doi: 10.5191/jiaee.2019.26207

Influence of Smallholder Farmer Groups on the Application of Best Horticultural Farming Practices in Kenya

Raphael Mwiti Gikunda
David Lawver
Texas Tech University

Abstract

This study aimed at establishing the relationship between group membership and application of best horticultural farming practices (BHFP) among the group and non-group farmers in Meru County, Kenya. A descriptive design involving a cross-sectional survey was applied to address the research objectives. The target population consisted of 4950 smallholders from horticultural group and non-group farmers. The study sample was 224 farmers chosen through stratified random sampling. Data were gathered using a researcher-developed questionnaire. Both descriptive and inferential statistics were employed in data analysis. The analysis was accomplished using the Statistical Package for Social Sciences (SPSS). The study revealed a variance in mean BHFP application scores between groups' farmers (M =76.49, SD = 4.78) and non-groups' farmers (M = 67.71, SD = 8.57). There was a positive substantial correlation between group membership and application of BHFP, which was statistically significant (r_{pb} = .50, N = 224, p < .01). Discriminant function analysis revealed that Wilks' lambda was significant, $\lambda = .47$, χ^2 (16) = 162.63, p = <.05, R^2 = .53 implying that the group means differed significantly. Farmers in groups applied BHFP more than the non-group farmers hence a clear association between group membership and BHFP application. The study recommends that farmer groups should be promoted to facilitate dissemination and application of BHFP.

Keywords: best horticultural farming practices; farmer group; smallholder farmers

Introduction

The tropical and humid climate found in Kenya suggests favorable conditions for production of horticultural crops. This subsector produces a variety of crops including fruit, flowers, vegetables, spices, root crops and herbs. Horticulture employs about two million people where most of them are smallholder growers who constitute 80% of farmers. According to Ongeri, (2014), the horticultural subsector helps to eradicate poverty and improve smallholders' farm income. It has also proven to be one of the top foreign exchange earners for the country generating about 1 billion US dollars annually. In 2015, horticulture's contribution to national gross domestic product was 1.45% while that of flowers alone was 1.01%. Horticultural export volumes increased by nearly 3% to reach 220,200 tons in 2014. Earnings from exports of fresh produce hit KSh84.1bn ($ 925.1m), a rise of around KShs 700m ($ 7.7m) over 2013 and driven by a 12.5% spike in fruit export revenues, which reached KShs 5.4bn ($ 59.4m). Earnings from vegetables, however, fell nearly 18% to KSh18.8bn ($ 206.8m), despite higher volumes (Kenya National Bureau of Statistics, 2015).

Much of the fresh fruit and vegetables produced in Kenya targets almost exclusively the European market, thus the produce are checked against Euro-Retailer Produce Working Group for Good Agricultural Practice (EurepGAP) standards before export. Rising quality control standards have meanwhile affected the industry. In October 2014, horticulture exporters were concerned to learn that Kenya's 30-year economic partnership agreement (EPA) with the EU had not been renewed, as officials continued to negotiate issues such as taxation, good governance, and subsidies. EU-bound exports were instead subject to tariffs under the Generalized System of Preferences, which range from 4% to 24% and apply to some 67% of goods flowing from Kenya to Europe. The EU had earlier set a September 30, 2014, deadline for Kenya to cut the amount of chemical residue in all EU-destined produce exports, promising to introduce stricter inspections (Kenya National Bureau of Statistics, 2015).

The compliance with EurepGAP standards by smallholder farmers has been a center of focus due to food safety concerns in recent years. However, this compliance entails application of BHFP, which involve expensive investment in farm inputs and long-term farm structures (Asfaw, 2010). In Kenya, smallholder farmers contribute about 50-60% of total horticultural crop production (Ongeri, 2014). Very few studies have been conducted to determine the level of application of BHFP among horticultural farmers. Not much research has been done on smallholder farmer groups in Kenya and empirical studies on their influence on the application of agricultural technologies are limited. In Meru County, horticulture involves the production of cut flowers; fruit such as passion fruit, mangoes, avocadoes and vegetables such as French beans and snow peas (Meru County, 2014). Most horticultural smallholder farmers in Meru County have formed groups to enjoy economies of scale. Penunia (2011) contends that through the groups, farmers enjoy lower production costs through improved access to farm inputs such as agrochemicals and fertilizers. These farmers, through their groups, are well positioning to meet EurepGap standards and manage the grading, cleaning, processing, drying, packaging, storage, branding, collection and transportation of produce. As a group, farmers are better able to negotiate the prices of the produce resulting in increased profits that accrue to farmers rather than intermediaries and buyers.

Theoretical Framework

The research utilized social learning theory (SLT) to describe how farmers access, share, apply knowledge and apply skills related to BHFP. According to Kolb (1984), learning occurs from continuous communication and iteration between thinking and action: concrete actions result in certain experiences which when reflected upon generating cognitive changes resulting in new actions. Leeuwis, (2003) observed that organizational and social space also contribute in the learning process. Farmer groups serve as organizations for collective action in Africa and they have heightened participatory access to extension services and technologies (Prager & Creany, 2017). Through normative and informational influence, farmers in a group tend to conform to standards set by the group and apply practices agreeable to the group. Once the group has expressed a commitment, people in a group tend to exhibit a strong tendency to act in a way that is consistent with the commitment. Since farmers tend to adopt and practice what they see others doing, SLT principles can be used to change perceptions of the social environment by making certain practices more common. Groups provide social support its members and this makes them consider adopting practices agreed upon by the members.

Literature Review

Best Horticultural Farming Practices (BHFP)

Recent studies indicate that quality and safety of food have raised concerns of many European consumers and this has shaken their trust in the imported food safety (Jaffee & Masakure, 2005), some of which is produced in Kenya. This has resulted in the strict enforcement of EurepGAP (Zoss & Pletziger, 2007), which demands the application of BHFP in producing, harvesting, processing and transportation of horticultural produce (FAO, 2010). In response to the rising standards, food safety has received increased attention globally in recent times (Jaffee & Masakure, 2005; Narrod, Gulati, Minot & Delgado, 2005). Studies by Henson, Masakure and Boselie (2005) and Jaffee (2003) indicate that to meet this concern, some exporters choose input suppliers and agronomists to advise farmers on production, processing and transport of produce. Following heightened food safety concerns in retail markets; produce hygiene and handling practices at production, harvesting and processing are well monitored (Jaffee & Masakure, 2005). Farmers are expected to construct a pesticide storage structure, toilet, and a hand washing facility at the farm as well as a grading shed (Boselie, 2005). In certain instances, exporters have been conducting soil and water tests twice a year on farms of those contracted to produce crops for the European Union retail market. These exporters also require farmers to keep records either individually or collectively.

A number of studies have been conducted examining the costs of complying with BHFP and the likely benefits of adoption (World Bank, 2011). In the process of trying to deal with emerging opportunities and challenges associated with adoption of BHFP, many development agencies have applied a collection of measures to facilitate small-scale farmers' compliance with the standards, especially in Sub-Saharan Africa (SSA). There has been a continued modification of government policies and the institutional environment to improve the application of BHFP practices in developing countries (Jaffee, 2003). The World Bank has taken diverse measures involving various entry points, which include focusing on farmer group capacities for production, collective action, and standards compliance (World Bank, 2011).

Farmer Groups Membership

Various studies have been conducted to investigate the role of farmer groups in improving access to input, output markets and agricultural information by small-scale farmers (Shiferaw, Hellin & Muricho, 2011) however; very few studies have focused on the application of best horticultural practices. Farmer benefits from economies of scale in terms of access to less expensive inputs, marketing costs and better produce prices, all which are gained through participation in farmer organizations. Shiferaw et al., (2009) documented that farmer groups have enabled smallholders to access high-value markets in Africa, Asia, and Latin America. Collective action empowers farmers to access inputs, such as improved seed, fertilizer, and agrochemicals (Ofuoku & Urang, 2009).

Other than enhancing farmers' access, farmer groups are a means of alleviating inefficiencies in the market (Shiferaw et al., 2009). Further, in a study by Kirui and Njiraini, (2013) it was reported that farmer groups are valuable social assets to smallholder farmers as they enable them solve the challenge of accessing both input and output markets. Franzel, Wambugu, and Tuwei, (2003) recommended a critical review of farmer groups' contribution of improving smallholder agriculture since they were being professed as an effective platform for enhancing agricultural productivity in many African countries.

Purpose & Objectives

This research aimed at examining the association between group membership and application of BHFP among smallholder farmers in Kenya. The study was guided by the following objectives;

1. To identify the reasons why smallholder farmers subscribe to horticultural farmer groups' membership
2. To determine the relationship between farmer group membership and application of BHFP
3. To determine whether non-group and group horticultural farmers differed on the application of BHFP.

Omnibus Statistical Hypotheses

HO: In the population from which the samples are drawn, the group centroids from all the discriminant functions are equal.

Research Methodology

The study was conducted in Meru County, Kenya. It is located along the equator on the eastern slopes of Mt. Kenya. Agriculture is the main land use and involves both livestock and crop production. The county receives an average of 1250 mm (49.21inches) of rainfall per annum characterized by two rainy seasons. The long rains falls between March and May while the short rains occurs between the months of October and December. The temperatures varies from a low of 8°C (46.4 °F) during cold weather to a high of 32 °C (89.6 °F). This study used a quantitative research approach and specifically a cross-sectional survey design was used to address the objectives. The target population consisted of 4950 smallholder farmers, out of which 1950 belonged to 35 horticultural farmer groups in Meru County and 2000 were individual smallholder farmers (Non-group farmers). Stratified random sampling was used to select a sample of 224 farmers. This sample size was considered adequate at an alpha level of 0.05 (Bartlett, Kotrlik, & Higgins, 2001). The population was stratified based on group membership (group and non-group farmers) and then random sampling was used to select 112 farmers from each stratum.

A researcher developed questionnaire was used as a means of data collection. The questionnaire was comprised of three main parts; group membership, BHFP and benefits of group membership. Group membership was assessed based on group size, age, and number of meetings. It was also measured as a binary construct of either a group member or not (0= No, 1=Yes). The application of BHFP was measured using a 5-point Likert type scale. The application score for each farmer was computed by summating items. BHFP were developed through the ISEAL Alliance and Governmental Use of Voluntary Standards' project in 2008 to ensure food safety, protect workers' health and the environment (ISEAL Alliance, 2008). A panel of experts established face and content validity of the instrument. Reliability assessment for the instrument was accomplished by using Cronbach‘s alpha internal consistency reliability coefficient. The analysis revealed a Cronbach's alpha coefficients of .78 for group membership construct and .86 for BHFP application construct. George and Mallery (2003) indicate that the minimum acceptable alpha is .70.

Two hundred and twenty-four questionnaires were distributed to the sampled farmers at produce collection centers. The decision to administer questionnaires during produce collection days at marketing centers when all farmers were present, enabled the researchers to reach all the sampled members at once thus achieving 100% response rate. Point biserial correlation, (r_{pb}) was used to determine the association between group membership and application of BHFP. According to Howell, (2004) Point biserial correlation is equivalent to Pearson's correlation when one of the variables is dichotomous. Discriminant analysis was used to test the hypothesis that farmers belonging to producer groups and those who did not, differed significantly on BHFP application levels. The grouping variable (dependent variable) was farmer group membership in which there were two categories of farmers; non-group and group farmers coded as 1 and 2 respectively.

The discriminating variables (independent variables) included production, harvesting and post-harvesting hygienic practices. The three variables were measured using a Likert-type scale items of 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = always. Discriminant analysis was used to determine whether non-group and group horticultural farmers differed significantly on the application of production, harvesting and post-harvesting BHFP. Klecka (1980) observed that discriminant function analysis is used to determine which continuous variables discriminate between two or more naturally occurring groups. Data were found to be normally distributed through an observation of the histograms of the frequency distribution (Tabachnick & Fidell, 1996).

Box's M test was used to test the multivariate homogeneity of variance-covariance matrices assumption. An insignificant value of Box's M test shows that those groups do not differ from each other and would meet the assumption. The result showed that Box's M test *p*-value was less than .05. This shows that the assumption of homogeneity of the covariance matrices was not met, therefore the results should be interpreted with caution. However, Tabachnick & Fidell, (2001) argues that if sample sizes are equal, heterogeneity is not an issue but with unequal sample sizes, heterogeneity may compromise the validity of null hypothesis decisions. Correlation matrix was used to check multicollinearity of the variables and it was confirmed that none was exhibited as the coefficient ranged from .00 to .66. The centroids for each group were computed and Wilk's lambda was used to test for significant differences between groups. The tests were conducted at 95% level of significance ($p < .05$ a priori).

Results

Farmer Group Characteristics

The major horticultural crops produced by most of the horticultural smallholder farmers (43.8%) in Meru County were peas, tea, and cabbage. All farmer groups cultivated green peas and thus was a popular and a major horticultural crop in Meru County. According to KNBS (2015), green peas are one of the main Kenya's horticultural products that does well in the export market. In Meru County, the specific green pea cultivars grown mainly for export include snap peas and snow peas.

Table 1 presents the distribution of groups based on their sizes, number of meetings, and the length of time the groups had been in existence. More than half of the groups (68.6%) were comprised of between 20 to 59 members with a mean group size of 55.71. Regarding the frequency of meetings, the majority of farmers (90.2%) indicated that they held meetings once or twice per month. The study revealed that group meetings served as avenues for members to share information, discuss issues affecting the groups, get feedback from their leaders and to make important decisions. The study also established that most of the groups (51.8%) were young in that they had been in existence for between 1 and 2 years.

Table 1
Characteristics of Farmers Groups (n= 112)

Variable	Frequency	Percentage
Group sizes[a]		
20 – 59	24	69
60 – 99	8	23
100 – 139	1	3
140 – 179	2	6
Number of meetings per month[b]		
1	67	59.8
2	34	30.4
3	1	.9
4	5	4.5
Above 4	4	4.5
Period the group has been in existence[c]		
1 yr.	16	14.3
2 yrs.	42	37.5
4 yrs.	31	27.7
Above 4 years	23	19.8

Note. [a] = scale of 1-174, [b, c] = scale of 1-8

Reasons for Farmer Group Membership

The first objective sought to determine the reasons why farmers joined horticultural groups. Table 2 indicates the rank of reasons that caused farmers to subscribe to horticultural groups. The main reasons for horticultural group membership subscription were access to competitive credit facilities from banks such as equity or other microfinance institutions (M = 4.60, *SD* =.61), affordable farm inputs (*M* = 4.59, *SD* =.53), extension services (*M* = 4.58, *SD* =.53), manage risks involved in production of horticultural crops (*M* = 4.50, *SD* =.66) and access to produce market (*M* = 4.46, *SD* =.68). The findings confirm those of a study by IFPRI, (2012) which observed that farmer groups are useful avenues for increasing farmer productivity and food security. Farmer groups help in improving access to resources, better markets and consequently better prices for the produce.

Other reasons that caused farmers to become members of groups included, strengthen their bargaining power (*M* = 4.30, *SD* =.71), improved income through improved production and sales (*M* = 4.24, *SD* =.71), attraction to group income-generating activities (*M* = 4.23, *SD* =.75) and liking for the members (*M* = 4.10, *SD* =1.23). The majority of the farmers indicated that groups act as a platform for discussing other issues such as education, health, politics or other welfare services (*M* = 4.04, *SD* =1.16), and the group acts as a platform to save money for group uses (*M* = 3.96, *SD* =1.25). These reasons also came up in a study by Aliguma, Magala, and Lwasa, (2007) who found that groups improved access to better prices and facilitated produce transport to markets. Loevinsohn, Mugarura, & Nkusi, (1994) reported that farmer groups facilitate access to competitive credit facilities from financial institutions.

Table 2
Reasons for Joining Horticultural Farmers (N = 224)

Reasons[a]	*M*	*SD*
Access to competitive credit facilities from banks such as equity or other microfinance institutions	4.60	.61
Access to affordable farm inputs	4.59	.53
Access to extension services	4.58	.53
Manage risks involved in the production of horticultural crops	4.50	.66
Access to produce market	4.46	.68
Strengthen the bargaining power	4.30	.71
Improved income through improved production and sales	4.24	.71
Attraction to group income generating activities	4.23	.75
Liking for the members	4.10	1.23
The group acts as a platform for discussing other issues such as education, health, politics or other welfare services	4.04	1.16
The group acts as a platform to save money that is inter-lend among members(merry go round)	3.96	1.25

Note: [a] = 1= not at all, 2= very little, 3= somewhat, 4 = great extent, 5 = very great extent

Application of BHFP

The concept of BHFP evolved recently because of an immense concern about the safety and quality of food as well as the ecological sustainability of horticultural production. BHFP application helps farmers to produce safe and healthy food (Oyinlola, Obadina, Omemu, & Oyewole, 2016). The study revealed (Table 3) that among the practices "I prevent overfilling of produce in the harvesting containers" (*M* = 4.98, *SD* = .13), "I use clean containers for harvesting" (*M* = 4.97, *SD* = .21), "I prevent the damaging of produce due to rough handling" (*M* = 4.96, *SD* = .28), were the top three practices adopted by producers in farmer groups. "I harvest the produce at the right weather conditions" (*M* = 4.46, *SD* = .79), "I protect the fresh produce from any form of contamination (dust or rain or sunburn)" (*M* = 4.46, *SD* = .76), and "I use clean containers for harvesting" (*M* = 4.46, *SD* = .76), were the most applied practices among the non-group farmers.

Table 3
Comparison between Farmer Group and Non-Group Members based on Application of BHFP

Practices[a]	Group farmers (*n*=112)		Non-group farmers (*n*=112)	
	M	*SD*	*M*	*SD*
Production hygiene				
My toilet is not situated near a source of irrigation	4.96	.25	4.32	1.07
I avoid production of horticultural crops near potential harmful substances	4.88	.42	4.38	.98
I apply the right amount of organic manure using appropriate methods	4.87	.49	4.35	.85
I consider animals vehicles for contamination with pathogenic organisms	4.85	.62	3.88	1.02
I apply the right amount of inorganic fertilizers using appropriate methods	4.80	.72	4.47	.63
I prevent the build-up of pests by crop rotation or biological or integrated control methods	4.72	.65	3.84	1.03
I maintain soil cover to minimize soil erosion losses by wind **or** water	4.41	.82	3.89	1.04
Harvesting hygiene				
I prevent overfilling of produce in the harvesting containers	4.98	.13	4.40	.91
I use clean containers for harvesting	4.97	.21	4.46	.76
I prevent the damaging of produce due to rough handling	4.96	.28	4.31	.84
I harvest crops using the correct maturity index	4.93	.31	4.08	.82
I harvest crops using appropriate techniques	4.81	.66	4.32	.83
I use clean clothes and gloves when harvesting	4.54	.88	3.89	1.24
I harvest the produce at the right weather conditions	3.83	1.26	4.46	.79

Post-harvest hygiene				
I clean the areas for storing fresh horticultural crops before harvest	4.89	.49	4.18	.77
I protect the fresh produce from any form of contamination (dust or rain or sunburn)	4.83	.57	4.46	.76

Note. [a] = 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = always

The mean scores for non-group members were smaller than farmer groups' members. This means that the level of application of BHFP was lower than their counterparts in groups. The standard deviation for the non-group farmers was greater than those of farmer group members implying a higher variation in the application of BHFP among non-group farmers. Research has shown that farmer groups facilitate the adoption of agricultural technologies because they can lower transaction costs, enhance the exchange of information, and lower farmers' risk aversion toward new techniques and income shocks through a shared risk management (Hogeland, 2006; Shiferaw et al., 2011).

BHFP Application Scores

An application score for each individual farmer was computed using the Likert type scale items in Table 2. The index involved 16 horticultural practices and each was worth five points based on a five-point Likert-type scale, thus the total score for the 16 practices was 80 points. Figure 1 presents the BHFP application score for group and non-group farmers. The majority of farmers (97) who belonged to farmer groups received a score of between 74 and 80 whereas most of the non-groups members scored between 65 and 73. The BHFP application scores for farmer groups' farmers ranged between 49 to 80 out of a possible score of 80 (M = 76.49, SD = 4.78) whereas those of non-groups' farmers ranged from 38 to 80 (M = 67.71, SD = 8.57). This shows that the average application score of group farmers was higher than non-group farmers implying that the application of BHFP was higher in farmer groups.

Group Membership & the Application of Horticultural Practices

The second objective sought to determine the association between group membership and application of BHFP. Table 4 indicates various ways in which farmer group membership benefits horticultural production. According to the farmers, the groups helped in negotiating legally enforceable supply contracts with exporters or processors (M = 4.21, SD = .50), improving members' access to agricultural technologies such as improved crop varieties (M = 4.17, SD =.55), sourcing less expensive inputs (M = 4.16, SD =.51), and accessing knowledge on productivity-enhancing risk-reducing management practices (M = 4.15, SD =.67).

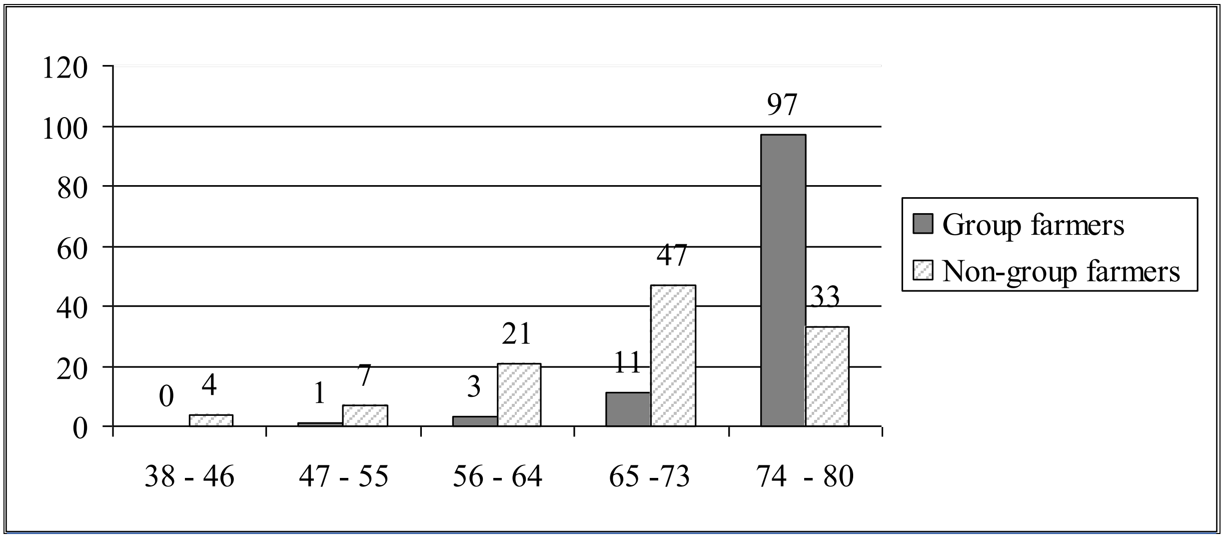

Figure 1. Distribution of Farmers Based on BHFP Application Score (N=224).

Meiguran, Nyangau and Basweti, (2016) observed that membership in an association positively influences farmer's decisions in agriculture as it enables farmers to access credit facilities using their collective produce as collateral. Farmers also pointed out that groups helped them in facilitating collective production activities (*M* = 4.09, *SD* =1.21), identifying market opportunities (*M* = 3.88, *SD* =1.16), improving access to banking services such as saving, loans and other forms of credit (*M* = 3.76, *SD* =1.33) and understanding how prices are determined (*M* = 3.48, *SD* =1.48).

Table 4
Benefits of Group Membership[a] on Horticultural Production (n = 112)

Items[a]	*M*	*SD*
Help farmers to enter into legally enforceable supply contracts with exporter or processor	4.21	.50
My group helps in improving members access to new farming techniques and appropriate farm inputs	4.17	.55
Help farmers to source for inputs more cheaply	4.16	.51
Help group members in accessing know-how on productivity-enhancing risk-reducing management practices	4.15	.67
It facilitates collective production activities	4.09	1.21
Helps group members in identifying market opportunities	3.88	1.16
Helps in improving access to financial services (saving, loans and other forms of credit)	3.76	1.33
Helps farmers in understanding how prices are determined	3.48	1.48

Note. 1= strongly disagree, 2 = disagree, 3= neither agree or disagree 4=agree, 5= strongly agree

A point-biserial correlation was run to determine the relationship. Table 5 shows the correlation between group membership and application of BHFP. There was a positive substantial (Davis, 1971) correlation between group membership and application of BHFP, which was statistically significant (r_{pb} = .50, N = 224, p < .01). This implies that farmers in groups applied BHFP more than those who were not members. These findings are in line with those of other researchers who found a positive association between group membership and technological uptake (Nwakwo, Peters & Bolkemann 2009; Odomenem & Obinne 2010).

Table 5
Correlation between Group Membership and Application of BHFP

Variable	1	2
1. Group membership[a]	-	.50
2. Application of BHFP[b]	.50	-

Note. [a]= scale of 0= No, 1= Yes; [b]= scale of 1-80, p <.01

Discriminant analysis was used to test the hypothesis that smallholder horticultural farmers belonging to producer groups and those who did not, differed significantly on a linear combination of three variables; production, harvesting and post-harvest hygienic practice application levels. As presented in Table 6 discriminant function analysis revealed that Wilks' lambda was statistically significant, λ = .47, χ^2 (16) = 162.63, p = <.05, R^2 = .53. Wilks' lambda is the proportion of the total variance in the discriminant scores *not* explained by differences among groups. A lambda of 1.00 occurs when observed group means are equal while a small lambda indicates that group means appear to differ. The analysis revealed a lambda of .47 at p <.05, implying that the group means differed significantly. It also implied that 47% of the variance in group membership was unexplained. The analysis yielded a large Eigenvalue of 1.14 which indicates that the discriminant function can explain 1.14 times of the variance in group membership; a higher eigenvalue explains a strong function. Since there is only one function, 100% of the variance is accounted by this function. The squared canonical correlation was .53, indicating that 53% of the variance in group membership was explained by production, harvesting and post-harvest hygienic BHFP.

Structure coefficients show the correlations of each variable with each discriminant function. There was only one discriminant function in this study since there were only two groups. The correlations function like factor loadings in factor analysis by identifying the largest absolute correlations associated with the discriminant function. The coefficients were interpreted based on the rule that they are considered meaningful if they are greater than .3 (Hair, Babin, Money, & Samouel, 2005). The correlations between variables and discriminant function showed that the variable *"I consider animals vehicles for contamination with pathogenic organisms"* reported the highest loading fairly well (.53). The structure coefficients ranged from .24 to .53. A majority of the variables were considered meaningful. This shows that they moderately correlated with the first function (Davis, 1971). Out of the 16 variables, only two were not meaningful. These were *"I apply the right amount of inorganic fertilizers using appropriate methods* (.24)" and "*I harvest the produce at the right weather conditions* (.27)." This implies that the two variables had a low association with the discriminant function.

The standardized discriminant function coefficients in Table 6 serve the same purpose as the standardized beta in regression. They indicate the relative importance of the independent variables in predicting group membership (Field, 2013). Coefficients with large absolute values correspond to variables with greater discriminating ability. The standardized coefficients were interpreted based on the rule that the coefficient whose absolute value is not less than one-half of the largest value is considered in the discriminant function (Hair, et al., 2005). The highest coefficient was .50 (divided by 2 =.25) meaning that variables in that function with a coefficient of more than .25 were considered in the discriminant function. These included applying the right amount of organic manure (-.47), considering animals vehicles for contamination with pathogenic organisms (.47), preventing build-up of pests (.31), maintaining soil cover (-.31), harvesting crops using the correct maturity index (.28), harvesting the produce at the right weather conditions (.50) and protecting fresh produce from contamination (.27). This shows that harvesting the produce at the right weather conditions emerged as the most important BHFP.

Table 6
Production, Harvesting, and Post-Harvest BHFP in Discriminant Function Analysis (N= 224)

Practices[a]	*Structure Matrix*	*Standardized Canonical Coefficient*
Production hygiene	Function 1	
My toilet is not situated near a source of irrigation	.39	.19
I avoid production of horticultural crops near potential harmful substances	.31	.07
I apply the right amount of organic manure using appropriate methods	.36	-.47
I consider animals vehicles for contamination with pathogenic organisms	.53	.47
I apply the right amount of inorganic fertilizers using appropriate methods	.24	-.11
I prevent the build-up of pests by crop rotation or biological or integrated control methods	.48	.31
I maintain soil cover to minimize soil erosion losses by wind **or** water	.26	-.31
Harvesting hygiene		
I prevent overfilling of produce in the harvesting containers	.43	.16
I use clean containers for harvesting	.43	.24
I prevent the damaging of produce due to rough handling	.49	-.01
I harvest crops using the correct maturity index	.48	.28
I harvest crops using appropriate techniques	.46	.20
I use clean clothes and gloves when harvesting	.44	.20
I harvest the produce at the right weather conditions	.27	.50

Post-harvest hygiene							
I clean the areas for storing fresh horticultural crops before harvest						.33	-.03
I protect the fresh produce from any form of contamination (dust or rain or sunburn)						.45	.27
	Wilks' lambda				Eigenvalue	% Variance	Canonical Correlation
Function	*λ*	*χ2*	*df*	*p*			
1	.47	162.63	16	<.05	1.14	100	.73

Note. [a] = 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = always

The group centroids are the mean discriminant score for each variable in the two groups (Field, 2013). The group centroids were equal in absolute value but have opposite signs (non-group = -1.06 and group = 1.06). Table 7 indicates the classification of farmers based on their scores on application of BFHP and the two functions at the group centroids. More than 80% were classified correctly. Reclassification of cases based on the new canonical variables was highly successful: 86.2% of the cases were correctly reclassified into their original categories.

Table 7
Classification Analysis for Application of BHFP among Non-Group and Group Farmers (N=224)

Group Membership[a]		Predicted Group Membership[b]	
		Non-Group	Group
Non-Group	Count	90	22
	%	80.4	19.6
Group	Count	9	103
	%	8.0	92.0
Group centroids		-1.06	1.06

Note. [a] = 1= non- group farmers, 2= group farmers; [b] = 86.2% of original grouped cases correctly classified

Conclusions & Recommendations

Based on SLT contentions (Leeuwis, 2004), farmers applied BHFP out of the influence of other members in the group and in the process of trying to abide by the group norms. Farmer groups are therefore an important factor in extension utilization and can be a major tool for community-based extension (Davis, 2004). The findings of the study confirm the power of farmer groups as a tool for enhancing the utilization of BHFP. Farmer groups form an important route for rallying producers around a common goal especially in the delivery of extension services and formulation of strategies that support agricultural advancement. The main reasons why smallholder farmers in Meru County subscribed to horticultural groups included access to credit facilities from banks such as equity or other microfinance institutions, affordable farm inputs, extension services, managing risks involved in the production of horticultural crops, and access to produce market (Bosc, et al., 2002).

The level of application of BHFP among farmers in the farmer groups was higher than non-group farmers (Franzel, Wambugu & Tuwei, 2003). This is because group membership had a significant association with the application of BHFP. Group membership enhanced the application of BHFP by improving access to agricultural technologies (Davis, et al., 2004), enabling sourcing of less expensive inputs and accessing knowledge on productivity-enhancing risk-reducing management practices. Additionally, membership facilitates collective production activities, identification market opportunities, improving access to financial services such as saving, loans and other forms of credit and understanding how prices are determined. Among the BHFP, the practice of keeping animals off the farm was considered the most meaningful. Animals can act as vehicles for contamination of produce with pathogenic organisms.

The promotion of farmer groups' formation may be an avenue of enhancing the dissemination and application of best horticultural practices. Government extension agencies and other stakeholders also need to commit more resources towards strengthening and growth of farmer groups to maximize horticultural production, optimize production costs and stabilize farmer prices (Davis, et al., 2004). Farmer groups help smallholder farmers to enter into legally enforceable supply contracts with exporters and/or processors thus their promotion would also boost smallholder farmers bargaining power and farmers access to credit facilities (Shiferaw, et al., 2009). A replication of this study in other countries in East Africa such as Uganda where farming is done under similar conditions would be instrumental in ascertaining the study results. Such evidence is important not only to smallholder farmers but also to the government for guiding agricultural policy reforms. An ex post facto research can be conducted to find out the causative relationship between group membership and application of BHFP.

References

Aliguma, L., Magala, D., & Lwasa, S. (2007). *Uganda: Connecting small-scale producersto markets: The case of the Nyabyumba United Farmers Group in Kabale district, Regoverning Markets Innovative Practice series.* London: IIED.

Asfaw, S. M. (2010). What impact are EU supermarket standards having on developing countries' export of high-value horticultural products? Evidence from Kenya. *Journal of International Food & Agribusiness Marketing, 22*, 3- 4. doi:10.1080/08974431003641398

Bartlett, J., Kotrlik, J., & Higgins, C. (2001). Organizational Research: Determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal, 19(1)*, 43-50.

Bosc, P., Eychenne, M., Hussen, K., Losch, B., Mercoiret, M., Rondot, R., & Walker, S. (2002). *The role of rural producer organizations in the World Bank rural development strategy.* Washington, DC: World Bank.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.).* Hillsdale, NJ: Erlbaum.

Davis, J. A. (1971). *Elementary survey analysis.* Englewood Cliffs, NJ: Prentice–Hall.

Davis, K. E. (2004). *Technology dissemination among small-scale farmers in Meru Central District Kenya: Impact of group participation* (Doctoral dissertation). Retrieved from http://etd.fcla.edu/UF/UFE0006340/davis_k.pdf

Davis, K., Franzel, S., Hildebrand, P., Irani, T., & Place, N. (2004). Extending technologies among small-scale farmers in Meru, Kenya: Ingredients for success in farmer groups. *Journal of Agricultural Education and Extension, 10(2)*, 53–62. doi:10.1080/13892240485300101

FAO. (2010). *Good Agricultural Practices (GAP) on horticultural production for extension staff in Tanzania: Training manual.* Rome: Food and Agricultural Organization of the United Nations.

Field, A. (2013). *Discovering statistics using SPSS: IBM SPSS statistics* (4th ed.). London: Sage.

Franzel, S., Wambugu, C., & Tuwei, P. (2003). *The adoption and dissemination of fodder shrubs in central Kenya. Agricultural Research and Network Series Paper No. 131.* London: Overseas Development Institute.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston: Allyn & Bacon.

Hair, J. F., Babin, B., Money, A., & Samouel, P. (2005). *Fundamentos de Métodos de Pesquisa Em Administração.* Porto Alegre: Bookman.

Henson, S., Masakure, O., & Boselie, D. (2005). Private food safety and quality standards for fresh produce exporters: The case of Hortico Agrisystems, Zimbabwe. *Food Policy, 30*(4), 371–384. doi: 10.1016/j.foodpol.2005.06.002

Howell, D. C. (2004). *Fundamental Statistics for the Behavioral Sciences.* Pacific Grove: Duxbury Press.

IFPRI. (2012). *Farmer groups, input access, and intragroup dynamics: A case study of targeted subsidies in Nigeria.* Washington, D.C: International Food Policy Research Institute (IFPRI).

ISEAL Alliance. (2008) *Kenya and the KenyaGAP standards for GOOD Agricultural Practice.* London: ISEAL Alliance

Jaffee, S. (2003). *From challenge to opportunity: transforming kenyan fresh vegetable trade in the context of emerging food safety and other standards. Agricultural and Rural Development Working Paper No. 2.* Washington, DC: World Bank.

Jaffee, S., & Masakure, O. (2005). Strategic use of private standards to enhance international competitiveness: Vegetable exports from Kenya and elsewhere. *Food Policy, 30 (3)*, 316-333. doi:10.1016/j.foodpol.2005.05.009

Jaffee, S., Henson, S., & Diaz Rios, L. (2011). *Making the grade: Smallholder farmers, emerging standards, and development assistance programs in Africa. A research program synthesis.* Washington, DC: IBRD, World Bank.

Kenya National Bureau of Statistics. (2015). *Economic Survey, 2015.* Nairobi: Government Printers.

Kirui, O., & Njiraini, G. (2013). Impact of collective action on the smallholder agricultural commercialization and incomes: Experiences from Kenya. *Paper prepared for the 4th Conference of AAAE* (pp. 1-12). Hammamet, Tunisia: African Association of Agricultural Economists.

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development.* Englewood Cliffs, N.J: Prentice-Hall, Inc.

Leeuwis, C. (2003). *Communication for rural Innovations: Rethinking agricultural extension* (3rd ed.). Garsington, Oxford, U.K: Blackwell Science Ltd.

Loevinsohn, M., Mugarura, J., & Nkusi, J. (1994). Cooperation and innovation by farmers groups: scale in the development of Rwandan Valley farming systems. *Agricultural Systems, 46*(2), 141–155. doi:10.1016/0308-521X(94)90094-V

Meiguran, M., Nyangau, T., & Basweti, E. (2016). Influence of farmer group membership on the practice of improved agricultural technologies: A Case of Nyamusi Division, Nyamira County Kenya. *International Journal of Recent Research in Life Sciences, 3(2)*, 25-34.

Meru County. (2014). *The Report Meru County 2014, Kenya.* Nairobi: Oxford Business Group.

Narrod, C., Gulati, A., Minot, N., & Delgado, C. (2005). *Food Safety Research Priorities for the CGIAR. .* Washington, DC: IFPRI.

Nwakwo, U. M., Peters, K. J., & Bolkemann, W. (2009). Can cooperative membership and participation affect adoption decisions? Issues for sustainable biotechnology dissemination. *AgroBio Forum, 12 (3 & 4)*, 437–451.

Ofuoku, A., & Urang, E. (2009). Effect of cohesion on loan repayment in farmers' cooperative Societies in Delta state, Nigeria. *International Journal of Sociology and Anthropology, 1(4)*, 070-076.

Ongeri, O. (2014). Small scale horticultural farming along the Kenyan Highways and local economic development: Exploring the effect of factor prices. *International Review of Research in Emerging Markets and the Global Economy (IRREM), 1(3)*, 102-119.

Oyinlola, L., Obadina, A., Omemu, A., & Oyewole, O. (2016). Prevention of microbial hazard on fresh-cut lettuce through adoption of food safety and hygienic practices by lettuce farmers. *Food Science and Nutrition, 5*(1), 67-75. doi:10.1002/fsn3.365

Penunia, E. A. (2011). *The role of farmers' organizations in empowering and promoting the leadership of rural women.* Philippines: Asian Farmers Association for Sustainable Rural Development (AFA).

Prager, K., & Creany, R. (2017). Achieving on farm practice change through facilitated group learning: Evaluating the effectiveness of monitor farms and discussion groups. *Journal of Rural Studies, 56*, 1- 11.

Shiferaw, B., Hellin, J., & Muricho, G. (2011). Improving market access and agricultural productivity growth in Africa: what role for producer organizations and collective action institutions? *Food Security, 3(4)*, 475–489. doi:10.1007/s12571-011-0153-0

Shiferaw, B., Obare, G., Muricho, G., & Silim, S. (2008). Leveraging institutions for collective action to improve markets for smallholder producers in less-favored areas. *African Journal of Agricultural and Resource Economics, 3(1)*, 1-18.

SoftKenya. (2018, May Thursday). *Horticulture Farming in Kenya*. Retrieved from Softkenya.com:

https://softkenya.com/kenya/horticulture-in-kenya

Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.). Needham Heights, MA: Allyn and Bacon.

World Bank . (2011). *Making the trade: Smallholder farmers, emerging standards, and development assistance programs in Africa.* Washington, DC: World Bank.

Zoss, M., & Pletziger, S. (2007). Linking African vegetable smallholders to high value markets: Potentials and constraints in smallholders' integration into GLOBALGAP-certified and/or domestic African high-value supply-chains. *Paper presented at the International Agricultural Research for Development Conference.* Witzenhausen, Germany: University of Kassel-Witzenhausen.