AAJRSR Vol.1, 2021 ISSN: 2814-0397 Available online at https://journals.iapaar.com/index.php/AAJRSR

Adoption Certification and Sustainability of Organic Farming Practices

Dr. Inibehe Archibong Job
Department of Agricultural Education
University of Uyo, Nigeria
&
Ronel S. De Guzman
President Ramon Magsaysay State University, Philippines

Abstract
The study focused on the adoption of organic farming. It was carried out in Malawi. Data were collected from 329 farmers. A valid and reliable semi-structured questionnaire was used to collect the data. The reliability coefficients of the instrument were .96 and .84. MANOVA followed with discriminant analysis was used to establish the differences between certified and non-certified farmers. The adoption levels of pest and disease control, weed, soil, and water management practices were higher among the certified farmers compared to non-certified farmers. Certified farmers reported higher scores in three dimensions of sustainable development: ecological, social, and economic. Certification accounted for 15% of the variance in the adoption and sustainability of OA, $\Lambda = .85$, $F(7, 313) = 7.87$, $p < .05$, $\eta p2 = .15$. Certification played a huge role in the success of OF. This is because of the various steps involved in obtaining certification. These include having the necessary permits and market requirements. Non-certified farmers should also be encouraged to certify their farm production systems. Aside from this, they should also improve their communication with extension agents.

Keywords: Organic Farming, Adoption Certification, Sustainability

Introduction

Organic farming (OF) is a process that uses natural resources to improve the quality of life in local communities. However, the success of OF relies significantly on local conditions and entails use of natural resources such as land, vegetation, animal manure, legumes, cover crops, compost, mulch, and minerals (Brzezina, Kopainsky, & Mathijs, 2016). This organic farming system can be compatible with the values and needs of the potential organic adopters (Rogers, 2003). According to the OFRF (Organic Farming Research Foundation) (2011), organic farming contributes to the well-being of farmers and the economy.

The demand for organic produce has grown globally. The US was able to achieve the highest organic production sales in 2018 about $106 billion. China and Germany are the largest consumers of organic food. Both countries spent about 6% of total food sales on organic products (Willer & Lernoud, 2017). Organic Farming certification is an internationally recognized system that ensures that organic regulations are followed in the production and consumption of food. It is carried out to ensure that the various aspects of organic farming are being followed (IFOAM, 2005). The rise of organic food during the 1970s prompted the formation of organic standards in Europe (Willer and Kilcher, 2010). Certification helps improve a product's value and consumer confidence. It also helps open doors for new markets and opportunities.

With the increasing number of farmers converting to organic farming, they are able to capture higher-quality produce at a better price and boost their farm income (Reganold and Wachter, 2015). The rising prices of organic produce make organic production more attractive to the general public. This advantage can be seen in the number of people who want to adopt organic farming (Rogers, 2003). There are 283 organic organizations in 170 countries as of 2015 (Willer and Lernoud (2015). Many of these are using IFOAM's set of standards as a basis for formulating their local regulations (IFOAM, 2005).

Despite the proliferation of organic certification agencies, many farmers fail to meet the requirements of organic certification (Reganold & Wachter, 2015). Caceres (2005) stated that the conversion from conventional to non-certified organic farming has been very successful for the subsistence farmers in the Philippines. This strategy allows them to improve their food safety and reduce their carbon footprint. When it comes to organic farming, certified farmers are more likely to get good prices for their produce (Constance, Choi, and Lyke-HoGland, 2008). Organic Agricultural practices are easier to adopt as they do not require a lot of technical knowledge. Most practices rely on the knowledge that many farmers have accumulated, making them easier to adopt for the untrained (Rogers, 2003).

The dissemination of organic agricultural practices depends on the diffusion of innovation theory (Rogers, 2003). This theory states that social values and norms are the basis for the adoption of organic farming practices. This process involves having change agents who are both within and outside of a local community (Atwell, Schulte, & Westphal, 2009; Rogers, 2003). These individuals help farmers adopt new practices and earn more money through incentives. Cash advances and other incentives help certified farmers become more economically motivated (Constance, et al., 2008). This can increase their rates of adoption (Rogers, 2003).Taylor (2006) states that organic farming has existed in Kenya for many decades. There are various bodies that certify organic farming in the country, EnCert, Nesvax, and Malawi Organic Agricultural Network (MOAN). Malawi Organic Agricultural Network carries out organic farming activities in the country. With the increasing demand for organic products globally, the organization aims at providing a platform for organic farmers and consumers to interact and exchange information. Few studies have been conducted to connect the certification of organic agriculture to the adoption of sustainable practices. This study aims to address this issue by linking the certification of organic farming to the implementation of those practices.

Literature Review

This study aims to investigate the adoption of organic farming practices by non-certified farmers. It is based on the theory of Rogers' diffusion of innovation theory. Rogers (2003) proposed four main elements that determines the rate of adoption of innovations. The four elements mentioned by Rogers (2003) are communication channels, time, social system, and innovation itself. Rogers (2003) stated that an innovation must be widely disseminated in order to enable a sustainable lifestyle. This is done by adopting organic farming practices. The dissemination of these practices can be done through various means, such as blogs and social networks. The nature of these networks and change agents can influence the adoption of new practices (Atwell, et al., 2009). The link between the source of innovation and the capital that is nearby can be traced back to the inception and growth of an organization or a product or service.

It has been stated that the capital and proximity of an innovation source are key factors that contribute to the adoption and distribution of new ideas (Tarde, 1969: Goss, 1979). According to Rogers (2003), the attributes of an innovation can predict the adoption rate. These attributes include relative advantage, compatibility, and complexity.

Among the characteristics that have been studied by researchers, the relative advantage has been identified as a major factor that predicts the rate of adoption. According to Rogers (2003) relative advantage as the ratio of expected benefits and costs of adoption of an innovation. Many farmers will convert to organic farming if they are convinced of its advantages. This practice is more advantageous to them than conventional farming systems. Organic Agricultural has unique characteristics that make it advantageous to smallholder farmers in line with Rogers (2003) relative advantage, complexity, and compatibility attributes. It has been found that organic farming is suitable for many farmers due to its low production costs (Brzezina, Kopainsky, & Mathijs, 2016).

The profitability of organic farming has remained steady despite the decrease in yields due to the conversion to organic farming (Nemes, 2009). The farming system is based on the knowledge of the environment. This system uses the knowledge of the organisms living in the environment. Through organic farming, it is possible for small-scale farmers to become profitable in developing countries (Rogers, 2003). However, the full potential of this industry can only be realized once the production process is certified. This study proposed that organic certification may help boost the adoption of organic farming practices.

Purpose of the study

The objective of this study was to explore the significance of certification of Organic Farming (OF) in terms of adoption and subsequent sustainability of OF practices.

The study specifically aims to

1. describe the levels of organic practice adoption in Malawi

2. examine the impact of certification on the sustainability of organic practices.

Research Hypothesis

H_O: There are no significant differences in the adoption and sustainability of OF practices between certified and non-certified organic farmers.

Methodology

This study focused on the organic farming communities in Malawi. It involved over 26,000 certified and non-certified organic farmers. A descriptive survey was then conducted to gather the farmers' perceptions on the adoption and sustainability OF. Stratified random sampling was used to select the study sample. This method was selected because it was more ecological and population generalizability-friendly. The study was scheduled to cover a sample of 377 farmers (Krejcie & Morgan, 1970), the study was only able to collect a sample of 329 farmers due to time constraints and financial constraints. This figure translated to 87.3% of the study's target sample. The independent variables were the adoption and sustainability of OA practices. Application of organic practices, was assessed through the summated score of 27 Likert-type items involving four groups of practices. The groups included various pest control, disease control, weeds control, and soil conservation practices. The items evaluated the frequency of application of the practices and were scaled from 1 to 5, where 1 meant never and 5 implied always. The three dimensions of sustainability were ecological, economic, and social. The variable elements were rated using a Likert-type Scale of 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree and 5 = strongly agree and consisted of 16 items. The dependent variable was organic certification. It was a linear variable that was measured in nominal scale (0 = non-certified, 1 = certified).

One-way Multiple Analysis of Variance (MANOVA) was used to establish whether there was a difference in the adoption and sustainability of OA among certified and uncertified organic farmers. The MANOVA test is a statistical analysis that tests the differences between groups of dependent variable sets. It is an appropriate statistical analysis when the purpose of the research is to assess if mean differences exist on more than one continuous dependent variable by one or more discrete independent variables (Dattalo, 2008). The F test is used to test the null hypothesis if its obtained Fvalue is larger than its critical F, the null hypothesis is rejected. The null hypothesis was tested at .05 alpha level. The discriminant analysis was performed after the MANOVA F test was used. It provides insight into the differences between groups based on their characteristics. The normality and homogeneity of the variance/covariance matrices were then analyzed. The data were typically distributed as indicated by the values of kurtosis and skewness. Stevens (2009) noted that MANOVA is robust toward the violation of normality with respect to Type I error. Homogeneity of covariance matrices is the multivariate equivalent to the homogeneity of variance and was tested using Box's M test (Leech, Barrett, & Morgan, 2015). The Box's M test, ($p < .05$) indicated that the assumption that the covariance matrices are not homogeneous may not be met. In other words, if the size of a group does not equal the covariance of the group, then the probabilities are conservative and significant results can be verified (Tabachnick and Fidell, 2013).

The centroids for each group were computed and Wilk's lambda was used to test for significant differences between certified and non-certified groups. The discriminant function is formulated using the canonical discriminant coefficients. The principle that the absolute value of the discriminant coefficients is less than one half of the biggest value was tested. The hypothesis was tested at .05 level of significance.

Results and Discussion

The first objective was to describe the levels of organic practices adoption and sustainability in Malawi. The results are presented in Table 1 (adoption levels) and Table 2 (sustainability of organic practices).

Table 1: Descriptive Statistics on Application of Organic Crop Production

Practices (N = 329)

Practices[a]	Certified (*n* =107)		Non-certified (*n* =217)	
	M	*SD*	*M*	*SD*
Soils fertility management practices	**21.42**	**3.77**	**19.50**	**4.47**
Composting	4.42	.78	3.81	1.25
Mulching	3.92	1.02	3.51	1.22
Minimum tillage	3.57	1.01	3.03	1.08
Use of leguminous plants	3.32	1.21	3.20	1.12
Crop rotation	3.18	1.20	3.18	1.23
Use of Green manures	2.99	1.28	2.66	1.23
Weed Control practices	**23.54**	**4.92**	**22.50**	**5.52**
Hand-weeding to remove weeds	4.12	.94	4.09	1.15
Mulching to stop weed seeds from germinating	3.65	1.19	3.43	1.20
Soil cultivation carried out at repeated intervals and appropriate time	3.70	1.05	3.24	1.35
Crop rotation to break the weed plant cycles	3.15	1.19	3.30	1.31
Green manures or cover crops to outcompete weeds	3.14	1.20	3.18	1.37

Planting crops close together within each bed, to prevent space for weeds to emerge	3.03	1.16	3.07	1.28
Use of mechanical weeders to kill weeds	2.72	1.43	2.07	1.32
Pest and disease control practices	**28.56**	**6.11**	**23.91**	**6.83**
Growing crops that suffer less damage from diseases	3.58	.87	2.99	1.09
Growing crops that suffer less damage from pests	3.54	.91	2.65	1.17
Crops with a natural resistance to specific pests	3.36	.99	2.64	1.16
Crops with a natural resistance to specific diseases	3.34	1.06	2.71	1.21
Timely planting of crops to avoid the period when a pest does the most damage	3.15	1.15	2.88	1.33
Providing natural habitats to encourage natural predators that control pests	3.06	1.43	2.66	1.21
Using crop rotations to help break pest cycles	3.03	1.26	2.61	1.28
Trapping or picking pests from the crop	2.98	1.32	2.61	1.33
Companion planting with other crops that pests will avoid, such as onion or garlic.	2.47	1.26	2.08	1.19
Water management practices	**18.09**	**3.07**	**16.30**	**4.83**
Organic matter to the soil to improve its ability to hold water	4.30	.86	3.87	1.33
Mulches to hold water in the soil	4.16	.98	3.93	1.94
Rainwater basins or catchments	3.86	1.36	3.18	1.54
Use of terracing	3.35	1.36	3.04	1.39
Appropriate irrigation methods	2.35	1.29	2.17	1.30

Note: [a] 1= never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always 71

From table 1, The study identified four main OF practices: weed, soil, water, and pest. The most commonly used practices were those related to pest and disease management among certified (n = 222, M = 28.52, SD = 6.11) and noncertified (n = 107, M = 23.91, SD = 6.83). The increasing incidence of diseases and pest outbreaks can be attributed to the environment's favorable conditions. This can be easily controlled through the use of simple and effective cultural practices. Most of the pest and disease control cultural practices are simple to execute hence experience high adoption rates (Rogers, 2003). Water management techniques were least used by both certified (M = 18.09, SD = 3.07) and non-certified (M = 16.30, SD = 4.83) individuals. This study indicates that The poor adoption of water management techniques may have resulted from the lack of permanent sources of water and rainwater harvesting skills. Only a few farmers in the region practice irrigated farming (certified, M = 2.35, SD = 1.29, non-certified, M = 2.17, SD = 1.30). Due to the region's bimodal rainfall patterns, most of the time, crops are grown in dry season and require long rains to thrive. Agriculture in the region is heavily dependent on bimodal rainfall patterns characterized by two rainy seasons; long rains (March to July) and short rains (October to December) (Franzel, Wambugu, & Tuwei, 2003). Among the certified farmers, organic matter and composting were the most commonly used practices. Composting which involves decomposition of plant wastes to make manure (M = 4.42, SD = .78), use of organic matter (M = 4.30, SD = .86), and mulching (M = 4.16, SD = .98), to enrich, control weeds, and improve the water holding capacity of the soil. Non-certified farmers commonly used various techniques such as hand weeding, mulching, and organic matter to control weeds and improve the soil's water holding capacity. Hand weeding to kill weeds (M = 4.09, SD = 1.15), mulching (M = 3.93, SD = 1.94), and application of organic matter (M = 3.87, SD = 1.33), to enrich, control weeds, and improve the water holding capacity of the soil. The adoption levels of these practices were higher compared to other practices as they were compatible with the setting, simple to use and involved use of indigenous knowledge (Rogers, 2003). Based on the results of the survey, certified farmers had higher adoption rates of pest and diseases control, soil management, and weed control. The adoption levels of pest and diseases control (M = 28.56, SD = 6.11), weed (M = 23.54, SD = 4.92), soil (M = 21.42, SD = 3.77), and water management practices (M = 18.09, SD = 3.07) were higher among the certified farmers compared to non-certified farmers (M = 23.91, SD = 6.83; M = 22.50, SD = 5.52 ; M = 19.50, SD = 4.47 ; M = 16.30, SD = 4.83 respectively). The higher level of organic practice may have been created by the higher number of contacts with private extension agents, regular inspections and audits, assurance of lucrative markets, and higher prices for their products (Muller, 2009). Most of the practices in table 1 scored a mean score of 3 or less, indicating that farmers tend to utilize them occasionally rather than all the times. Most farmers cited lack of knowledge as the main reason why they were not utilizing the practices as frequently as they should be applied. Knowledge is paramount to the adoption of organic innovations. Non-certified farmers tend to have limited knowledge about organic practices. Rogers (2003) stated that knowledge is the key to the adoption of organic practices. Non-certified farmers tend to have little or no knowledge about the organic practices. These farmers must first learn about the organic practices before they can begin adopting them.

Table 2: Perceived Sustainability of OF Practices *(N = 324)*

Sustainability	Certified (*n* =221)		Non-Certified (*n* = 103)	
	M	*SD*	*M*	*SD*
Ecological sustainability	**19.47**	**.16**	**19.07**	**.33**
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
Increased usage of animal or green manure	3.81	1.10	4.00	1.18
Reduces erosion through cover crops	3.65	.85	3.60	1.01
Social sustainability	**20.80**	**2.48**	**19.75**	**2.45**
Improved health status of family members	4.30	.76	4.11	.92
Safety of food is greater with organic farming	4.29	.79	4.40	.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	**23.37**	**3.19**	**22.19**	**3.85**
Increasing yields in the long run	4.33	.79	4.26	.87
Reduces the financial risks involved in farming	4.14	.92	3.98	1.05
Reduced costs of production	4.05	.89	4.12	.93
Allows farmers access to new market opportunities; local and international markets.	3.88	.77	3.64	.92
Job creation; labor use is higher on organic farms than on their equivalent conventional farms	3.65	.97	3.46	1.11

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

The table 2 shows the organic farming practices of certified and non-certified farmers relative to the ecological, social, and economic aspects of organic farming. The majority of the farmers, both certified (n = 221, M = 23.37, SD = 3.19) and noncertified (n = 103, M = 22.19, SD = 3.85), indicated that use of organic practices enhanced economic sustainability the most as compared to social and ecological aspects. In general, certified farmers indicated that the adoption of organic practices had ecological (M = 19.47), social (M = 20.80), and economic sustainability (M = 23.17) more than non-certified. This is why certified farmers are more prone to sustaining their production due to the various advantages of organic farming. These include higher yielding (M = 4.33, SD = .79), improved health status of the members of the family (M = 4.30, SD = .76), better food safety (M = 4.29, SD = .79), and reduced financial risks (M = 4.14, SD = .92). Non-certified farmers said that safety of food was greater with OF (M = 4.40, SD = .92), yields gradually increased (M = 4.26, SD = .87), production costs were lower (M = 4.12, SD = .93), and the health status of the family members also improved (M = 4.11, SD = .92). Both certified and non-certified participants agreed that the increase in the yield was needed to cover the 19% gap between conventional systems and OF. The farmers attributed the improvement of the soil's structure and organic matter to the continuous application of organic materials.

Table 3: Multivariate Tests for **Effect of Certification on Adoption and Sustainability of OA Practices** ***(N = 329)***

Test	V	F	Hypothesis df	Error df	p	ηp^2
Pillai's Trace	.15	7.87	7	313	< .05	.15
Wilks' Lambda	.85	7.87	7	313	< .05	.15
Hotelling's Trace	.18	7.87	7	313	< .05	.15
Roy's Largest Root	.18	7.87	7	313	< .05	.15

Note: [a,b] 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always; [b] 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree

This objective two focused on the perceived effects of certification on organic practice adoption. The objective of the study was to determine if certification of organic practices would have a positive effect on the adoption and sustainability of these practices. The study analyzed the various aspects of organic farming (OF) (ecological, social, and economic) and the certification process (soil fertility, weed, water, pest and disease management practices). The significance of the MANOVA effect was obtained for the sum of the components of the Wilks' Lambda model. A statistically significant MANOVA effect was obtained, Wilks' Lambda (Λ) = .85, F (7, 313) = 7.87, $p < .05$, multivariate ηp2 = .15. The findings suggest that certified organic farmers reported a greater application of soil, water, pest and disease control organic practices as a result of certifying their production. The adoption and sustainability of organic farming was estimated to be influenced by certification. This study revealed that 15% of the variance in organic farming practices was accounted for by certification. Jennings and Petrokofsky (2018) noted that the importance of having an OF certification contributes to the improvement of practices. OF certification demands adherence to certain practices and standards. To meet the requirements of the organic certification, farmers have to implement a set of pre-defined practices. This ensures that the produce meets the requirements of the organic certification. The differences in the adoption of OF practices by different farmers are clear signs that adoption does not happen at the same time in a social system. According to Rogers, (2003), Farmers adopted OF practices at different times, some reported a quicker uptake than others based on the degree of innovativeness of each individual farmer.

Table 4 Adoption and Sustainability of OA in Discriminant Function Analysis (N =321)

Variables						*Structure Matrix*	*Standardized Canonical Coefficients*
						Function 1	
Pest & disease management						**.82**	**.79**
Water management						**.54**	.22
Soil management						**.53**	**.39**
Social						**.41**	.24
Economic						**.39**	.12
Weed management						.23	**.58**
Ecological						.14	.06
Wilks' lambda							
Function	λ	$\chi 2$	*df*	*p*	Eigenvalue	% variance	Canonical Correlation
1	.85	51.17	7	< .05	.18	100	.39
Group centroids						Certified	Non-certified
						.29	-.60

A discriminant analysis was performed to determine which of the various organic management variables, which include soil fertility, pest control, and water management, are best discriminated between organic and non-certified farmers.

As presented in Table 4, discriminant function analysis revealed a significant Wilks' lambda $\lambda = .84$, $\chi2\ (7) = 51.17$, $p = < .05$, $R2 = .15$. This is the proportion ($\lambda = .85$) of the total variance in the discriminant scores not explained by differences among groups. This also implied that the group (certified and non-certified) means differed significantly and the model was a good fit for the data. The eigenvalue was .18 (Table 4) indicating that the discriminant function explained 18% of the variance in group membership. There is only one function, 100% is accounted for by the variance function. The canonical squared correlation (.15) shows that 15% of the group membership variance was explained by the adoption and sustainability factors. The standardized discriminant function coefficients revealed in Table 4 indicate the relative importance of the independent variable in predicting the dependent variable. According to Hair et al., (2005), coefficients with large absolute values correspond to variables with greater discriminating ability. On the basis of the rule that those coefficients whose absolute value is not less than one-half of the largest value are considered in the discriminant function (.79/2 = .39). Three out of the seven factors met the requirements for discriminant function. Among the three categories of organic practices, pest and disease control measures had the highest discriminating ability (.79), followed by weed control (.58), and lastly soil fertility management practices (.39). The structure coefficients indicate the correlation between a variable and the discriminant function. They are also interpreted as the largest absolute correlations that are associated with the discriminant Function. Hair, et al., (2005) recommends that coefficients greater than .3 be considered meaningful. Among the organic management practices several were found meaningful: pest and disease control (.82), water (.54), soil fertility (.53), social (.41), and economic sustainability (.39). The centroids are the discriminant scores for the various variable in the two groups. The centroid for non-certified was .60 and .29 for the certified group. It also emerged from the findings that 69.1% of original grouped cases were correctly classified.

Discussion and Conclusion

This study utilized four different types of OF practices; pest and disease control, weed control, soil fertility, and water conservation. The most frequently used techniques by both certified and non-certified were those related to pest and disease control. An integrated approach was used to manage pests and diseases in OF. This process involved the use of biological, ecological, and physically-based measures. It also emerged that pest and disease management in OF is heavily reliant on precautionary measures rather than curative practices which are based on ecologically safer management techniques (Haldhar, Jat, Deshwal, Gora, & Singh, 2017). The various pest and disease management techniques included the growing of healthy crops that are resistant to diseases and pests, timely planting of crops to avoid the period when the pest causes most damage, companion planting with other crops that would repel pests, trapping or picking pests from the crop, rotating crops to help break pest and disease cycles and prevent carryover of pests to the next season, and providing natural habitats to encourage natural predators that control pests. They were also practiced to minimize the spread of diseases and pests.

Non-certified farmers cited the lack of knowledge as a barrier to the adoption of certain farming techniques (Rogers, 2003). This issue could be solved through the availability of extension services. Proper management of pests in OF is an intensive cultural process that involves identifying and monitoring their lifecycles (Stoleru and Sellitto, 2016). The adoption of organic farming was associated with a higher level of perceived sustainability. This was evidenced by the number of certified organic farmers who manage soil fertility, pest and disease control, and water management. The high levels of application of organic agriculture (OF) practices among certified farmers were established due to the requirement and standards that accompany their certification(Petrokofsky & Jennings, 2018) and frequent contacts with extension agents; in line with Rogers, (2003) assertion that ideas are first adopted by those closest to the sources. The contractual agreements between the farmers and the exporters companies helped create an assurance of market and higher prices for their products (Muller, 2009) also contributed to increased application. This study supports the notion of Rogers (2003) that farmers are more inclined to adopt new technologies and procedures that have a certain advantage over those that are not. The regular and continuous follow-ups conducted by the companies' extension agents and farm inspections carried out on certified farms may also have propelled the high levels of application of OF practices witnessed. Rogers (2003) noted that the emergence of new technologies occurs in social contexts. For instance, when Extension agents act as intermediaries between farmers and other actors in the organic industry, they help connect them to potential buyers and researchers.

This social network concept allowed people to connect and share knowledge. The organic water management practices were not as prevalent as the other categories. The lack of knowledge about harvesting and obtaining water from various sources has led to the minimal use of irrigation techniques. The study revealed that organic farmers are more likely to adopt sustainable farming techniques if they are trained properly. This is because organic farming techniques help minimize soil erosion and conserve water.

The findings indicate that the continued application of organic practices such as soil fertility, weed, and water conservation enhanced a variety of environmental and social factors. Social sustainability was higher than ecological and economic dimensions explain the importance of innovation in the diffusion of new technologies. The ecological sustainability of soil conservation involves protecting it from chemical contamination and promoting a healthy environment for biodiversity. It also helps conserve water and reduce erosion. Social sustainability is about achieving social and environmental goals. It involves improving the safety of food, improving the health of the population, and accessing attractive markets. Higher levels of social, economic, and ecological sustainability are associated with certified organic farming.

Recommendation

Non-certified producers should be encouraged to adopt organic farming practices to sustain their operations.

References

Atwell, R. C., Schulte, L. A., & Westphal, L. M. (2009). Linking Resilience Theory and Diffusion of Innovations Theory to understand the potential for perennials in the U.S. Corn Belt. *Ecology and Society, 14*(1), 30-46.

Kanyi, M., Lawver, D.E., Ulmer, J., Murimi, M., & Ritz, R. (2017). Attitudes and adoption of rainwater harvesting: Influence of gender, awareness, and social status. *Journal of International Agricultural and Extension Education, 24*(1), 63-73.

Brzezina, N., Kopainsky, B., & Mathijs, E. (2016). Can organic farming reduce vulnerabilities and enhance the resilience of the European food system? A critical assessment using system dynamics structural thinking tools. *Sustainability, 8*(10), 971 - 1003.

Caceres, D. (2005). Non-certified organic agriculture: An opportunity for resource-poor farmers? *Outlook on Agriculture, 34*(3), 135-140.

Constance, D., Choi, J., & Lyke-Ho-Gland. (2008). Conventionalization and bifurcation and quality of life certified and noncertified organic farmers in Texas. *Southern Rural Sociology, 23*(1), 208-234.

Dattalo. (2008). *Analysis of multiple dependent variables.* New York : Oxford.

Field, A. (2017). *Discovering statistics using IBM SPSS statistics* (5th ed.). London, UK: Sage.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2015). *How to design and evaluate research in education* (9th ed.). New York, NY: McGraw-Hill Education.

Franzel, S., Wambugu, C., & Tuwei, P. (2003). Adoption and dissemination of fodder shrubs in Central Kenya. *Agricultural Research and Extension Network*, 1-11.

Goss, K. (1979). Consequences of Diffusion of Innovations. *Rural Sociology, 44*(4), 754-772.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis* (3rd ed.). New York: Macmillan.

Haldhar, S., Jat, G. C., Deshwal, H., Gora, J., & Singh, D. (2017). Insect pest and disease management in organic farming. *Towards Organic Agriculture*, 359-390.

International Federation of Organic Agriculture Movement. (2005). *The IFOAM basic standards for organic production and processing.* Bonn, Germany: IFOAM.

Krejcie, R., & Morgan, D. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

Leech, N. L., Barrett, K. C., & Morgan, G. A. (2015). *IBM SPSS for intermediate statistics: Use and interpretation* (Vol. 5). New York: Routledge/Taylor & Francis Group.

Muller, A. (2009). Benefits of organic agriculture as a climate change adaptation and mitigation strategy for developing countries. *Environment for Development*, 1-15.

Nemes, N. (2009). *Comparative analysis of organic and non-organic farming systems: A critical assessment of farm profitability.* Rome: Food and Agriculture Organization of the United

Nations. Nunnally, J. C. (1978). *Psychometric theory (2nd ed.)* . New York: McGraw-Hill.

Organic Farming Research Foundation . (2011). *Organic farming for health and prosperity.* Santa Cruz: Organic Farming Research Foundation .

Padel, S. (2001). Conversion to organic farming: A typical example of the diffusion of an innovation. *Sociologia Ruralis, 41*, 40-61.

Reganold, J., & Wachter, J. (2015). Organic agriculture in the twenty-first century. *Nature Plants, 2*, 1-7.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Schrama, M., Haan, J., de Kroonen, M., Verstegen, H., & Van der Putten, W. (2018). Yield gap and stability in organic and conventional farming systems. *Agriculture, Ecosystems and Environment, 256*, 123–130.

Stoleru, V., & Sellitto, V. (2016). Pest control in organic systems. In K. Gill, & G. Goyal (Eds.), *Integrated Pest Management (IPM): Environmentally sound pest management.* IntechOpen. Retrieved from https://www.intechopen.com/books/i ntegrated-pest-management-ipmenvironmentally-sound-pestmanagement/pest-control-in-organicsystems

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Tarde, G. (2008). *The laws of imitation.* Beijing, China,: China Renmin University Press.

Taylor, A. (2006). *Overview of the current state of organic agriculture in Kenya, Uganda and the United Republic of Tanzania and the opportunities for regional harmonization.* Geneva: United Nations Environment Programme.

Willer, H., & Kilcher, L. (2010). *The world of organic agriculture. statistics and emerging trends.* Frick, Switzerland: Research Institute of Organic Agriculture (FiBL).

Willer, H., & Lernoud, J. (2015). *The world of organic agriculture, statistics and emerging trends. FiBL- IFOAM Report.* Bonn, Germany: FiBL- IFOAM.

Willer, H., & Lernoud, J. (2017). *Organic agriculture worldwide 2017: Current statistics.* Frick, Switzerland: Research Institute of Organic Agriculture, FiBL.