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Culture as a Predictor of Effective Adoption of Climate-Smart Agriculture in Mbeere North, Kenya

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Abstract

The research advances the existing extension education knowledge by illustrating the relationship between culture and adoption of Climate-Smart Agriculture (CSA). Using a sample of 127, the study adopted a descriptive correlational design to gather data that addressed the hypotheses. The sample was selected randomly through systematic sampling procedures covering all parts of the sub-county. A semi-structured questionnaire was utilized to gather data. Independent samples t-test and multiple regression analysis were applied in data analysis. The results indicated that farmers who received climate-smart information compared to farmers not receiving the information demonstrated significantly higher CSA practices adoption levels. A combination of cultural elements significantly predicted the adoption of climate-smart practices. The moderate effective adoption rates witnessed may have been contributed by limited access to extension services and cultural barriers. Among the cultural elements inability of extension agents to communicate in the local language was found to be the main inhibitor to effective dissemination and subsequent adoption. Hence, extension agents conversant with local language should be recruited to break the communication barrier to improve the diffusion of CSA practices. The county extension agents should be encouraged to use a mix of mass media extension education methods so as to expand the coverage.

Keywords

Extension education, indigenous knowledge, information access, sustainability

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Introduction and Problem Statement

Climate smart agriculture (CSA) has been cited as a key element in climate change risk management (Muriithi et al., 2021; United States Agency for International Development [USAID], 2016). To mitigate climate change agricultural systems must be resilient to sustain crop and livestock production ecologically, economically, and socially (National Sustainable Agriculture Coalition [NSAC], 2019). CSA helps in building resilience of agricultural systems to climate change by minimizing greenhouse gas (GHGs) emissions (Government of Kenya [GoK], 2017). Research has shown that suitable agricultural practices are capable of offsetting up to 20% of carbon dioxide (CO2) emissions in a year (Thornton & Herrero, 2010). A study by Lobell and Gourdji (2012) showed that global crop production is likely to drop by 5% by 2050 and about 1.5% every decade without climate change adaptation. Kenya's policies and legislations are not robust to ensure a smooth coordination of CSA programs meant to address climate change hazards (GoK, 2017). The CSA programs' implementation is also impeded by among others, poor infrastructure, inadequate extension capacity, unsuitable land tenure system, outdated traditions, and culture (Mutoko et al., 2015).

Climate change adaptation research has been undertaken widely and in large scales, however, little information exists on the subject at local levels (Perez, et al., 2015; Wreford et al., 2010). Moreover, the lack of data on effective climate-resilient strategies is the main impedement to formulation and implementation of robust localised adaptation and mitigation policies. Although there is a growing body of literature on CSA (Anuga et al., 2019; Murray et al., 2016) much remains to be unveiled regarding the forms of interactions that are most effective at generating equitable gains. Moreover, little is known about the correlation between cultural elements and effective adoption of climate-smart practices.

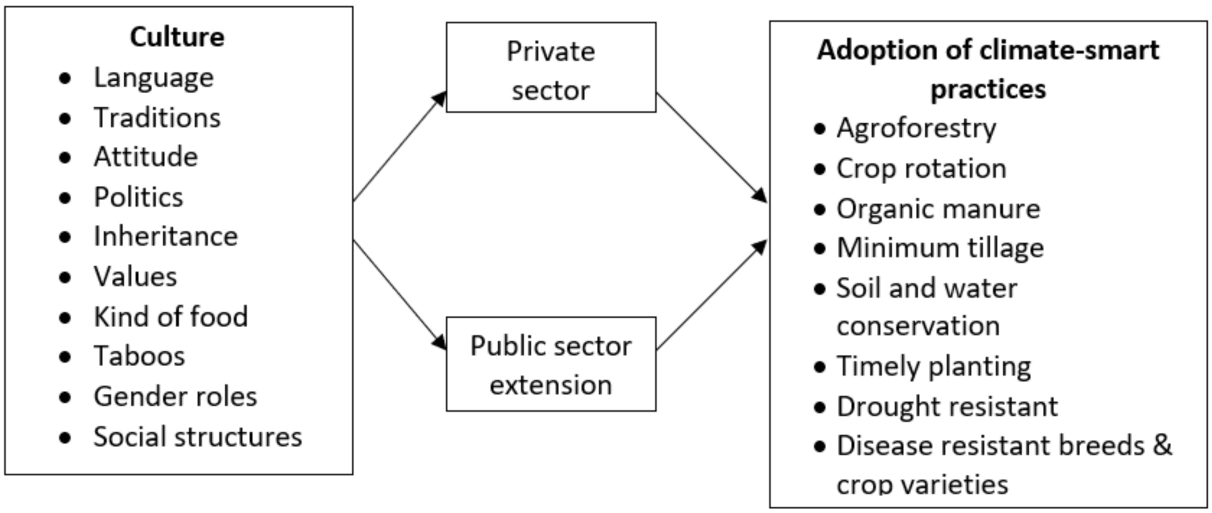
Theoretical and Conceptual Framework

This research hypothesized that culture plays a significant role in the effective dissemination and adoption of climate-smart agricultural practices as shown in Figure 1. The diffusion and adoption of practices occurs within social and cultural systems (Rogers, 2003). As observed by Katz (1961) knowledge of social structures enables extension agents to locate potential adopters in a social system. The social system's norms serve as a guide that describes the acceptable behavior either in form of taboos, folkways or mores. As such the norms can deter the adoption of some practices (Rogers, 2003).

The farmers attitudes, desires, and expections are driven by the society's culture and the groups they belong to in the social structure. Notably, farmers' attitudes correlates positively with adoption of technologies (Gikunda et al., 2021; Kanyi et al., 2017). Therefore, extension approaches should be aligned with farmers cultural norms and aspirations (Millar, 2009). However, as reported by Rogers (2003) very few studies exist to illustrate how social stuctures affects diffusion and adoption of innovations. The dissemination of CSA in Kenya and Mbeere in particular is undertaken by both private and public sector organizations. Although effective dissemination and adoption of the CSA practices in the target area would require appropriate communication channels and an understanding of the local langauge, farmers are more likely to adopt the practices based upon the past experiences with ecologically responsible behaviors (Gikunda et al., 2022; Moyo & Salawu, 2017).

Figure 1

Conceptual framework



Purpose

The purpose of this research was to generate data that would shed light on the amount of variation accounted for by culture in effective dissemination and adoption of climate-smart practices.

The specific research objectives were to: (a) determine if farmers with and without access to information differed significantly based upon the adoption levels of climate-smart practices, and (b) find out if language, traditions, attitude, politics, religious beliefs, and values are significant predictors of effective adoption of climate-smart practices.

Methods

This research is a part of a larger study being conducted in Mbeere North Sub-county by several research teams (Gikunda et al., 2022). The research project employed a correlational survey design involving a population of 2,047 farmers (Chimoita et al., 2017). The design was considered suitable since the study was intended to relate culture to adoption of climate-smart practices (Fraenkel et al., 2015). The study sample was comprised of 127 farmers selected through systematic random sampling (Fraenkel et al., 2015). Out of 127 farmers, 66 were female (52%) while 61 were male (48%). The respondents farm sizes ranged from 0.25 to 15 acres (*M* = 3.89, *SD* = 2.79). The research data was gathered using a peer reviewed semi-structured questionnaire. The questionnaire was comprised of majorly five-point Likert-type items covering the main study variables. With the assistance of trained enumerators, the questionnaires were distributed to farmers in their respective households. A pilot study involving male (n = 12) and female (n = 18) farmers was conducted in Embu North Sub-county to establish the reliability and validity of the research instrument prior to the main study. Sudman (1983) recommends a pilot study sample of between 12 and 50 participants in a survey research. The pilot study data was subjected to reliability analysis by use of SPSS. The resulting Cronbach's alpha values were adoption of climate-smart practices (M = 3.89, α = .69), and cultural elements (M = 2.16, α =.59). The results shows that adoption and cultural elements variables did not attain the acceptable coefficients, hence additional items were included to raise the values as recommended by George and Mallery (2003).

An independent samples t-test was conducted to determine if farmers with and without access to information differed significantly based upon the adoption of climate-smart practices. The values of skewness (-0.29) and kurtosis (-1.15) were within the acceptable levels indicating that data were normally distributed (George & Mallery, 2010). The resulting insignificant Levene's statistics F (120) = 0.48, p = 0.49 showed that the assumption of homogeneity of variance had been met (Levene, 1960). Multiple regression was performed to determine if language, traditions, attitude, social structures, kind of food, literacy level, politics, taboos, gender roles, and values were significant predictors of effective adoption of climate-smart practices. An examination of the correlation matrix revealed a lack of perfect correlations between predictor variables. The correlations ranged from r = - 0.01, p = 0.89 (very weak) to r = - 0.70, p < .01(substantial) (Davis, 1971). The variance inflation factors (VIFs) ranged from 1.36 to 2.28 while tolerance statistics varied from 0.44 to 0.74 signifying a lack of perfect multicollinearity (Menard, 1995; Myers, 1990). The three diagnostic test statistics indicated that the assumption of lack of perfect multicollinearity had been met.

Findings

The dissemination of climate-smart practices in Mbeere Sub-county is undertaken by public (n = 22, 17.3%), private (n = 25, 19.7%) and/or both sectors (n = 64, 50.4%). This shows that about half of the farmers in the area were receiving information on the practices from both private and public extensionists. The public sector extensionists included county agricultural officers as well as researchers from universities and research stations such as Kenya Livestock and Research Organization, and Kenya Forestry Services. Organizations such as agrochemical companies, churches, and community-based organizations (CBOs) formed a part of the private sector extensionists that provided advice to farmers. However, a significant number of farmers (n = 16, 12.6%) had no access to climate-smart extension education. This indicates the need for extension service to be expanded to cover more farmers in the area so as to raise the uptake of climate smart practices. This implied that there was inadequate delivery of extension services in disseminating CSA and can be taken to mean that extension agents' particularly those working for the state were not doing enough to disseminate a diverse mix of CSA practices to farmers. A fact that was further alluded by some farmers (n = 38, 29.9%) who indicated that they had not received information relating to climate-smart information.

Moreover, the mean annual number of contacts involving farmers and extension agents was very low (M = 2.03, SD = 2.23). The finding confirms the results of previous research in the county which reported a lack of access to quality information to farmers (Kavita, 2018). Many of the farmers who did not have direct access to extension advise relied upon radio programs (M = 3.45, SD = 1.06) and indigenous knowledge (Muthee et al., 2019). One of the most common radio stations that provided agricultural information in local language to a majority of farmers was Inooro FM. The use of indigenous knowledge may have resulted from the farmers' continued engagement in traditional agriculture that is largely rain-fed.

Access to Information and Effective Adoption of Climate-Smart Practices

The first objective sought to determine if farmers with access to information differed significantly from those without based upon the adoption levels of climate-smart practices. An independent samples *t*-test was performed to test the hypothesis. Table 1 presents the descriptive and *t*-test results for access to information and adoption levels of climate-smart practices. The results indicated that farmers who received climate-smart information (n = 84, M = 60.52, SD = 9.71) compared to farmers not receiving the information (n = 38, M = 55.21, SD = 9.68) demonstrated significantly higher practices adoption levels, t (120) = -2.80, p = 01. The resulting Cohen's *d* was 0.55 signifying a medium effect (Cohen, 1992). This implied that access to information had a medium effect on adoption of climate-smart practices. It is also clear from the findings that a significant number of farmers were not receiving agricultural information in the sub-county. Since the farmers receiving information reported higher adoption scores, it can be taken to mean that improving access to climate-smart information would improve the adoption of the practices (Jack & Tobias, 2017).

Table 1

Descriptive and t-Test Statistics for Access to Information and Effective Adoption of Climate-Smart Practices (N = 122)

Group [a]	*n*	*M*	*SD*	*t*	*Df*	*p*
Receiving information	84	60.52	9.71	-2.80	120	.01
Not receiving information	38	55.21	9.68			

Note. [a] = 1 = Yes, 0 = No; Levene's p = .49

Table 2 presents the means and standard deviations of cultural aspects that are thought to influence effective adoption of climate-smart practices. The results indicated that the prevailing cultural values such as respect and responsibility (M = 3.00, SD = 1.60), bias on particular kinds of food (staple food) (M = 2.88, SD = 1.44), inability of extension agents to communicate in the local language (M = 2.80, SD = 1.65), and illiteracy levels structures (M = 2.76, SD = 1.22) were likely to deter the adoption of climate-smart practices to a great extent.

Table 2

Descriptive Statistics for Cultural Elements [a] and Effective Adoption of Climate-Smart Practices [b] (N = 120)

Cultural elements	*M*	*SD*
Prevailing cultural values such as respect and responsibility	3.00	1.60
Bias on particular kinds of food (staple food)	2.88	1.44
Inability of extension agents to communicate in the local language	2.80	1.65
Illiteracy levels	2.76	1.22
Political interference	2.09	1.20
Rigid social structures	1.95	.96
Negative attitude towards the practices	1.88	1.16
Unfavorable societal taboos	1.83	1.16
Production resource acquisition (inheritance) e.g. women cannot inherit land	1.83	1.07
Gender roles; male and female roles	1.65	.99
Conservation of societal traditions such as women taking farm decisions	1.54	.93

Note. [a] 1 = Not at all; 2 = slight extent; 3 = moderate extent; 4 = great extent; 5 = very great; [b] = Not at all, 2 = rarely; 3 = sometimes; 4 = occasionally; 5 = always; effective adoption of climate-smart practices, *M* = 58.95, *SD* = 10.07

Previous research shows that extension competency and farmers' education levels are among the main determinants of agricultural technologies adoption rates (Suvedi et al., 2017). The applicability of the practices would require a clear understanding of the disseminated information. As such farmers must be educated for a complete grasp of the concepts to be realized. In situations where the farmers are not educated, the extension agent must be able to deliver the message in a language that is easily understandable to the clients. This can also be enhanced by applying a mix of extension methods such as experiential learning (field days and field demonstrations) that would allow the uneducated farmers to observe the practices in the course of the implementation. A majority of the farmers also felt that gender roles (*M* = 1.65, *SD* = 0.99) and conservation of societal traditions such as women taking farm decisions (*M* = 1.54, *SD* = 0.93) were less likely to affect effective application of the practices. This implied that culture played a pivotal role in the dissemination and adoption of climate-smart practices. A confirmation of an observation made by Rogers (2003) that culture is a critical pillar in agriculture as it can either impede or enhance diffusion and adoption of agricultural innovations.

Effective Adoption of Climate-Smart Practices

The adoption of CSA practices was assessed through summated scores of five-points Likert-type items. The scale for adoption of practices was comprised of 16 items (Table 4) each item consisting of five points; giving a total of 80 points. An assessment of the adoption rates of the practices revealed that out of the 127 farmers who were engaged in the study, only 13 (10.24%) were utilizing the practices sustainably (Table 3). However, a majority of the farmers (*n* = 72, 56.69%) frequently applied the practices in their farms. The poor adoption rates (*n* = 26, 20.47%) witnessed among some farmers may have been contributed by inefficiencies and/or ineffectiveness on the part of the extension agents, cultural barriers, farm, and farmer related factors (Mwamakimbula, 2014; Mwangi & Kariuki, 2015). As shown in Table 3, the adoption scores ranged from 40 to 79. On average (*M* = 59.08, *SD* = 9.83) a majority of farmers had fairly adopted the practices. This calls for a concerted effort among the stakeholders to improve the adoption so as to successfully manage the climate changes being experienced.

Table 3

Distribution of Farmers by the Adoption Scores [a] (N = 127)

Adoption scores	Frequency (*f*)	Percent (%)
40 – 47	26	20.47
48 -55	16	12.60
56 – 63	35	27.56
64 – 71	37	29.13
72 – 79	13	10.24

Note. [a] 1 = Not at all, 2 = rarely, 3 = sometimes, 4 = occasionally, 5 = always; *M* = 59.08, *SD* = 9.83

As shown in Table 4, timely planting (*M* = 4.44, *SD* = 0.85), terracing (*M* = 4.28, *SD* = 1.06), cover-cropping (*M* = 4.28, *SD* = 1.09), use of organic manure (*M* = 4.26, *SD* = 1.13), and use of legumes in crop rotation (*M* = 4.22, *SD* = 1.08) were among the most frequently applied practices. This shows that a majority of farmers in the area concentrated on land-use system practices at the expense of other climate change mitigation practices. The integration of trees with crops and/or livestock (*M* = 3.19, *SD* = 1.35), use of improved livestock breeds (*M* = 2.89, *SD* = 1.36), and the cultivation of crops with zero or minimum tillage (*M* = 2.63, *SD* = 1.41) were only utilized from time to time. Based on the findings, many of the practices were applied from time to time in a year rather than in a sustainable manner so as to cushion farmers from the risks associated with changes in climate (Asfaw & Lipper, 2016).

Table 4

Descriptive Statistics for Adoption of Climate-Smart Practices (N = 127)

Practice [a]	*M*	*SD*
Timely planting	4.44	.85
Use of terraces	4.28	1.06
Use of cover crops	4.28	1.09
Use of organic manure	4.26	1.13
Use of legumes in crop rotation	4.22	1.08
Intercropping to maximize space	4.20	1.22
Use of drought resistant crop varieties	3.94	1.51
Use of mulching	3.72	1.27
Diversified crop and animal breeds	3.65	1.24
Use of disease resistant varieties	3.63	1.63
Contour farming	3.46	1.28
Diversification of water sources e.g. rainwater harvesting	3.24	1.49
Water saving irrigation methods	3.03	1.40
Agroforestry	3.19	1.35
Use of improved livestock breeds	2.89	1.36
Minimum tillage	2.63	1.41

Note. [a] = 1 = Not at all, 2 = rarely, 3 = sometimes, 4 = occasionally, 5 = always

Culture and Effective Adoption of Climate-Smart Practices

Objective two sought to examine if cultural elements were significant predictors of effective adoption of climate-smart practices. Multiple regression analysis was conducted to determine if cultural elements were significant predictor of effective adoption of climate-smart practices. The analysis revealed that a combination of cultural elements explained a significant variation in the adoption of climate-smart practices, $[R^2 = .21,\ R^2_{adj} = .13, F(11{,}108) = 2.66, p = .001]$ as shown in Table 5. Specifically, the cultural elements accounted for 21% of the variance and this shows that culture had a medium effect on the adoption of the practices (Field, 2017).

The resulting model was summarized as follows;
Effective adoption = 57.13 + (.01 traditions) - (1.48 language) + (1.72 structures) + (1.72 values) + (1.32 food type) + (1.39 politics) - (.73 literacy) – (.58 taboos) – (.74 attitude) – (.42 inheritance) – (2.43 gender roles) + ε

Table 5

Regression Analysis for Cultural Elements[a] to Effective Adoption of Climate-Smart Practices[b] (N = 120)

Variables	*b*	*SE B*	*Β*	*p*
(Constant)	57.13	3.51		.00
Societal traditions	.01	1.07	.00	.99
Local language	-1.48	.66	-.24	.03
Social structures	1.72	1.05	.16	.11
Cultural values	1.72	.81	.27	.04
kinds of food (staple food)	1.32	.87	.19	.13
Politics	1.39	.85	.17	.11
Literacy levels	-.73	.83	-.09	.38
Societal taboos	-.58	.96	-.07	.55
Attitude towards the practices	-.74	.98	-.09	.45
Inheritance of resources	-.42	1.05	-.05	.69
Gendered roles	-2.43	1.11	-.24	.03

Note. [a] 1 = Not at all, 2 = slight extent, 3 = moderate extent, 4 = great extent, 5 = very great; [b] 1= Not at all, 2 = rarely, 3 = sometimes, 4 = occasionally, 5 = always; F (11, 108) = 2.66, p = 0.01 R^2 = 0.21, $R^2_{Adjusted}$ = 0.13

It was also found (Table 5) that local language (b = -1.48, t = -2.25, p = .03), cultural values (b = 1.72, t = 2.13, p = .04), and gender roles (b = -2.43, t = -2.18, p = .03), significantly predicted effective adoption. However, societal traditions (p = .99), social structures (p = .11), kind of food (p = .13), politics (p = .11), literacy levels (p = .38), taboos (p = .55), attitude towards the practices (p = .45), and inheritance (p = .69) were not significant predictors. This implied that increased inability of extension agents to communicate in the local languages would inhibit effective diffusion of climate-smart practices and subsequently slow the adoption levels. An enhancement of the prevailing cultural values in the sub-county would provide a conducive environment for the dissemination of the practices thus, increase the adoption. However, an increase in gender roles demarcation would reduce the adoption rates for the practices. This means that language, cultural values, and gendered roles are very important cultural aspects that extensionists must put into consideration when planning and implementing extension education programs not only on climate-smart but also in other areas of agriculture. Failure to incorporate culture in the programs would then result in inefficiencies.

Conclusions, Discussion, and Recommendations

The adoption of climate-smart practices in Mbeere North Sub-county was moderately effective. This was due to minimal dissemination of information relating to the practices; a service offered by private and public sector extensionists (Gikunda et al., 2022). As such a majority of the farmers utilized indigenous knowledge and own experiences which were culturally embedded. Timely planting, terracing and cover cropping were the most frequently practices utilized. Although the majority of the farmers were receiving climate-smart information, a reasonable number had no access to it. This establishes a climate-smart extension education need that calls for a collaborative effort between the private and public sector extensionists operating in the area. The utilization of mass extension methods such as the use of text messages, radio, and television programs should be expanded to supplement the few individual farm visits, off –farm, and field demonstrations that are occasionally applied. This would also go a long way in addressing the problem of high extension to farmer ratio (Davis, 2008).

Culture was key to effective dissemination and adoption of climate-smart practices (Gikunda et al., 2021). Among the cultural elements, language, cultural values, and gendered roles were more likely to inhibit or enhance the diffusion and adoption processes. However, politics, societal traditions, taboos, attitude, social structures, kind of food, and farmers' literacy levels were less likely to influence the processes. The increasing inability of frontline extension workers to communicate in the local language repressed effective dissemination of CSA practices and subsequent adoption rates. To address the problem, communications barriers should be removed through learning of local languages by extensionist, translation of extension messages to local languages, and among others. A mix of staff with in-depth understanding of the local languages would also address the communication problem as well as enhancing community diversities and/or co-existence. Entrenchment and continued transfer of the cultural values to the upcoming farmers should be sustained to expand the adoption of the practices. This is due to the finding that cultural values favored CSA adoption. Clarity of roles in the communities also favored the utilization of the practices and as such it should be carried over generations. Therefore, it is important for the agents to attune the extension programs especially those related to CSA in line with the clients' cultural values and traditions in order to boost the adoption rates. This study focused on the relationship between culture and adoption of the practices therefore, research is needed to establish the influence of culture on effective dissemination of the CSA practices since dissemination is positively correlated to adoption.

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