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Extension Education Needs for Improved Adoption of Sustainable Organic Agriculture in Central Kenya

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Abstract The study highlights organic agriculture (OA) information gaps that need to be filled in order to upscale the adoption of OA practices. The survey data were gathered from 329 organic farmers selected through stratified random sampling from Central Kenya. An independent *t*-test, bivariate Moran's *I*, and linear multiple regression were used to examine the differences in information access among organic farmers and relate OA advice to its sustainability. Information gaps exist in aspects of soil, water, weed, pest, and disease management. Certified organic farmers significantly differed from non-certified on access to OA advice, t (139.93) = -3.69, $p < .05$. Extension advice (Moran's I = .02, p = .01) and sustainability of OA (Moran's I = .04, p = .01) were slightly clustered. OA advice dimensions significantly accounted for 6% of the variance on the sustainability of OA, F (3, 319) = 6.14, $p < .05$, R^2 = .06. Improved access to information relating to field management practices; soil, water, weed, pest, and disease management is crucial for sustainable organic crop production. Social networks should be strengthened to enhance information sharing among extension actors in the organic industry. The study adds to the knowledge of the spatial patterns of OA advice and the significance of extension advice on the sustainability of OA. This study illuminates the current knowledge gaps that exist among organic farmers, thus providing a basis upon which extension advice can be repackaged to meet the needs of the farmers.

Keywords Agricultural advice, Information access, Organic agriculture, Sustainability

1. Introduction

The organic industry is one of the fastest-growing agricultural subsectors worldwide (Constance & Choi 2010). The global demand for organic products is increasing resulting in increased conversion to OA and acreage under certified organic (Gikunda & Lawver, 2020; Willer & Lernoud, 2019). OA has been described as a sustainable farming system due to a broad range of conservation benefits above its ability to address food safety and health concerns (Benbrook & Baker, 2014; El-Hage Scialabba 2013). OA relies heavily on ecosystem management rather than synthetic agricultural inputs that are unaffordable to a majority of smallholder farmers. Ensor, (2009) observed that OA fosters biodiversity that is resilient to droughts and floods that have engulfed the country over the years. The systems depend on and sustains ecosystem services as well as tapping into and intensifying the knowledge, practices, and innovations of local communities (Morgan & Murdoch, 2000) leading to more reliable and increased food security and incomes.

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Sustainable agri-food systems, OA included, are knowledge/information-intensive systems (Allahyari, 2009). Therefore, the achievement of OA sustainable systems will be contingent upon the success of extension agents in assisting farmers to gain access to more relevant and timely information (Abi-Ghanem et al., 2013). The ability of extension agents to clear all uncertainties surrounding the disseminated technologies is also essential to the success of OA systems. In response to the uncertainties, adjustments to the existing advisory and extension approaches are taking place (Coutts, et al., 2019) worldwide.

Most African countries lack supportive policies for efficient OA systems. Moreover, there is little government extension for organic production in these countries (Agunga & Igodan, 2008). Research has shown that extension is a critical institution in disseminating sustainable agricultural practices (Davis, 2016; Wijaya & Offermans, 2019) and providing support services for rural producers to meet the new challenges confronting agriculture. The greatest constraints faced by transitioning organic farmers are the lack of knowledge, information sources, and technical support (Abi-Ghanem, et al., 2013; Marsh, et al., 2017). Padel (2001) reported that organic producers favour information that is designed and packaged precisely for the organic community rather than the larger agricultural community. Organic farmers rely heavily upon and often unknowingly on tacit knowledge that is diffused through high trust relationships (Morgan, 2011; Morgan & Murdoch, 2000). Farmers who believe in the spirit of neighbourhood expectations and with greater availability of information in their spatial network are more likely to adopt OA (Wollni & Anderson, 2014).

In Kenya, extension services are provided by a wide pool of actors including the ministry in charge of agriculture, government parastatals, out-grower companies, non-governmental organizations, cooperatives, agrochemical companies, faith-based organizations, and county governments (Kavita & Muthoni, 2018; Odongo, 2014). Although the institutions utilize a variety of methods and approaches, little information reaches a majority of smallholder farmers scattered over wide and sometimes inaccessible areas. However, with the knowledge of organic farms clusters, extension agents are better able to provide localized and crop-based advice to the smallholder organic farmers (Gikunda, et al., 2020).

Previous studies have recommended additional investment in the Kenyan extension systems to boost service delivery and increase smallholder productivity (Ong'ayo, 2017; Tata & McNamara, 2017). However, there is no indication of additional resources being set aside to arrest the situation (Kavita & Muthoni, 2018). Better government investment in appropriate research and extension services is needed to ensure a continuous network of information and innovation regarding OA. Diverse training programs and capacity building initiatives are crucial to sustain OA and keep farmers in the farming business (Coutts, et al., 2019). The success of extension efforts cannot be achieved and sustained without a conducive agro-economic enabling environment. The enablers, according to Davis, et al. (2010), include agro-production, market, and economic enablers. A combination of these factors coupled with the expansion of existing producer groups could help overcome the challenge of inadequate knowledge and skills especially to uneducated subsistence farmers who occupy a large portion of the farming community in developing countries (Kavita & Muthoni, 2018; Ong'ayo, 2017). This study was intended to contribute to addressing the paucity of information relating to farmers' knowledge and skill deficiencies in OA.

2. Theoretical Framework

The study was grounded on social learning theory (SLT) (Bandura, 1977) which has become prominent in the understanding acquisition of agricultural knowledge (Altieri, 2004; Leeuwis & Ban, 2004; Warner, 2008) explaining the sustainability of agricultural systems and in campaigning for desirable behavioral changes (Lindblom, et al., 2017). OA is entrenched in the social and cultural environment of farmers and their communities (Pretty & Uphoff, 2002) thus, the understanding of OA information sharing as a social process involving localite, cosmopolite, and interpersonal communication channels (Rogers, 2003) was inherent. SLT theory is particularly helpful in facilitating the understanding of information exchange networks embedded within the social systems where organic farmers are operating. This argument is advanced by Morgan (2011) that advisory services have increasingly recognized the value of social learning processes along with the traditional focus on science and technology transfer.

SLT is based on the premise that learning does not always occur as a result of firsthand experience but also through observation and imitation (Martinez, 2010) as depicted in Figure 1. Organic farmers, just like the rest of us, associate and engage in social learning with peers who share similar attitudes to farm business enterprises and farming systems (Morgan, 2011). The farmers learn when they pay attention to what others are doing, rehearse, and consider the likely consequences before imitating the behavior. The benefits of the observed behavior serve as a motivation and can determine the speed at which the behavior is adopted. These farmers learn through both vertical and horizontal exchange of OA information amongst themselves, with experts, extension agents, and other promoters of OA practices (Mukute, 2010).

Sumner (2008) argues that most OA knowledge has been developed tested, protected, passed down and expanded upon by practitioners in the field of organic farmers communicating with other organic farmers. Organic farmers acquire knowledge through social networks, farmer groups (Gikunda & Lawver, 2019) public meetings, socio-cultural events, and group socialization. Organic farmers also get information from public and private extension agents. Social learning based on farmers' social networks can augment information sharing and knowledge transfer (Li, etal. 2018; Nyantakyi-Frimpong, et al., 2019). Extension agents not only provide agricultural information to farmers but also serve to link farmers to networks of knowledge and resources. These networks enhance information exchange and communication (Morgan, 2010), thereby helping to clear doubts that may make farmers hesitant when applying new agricultural technologies.

However, Comin, et al. (2012) observed that the rate at which the information diffuses depends on spatial clusters whereby the exchange is slower at locations that are farther away from the sources. Information spreads from the centre of innovation source to its surroundings through a spatial path (Li, et al., 2018). Therefore, the impact of the dissemination of innovations decreases as spatial distance increases (Morrill, 1970). It is worth noting that the effect of geography is initially solid, declines over time, and eventually dies away (Comin, et al., 2012). Although social learning is key in disseminating OA practices, it may become maladaptive if ecological learning is challenged (Stone, 2016). This is due to the changes in the environment which will automatically lead to changes in the farmers' behaviour. It is also worth noting that OA is strongly entrenched in the local environment and indigenous knowledge. Therefore, learning OA practices may also take place through a community of practice, a process that is seen as a social construction where knowledge is generated through practice and mastery as observed by Lave & Wenger (1991).

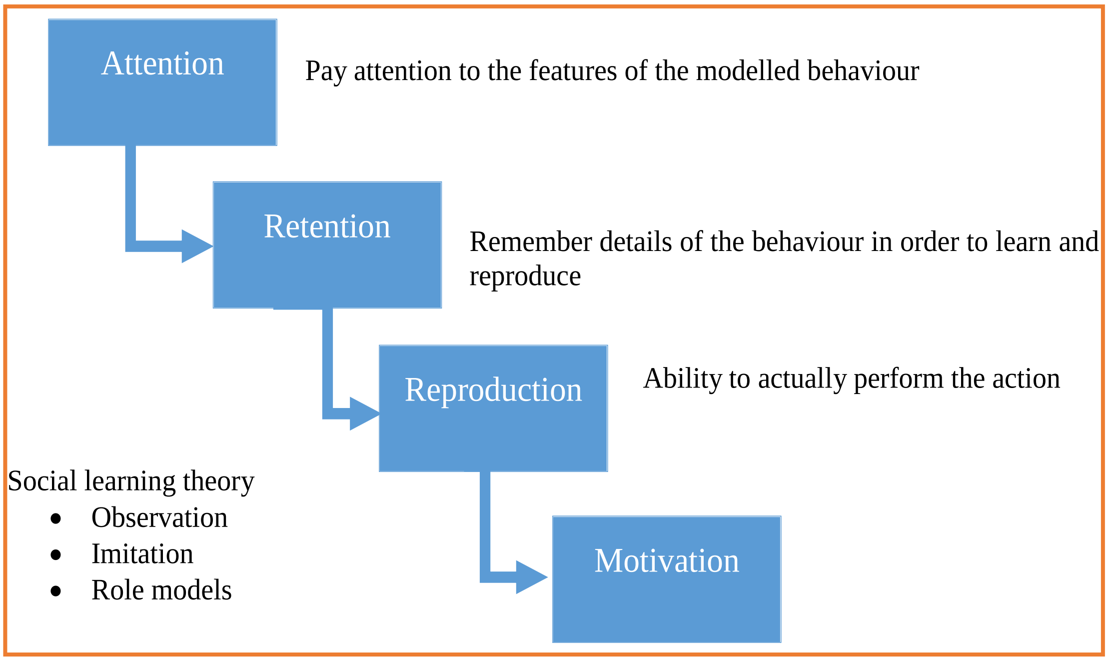

Figure 1. Social learning theory (Bandura, 1977)

3. Purpose and Objectives

The purpose of this research was to identify farmers' needs for extension advice relating to OA which when continually put to use would result in a sustained farming system.

The research objectives were to;

i. Identify organic agricultural advice needs for farmers in Central Kenya
ii. Examine if certified and non-certified farmers significantly differed based upon access to organic agricultural advice
iii. Describe the spatial autocorrelation of organic agricultural information in Central Kenya
iv. Describe the perceived contribution of organic agricultural advice on the ecological, social, and economic sustainability of OA

4. Materials and Methods

Research Design

A quantitative approach involving a survey was adopted to gather data from 377 (Krejcie & Morgan, 1970) organic farmers in Central Kenya. However, only 329 farmers were accessible due to data collection constraints. Quantitative research is used to quantify the problem by generating data that can be transformed into usable statistics. The approach was utilized to quantify the extension education needs of organic farmers, describe access, sources, and timeliness of OA information relating to sustainable organic practices. The study analyzed relationships between certification and access to extension advice and how the availability of the OA information relates to the ecological, social, and economic sustainability of the system. Information relating to organic practices is mainly shared through social interactions; a philosophy embedded in social learning theory.

Study Area

Central Kenya has an altitude ranging between 1300 to 1800 meters above sea level and it is located on the slopes of Mt Kenya. In Central Kenya, rainfall occurs in two seasons, March–June, and October–December, and averages between 1200 mm to 1500 mm annually. The soils, which are primarily nitosols, are deep, and of moderate to high fertility (Franzel, et al., 2003). The study covered four counties of central Kenya: Murang'a, Nyeri, Kirinyaga, and Kiambu.

Data Collection

The study employed a semi-structured questionnaire with Likert-type scale items and handheld Garmin GPSMAP 64 devices to gather data. Prior to data collection, GPS receivers were initialized and set at UTM coordinate system, WGS 1984 datum, and units in meters. The Wide Area Augmentation System (WAAS) was enabled to enhance the accuracy of the coordinate system (Gikunda & Griffith, 2019). The instrument's validity was reviewed by peers and experts from the Department of Agricultural Education, [University]. A pilot study involving 33 organic farmers was conducted in Nyandarua County in the study region (Hair, et al., 2005). Pilot study data aided in instrument improvement and reliability analysis. This shows that the internal consistencies of the study variables were above the minimum recommended alpha of .7 (Nunnally, 1978) thus the instrument was considered reliable.

Data Analysis

Descriptive statistics were generated to describe the variables of the study. Organic agricultural advice consisted of three constructs namely Soil and water management; weed, pest and disease management; and market information (independent variables). The constructs were measured using summated scores of Likert-type items on a five-point scale ranging from never (1) to always (5). Sustainability was assessed with an aid of Likert-type items on a five-point scale of strongly disagree (1) to strongly agree (5). An independent *t*-test was conducted to examine the difference in access to organic agricultural advice between certified and non-certified farmers. Before conducting the test, data were tested for the assumptions of normality of distribution, and homogeneity of variances. The normality assumption was met while homogeneity of variance ($H0$: $\sigma_1^2 = \sigma_2^2$), tested by use of Levene's F test of equality of variance, was violated, F (139.93, 324) = 40.05, $p < .05$, thus, as recommended by Field (2017) the results of unequal variances (equal variances not assumed) were reported.

Bivariate Local Moran *I* was used to analyze spatial autocorrelation between extension advice and sustainability of OA. Univariate Moran's *I* was used to check uniformity of OA information dissemination. Local spatial autocorrelation statistics provide a measure, for each unit in the region, of the unit's tendency to have an attribute value that is correlated with values in nearby areas.

$$I_i = z_i \sum_j w_{ij} z_j$$

Where z_i and z_j are standardized scores of attribute values for unit *i* and *j*, and *j* is among the identified neighbors of *i* according to the weights matrix w_{ij} (O'Sullivan & Unwin, 2010).

Moran's, *I* require a weights matrix that defines a local neighborhood around each geographic unit. Therefore, before bivariate Moran's *I* was conducted, a weight matrix was created using queen contiguity. The value at each unit is compared with the weighted average of the values of its neighbors. A weights file identifies the neighbors and it's calculated from the distance between points. The formula of each weight is as follows;

$$w_{ij} = \frac{C_{ij}}{\sum_{j=1}^{N} C_{ij}}$$ with C_{ij} = 1 when *i* is linked to *j* and

C_{ij} = 0 when otherwise (O'Sullivan and Unwin 2010).

Linear multiple regression analysis was performed to determine the amount of variance in the sustainability of OA that can be attributed to organic agricultural advice (soil and water, weed, pest, and disease management, market information). The goodness of fit of the sample data to the population was evaluated through *R* squared, *F*- test, and Root Mean Square Error (RMSE) tests (Field, 2017). Pearson product moment correlation was performed to check multicollinearity and also to determine the relationship between extension advice and sustainability of OA.

5. Results

Organic Agricultural Advice

The study sought to describe access, sources, and timeliness of organic agricultural information. OA has been found to require localized and technical management skills based on the local conditions (Özkaya, 2003) resulting in diverse knowledge needs (Seppänen & Francis, 2004). As reported in Figure 2, a majority of the respondents (*n* = 309, 93.9%) confirmed receiving OA advice from extension agents. This suggests that many of the farmers in the region cultivating organic crops had access to extension advice. This may have resulted from social relationships built between farmers and different actors in the organic industry. The inability to reach some of the organic farmers can be attributed to a higher farmer-to-extension agent ratio and an insufficient enabling environment in the region (Davis et al., 2010). Very few farmers had access to public extension since there very few extension workers operating in the region. This, therefore, limited farmers' access to organic inputs and market for organic products especially to the uncontracted farmers as extension agents are known to serve as a link between markets and input suppliers. Farmers who had no access to extension agents relied upon knowledge constructed through experiences in the process of managing the organic crops (Lave & Wenger, 1991).

Figure 3 presents the main sources of organic agricultural information in Central Kenya. Most of the farmers (75.9%) stated that they were regularly being trained by extension agents from organic produce exporter companies. Five exporter companies; Kakuzi, Kenya Nut, Olivado EPZ, Fair Trade, and Jungle Nut Ltd are operating in the region. These companies had contracted organic farmers to produce crops and as such, they were regularly training them to ensure that the organic produce met the European market standards (Edwardson & Santacololoma, 2013). Other sources included public extension (19.1%), friends and neighbors (19.1%), media (8.8%), agricultural companies producing organic inputs (5.2%), and research institutions (4.9%). The results suggest that there are various sources of organic agricultural information in the region in line with the findings of Zelaya, et al. (2016) who reported that farmers' sources of knowledge were numerous. This is a clear indication that organic knowledge sharing in the region involves social and interactional collective efforts from various actors in the industry as postulated in social learning theory (Lave & Wenger, 1991).

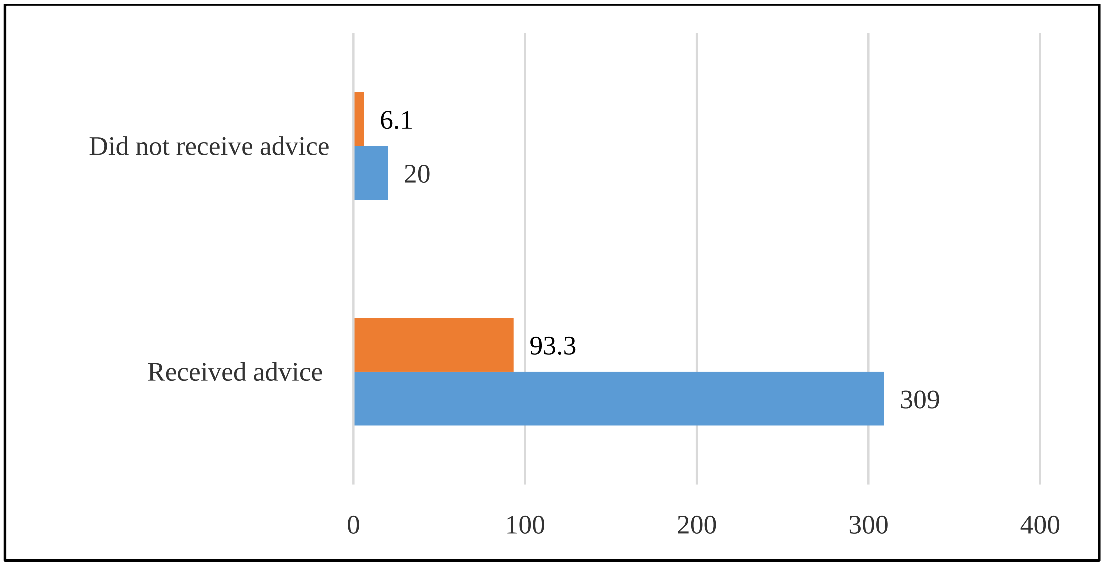

Figure 2. Distribution of farmers by extension agents' advice (*n* = 329)

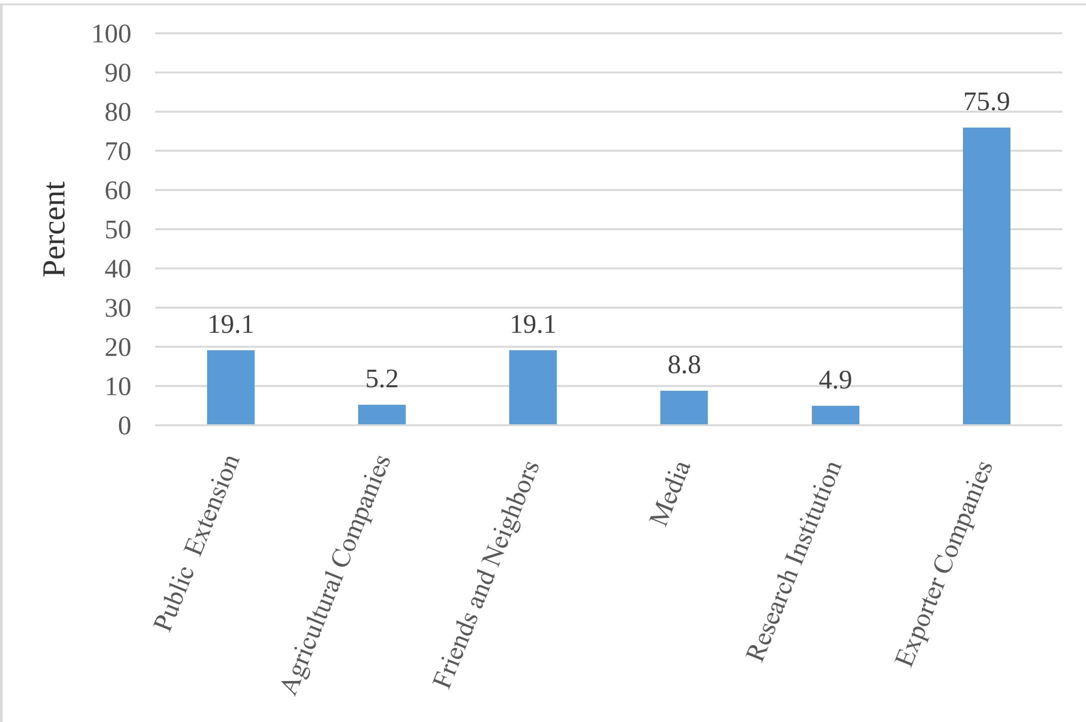

Figure 3. Sources of organic agricultural advice (*n* = 329)

Timeliness plays a critical role in agricultural operations (Nichols, 2016) and therefore, OA information needs to be delivered on time. When asked to describe the timeliness of organic agricultural advice, (*n* = 145), 44.3% noted that it was delayed, about half of the farmers (*n* =160, 48.9%) believed it was timely and only (*n* = 22), 6.7% stated that it was very timely as reported in Table 1. This shows that most of the farmers received information in a good time although substantial amounts were also delayed. The delay may have negatively affected the rates of adoption of the disseminated practices as demonstrated in previous research (Uzonna & Gao, 2013). Therefore, knowledge sharing needs to be aligned with the cropping and rainfall patterns as a majority of the organic farmers in the region practiced rain-fed agriculture.

Table 1. Distribution of Farmers by Timeliness of Organic Agricultural Advice (n = 327)

Timeliness[a]	Frequency *(n)*	Percent (%)
Delayed	145	44.3
Timely	160	48.9
Very timely	22	6.7

Note. [a]1= delayed, 2 = timely, 3 = very timely

Organic Agricultural Advice Needs

The first objective sought to determine the frequency with which farmers received organic agricultural advice and then identify areas that needed more training. As shown in Table 2, most farmers received market information as reported by the mean scores. Among the certified farmers, produce quality requirements were the most frequent (*M* = 4.23, *SD* = .72) form of information provided while water conservation was the least emphasized (*M* = 3.23, *SD* = 1.13). On the other hand, non-certified farmers received more information on produce quality requirements (*M* = 3.83, *SD* = 1.01), and least on bio-intensive integrated pest management (*M* = 3.05, *SD* = 1.20). This implies that the main training needs for both certified and non-certified organic farmers revolved around soil, water, weed, pest, and disease management practices, especially bio-intensive integrated pest management. A confirmation that OA is a knowledge-intensive system as noted by Allahyari (2009).

Table 2. Descriptive Statistics for Organic Agricultural Advice Needs (n = 377)

OA Advice[a]	Certified		Non-certified	
Soil and Water Management	*M*	*SD*	*M*	*SD*
Soil fertility management	3.64	.93	3.31	1.20
Soil erosion control	3.52	.79	3.38	1.13
Water conservation	3.23	1.13	3.56	.86
Cover cropping	3.36	.88	3.19	1.06
Weed, Pest and Disease Management				
Physical and mechanical practices e.g. hand weeding, handpicking, trapping insects	3.56	.97	3.22	1.10
Biological control of weeds, insect pests or diseases	3.45	.87	3.13	1.17
Bio-intensive integrated pest management	3.37	.86	3.05	1.20
Cultural practices like crop rotation, trap crops, intercropping, and use of resistant varieties, etc.	3.49	.83	3.19	1.17
Conservation tillage	3.50	1.09	3.21	1.12
Marketing Information				
Availability of markets	4.05	.87	3.67	1.01
Produce quality requirement	4.23	.72	3.83	1.01
Price information	4.18	.81	3.75	1.03

Note. 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always

Although pests and diseases are known to contribute to significant crop losses (Oerke, 2006), most of the non-certified farmers had trouble managing them. This can be attributed to lower access to extension advice that characterizes non-certified farmers compared to certified farmers who enjoyed better extension services resulting from contractual arrangements with the exporter companies. Many of the non-certified farmers relied mostly on indigenous knowledge and neighborhood sources of OA advice. Both certified and non–certified farmers received significant amounts of information relating to the market and product quality. Other than market information, soil, water, weed, pest, and disease management information was only occasionally provided. More training is needed in field management practices, especially soil and water management.

Objective two sought to determine if certified and non-certified farmers significantly differed based upon access to organic agricultural advice. An independent-samples t-test was conducted to compare access to organic agricultural advice among certified and non-certified farmers. The null hypothesis tested was;

H_0: $\mu_{\text{(certified)}} = \mu_{\text{(non-certified)}}$

As shown in Table 3, there was a significant difference in the scores for certified (*M* = 40.48, *SD* = 5.60) and non-certified farmers (*M* = 36.81, *SD* = 9.43) in regard to access to organic agricultural advice, t (139.93) = -3.69, $p < .05$. Certification had a medium effect (Cohen, 1988) on access to extension advice (d = .39). These results suggest that certified farmers are more likely to access organic agricultural advice than non-certified (Gikunda & Lawver, 2020). The certified farmers reported a higher number of contacts with extension agents resulting from the frequent visits made by the agents to inspect and audit the farms. Certified farmers took advantage of these visits to make inquiries and extract information relating to OA from the agents, auditors, and inspectors. As a result, OA informational needs for certified farmers were much lower as compared to non-certified farmers.

The link between exporter companies' extension agents and certified farmers facilitated a constant flow of information. Besides, the extension agents linked the farmers to other institutions such as organic input suppliers and research solutions, in cases where they were unable to offer solutions to problems facing farmers. This created social networks that enhanced the sharing of OA information (Mittal, et al., 2018). Other sources of information included the public extension, private agricultural companies dealing with organic inputs, friends and neighbors, research institutions, and media. This confirms Bandura's (1977) social learning theory assertions that learning occurs within a social context. Non-certified farmers should be encouraged to get their farms certified as to open gates for more information.

Table 3. Descriptive and t-test Statistics for Organic Agricultural Advice[a] by Certification (N = 326)

Certification	*n*	*M*	*SD*	*F*	*t*	*df*	*P*
Non-certified	105	36.81	9.43				
Certified	221	40.48	5.60				
Access to OA Advice				40.05	-4.38	324	< .05
					-3.69	139.93	< .05

Note. [a] 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always; $p < .05$; *Cohen d* =.39

Spatial Autocorrelation of Organic Agricultural Advice

Objective three sought to describe the spatial autocorrelation of organic agricultural information in central Kenya. The Moran's *I* is interpreted the same way as product moment correlation coefficient, where +1 indicates strong positive spatial autocorrelation (clustering of similar values), 0 indicates random spatial ordering, and -1 indicates strong negative spatial autocorrelation (dispersed pattern) (O'Sullivan & Unwin, 2010). Table 4, presents the univariate and bivariate Moran's *I* result for agricultural advice and sustainability of OA. The univariate local Moran's *I* test revealed a weak positive spatial autocorrelation for agricultural advice (I = .02, p =.01) and sustainability of OA (I = .04, p =.01). This signifies a slightly uniform (random) pattern in both dissemination of agricultural advice and the sustainability of OA.

Table 4. Spatial Autocorrelation for Agricultural Advice[a] and Sustainability of OA[b]

Variable	Moran's *I*	*p*
Sustainability	.04	.01
Organic agricultural advice	.02	.01
Sustainability & agricultural advice	.01	.01

Note. [a] 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always; [b]1= strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly Agree; p < .05

A bivariate local Moran's *I* test between agricultural advice and sustainability of OA resulted in a weak positive correlation (I = .01, p =.01) as shown in Figure 4. This means that farmers in areas with higher reception of agricultural advice are likely to sustain the adoption of OA practices compared to areas with poor access to agricultural advice.

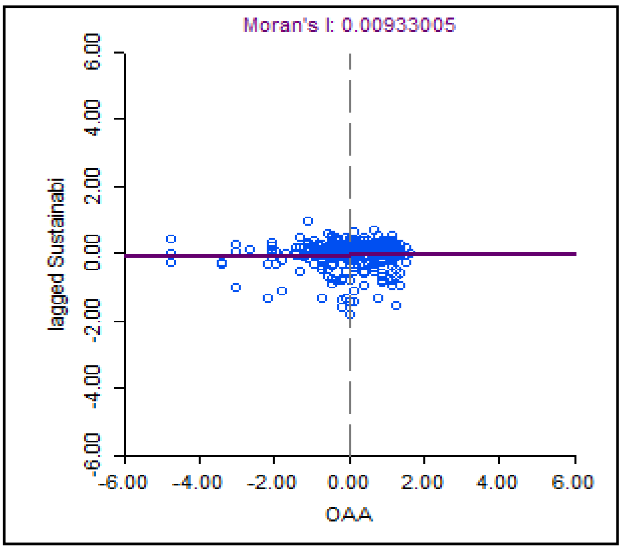

Figure 4. Bivariate Moran *I* for agricultural advice and sustainability of organic agriculture

Significance of Extension Advice in Sustaining OA

The fourth objective sought to find out the perceived contribution of OA advice on the sustainability of OA. As reported in Table 5, most of the farmers believed that OA was more socially sustainable compared to other sustainability dimensions.

Table 5. Comparison between Certified and Non-Certified Organic Farmers Based Upon Sustainability of OA (n = 324)

Sustainability measures[a]	Certified (n = 103)		Non-Certified (n =221)	
Ecological sustainability	*M*	*SD*	*M*	*SD*
Building and maintaining healthy soil free of chemical contamination	4.10	.77	4.07	1.12
Supports water conservation and water health	4.00	.80	3.85	1.07
Help conserve biodiversity as it encourages a natural balance within the ecosystem	3.91	.60	3.57	1.23
Reduces erosion through cover crops	3.65	.85	3.60	1.01
Increased usage of animal or green manure	3.81	1.10	4.00	1.18
Social sustainability				
Safety of food is greater with organic farming	4.29	.79	4.40	.92
Organic farming produces more yields than conventional systems	4.25	.80	4.17	.99
Improved health status of family members	4.30	.76	4.11	.92
Provides access to attractive markets through certified products	4.00	.84	3.45	1.15
Improved quality of rural life	3.97	.97	3.75	.99
Improves access to credit facilities	3.32	1.24	2.80	1.22
Economic sustainability				
Job creation; labor use is higher on organic farms than on their equivalent conventional farms	3.65	.97	3.46	1.11
Allows farmers access to new market opportunities; local and international markets.	3.88	.77	3.64	.92
Reduces the financial risk by replacing expensive chemical inputs with locally available renewable resources	4.14	.92	3.98	1.05
Increasing yields in the long run	4.33	.79	4.26	.87
Reduced costs of production	4.05	.89	4.12	.93

Note. [a]1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly Agree.

Many of the certified farmers pointed out that although OA produces lower yields than conventional farming systems at the beginning, the yields increased with time thus closing the gap (M = 4.33, SD = .79). However, they disputed the claim that OA improved access to credit facilities (M = 3.32, SD = 1.24). This finding confirms an observation made by Schrama, et al. (2018) that the yield gap between OA and conventional agriculture lessens over time. This is brought about by the gradual enrichment of the soil and improvement of the soil structure arising from the continuous application of organic matter, composted manure, and other organic inputs. On the other hand, most of the non-certified farmers noted that food safety was greater with OA (M = 4.40, SD

= .92), and also agreed with their counterparts that OA does not enhance access to credit facilities (M = 2.80, SD = 1.22).

Multiple linear regression was carried out to investigate whether organic agricultural advice on soil, water, weed, pest and disease management, and market information explained a significant variance on the sustainability of OA.

The omnibus hypothesis tested was;

H_O: $R^2 = 0$ in the population

As shown in Table 6, regression results indicated that the model explained 6% of the variance (R^2 = .06). This according to Cohen (1988) was a small effect although, the model was a significant predictor of sustainable OA, F (3, 319) = 6.14, $p < .05$. However, on examination of individual dimensions of agricultural advice, it was revealed, the three dimensions of OA advice namely soil and water management (β = .12, t = .76, p = .45), weed, pest and disease management, (β = .30, t = 1.94, p = .05), and market information, (β = .23, t = 1.42, p = .16) were not significant.

The amount of variance explained by information access illuminates its importance in the sustainability of OA. This can be taken to mean that OA advice plays a vital role in sustaining OA ecologically, economically, and socially. Extension advice relating to organic soil and water management, weed pest, and disease management, and market information is necessary for sustaining OA (Carlisle 2016). Lack of knowledge in the area of OA has been cited as an impediment in managing farm operations (Kucinska, et al., 2009).

Table 6. Multiple Regression Analysis for Organic Agricultural Advice[a] Predicting Sustainability of OA[b] (N = 323)

Organic Agricultural Advice	R^2	F	β	SEB	t	P
Organic soil and water management	.06	6.14	.12	.16	.76	.45
Weed, pest and disease management			.30	.16	1.94	.05
Marketing information			.23	.16	1.42	.16
Constant			54.24	2.13	25.43	< .05

Note. [a] 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always; [b]1= strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly Agree; Adjusted R^2 =.05; p <.05.

6. Conclusions and Implications

A need for OA information relating to soil, water, weed, pest, and disease management exists among certified and non-certified organic farmers in Central Kenya. The study revealed a need for information related to bio-intensive integrated pest management and water conservation. The study established that areas with higher access to OA information are more likely to sustain the application of OA practices. The t-test results suggested a bias in access to information, certified farmers received more with information compared to non-certified farmers. This divergence can be attributed to the fact that certified farmers, most of whom had been contracted by exporter companies, had constant access to OA information from the firms' extension agents.

The main source of organic practices, especially to certified farmers, was organic produce exporter firms. Only a few farmers had contacts with public extension agents even though extension service provision in Kenya is a function of the government. Therefore, this is a sign of weakness on the part of the public extension and thus, a relook of the extension approaches with a view of modifying them to address the needs of the farmers would boost the efficiency of extension delivery (Ong'ayo, 2017; Kavita & Muthoni, 2018). Most of the extension information emphasized market requirements for product quality and pricing at the expense of field management information. OA advice in the region involved numerous private and public organizations (Kavita and Muthoni 2018), thus there is a need to strengthen the linkages between farmers and the actors. Tapping on the philosophy of social learning (Bandura, 1977), farmers should also be encouraged to form social relations in addition to expanding existing producer groups. Strengthening social networks would foster effective OA information sharing, thus boost adoption of the practices.

It was also evident that a lot of information disseminated to the organic farmers was delayed, thus making it difficult for them to apply. Since OA in the region is mainly rain-fed (Rapsomanikis, 2015) certain farm practices are undertaken before the rain sets and after the rains cease. Based on the perceptions of the farmers, extension advice on soil, water, weed, pest, and disease control, and market requirements were found to be important in sustaining OA. However, most of the farmers believed that OA is more socially sustainable compared to other sustainability dimensions. Social traditions of communities have been seen to play a great role in determining the adoption of technologies and the subsequent sustainability of those practices. A sustained application of organic practices brings about gradual enrichment of the soil and improvement of its structure resulting in improved productivity (Schrama, et al., 2018). To sustain OA ecologically, socially, and economically a constant supply of information in all aspects of production and marketing of the product is needed. Extension programs should be designed to address the needs of specific categories of clients, support farmers organizations, and farmer to farmer extension especially in areas with few extension agents.

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Declaration of Interest Statement

No potential interest was reported by the authors.

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