Extent of Adoption of Selected Climate-Smart Agricultural Practices among Smallholder Farmers in Laikipia County, Kenya

ABSTRACT

Aim: Climate Smart Agriculture (CSA) is an integrative approach to address the challenges of food security and climate change. This study sought to assess the extent of adoption climate smart agricultural practices in Laikipia County, Kenya.

Study Design:This study used correlation research design

Place and Duration of Study: The study was carried out in Laikipia county. Specifically in the sub-counties Laikipia West, Laikipia East and Laikipia North. The study was carried out in July – August 2022.

Methodology: A multi-stage sampling technique was used to obtain a representative sample of 384 smallholder farmers households across the three sub-counties. Systematic random sampling was used to select every tenth household from the sample size. A questionnaire was used to collect data from the sampled households (all of whom were farmers).Descriptive statistical analysis was used to determine the extent of adoption of selected Climate Smart Agricultural Practices among smallholder farmers in Laikipia County, Kenya. The study used a chi-square (X^2) test of independence to establish a relationship in the adoption of CSA practices across the three study sites

Results: This study found that crop diversification (87%), mixed farming (crop farming and livestock keeping) (83%), use of pesticides and fungicides (80%) and crop rotation (74%) were the most adopted climate smart agricultural practices (CSAPs). On extent of adoption, full adoption was highest on pest and disease control (54%) and diversification of farming practices (52%); partial adoption was highest in conservation agriculture (54%); and non-adoption was highest on agroforestry (42%).

Conclusion: It is recommended that stakeholders should improve the adoption of water harvesting/use, conservation agriculture and agroforestry – critical climate smart agricultural practices in semi-arid environments.

Keywords: climate smart agriculture, practices, adoption, Laikipia

1. INTRODUCTION

Climate Smart Agriculture (CSA) is an integrative approach to address the challenges of food security and climate change by sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change and reducing and/or removing greenhouse gas emissions, where possible [1]. Many researches have shown the advantages of CSAs in enhancement of productivity, food security, and resilience. In Paraná, Brazil, plots with zero-tillage were reported to yield a third more wheat and soybean than conventionally ploughed plots and reduce erosion by up to 90% (Altieri *et al.*, 2011). In its lending conditions, the Brazilian National Development Bank (BDNES) now includes criteria for sustainable land, water, and forest management [2].

Climate smart agriculture (CSA) has been embraced and endorsed in many African countries [3]. It is well recognized that CSA has a potential to lift the poorest farmers out of poverty in line with the Sustainable Development Goals' (SDGs) commitment to 'leave no one behind' [4]. Despite some concerns, efforts to promote CSA in Africa are advancing at the policy level. At the 23rd ordinary session of the African Union (AU) held in June 2014 in Malabo, Equatorial Guinea, African leaders endorsed the inclusion of CSA in the NEPAD programme on agriculture and climate change. The session also led to the development of the African Climate Smart Agriculture Alliance, which is expected to enable the NEPAD Planning and Coordinating Agency to collaborate with Regional Economic Communities (RECs) and Non-Governmental Organisations (NGOs) in targeting 25 million farm households by 2025. As a follow up action at the sub-continental level, ECOWAS, for instance, also put in place the West Africa CSA Alliance to support the mainstreaming of CSA into the ECOWAP/CAADP programmes [5,6]. The NEPAD Heads of State and Government Orientation Committee at its 31st session also welcomed the innovative partnership between NPCA and major global NGOs to strengthen grass-root adaptive capacity to climate change and boost agricultural productivity.

In Kenya, CSAs application is mostly tailored to specific situations using information from many sources. [3] advocate that CSAPs should be site-specific rather than universal. Despite the great importance of modern technologies in agriculture, especially in meeting the food needs of a growing population and in generating economic growth needed for poverty reduction, certain circumstances associated with these practices and techniques cause ecological damage, degradation of soils, unsustainable use of resources; outbreak of pests and diseases. These have caused health problems to both livestock and humans. The unsustainable practices have also resulted in lower yields, degraded or depleted natural resources and have been a driver of agriculture's encroachment into important natural ecological areas such as forests [3]. Most CSAs are aimed at increasing yields without expanding the amount of land under cultivation [7]. According to [8], a number of existing systems, practices, and methods in the study area are suitable for climate smart agriculture.

Generally, the rate of adoption of most CSAPs in the study area is low. This is attributed to low awareness, inadequate technical knowledge and low capital. At best, most CSAPs such as cultivation of early maturing and drought tolerant, disease/pest resistant varieties, intercropping cover crops with main crops as a way of improving soil fertility and growing appropriate mix of crops in rotation on same parcel is only fairly adopted. According to [8], the reason for high adoption of short duration and drought tolerant varieties was traced to the need to provide adaptation measure against short rainfall duration in the zone. The adoption of agronomic practices is generally influenced by the realization of its yield enhancing potential. This means that the dissemination of the information about the practices should be enhanced.

Climate change has not only led to adverse effect on food security and sustainable community development but also negative environmental impact such as, drought, floods, increase in pest, and diseases and loss of livelihood by smallholder farmers. Besides mitigation efforts, adaptation measures are needed to counteract the impacts of climate change. Several households in Laikipia County have adopted a number of mitigation measures and coping strategies to climate variability. Some of these coping strategies include adaptation of Climate Smart Agricultural Practices (CSAPs). These include water harvesting and use; conservation agriculture; agroforestry; pest and disease control; and diversification. Despite differences in merit in the different CSA, little has been done to establish the extent of adoption in Laikipia County. This has made it difficult for decision-makers to determine progress and the contribution of climate smart agriculture in Laikipia County. Against this background, the proposed study sought to establish the extent of adoption of climate smart agricultural practices among smallholder farmers in Laikipia County, Kenya.Study findings are expected to contribute to key policies and development programmes that the government of Kenya has put in place in ensuring food security amidst climate change in the country. These include the Kenya Climate Smart Agriculture Strategy 2017-2026, Climate Change Act 2016, National Climate Change Response Strategy (2010).

2. METHODOLOGY

2.1 The Study Area

The study was carried out in Laikipia County, Kenya (Figure 1). Most of Laikipia County is dry and largely unfavourable for cultivation. Less than 2% of land is deemed highly viable for agriculture. More than half of the county land is defined as wildlife habitat [9]. In addition, the county consists of a rangeland plateau with a varying altitude of 1500 to 2611 metres above sea level at EwasoNyiro basin in the north and Marmanet forest. In the northern part, the mean annual rainfall is estimated to be 400mm while in the south-west it is 1200 mm [10]. Like most parts of Kenya, Laikipia county Kenya has three rainfall seasons – March-May, June-August and October- December. The March-May and October-December are the main growing seasons but highly variable [11]. Agro-ecological zones range from Upper Highlands (UM) 2 to the West near Nyahururu to the Upper Midland (UM) 6 in the north. The Upper Midland zone is the largest AEZ and is largely associated with ranching. Laikipia County is a multi-ethnic county with a substantial number of agro-pastoral and pastoral communities, ranchers, and horticulturalists. The county also hosts numerous wildlife conservancies [8]. It is made up of extensive semi-arid lands as well as arable and urban areas. Pressures on water and land resources has greatly gone up in recent years, with increased farming activities, rapid population growth, and periodic drought as well as climate variability [8].

The land use systems in Laikipia are strongly reflected by population dynamics in the sub-county. In the upper region, intensive maize, wheat, and beans farming is practiced as well as rearing of dairy animals. In the lower region, agro-pastoralism and pastoralism is practiced. Irrigation farming has also been practiced in the lower region where tomatoes and onions are grown. Most immigrants moving to Laikipia are Kikuyu peasants from high potential regions in Central Province who continue their habitual systems of rain-fed mixed farming in their new home area [12]. The main crops grown include wheat, maize, beans, potatoes, and vegetables. Maize takes about 51 percent of the total planted area. Crop farming is mainly undertaken in the south western parts of the county due to favourable weather conditions [13]. Efforts are now being put in place to promote the resistant crops such as millet, sorghum, sunflower, and black beans (dolichos). There is an emerging trend of increased horticulture production both at large-scale and small-scale levels. This constitutes production of cut flowers, tomatoes, French beans, Aloe, chilies, and water melons. There are also pockets of pineapple farms, orange trees, and coffee bushes [13]. Laikipia County has a total population of 518,560 of which 259,440 are males, 259,102 females and 18 intersex persons. There are 149,271 households with an average household size of 3.4 persons per household and a population density of 54 people per square kilometre [14]. Laikipia County was selected because of its adverse effect of climate change, its prevalence of climate-smart agricultural practices and its vulnerability to drought. In addition, majority of the farmers are smallholders.

Figure 1 here

2.2 Data Collection

A multi-stage sampling technique was used to obtain a representative sample of 384 smallholder farmers households. In the first stage, three sub-counties were purposively selected – Laikipia East, Laikipia West and Laikipia North. In the second stage, five wards were purposively (owing to the importance of farming activities) selected (Ngobit and Tigithi wards from Laikipia East Sub-county; Salama and Marmanet wards in Laikipia West Sub-county; and Sosian ward in Laikipia North Sub-county). The determination of the sample size followed proportionate to size sampling methodology (Kothari, 2004) as shown in the equation below:

Equation 1

$$n = \frac{z^2 pq}{E^2}$$

$$n = \frac{1.96^2 0.5^* 0.5}{0.05^2} = 384$$

Where; n = Sample size; Z= confidence level (α=0.05); p = proportion of the population containing the major interest q = 1-p E= allowable error. Since the proportion of the population is not known, p= 0.5, q= 1-0.5=0.5, Z= 1.96 and E = 5%. **Table 1**shows the population and the household sample size from each of the sub-counties studied. Systematic random sampling was used to select every tenth household from the sample size. A questionnaire was used to collect data from the sampled households (all of whom were farmers).

Table 1here

2.3 Data Analysis

This study used correlation research design. A correlational research design attempts to determine or estimate the extent to which values of two or more factors are related or change in an identifiable pattern. The design is applicable in numerous situations where the strength and direction of the linear relationship is to be examined. Descriptive statistical analysis was used to determine the extent of adoption of selected Climate Smart Agricultural Practices among smallholder farmers in Laikipia County, Kenya. The study used a chi-square (X^2) test of independence to establish a relationship in the adoption of CSA practices across the three study sites; Laikipia East, Laikipia West and Laikipia North. To apply chi-square, requirements were observed as discussed by [15].The calculated X^2 is then compared with the critical table X^2 at the required degree of freedom (d.f) and probability. If the calculated X^2 is less than the critical table value at a given level of significance (in this case 5%) for a given degree of freedom, it is concluded that the null hypothesis, $H_{0,}$ is true and therefore no difference between the variables. But if the calculated table chi-square value is greater than the tabular X^2 value, its then concluded that the H_0 does not hold, giving way to acceptance of the alternative hypothesis, $H_{1,}$ and a confirmation that there exist a difference between the variables under investigation.

3. RESULTS AND DISCUSSION

3.1 Climate smart Agricultural Practices in Laikipia County

Table 2 shows the specific forms of climate smart agricultural practices implemented in Laikipia county. The most implemented water harvesting and use practices among the sampled farmers included manual watering of crops (bucket) as adopted by 56.0% of the total respondents, followed by water storage through pools, dams, pits and retaining ridges as adopted by 50.0% of the total respondents. About 22.4% of the farmers had adopted the practice of water-use efficiency (i.e drip irrigation). There was a significant difference in the adoption of water storage through pool, dam, pit or retaining ridges across the three sub-counties since the calculated Pearson's chi-square value of 12.896 was significant at 5% level (p = 0.002). Water storage through pool, dam, pit or retaining ridges was most practiced in Laikipia West (56.3%), moderately practiced in Laikipia East (28.1%) and least practiced in Laikipia North (15.6%). Adoption of water-use efficiency (e.g. drip irrigation) differed across the three sub-counties since the calculated Pearson's chi-square value of 30.487 was significant at 5% level (p = 0). Water-use efficiency practices (e.g. drip irrigation) was most practiced in Laikipia West (73.3%), followed by Laikipia East (16.3%) and least practiced in Laikipia North (10.5%). There was no significant difference in the adoption of manual watering of crops (bucket) across the three sub-counties since the calculated Pearson's chi-square value of 2.906 was not significant at 5% level (p = 0.234).

The most adopted pest and disease control practices by respondents included use of pesticides/fungicides (79.9%), adopting pest/disease tolerant varieties of crops (65.1%), companion planting (59.6%), adopting new drought tolerant varieties of crops (54.7%) and biological weed control (47.9%). There was a significant difference in the adoption of adopting new drought tolerant varieties of crops across the three sub-counties since the calculated Pearson's chi-square value of 17.501 was significant at 5% level (p = 0). Adoption new drought tolerant varieties of crops was most practiced in Laikipia West (56.7%), followed by Laikipia East (27.1%) and least practiced in Laikipia North (16.2%). Adoption of pest/disease tolerant varieties of crops had a significance difference across the three sub-counties (Pearson's chi-square value = 55.107; p = 0.000). Pest/disease tolerant varieties of crops were most practiced in Laikipia West (60.4%) and in Laikipia East (23.2%), but least practiced in Laikipia North (16.4%). The low practice of climate smart variety crops (pest and disease tolerant) in Laikipia North can be attributed to low prevalence of crop farming due to its low rainfall potential that make most of its area as not arable (Huho et al., 2010).

There was a significant difference in the adoption of biological weed control across the three sub-counties since the calculated Pearson's chi-square value of 28.231 was significant at 5% level (p = 0.000). Biological weed control was most practiced in Laikipia East (45.1%), Laikipia West (33.2%) and least practiced in Laikipia North (21.7%). There was a difference in companion planting across the three sub-counties (Pearson's chi-square value = 64.112; p = 0.000). Companion planting was most practiced in Laikipia West (63.3%), moderately practiced in Laikipia East (21%) and least practiced in Laikipia North (15.7%). There was a significant difference in the adoption of use of pesticides/fungicides across the three sub-counties since the calculated Pearson's chi-square value of 15.975 was significant at 5%

level (p = 0). Use of pesticides/fungicides was most practiced in Laikipia West (52.1%), followed by Laikipia East (30.6%) and in Laikipia North (17.3%).

Some of the farmers implemented Conservation Agriculture (CA) practices in their farming enterprises. Majority of the farmers had implemented rotations or sequences and associations of crops (74.5%). About 62.0% and 51.3% of the farmers had implemented mulching and minimal mechanical soil disturbance (i.e. minimum tillage and direct seeding), respectively. There was a significant difference in the adoption of minimal mechanical soil disturbance (i.e. minimum tillage and direct seeding) across the three sub-counties since the calculated Pearson's chi-square value of 16.71 was significant at 5% level (p = 0). Minimal mechanical soil disturbance (i.e. minimum tillage and direct seeding) was most practiced in Laikipia East (38.6%) and Laikipia West (37.6%) and least practiced in Laikipia North (23.9%). There was a significant difference in the adoption of mulching across the three sub-counties since the calculated Pearson's chi-square value of 8.443 was significant at 5% level (p = 0.015). Mulching was most practiced in Laikipia West (47.1%) and least practiced in Laikipia North (22.3%). About 30.7% of the farmers in Laikipia East practiced mulching. There was a significant difference in the adoption of rotations or sequences and associations of crops across the three sub-counties since the calculated Pearson's chi-square value of 11.433 was significant at 5% level (p = 0.003). Rotations or sequences and associations of crops was most practiced in Laikipia West (45.1%), moderately practiced in Laikipia East (39.2%) and least practiced in Laikipia North (15.7%).

The most popular agroforestry practice among the respondent farmers was planting and maintenance of trees and shrubs as implemented by 48.7% of all the farmers. About 6.3% of the farmers had adopted other agroforestry practices. There was a significant difference in the adoption of planting and maintenance of trees and shrubs across the three sub-counties since the calculated Pearson's chi-square value of 12.004 was significant at 5% level (p = 0.002). Planting and maintenance of trees and shrubs was most practiced in Laikipia West (43.9%), in Laikipia East (38%) and least practiced in Laikipia North (18.2%).

There was a significant difference in the adoption of other agroforestry practices (growing of fruit trees) across the three sub-counties since the calculated Pearson's chi-square value of 45.12 was significant at 5% level (p = 0.000). Growing of fruit trees was most practiced in Laikipia West (96.2%), with very few respondents practising in Laikipia East (3.8%) and none inLaikipia North (0%). According to Laikipia Kingoriet al.(2021), Laikipia West is more arable than all the other sub-counties owing to its high rainfall potential.

The most implemented diversification practice among the farmers was growing of different types of crops as practiced by 86.7% of the total farmers. Other diversification practices included: keeping of livestock as well as growing of crops (83.1%) and engagement in both farm and off-farm activities (62.5%). There was a significant difference in the adoption of keeping of livestock as well as growing of crops across the three sub-counties since the calculated Pearson's chi-square value of 13.957 was significant at 5% level (p = 0.001). Keeping of livestock as well as growing of crops was most practiced in Laikipia West (48.9%), Laikipia East (34.5%) and least practiced in Laikipia North (16.6%).

There was a significant difference in the adoption of growing of different types of crops across the three sub-counties since the calculated Pearson's chi-square value of 17.463 was significant at 5% level (p = 0). Growing of different types of crops was most practiced in Laikipia West (49.2%) as well as in Laikipia East (35.7%) and least practiced in Laikipia North (15%). Engagement in both farm and off-farm activities differed across the three sub-counties since the calculated Pearson's chi-square value of 10.111 was significant at 5% level (p = 0.006). Engagement in both farm and off-farm activities was most practiced in

Laikipia West (53.3%) and in Laikipia East (31.3%), but least practiced in Laikipia North (15.4%). According to Kinyumuet al. (2021), ranching is the main economic activity in Laikipia North and hence the low practice of non/off-farm activities.

Table 2 here

3.2 Extent of Adoption of Climate Smart Agricultural Practices

Extend of Adoption by Land Area

Table 3 shows results of the extent of adoption of selected climate smart agricultural practices by land area (land acreage) in Laikipia county. Pest and disease control practice and technology was the highest adopted CSAP with a mean land area of 1.29 acres. The extent of adoption was followed by conservation agriculture as implemented on a mean acreage of 0.91 acres. Other CSAPs that were considered had been adopted in a lower extent: water harvesting and use (0.40 acres) and agroforestry (0.28 acres). There was a significant difference in the land area under water harvesting and use across the three sub-counties since the calculated F-ratio of 7.031 was statistically significant at 5% level ($p = 0.001$). Water harvesting and use was practiced more (in terms of land area) in Laikipia West (0.394 acres), followed by Laikipia East (0.226 acres) and least practiced in Laikipia North (0.03 acres). According to [13], ranching is the main economic activity in Laikipia North and hence the low prevalence of water harvesting practices since the main livestock keeping may not require a lot of water as compared to crop farming.There was a significant difference in the land area under conservation agriculture across the three sub-counties since the calculated F-ratio of 5.108 was statistically significant at 5% level ($p = 0.006$). Conservation Agriculture was practiced more (in terms of land area) in Laikipia West (0.862 acres), followed by Laikipia East (0.781 acres) and least practiced in Laikipia North (0.4 acres).

There was a significant difference in the land area under agroforestry across the three sub-counties since the calculated F-ratio of 7.185 was statistically significant at 5% level ($p = 0.001$). Agroforestry was practiced more (in terms of land area) in Laikipia East (0.474 acres), followed by Laikipia West (0.315 acres) and least practiced in Laikipia North (0.208 acres).There was a significant difference in the land area under pest and disease control across the three sub-counties since the calculated F-ratio of 5.094 was statistically significant at 5% level ($p = 0.007$). Pest and disease control was practiced more (in terms of land area) in Laikipia East (1.472 acres), followed by Laikipia West (1.3 acres) and least practiced in Laikipia North (0.501 acres). Pest and disease control practices in crops are not highly practiced in Laikipia North sub-county due to low prevalence of crop farming as an economic activity. The practice is more in Laikipia West and Laikipia East where crop farming is popular (Ndah et al., 2020).

Table 3

Rating on Extent of Adoption

The extent of adoption of selected climate smart agricultural practices among smallholder farmers was assessed in terms of degree of adoption (full adoption, partial adoption, non-adoption) as summarized in **Table 4**.The study shows that majority of the respondents partially (36.7%) and fully (39.3%) adopted water harvesting and use practices and technologies. Full adoption of climate smart water harvesting and use was more in Laikipia West (51.9%). According to the overall sample, majority of the respondents had partially adopted conservation agriculture as represented by 54.2% of the total responses. Full adoption of conservation agriculture was more in Laikipia North (32.9%). In Laikipia county, 42% of the respondents do not practice agroforestry, while 37% and 33% had partially and fully agroforestry respectively. Majority of the respondents from the overall sample had fully adopted pest and disease control practices and technologies as represented by 54.4% of the total responses. This was closely followed by respondents who had partially adopted 37.5%. Pest and disease control practices and technologies full adoption was more in Laikipia West (61.9%) and Laikipia East (56.4%). According to the overall sample, majority of the respondent had fully adopted diversification as represented by 51.8% of the total responses. The full adoption of diversification was more in Laikipia West (63.0%) and Laikipia North (45.7%).These results imply the need to support farmers in their adoption of CSAPs that require an initial outlay (capital investment). Such support may come from government and development partners' interventions.

Table 4 here

Extent of Adoption by Number of Years and intensity

Table 5 presents results on extent of adoption by years. Majority of the farmers had implemented climate smart agriculture practices and technologies for 0 – 10 years as represented by 76.7% of the total responses. In 0-10years, farmers had implemented conservation agriculture (85.0%), agroforestry (84%), and pest and diseases control (79%).The duration of continuous practice of the selected CSAPs among smallholder farmers ranged between zero years and 50 years. The most implemented CSAP in the study area were diversification in production systems (5.96 years), pest and disease control (5.77) and water harvesting and use (5.57). Conservation Agriculture and agroforestry had been implemented for an average of 4.44 and 4.01 years, respectively.

Table 5 here

The extent of adoption of selected climate smart agricultural practices was also assessed with respect to the intensity of practice (number of specific types of CSAPs) (**Table 6**). Three possible forms of water harvesting was taken as water storage through a pool/dams/pits/retaining ridges, etc.), water-use efficiency (e.g. drip irrigation) and manual watering of crops (e.g. bucket). Six possible versions of pest and disease control CSAP were considered as follows: drought tolerant varieties of crops, pest/disease tolerant varieties of crops, biological weed control, companion planting and use of pesticides/fungicides. Conservation Agriculture (CA) as a form of climate smart agriculture was assessed in terms of four levels depending on adoption and non-adoption of three types of practices/technologies namely, minimal mechanical soil disturbance (i.e. minimum tillage and direct seeding), mulching and rotations or sequences and associations of crops. The extent of adoption of agroforestry as a climate smart agricultural practice was measured in terms of three levels (non-growing of trees, planting and maintenance of trees and shrubs and other forms of agroforestry practices). Diversification (diversified production systems) was assessed in three main levels (keeping of livestock as well as growing of crops, growing of different types of crops and engagement in both farm and off-farm activities). Due to the differences in the size of scales that were used in assessing the intensity of practice of selected CSAPs, the original values were transformed into values ranging between zero and one (normalized values). Based on the normalized values of extent of adoption of the selected CSAPS, diversification was the most adopted practice/technology at 77.5% followed by agroforestry at 62.7%. Others included: Conservation Agriculture (52.8%), water harvesting and use (42.8%) and pest and disease control (27.5%).

Table 6here

4. CONCLUSION

This study assessed the extent of adoption of selected climate smart agricultural practices in terms of number of adopters, the area that the practices were implemented on, degree of adoption (full adoption, partial adoption, non-adoption), number of years of continuous practice and intensity of practice (number of specific types of CSAPs).Pest and disease control and diversified production systems were the most adopted CSAPs in terms of number of farmers who had implemented the practices. In terms of area under implementation, pest and disease control practice and technology was the highest adopted CSAP. Pest and disease control and diversified production systems were the most adopted climate smart agricultural practices in terms of extent of adoption of selected CSAP. The most implemented CSAP in terms of duration of continuous practice were diversification in production systems, pest and disease control and water harvesting and use. In terms of intensity of practice (number of specific types of CSAPs), diversification and agroforestry were the most adopted practices/technologies. There were fewer farmers who had adopted water harvesting/use, conservation agriculture and agroforestry CSAPs, yet Laikipia county is largely a semi-arid county. Extension service at both national and county levels should focus on these approaches given their potential in improving water availability (and moisture content) for crop farming.

CONSENT

Not applicable

ETHICAL APPROVAL

Not applicable

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FIGURES

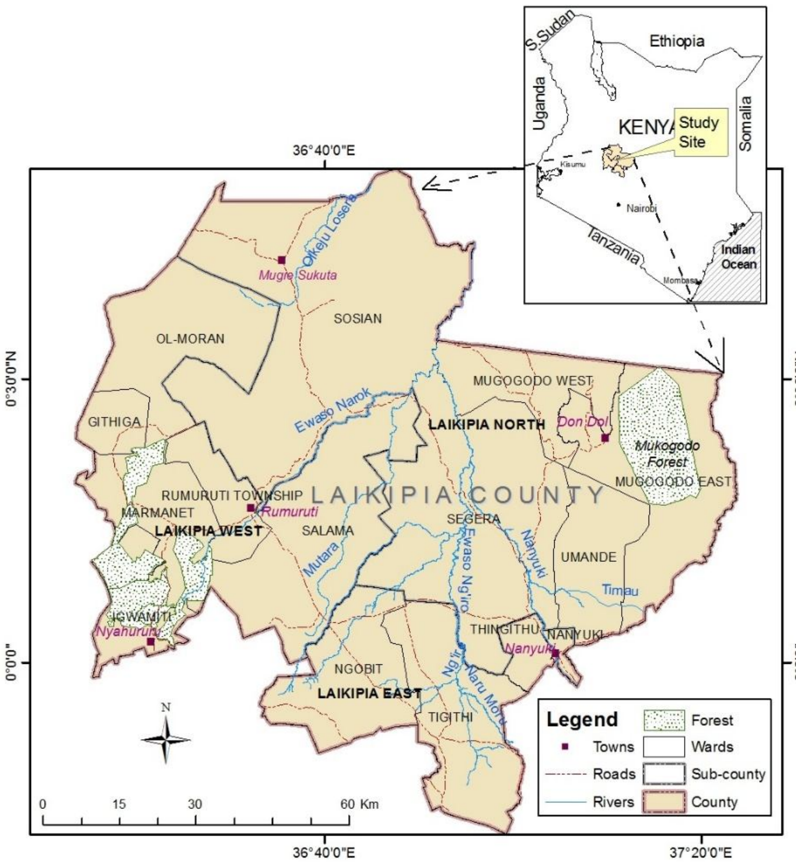

Figure 2: Map of Laikipia County, the study area
(Source: State Department of Lands, Laikipia County (2022)

TABLES

Table 1: Sample Size Selection per Sub-County in Laikipia County

Sub-County	Population	Households	Percent	Sample size
Laikipia East	187,707.92	26,888.54	36.2%	139
Laikipia West	195,810.42	28,049.19	37.8%	145
Laikipia North	135,041.67	19,344.27	26.0%	100
Total	518,560.00	74,282.00	100.0%	384

Source: Rep. of Kenya (2019)

Table 2: Specific forms of CSAPs implemented by respondents

CSAPs	*Specific CSAPs*	*Laikipia East*	*Laikipia West*	*Laikipia North*	*Overall*	*%*	*Pearson χ^2*	*df*	*P-value*
Water harvesting and use	Water storage through a pool/dams/pits/retaining ridges	54(28.1%)	108(56.3%)	30(15.6%)	192	50.0%	12.896a	2	0.002
	Practice water-use efficiency (e.g. drip irrigation)	14(16.3%)	63(73.3%)	9(10.5%)	86	22.4%	30.487a	2	0.000
	Manual watering of crops (bucket)	81(37.7%)	100(46.5%)	34(15.8%)	215	56.0%	2.906a	2	0.234
Pest and disease control	Adopting new drought tolerant varieties of crops	57(27.1%)	119(56.7%)	34(16.2%)	210	54.7%	17.501a	2	0.000
	Adopting pest/disease tolerant varieties of crops	58(23.2%)	151(60.4%)	41(16.4%)	250	65.1%	55.107a	2	0.000
	Biological weed control	83(45.1%)	61(33.2%)	40(21.7%)	184	47.9%	28.231a	2	0.000
	Companion planting	48(21%)	145(63.3%)	36(15.7%)	229	59.6%	64.112a	2	0.000
	Use of pesticides/fungicides	94(30.6%)	160(52.1%)	53(17.3%)	307	79.9%	15.975a	2	0.000
	Others	18(30.5%)	31(52.5%)	10(16.9%)	36	9.4%	21.876a	4	0.000
Conservation Agriculture	Minimal mechanical soil disturbance	76(38.6%)	74(37.6%)	47(23.9%)	197	51.3%	16.710a	2	0.000
	Mulching	73(30.7%)	112(47.1%)	53(22.3%)	238	62.0%	8.443a	2	0.015
	Rotations or sequences and associations of crops.	112(39.2%)	129(45.1%)	45(15.7%)	286	74.5%	11.433a	2	0.003
Agroforestry	Planting and maintenance of trees and shrubs	71(38%)	82(43.9%)	34(18.2%)	187	48.7%	12.004a	2	0.002
	Others	1(3.8%)	25(96.2%)	0(0%)	24	6.3%	45.120a	4	0.000

Diversifying production systems	Keeping of livestock as well as growing of crops	110(34.5%	156(48.9%)	53(16.6%)	319	83.1%	13.957a	2	0.138
	Growing of different types of crops	119(35.7%)	164(49.2%)	50(15.0%)	333	86.7%	17.463a	2	0.000
	Engagement in both farm and off-farm activities	75(31.3%)	128(53.3%)	37(15.4%)	240	62.5%	10.111a	2	0.006

Table 3: Land area (in acres) under the CSAPs

Climate Smart Agricultural Practice	***Laikipia East***	***Laikipia West***	***Laikipia North***	***Overall***	***Total***	***F-ratio***	***P-value***
Water harvesting and use	0.226	0.394	0.030	0.40	0.453	7.031	0.001
Conservation Agriculture	0.781	0.862	0.400	0.91	0.933	5.108	0.006
Agroforestry	0.474	0.315	0.208	0.28	0.350	7.185	0.001
Pest and disease control	1.472	1.300	0.501	1.29	1.395	5.094	0.007

Degrees of freedom: numerator = 2; denominator = 379; Critical F-ratio = 3.02

Table 4: Extent of Adoption of Selected Climate Smart Agricultural Practices

Sub-county	**CSAPs**	**Not AdoptedN(%)**	**Partially AdoptedN(%)**	**Fully AdoptedN(%)**	**Total (%)**
Laikipia East	Water harvesting and use	47(35.3)	51(38.3)	35(26.3)	133(100)
	Conservation Agriculture	39(29.3)	70(52.6)	24(18)	133(100)
	Agroforestry	59(44.4)	63(47.4)	11(8.3)	133(100)
	Pest and disease control	12(9)	46(34.6)	75(56.4)	133(100)
	Diversification	25(18.8)	55(41.4)	53(39.8)	133(100)
Laikipia West	Water harvesting and use	29(16)	58(32)	94(51.9)	181(100)
	Conservation Agriculture	44(24.3)	102(56.4)	35(19.3)	181(100)
	Agroforestry	74(40.9)	47(26)	60(33.1)	181(100)
	Pest and disease control	2(1.1)	67(37)	112(61.9)	181(100)
	Diversification	45(24.9)	22(12.2)	114(63)	181(100)
Laikipia North	Water harvesting and use	16(22.9)	32(45.7)	22(31.4)	70(100)
	Conservation Agriculture	11(15.7)	36(51.4)	23(32.9)	70(100)
	Agroforestry	29(41.4)	31(44.3)	10(14.3)	70(100)
	Pest and disease control	17(24.3)	31(44.3)	22(31.4)	70(100)
	Diversification	9(12.9)	29(41.4)	32(45.7)	70(100)
Overall sample	Water harvesting and use	92(24)	141(36.7)	151(39.3)	384(100)
	Conservation Agriculture	94(24.5)	208(54.2)	82(21.4)	384(100)

Agroforestry	162(42.2)	141(36.7)	81(21.1)	384(100)
Pest and disease control	31(8.1)	144(37.5)	209(54.4)	384(100)
Diversification	79(20.6)	106(27.6)	199(51.8)	384(100)

Table 5: Number of years Practice

Number of years practice	Water harvesting and use	Conservation Agriculture	Agroforestry	Pest and disease control	Diversifying production systems
0-10	293(76.7%)	324 (85%)	319 (83.5%)	302(79.1%)	291 (76.4%)
10-20	67 (17.5%)	55 (14.4%)	54 (14.1%)	76 (19.9%)	66 (17.3%)
20-30	17(4.5%)	2(0.5%)	9(2.4%)	4(1%)	21(5.5%)
30-40	4(1%)	0(0%)	0(0%)	0(0%)	0(0%)
40-50	1(0.3%)	0(0%)	0(0%)	0(0%)	3(0.8%)
Mean	5.57	4.44	4.01	5.77	5.96
Total	382(100%)	381(100%)	382(100%)	382(100%)	381(100%)

Table 6: Extent based on the Intensity of Practice (number of specific types of CSAPs)

Climate Smart Agricultural Practice	**Original values**				**Normalized values**			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Water harvesting/use	1.28	0.94	0	3	0.428	0.31	0	1
Conservation Agriculture	3.17	1.39	0	6	0.528	0.23	0	1
Agroforestry	1.88	1.02	0	3	0.627	0.34	0	1
Pest and disease control	0.55	0.56	0	6	0.275	0.28	0	1
Diversified prod. Systems	2.32	0.88	0	3	0.775	0.29	0	1