared	0.340					0.271				
Std. Error	1.986					.8538				
F – ratio (2, 263)	6.231					4.512				
Prob. > F	0.000					0.000				

Source: Author (2021)

The probability of the ANOVA test shows that the findings are statistically significant. The R squared statistic of 0.366 and 0.279 indicates that the explanatory variable (socioeconomic characteristics) accounts for 36.6% and 27.9% variation in the CA farmer's availability of food and catering for education and healthcare respectively. This imply that socioeconomic characteristics have relatively lower impact on the CA farmer's livelihood outcomes as compared to both input cost and land productivity.

With regard to the estimated coefficients, the study has revealed that the famer's skills on CA has a positive effect on both availability of food and catering for education and healthcare. Nevertheless, only the coefficient of catering for education and healthcare was statistically significant. This imply that skills on CA has a positive impact on catering for education and healthcare. Improved skills on CA helps farmers to implement the farming practices well which eventually improves livelihood outcomes through increased output and income.

There is a negative and statistically significant relationship between non-farm activities and availability of food and catering for education and healthcare livelihood outcome variables given negative coefficients. This means that having another occupation apart from CA discourages production and hence, livelihood outcomes of the farmers. This also means that wages from non-farming activities are not used to promote CA practices through purchase of farm inputs and equipment. In addition, having another occupation is likely to reduce the

number of hours a farmer spends on farming which eventually reduces the quantity of harvest.

The results indicate a positive and statistically significant relationship between the access to income and livelihood outcomes given positive and statistically significant coefficients. This means that farmers with more access to income are likely to produce more with CA practices. More income could imply more ability to purchase farm tools and inputs, attend relevant training, seek for extension services and hence, more production. Indeed, Maphosa et al (2012) argues that in good harvest years there are opportunities for increased incomes emanating from increased sales. These increased incomes enhance the access dimension of food security as the farmers are in a position to buy food items that they would not have grown in their fields. According to Ding (2018); Harper et al (2018), additional assistance may be required for poorer farmers who are less likely to adopt CA due to the initial investment required with establishment and the risk associated with decreased yields early in the adoption process. Bisangwa (2013) argues that farmers who have received some training in agriculture have a high likelihood of using CA on their fields which could enhance farm produce, income and better livelihood outcomes by extension.

During an in-depth interview, 28 out of 34 group leaders argued that access to income was very critical for the CA farming since acquisition of farming technology, training and hiring of labour dependent on money. The leaders (34) also argued that farmers who possessed relevant skills in CA stood a better chance of uplifting their farming and therefore, livelihood outcomes. For instance, a leader argued that

> *Having relevant knowledge and skills in conservation agriculture is very important and could influence the outcome of farming. (L24).*

Hypothesis Testing
The study conducted Hypothesis testing based on regression analysis output. Rejection or acceptance of a hypothesis depends on the p-values. In this study, the null hypothesis was rejected when $p < 0.05$, otherwise accepted. Table 10 shows that the null hypotheses was rejected. This means that there is a significant influence of input costs.

Table 10
Summary of hypothesis testing

No	Hypothesis	P value	Verdict
$H0_1$	There is no significant effect of socio-economic characteristics on livelihood outcomes in Makueni and Machakos Counties.	0.000<0.05	Reject

Summary, Conclusion and Recommendation
Summary of the Findings
Concerning socioeconomic characteristics, descriptive results indicate that most CA farmers are not engaged in any other occupation apart from farming. This means that farming is the main economic activity practiced in rural Makueni and Machakos counties. In addition, the study has demonstrated that majority of the CA farmers in the two counties are small-scale. Regression findings show that skills on CA and access to income have a positive influence on livelihood outcomes (catering for education & healthcare). This shows that with more skills in CA practices, more income is generated through increased production and hence, better

education and healthcare. On the existence of non-farm activities, mixed results are reported. On one hand, the study established a negative coefficient between food availability and non-farm activities and on the other hand, catering for healthcare reported a positive coefficient. This is consistent with the theory that non-farm activities can either have a positive or negative influence on agricultural production. Spending more hours in non-farm activities for instance can reduce the time spend in the farm and this could reduce crop production. Conversely, farmers can use income from non-farm activities to boost their agricultural produce through purchase of farm inputs and equipment. The null hypothesis that there is no statistically significant effect of socioeconomic characteristics on livelihood outcomes was rejected. This means that both the regression findings and hypothesis test had a convergence.

Conclusion

S/No.	Major conclusions
1.	Most CA farmers are not engaged in any other economic activity
2.	Majority of the CA farmers in the two counties are small-scale
3.	Skills on CA and access to income have a positive influence on catering for education and healthcare among CA farmers in the two counties.
4.	There is a negative coefficient between non-farm activities and livelihood outcomes

Significance of the Study

This study makes several contributions. First, it seeks to fill the literature gap that exits. There are very limited studies on the effect of conservation agriculture on livelihoods of people particular in Kenya thus the study sheds some more light on this. Secondly, findings could be used by policy makers at national, county, intergovernmental and non-governmental organizations to formulate measures to improve rural agricultural practices and enhance yield for poverty alleviation. Third, findings of the study might act as a spring board upon which other studies will be based.

Recommendations

Food security in Kenya has remained a challenge even though majority of the population especially those residing in rural areas depend on the agricultural sector both in terms of food and jobs. This study has demonstrated that CA can help to solve some of the challenges experienced by farmers and address food insecurity issues, increase farmers income and ultimately enhance household livelihoods. Thus, the government at national and county levels should come up with programs which seek to train farmers on CA farm techniques and also offer credit services to farmers who have expressed interest in the practice.

Suggestions for Further Studies

Even though this study largely achieved its objectives, there are some glaring gaps which requires further investigations. Non-farm activities are known to influence agricultural production either negatively or positively. This aspect did not come out clearly in the study. In this regard, it is important that future studies investigating the influence of non-farm activities on agricultural production are considered and conclusive findings provided.

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