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Quality of Climate-Smart Agricultural Advice Offered by Private and Public Sectors Extensionists in Mbeere North Sub-County, Kenya

R. Gikunda[1], M. Jepkurui[2], S. Kiptoo[3], M. Baker[4]

Abstract

This research adds to the 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 to the quality of CSA advice. Using a semi-structured questionnaire, the descriptive and correlational study gathered data from a systematic sample of 115 farmers. There was a moderate positive correlation between extension effectiveness and adoption of CSA. There were significant differences between public, private, and both sectors in relation to the quality of information disseminated. The quality of private sector's advice was significantly lower than that of public sector and both sectors. There was no significant difference in quality of advice between public sector and both sectors. The quality of CSA advice was generally fair, however, heightened dissemination of CSA practices by both sectors of extension would yield better quality advice thus improve the adoption of the practices among farmers.

Keywords

Adoption, climate change, extension education, effectiveness

1. Raphael Gikunda, Lecturer, Chuka University, Po Box 109, Chuka, rgikunda@chuka.ac.ke, https://orcid.org/0000-0002-7154-7025
2. Mary Jepkurui, Graduate Student, University of Arkansas, Fayetteville, 72701, AR, marysamoei@yahoo.com, https://orcid.org/0000-0002-8845-0000
3. Simion Kiptoo, Graduate student, Chuka University, Po Box 109, Chuka, skiptoo43@gmail.com, https://orcid.org/0000-0002-0619-7030
4. Mathew Baker, Professor & Department Head, Texas A&M, 2116 TAMU, College Station, TX 77843-2116, mathew.baker@ag.tamu.edu, https://orcid.org/0000-0002-0556-744X

Introduction and Problem Statement

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 (Oduniyi & Tekana, 2019; World Bank, 2015). The climate risks are expected to increase in the coming decade especially in less developed countries. Globally, more than a billion farmers are facing climate-related risks and hazards (Nagargade et al., 2017). It is estimated that between five to 170 million people will be food insecure by 2080 in Africa as a result of climate change (Rosegrant et al., 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, the resilience of farming systems, and mitigate climate change (Ministry of Agriculture, Livestock, and Fisheries [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 et al., 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 into 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 fully by 2030 (United Nations Environment Programme [UNEP], 2016). Although a significant amount of resources have been secured to promote the dissemination and application of CSA farming systems, many of the smallholder farmers lack adequate skills and knowledge in the subject (Jirata et al., 2016). Additionally, 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 (United States Agency for International Development [USAID], 2016).

Kenya has not been able to realize the benefits of CSA due to the low adoption rates resulting from poor policies formulation and implementation. This has been 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 require 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 et al., 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 (Gikunda et al., 2021; 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 et al., 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 et al., 2016). Even though literature on the adoption and impact of CSA is growing (Kurgat et al., 2020), researchers have largely neglected to focus on the effectiveness of extension and quality of information disseminated by different sectors. The provision of extension services particularly by the private sector has also been skewed towards high potential regions (Muyanga & Jayne, 2008). Mbeere North being a semi-arid region may have been underprivileged. A gap that this research was set out to address.

Methods

A descriptive correlational survey was conducted in Mbeere North Sub-County involving a population of 2,047 farmers (Chimoita et al., 2017). The design was deemed suitable since the study was aimed at drawing a connection between culture and effective dissemination of climate-smart practices (Fraenkel et al., 2015). The study utilized a sample of 115 farmers selected through systematic random sampling to ensure representativeness with regard to gender and farm sizes. Fraenkel et al. (2015) observed that a sample of 100 is adequate for survey research. Of the 115 farmers, 59 (51.3%) were male and 54 (47.0%) were female. The participants farm sizes ranged from 0.25 to 15 acres (M = 3.89, SD = 2.79).

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 Cronbach's 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).

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 objectives of the study were tested at a 95% level of significance or 0.05 alpha level *apriori*. Tukey's HSD post hoc test was conducted to compare the three groups of extension advice providers. Effect size was estimated using omega squared.

Findings

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

The study also sought to determine the effectiveness of the extension services as shown in Table 1. 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'et al. (2018). Many of the farmers received information from mass media such as television and radio programs that did not necessarily target their needs and may not have been adequate to drive adoption.

Table 1

Descriptive Statistics for Effectiveness of Extension (N = 115)

Statement[a]	*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 the understanding of the 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 on time	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

Table 2 shows the application rates of the climate-smart practices among farmers in Mbeere North. Among the three categories of CSA practices, cropping such as timely planting ($M = 4.43$, $SD = .87$), intercropping ($M = 4.30$, $SD = 1.18$), and crop rotation ($M = 4.30$, $SD = .98$) were frequently applied as compared to livestock management, and soil and water management practices. This may have stemmed from the fact that that a majority of the cropping practices did not require advanced knowledge and skills as compared to soil and water management practices such as terracing that requires engineering knowledge. Many of the farmers utilized indigenous knowledge acquired through experiences and observations since they had limited access to extension advice.

Table 2

Descriptive Statistics for Adoption of Climate-Smart Practices (N = 115)

Practice[a]	*M*	*SD*
Cropping management practices		
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		
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		
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 3 presents the correlation between extension effectiveness, quality of CSA advice, and adoption of CSA practices. Quality of advice involved four items with a maximum sum of 20 points, 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, $r = 0.38$, $p = < 0.05$. 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, $r = 0.57$, $p = < 0.05$ (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, $r = 0.40$, $p = < 0.05$. This showed that improved extension effectiveness would enrich the quality of CSA advice.

Table 3

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 4 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 4

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* 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 5, 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 emerge from the various sources (Mamun-ur-Rashid & Qijie, 2016).

Table 5

Descriptive Statistics for the Quality of Climate-Smart Information Disseminated By Private and Public Extension Agents (N = 115)

Group of farmers	*n*	M^a	*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 = very poor; 2 = poor; 3 = fair; 4 = good; 5 = excellent.

The results in Table 6 show that there were significant differences between public, private, and both sectors in relation to the quality of information disseminated, F (2) = 12.98, p = < 0.05, ω = .33 (medium effect). As reported in Table 5, the quality of the private sector's advice (39.20 ± 10.94) was significantly lower than that of the public sector (45.27 ± 6.92, $p < 0.05$) and both sectors (48.04 ± 10.07, p = < 0.05). A Tukey HSD post hoc test revealed that there was no significant difference in quality of advice between public sector and both sectors ($p > .45$). 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 et al., 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 and non-governmental organizations.

Table 6

Analysis of Variance for Quality of Climate-smart Advice by Private Sector Extension, Public-Sector Extension, and both Sectors Combined (N =115)

Source	*SS*	*df*	*MS*	*F*	*p*
Between Groups	1432.56	2	716.28	8.14	< 0.05
Within Groups	9851.23	112	87.96		
Total	11283.79	114			

Note. Tukey's HSD = p = .45; ω = .33.

Conclusions, Discussion, and Recommendations

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 the private sector. Collaborative efforts involving both private and public sectors resulted in better quality CSA advice. This is so because the sectors enhanced the qualities of one another. Whenever public sector agents organized field days, exhibits, and agricultural shows, private sector agents would be invited to participate. This provided private sector extensionists with opportunities to supplement the public agents’ advice thus enhancing the quality. There is need for sustainable public-private partnerships to sustain provision better quality advice.

The limited access to extension advice, particularly that offered by public extension staff, may be attributed to content that was not focused on farmers' needs, lack of adequate staff, staff inefficiencies, limited transport facilities, and language barrier (Gikunda et al., 2021; Odhong’et al., 2018). These factors may have compromised the quality of extension. To improve on the quality of extension service, the County Government of Embu needs to commit much more human, financial, and transportation resources (Antwi- Agyei & Stringer, 2021). This will not only facilitate timely delivery of extension services but also advice that targets the needs of the farmers since there will be much more contacts between the farmers and the agents. Agrochemical companies also need to hire qualified extension agents who will not only market the products but also provide quality advice to farmers.

It also emerged that extension effectiveness is a basic necessity to improved adoption of CSA practices. However, many of the extension workers were found to be moderately effective in the dissemination of CSA practices. This due to inability to meet some of the needs of the farmers and also the untimely delivery of some services. The county extension staff should be closely monitored and facilitated to ensure that agricultural information gets to the farmers at the right time. For extension programs to be beneficial to the farmers, the programs should be founded on the needs of the farmers.

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 was largely contributed by the topography of the area. There is need for public extension agents to organize training programs on soil and water conservation that would boost farmers indigenous knowledge and improve the efficiency, design, and construction of better structures such as terraces, contour bunds, and gabions. Most of the farmers practiced agroforestry and mixed farming systems to minimize the risks associated with erratic rainfall patterns as agriculture is majorly rainfed. There is a need to design and implement intricate CSA programs involving both sectors of extension to improve the adoption levels of the practices in Mbeere North. The County Government of Embu would increase the adoption of CSA by facilitating extension workers through the provision of alternative means of transport like bicycles and motorbikes that require 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. A confirmatory study in other parts of the country with similar conditions as Mbeere North such as Northeastern would be worthwhile. A comparative study should be conducted in high potential areas to find out if private sector extension is skewed towards those areas.

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