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QUALITY OF CLIMATE-SMART AGRICULTURAL ADVICE OFFERED BY PRIVATE AND PUBLIC SECTORS EXTENSIONISTS IN MBEERE NORTH SUB-COUNTY, KENYA

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ABSTRACT

This research adds to knowledge of extension education by revealing the quality of climate-smart agricultural (CSA) advice offered by private and public extension sectors. The study was aimed at addressing the paucity of empirical data that exists relating the quality of CSA advice. Using a semi-structured questionnaire, the descriptive correlational study gathered data from a systematic sample of 109 farmers. Data were analyzed using Pearson's correlation and ANOVA tests. There was a moderate positive correlation between extension effectiveness and adoption of CSA, $r = 0.37$, $p = < 0.01$. There were significant differences between public, private, and both sectors in relation to the quality of information disseminated, $F (2) = 12.98$, $p = < 0.01$.The quality of private sector's advice (36.24 ± 10.94) was significantly lower than that of public sector (45.27 ± 6.92, $p = 0.01$) and both sectors (47.98 ± 10.07, $p = < 0.01$). The quality of CSA advice was generally fair, even though collaborative effort between public and private would yield better quality advice. Heightened dissemination of CSA practices would improve the adoption of the practices among farmers. There is need to design and implement intricate CSA programs involving both sectors of extension to improve the adoption levels of the practices in Mbeere North.

Keywords: adoption, climate-smart agriculture, Extension advice**,** effectiveness, quality

INTRODUCTION

The climatic changes currently being experienced in the globe have resulted in reduced livestock and crop yields thus threatening farmers livelihoods especially in rural areas (World Bank Group, 2015; Oduniyi & Tekana, 2019). The climate risks are expected to increase in the coming decade especially in less developed countries. Globally, more than a billion farmers are facing the climate related risks and hazards (Nagargade, Tyagi, & Sigh, 2016). It is estimated that between 5 to 170 million people will be food insecure by 2080 in Africa as a result of climate change (Rosegrant, Ewing, Yohe, Burton, & Huq, 2008). To mitigate the climate risks such as heat stress, flooding and drought, climate smart agriculture (CSA) was developed. CSA has the potential to improve productivity, resilience of farming systems, and mitigate climate change (MoALF, 2017; Netherlands Enterprise Agency, 2019). CSA encompasses verified practices such as mulching, intercropping, minimum tillage, crop rotation, integrated crop- livestock management, agroforestry, improved grazing and improved water, management (Jirata, Grey, & Kilawe, 2016; World Bank & CIAT, 2015). CSA also encompasses practices such as improved weather forecasting, early- warning systems and climate-risk insurance. Technologies such as remote sensing, global positioning systems, and cloud sensing have been incorporated in CSA farming systems (Adamides, 2020).

It is projected that between 140 and 300 billion US dollars annually are needed in less developed countries to adopt CSA by 2030 (UNEP, 2016). Although significant amount of resources have been secured to promote the dissemination and application of CSA, many of smallholders lack adequate skills and knowledge (Jirata, Grey, & Kilawe, 2016). The effects of widespread application of the practices have not been investigated (De-Pinto, et al., 2020). Sustained incorporation of CSA into national agriculture and food security programs is a necessity in realizing greater resilience to climate change in Africa, Asia, and Latin America. Safe access and control of land, water and natural resources will be critical for improved utilization of CSA practices (USAID, 2016). Kenya has not realized the benefits of CSA due to low adoption rates resulting from poor policies formulation and implementation, worsened by duplication of roles and inefficiencies among institutions mandated to enforce the policies. However, a variety of initiatives involving the diffusion and adoption of CSA are largely ongoing (World Bank, 2012). Effective CSA drives requires sufficient mechanisms for creating, documenting, and diffusing knowledge through the use of effective procedures and institutional engagements. Climate information and policies are very essential to address the impacts of climate variability (Jirata, Grey, & Kilawe, 2016). Opportunities to increase adaptation and mitigation to climate change go beyond cultivation to postharvest handling, value chains and the larger agri-food system that connects farmers with consumers. The adoption of CSA farming practices can be enhanced through innovative county extension delivery systems and public-private service providers' partnerships (USAID, 2016). This comprises the institutions and players engaged in offering extension and associated services.

Awareness creation on climate change adaptation and mitigation is crucial and should encompass structures of information sharing through field visits and demonstrations (Wambugu, Franzel, & Rioux, 2014). Notwithstanding the recognized significance of CSA by local and international institutions and the continued initiatives in the system's awareness creation, the dissemination and uptake of the CSA innovations and practices is still largely an ongoing, challenging process (Sala, Rossi, & David, 2016). Even though literature on adoption and impact of CSA is growing (Abegunde, Sibanda, & Obi, 2020; Kurgat, et al., 2020; Issahaku, & Abdulai, 2020), researchers have largely neglected to focus on the effectiveness of extension and quality of information disseminated by different sectors. Provision of extension services particularly by private sector has also been skewed towards high potential region (Muyanga & Jayne, 2008). Mbeere North being a semi-arid region may have been underprivileged. A gap that this research was set out to address.

METHODOLOGY

Participants

A descriptive correlational survey was conducted in Mbeere North Sub-county involving a population of 2,047 farmers (MOA, 2010). The design was deemed suitable since the study was aimed at drawing a connection between culture and effective dissemination of climate-smart practices (Fraenkel, Wallen, & Hyun, 2015). The study utilized a sample of 127 farmers selected through systematic random sampling. Fraenkel et al., (2015) observed that a sample of 100 is adequate for a survey research. Of the 127 farmers, sixty six were female (n = 66, 52%) while sixty one were male (n = 61, 48%). The participants farm sizes ranged from 0.25 to 15 acres (M = 3.89, SD = 2.79).

Data Collection

The research was conducted with the assistance of four enumerators selected from the study area. Data collection involved a peer reviewed semi-structured questionnaire that had been distributed to the farmers in the farms. A pilot study was conducted in Embu North Sub-county involving 30 smallholder farmers where 12 were male and 18 were female prior to actual data collection. The Cronbanch' alpha values study variables were; quality of CSA information (M = 4.37, α =.72), extension effectiveness (M = 2.42, α =.72), and adoption of climate-smart practices (M = 3.89, α = .69).

Table 46. Cronbach's Alpha Values for Information Quality, Extension Effectiveness, and Adoption of Practices and Cultural Elements (N = 30)

Variable	**No. of Items**	***M***	**Cronbach's alpha *(α)***
Quality of CSA information[a]	4	4.37	.72
Extension effectiveness[b]	6	2.42	.72
Adoption of climate-smart practices[c]	13	3.89	.69

Note. [a] = 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = excellent; [b] = 1 = not effective, 2 = slightly effective, 3 = moderate, 4 = effective, 5 = very effective; [c] 1 = Not at all, 2 = rarely, 3 = sometimes, 4 = occasionally, 5 = always

Data Analysis

Pearson's correlation test was performed to determine the correlation between effective dissemination and adoption of CSA. A one way Analysis of Variance (ANOVA) was utilized to find out if private, public and both sectors differed based upon the quality of CSA advice. The assumptions of normality and homogeneity of variances were checked before the analysis. The values of skewness (-0.29) and kurtosis (-1.15) were within the acceptable levels indicating that data were normally distributed (George & Mallery, 2010). Levene's test showed that the variances of the three groups; private, public, and both did not differ significantly F (2,112) = 2.15, p = 0.12, hence, homogeneity of variance assumption had been met (Levene, 1960). The hypotheses of the study were tested at 95% level of significance or 0.05 alpha level *apriori*.

RESULTS

The study involved 115 farmers where 59 (51.3%) were male and 54 (47.0%) were female. This implied that most of the households were headed by male farmers. A majority of the farmers were smallholder farmers with farm sizes ranging from 0.25 to 15 acres (M = 4.22 acres, SD = 2.91). Very few farmers (n = 24, 20.9%) had received CSA advice in the sub-county as a result of few contacts (M = 2.60, SD = 4.89) with the extension staff. This may have resulted from the inefficiencies and inadequacy of county extension staff. However, most of the farmers (n = 68, 59.1%) were receiving advice on general agricultural production from both private and public sector extension staff (Muyanga & Jayne, 2008).

Effectiveness of Extension Services

Many of the farmers stated that information disseminated was easy to apply (*M* = 4.16, *SD* = 1.00, materials provided were written in simple language (*M* = 4.06, *SD* = 1.09), and extensionists utilized local languages (*M* = 4.03, *SD* = 1.14). Nonetheless, extension service providers were moderately effective in the dissemination of CSA information. The information provided was generally moderately met the farmers' needs (*M* = 3.99, *SD* = 1.15), offered at the right season (*M* = 3.81, *SD* = 1.09), up to date (*M* = 3.80, *SD* = 1.07), resulted in CSA practices adoption (*M* = 3.77, *SD* =1.34), and timely manner (*M* = 3.73, *SD* =1.17). The deficiency in effectiveness may have been brought about by inadequate extension resources resulting in few farmer-extension staff contacts as reported by Odhong', Wilkes, & Dijk, (2018). Many of the farmers received information from mass media such as television and radio programs that did not necessary target the needs and may not have been adequate to drive adoption.

Table 47. ***Descriptive Statistics for Effectiveness of Extension (N =115)***

Statement	***M***	***SD***
The practices disseminated are easy to apply	4.16	1.00
The materials provided are written in simple language	4.06	1.09
Extension providers utilize local languages to ease understanding of diffused information	4.03	1.14
The information provided meets the needs of the farmers	3.99	1.15
CSA information is provided at the right season	3.81	1.09
The information provided is up to date	3.80	1.07
Most farmers have reported increased crop yields as a result of CSA practices adoption	3.77	1.34
CSA information is provision is done in a timely manner	3.73	1.17
Access to CSA information is easy	3.68	1.18
The CSA information diffused by extension providers is adequate	3.65	1.30
On-farm and field demonstrations are organized to ease the understanding of most practices	3.57	1.32
There is a constant interaction between farmers and extension agents on CSA	3.36	1.33

Note. ^{a} = 1 = not effective, 2 = slightly effective, 3 = moderately effective, 4 = effective, 5 = very effective

Adoption of Climate-Smart Practices

Soil and water, cropping, and livestock management practices scores were computed by summating Likert-type items under each category as presented in Table 3. Among the three categories of CSA practices, soil and water management practices (*n* =112, *M* = 28.11, *SD* = 5.52), were frequently adopted as compared to cropping (*N* = 115, *M* = 21.17, *SD* = 4.54*)*, and livestock management (*n* =114, *M* = 10.91, *SD* = 2.45). This stemmed from the terrain of the area that is prone to soil erosion and the need to harvest water to supplement the little piped water supply.

Table 48. ***Descriptive Statistics for Adoption of Climate-Smart Practices (N =115)***

Practice	***M***	***SD***
Cropping management practices (*N* = 115, *M* = 21.17, *SD* = 4.54)		
Timely planting	4.43	.87
Intercropping to maximize space	4.30	1.18
Use of legumes in crop rotation	4.30	.98
Use of drought resistant crop varieties	4.15	1.37
Use of disease resistant varieties	3.99	1.45
Livestock management practices (*n* =114, *M* = 10.91, *SD* = 2.45)		
Use of organic manure	4.30	1.12
Diversified animal breeds	3.65	1.19
Use of improved livestock breeds	2.96	1.34
Soil and water management practices (*n* =112, *M* = 28.11, *SD* = 5.52)		
Use of cover crops	4.35	1.02
Use of terraces	4.26	1.07
Use of mulching	3.66	1.29
Diversification of water sources e.g. rainwater harvesting	3.38	1.43
Contour farming	3.29	1.29
Agroforestry	3.23	1.28
Water saving irrigation methods	3.11	1.35
Minimum tillage	2.70	1.40

Note. $^{a\,=}$ 1 = not at all, 2 = rarely, 3 = sometimes, 4 = often, 5 = always

Extension Effectiveness and Adoption of Climate-Smart Practices

Extension effectiveness, quality of advice, and adoption of CSA practices were assessed through summated scores of Likert-type items. The scale for extension effectiveness was comprised of 12 items hence the scores ranged from 1-60. Table 4 presents the correlation between extension effectiveness, quality of CSA advice, and adoption of CSA practices. Quality of advice involved four items worthy 20 points and adoption of CSA practices had 16 items with a total 80 points. There was a moderate positive correlation between extension effectiveness and adoption of CSA, $r = 0.38$, $p = < 0.01$. This implied that as the level of extension effectiveness increases, the adoption of CSA practices also increases. The correlation between quality of advice and adoption of CSA was positive and substantial, $r = 0.57$, $p = < 0.01$ (Davis, 1971). This meant that the adoption of practices would increase with improved quality of advice. Quality of advice was positively and moderately related to extension effectiveness, $r = 0.40$, $p = < 0.01$. This showed that improved extension effectiveness would enrich the quality of CSA advice.

Table 49. ***Pearson Correlation Statistics for Adoption of CSA by Quality and Effective Dissemination (N =115)***

Variables	1	2	3
1. Effective dissemination[a]	-	$.40^{**}$	$.38^{**}$
2. Quality of Climate smart information[b]		-	$.57^{**}$
3. Adoption of climate-smart practices[c]			-

Note. [a] = scale = 1- 60, [b] = 1- 20, [c] = 1- 80

Quality of Extension Advice

Table 2 presents the quality of CSA advice offered to farmers in Mbeere North. Among the quality elements, relevance ($M = 3.85$, $SD = 1.10$) and accuracy ($M = 3.78$, $SD = 1.06$) emerged top. However, the quality of advice was observed to be fair. This may have been contributed by extension staff in-competencies, advise that is not packaged to meet the needs of the farmers, easy to understand and inaccurate. Many of the county extension agents were not from the area thus had difficulties communicating with the local farmers especially those with no formal education. The failure of the agents to make regular follow ups to ensure that farmers adopted the practices appropriately may have compromised the quality of the advice.

Table 50. Descriptive Statistics for Quality of CSA Advise (n = 98)

Quality elements[a]	*M*	*SD*
Relevance	3.85	1.10
Accuracy	3.78	1.06
Depth of coverage	3.60	1.03
Ease to understand	3.60	1.16

Note [a] = 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = excellent

Objective two sought to determine if private, public, and both sectors differed significantly based upon the quality of CSA advice. A one way ANOVA test was conducted to determine if the quality of climate-smart practices disseminated to farmers was dependent upon the extension provider. The extension provider groups included public, private, and a combination of private and public extensionists. As presented in Table 3, public sector extension ($M = 45.27$, $SD = 6.92$) was found to provide better quality advise compared to the private sector ($M = 39.20$, $SD = 9.23$). However, a joint effort by the private and public sector extension bore a better quality advise than the individual sectors ($M = 48.04$, $SD = 10.07$). This may have resulted from the diverse aspects of agricultural information and experiences that emerges from the various sources (Mamun-ur-Rashid & Qijie, 2016).

Table 51. Descriptive Statistics for the Quality of Climate-Smart Information[a] Disseminated By Private and Public Extension Agents (N = 115)

Group of farmers	*n*	*M*	*SD*
Public extension	22	45.27	6.92
Private extension	25	39.20	9.23
Both sectors	68	48.04	10.07

Note. [a] = 1-60

There were significant differences between public, private, and both sectors in relation to the quality of information disseminated, $F(2) = 12.98$, $p = < 0.01$. As reported in Table 4, the quality of private sector's advice (36.24 ± 10.94) was significantly lower than that of public sector (45.27 ± 6.92, $p = 0.01$) and both sectors (47.98 ± 10.07, $p = <$

0.01). This may have resulted from the fact that the main role of public extensionists is to advise farmers while the private sector particularly the agrochemical companies are principally involved in marketing agrochemicals (Muyanga & Jayne, 2008). The narrow scope of advice packages of the private sector extensionists may also have contributed. Nonetheless, the quality of private sector extension has been observed to be better than that of public extension (Ayansina, Oyenyinka, & Ayinde, 2015). The main agrochemical companies working in the area included Amiran, Osho, and Bayer. The agrochemical extensionists organize occasional field days and demonstrations for diffusing agricultural information. Among the private sector extensionists, agrochemical retailers (agro-vets) were the main agents of CSA information diffusion. Other private extension institutions included community based organizations (CBOs) and non- governmental organizations (NGOs).

Table 52. Analysis of Variance for Quality of Climate-smart Information Scores by Private and Public Extension (N =115)

Source	***SS***	***df***	***MS***	***F***	***p***
Between Groups	1432.56	2	716.28	8.14	.000
Within Groups	9851.23	112	87.96		
Total	11283.79	114			

Note. [a] = 1-60

CONCLUSIONS AND IMPLICATIONS

CSA advice in Mbeere North was being offered by public and private sector extensionists. The quality of CSA advice offered by private and public sector extension was fair although very few farmers had access to it. However, the quality of public extensionists' advice was better than that of private sector. Collaborative efforts involving both private and public sectors resulted in a better quality CSA advice although public sector's advice was of better quality. The limited access to extension advice particularly that offered by public extension staff may be attributed to advice packages that were not focused to farmers' needs, lack of adequate staff, staff inefficiencies, limited transport facilities, and language barrier. These factors may have comprised the quality of extension. The adoption of CSA practices was found to be good as most farmers depended on indigenous knowledge accumulated over years. Soil and water management practices were primarily utilized by a majority of farmers to manage perennial soil erosion that were largely contributed by the topography of the area. Most of the farmers practiced agroforestry and mixed farming systems to minimize the risks associated with erratic rainfall patterns as agriculture is majorly rainfed. It also emerged that extension effectiveness is a basic necessity to improved adoption of CSA practices. There is need to design and implement intricate CSA programs involving both sectors of extension to improve the adoption levels of the practices in Mbeere North. County Government of Embu could as well boost the adoption of CSA by facilitating extension workers through provision of alternative means of transport like bicycles and motorbikes that requires minimal operational costs. Increasing the number of extension staff by hiring frontline extension workers and close supervision to ensure efficient service delivery are also core to advance CSA adoption.

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